(b) that the Contractor undertakes to make good and complete with due expedition any defects which the Engineer may notify him before the expiry of the Defects Liability Period.

47.2 Certificate of Completion

(1) The Engineer must, within 14 days of his receipt of the Completion Notice do either of the following:

(a) The Engineer must issue the Certificate of Completion certifying that in his opinion the Works have been completed in accordance with the requirements of the Contract.

(b) The Engineer must reply stating that in his view the Works have not been completed. The Engineer must also specify in his reply the following:

(i) the detailed list of the works which remain to be completed; and

(ii) the detailed list of works which are not constructed in accordance with the requirements of the Contract and are thus not acceptable.

(2) The Contractor may submit again the Completion Notice after he considers that he has completed the Works including those listed by the Engineer in his instruction issued in accordance with Clause 47.2(1) (b).

(3) The Certificate of Completion must certify that the Works are completed on the date of his receipt of the Completion Notice or the date of his receipt of the re-submitted Completion Notice as the case may be.

47.3 The Meaning of Completion

(1) For the purpose of this Contract, 'completion' means

(a) that the Works can be operational and used to their full extent to satisfy the purposes and functions to which the Works were designed and intended;

(b) that the Works are free of any defects which are readily observed and recognised;

(c) that even if the Works contain some defects, the Engineer in his discretion considers that

(i) the purposes, functions, safety and integrity of the Works are not affected or compromised by these defects; and

(ii) the defects are otherwise minor; and

(d) the Works have passed all the tests if such tests are required by the Contract.

48 DEFECTS LIABILITY

48.1 Defects Liability Period

(1) The phrase 'Defects Liability Period' means the period stated in the Appendix calculated from the date when the Contractor has completed the Works and the Engineer has certified this in Certificate of Completion.

(2) The Engineer must notify the Contractor of any defects, minor or otherwise, that are required to be made good. The Contractor must make good all these defects notified to him

(a) before the end of the Defects Liability Period; or

(b) as soon as practicable after the expiry of the Defects Liability Period.

(3) The notice referred to in Clause 48.1(2) must be issued to the Contractor on or before the expiry of the Defects Liability Period.

(4) For the purpose of this Contract, 'defects' means works

(a) which are not constructed to the expressed or implied requirements of the Contract; or

(b) which have deteriorated through the neglect of the Contractor.

48.2 Cost of Making Good Defects

(1) The Contractor is solely responsible and to bear all expenses and costs incurred by him in making good any defects notified to him by the Engineer under Clause 48.1(2).

(2) If the Contractor considers that the works which he is required to make good are not defects within the meaning of Clause 48.1(4), he may then claim the rectification of these defects as Variations in which case the provisions of Clause 51 will be applicable.

48.3 Failure to Make Good Defects

(1) If the Contractor fails within a reasonable time to commence and the making good of the defects notified to him by the Engineer, the Employer or the Engineer on his behalf is then entitled to employ and pay other persons to carry out the making good of the defects.

(2) The Employer is entitled to recover the costs and expenses incurred in employing and paying other persons to make good the notified defects if the Contractor fails to do so by

(a) demanding that the amount of the costs and expenses so incurred be paid by the Contractor; or

(b) setting-off such amount from any amount due or to become due to the Contractor under the Contract.

(3) The Employer must provide all details and substantiations to the Contractor

(a) when making the demand in Clause 48.3(2)(a); or

(b) before setting-off the amount due or to become due to the Contractor in Clause 48.3(2)(b).

48.4 Certificate of Making Good Defects

(1) When the Engineer is satisfied that all defects notified to the Contractor in accordance with Clause 48.1(2) have been made good by the Contractor, he must issue a certificate to that effect. Such a certificate is called in this Contract 'Certificate of Making Good Defects'.

(2) The Certificate of Making Good Defects must be issued to the Contractor with a copy to the Employer.

(3) The Certificate of Making Good Defects signals that

(a) the Contractor is fully discharged from physically attending to the Works for the making good of defects;

(b) the Contractor is permitted to demobilise any remaining Constructional Plant and Equipment from the Site without requiring to secure the approval of the Engineer;

(c) the Contractor is only allowed to remain on Site upon the written consent of the Engineer or the Employer.

(4) The Certificate of Making Good Defects does not discharge the Contractor from any liability

(a) incurred prior to the issuance of the Certificate; and

(b) in regard to any defects which are not readily observed or recognised.

48.5 Diminution in the Value of the Works

(1) If the defects which the Contractor is required to remedy are such that, in the view of the Engineer,

(a) they do not affect directly or indirectly the safety, integrity or aesthetics of the Works;

(b) the Works or part of the Works may be further damaged in the course of making good the defects;

(c) the making good of the defects is relatively complex in relation to the nature of the defects;

(d) the making good of the defect will take considerable time and which will disrupt and inconvenience the functional use of the Works;

(e) the Engineer may then, in his absolute discretion, or upon an application by the Contractor, instruct that the defects be not made good.

(2) In issuing the instruction pursuant Clause 48.5(1), the Engineer may determine and include an amount representing the reduction in the value of the Works by leaving the defects as they are. This is deemed a variation (omission) for waiving the strict requirements of the Contract.

49 SECTIONAL COMPLETION

49.1 Completion in Sections

(1) With respect to each Section of the Works, the provisions of the clauses identified in Clause 49.1 (2) are applicable as if each Section is the subject of a separate and distinct contract between the Employer and the Contractor.

(2) The relevant Clauses are as follows:

(a) Clause 39 on Rate of Construction;
(b) Clause 44 on the Date for Completion;
(c) Clause 45 on Extended Date for Completion;
(d) Clause 46 on Liquidated Damages, Certificate of Non-Completion and common law rights;
(e) Clause 47 on the Certificate of Completion; and
(f) Clause 48 on Defects Liability.

50 CONTRACTOR TO SEARCH

50.1 Contractor to Search

(1) The Engineer may at any time before the issue of the Certificate of Making Good Defects instruct the Contractor to carry out tests, trials or any measures which may be necessary and required to search and ascertain the cause of any defects.

(2) If the Contractor is liable for these defects under the Contract, the cost of carrying out the tests, trials or measures are to be fully borne by the Contractor including the costs and expenses incurred by the Contractor in remedying the defects.

(3) If however the Contractor is not liable for the defects under the Contract, then the instruction issued under Clause 50.1(1) is an instruction for a Variation. The scope of this Variation includes the expenses both in searching and remedying of the defects.

51. VARIATIONS

51.1 Duty and Power to Issue Variations

(1) The Engineer must issue instructions for Variation for any part of the Works if the Variation is necessary for the completion of the Works.

(2) The Engineer may issue instruction for Variation for any part of the Works if

(d) he is of the opinion that the Variation is desirable for the Works; or

(e) if the Variation is in any way a result of any subsequent change in the original intent of the Contract.

(3) The Engineer's instruction for Variation will not in any way nullify the Contract.

(4) The Contractor must comply with all instructions requiring Variations and to complete all works comprising the Variations before the Date for Completion or any extended Date for Completion. If however the instruction for the Variations is issued by the Engineer after the Date for Completion or any extension to this date, the Contractor must then complete the works comprising the Variation within a reasonable time following the issue of the instruction.

51.2 What Can be Variations

(1) A Variation which must be incidental and relating to the Works can be in any of the following manner or form or a combination of them:

(a) an increase or decrease in the quantity of the Works or any part of it;

(b) an omission of any part of the Works;

(c) a change in the character or quality of any part of the Works;

(d) a change in the Drawings;

(e) any required demolition or removal of any part of the Works as a consequence of a change in the Drawing; and

(f) a change in any specified sequence or timing of construction of any part of the Works.

(2) An instruction which is issued to cure, or which is necessitated by, a breach of the Contract by the Contractor cannot give rise to any Variation.

(3) There cannot be any Variation without a written instruction to that effect by the Engineer. A confirmation of verbal instruction under Clause 3.2 is a properly issued instruction within the meaning of this Clause.

(4) The Engineer cannot by way of an instruction omitting any part of the Works and award the omitted works to any other person. The Contractor is entitled to claim for the loss of profit by reason of this omission.

51.3 Change in Quantity

(1) If there is any increase or decrease in the quantity of works for any Remeasured Work which is a result of the quantity exceeding or being less than the quantity stated in the corresponding item in the Bill of Quantities for Remeasured Works, then no instruction is necessary to effect any such Variation.

51.4 Contractor to Carry Out Variations

(1) The Contractor must give effect and implement all instructions giving rise to Variations.

51.5 Tracking of Variations

(1) The Engineer must assign to each Variation a number for ease of tracking and monitoring. This designation of the Variation must be notified to the Contractor.

(2) Upon so notified, the Contractor must follow the same numbering system used and assigned by the Engineer in all his correspondence and claims submissions relating to the Variation.

52 VALUATION OF VARIATIONS

52.1 Valuation Rules

(1) The following are applicable to all Variations instructed under Clause 51.

(a) If the Engineer considers that the works of a Variation are such that they are similar, and are executed under similar conditions, to corresponding items in the Bill of Quantities for Remeasured Works or Schedule of Rates for Lump Sum Items, then the rates in those items are applicable and must be used to value the works of the Variation.

(b) If the rule in Clause 52.1(1)(a) is not applicable, then reasonable rates in the Bills of Quantities are to be used as a basis or guide in arriving at rates of the works for the Variation.

(c) If the Engineer considers that the rules in both Clauses 52.1(1)(a) and (b) are not applicable, he must then fix rates which are appropriate, fair and reasonable.

(2) If the Contractor considers that the actual executed quantity of any item in the Bill of Quantities for Remeasured Works is such the rate for that item is rendered unreasonable or inapplicable, he may by notice to the Engineer request the Engineer to fix a rate which is fair and reasonable under valuation rule in Clause 52.1(1)(c). Within 14 days of the Engineer's receipt of the Contractor's notice, the Engineer must notify the Contractor that he

(a) objects to the Contractor's request to fix rates if he considers that the valuation rule in either Clause 52.1(1)(a) or (b) is applicable; or

(b) agrees to fix rates under the valuation rule in Clause 52.1(1)(c).

(3) The Contractor must include in his notice in Clause 52.1(2) the following information:

(a) his reasons for requiring new rates and his proposed revised rates including how he has arrived at those revised rates; and

(b) the documents or records which he intends to maintain or keep to substantiate the proposed revised rates.

(4) The rates in the Bill of Quantities for Remeasured Works or the Schedule of Rates for Lump Sum Items must be used for the valuation of works omitted from the Contract.

52.2 Provisional Rates

(1) If the Engineer requires time to fix rates in accordance with the valuation rule in Clause 52.1(1)(b) or (c), he may determine provisional rates to enable the Contractor to include the completed Variations in Interim Payment Applications submitted under Clause 58.1.

(2) These provisional rates may be used in all Interim Payment Applications by the Contractor until the relevant rates are finalised or fixed by the Engineer.

(3) The rates finalised or fixed must not be less than the provisional rates.

52.3 Payment of Variations

(1) The Contractor is entitled to include the completed Variations or identifiable part of them in his Interim Payment Applications submitted under Clause 58.1.

(2) In doing so, the Contractor is entitled to use either the rates valued in accordance with the valuation rules in Clause 52.1(1) or the provisional rates determined in accordance with Clause 52.2.

52.4 Agreement on Rates

(1) Despite the valuation rules in Clause 52.1, the Engineer and the Contractor may, in the Engineer's discretion, agree on rates to be used to value Variations.

(2) In attempting to agree on any rates to value any Variations, the Engineer may require the Contractor to submit quotations prior to any negotiation to agree on any rates to be used.

52.5 Valuation by Daywork

(1) Despite the valuation rules in Clause 52.1, the Engineer may include in his instruction for Variations that the Variations must be valued on a daywork basis.

(2) In valuing Variations on a daywork basis, the rates included in the Daywork Schedule must be used subject to any terms set out in the Daywork Schedule.

(3) If the execution and completion of the Variations include materials whose rates are not included in the Daywork Schedule, the Contractor must furnish to the Engineer such receipts and vouchers which are necessary to prove the amounts actually incurred by the Contractor. The Contractor must also obtain the approval of any quotations before he orders any materials for Variations which are to be valued on a daywork basis.

52.6 Procedure for Daywork Claim

(1) The Contractor must, during the progress of executing the Variations, deliver at the end of each day to the Engineer

(a) an exact list of the names, job classifications and the actual hours of work of all workmen involved in the execution of the works for the Variations on that day;

(b) an exact list of the descriptions of all materials and their quantities incorporated into the works for the Variations on that day; and

(c) an exact list of the Contractor's Constructional Plant and Equipment (including names of the models and the rated capacity) which are deployed and used in the execution of the works for the Variations and their actual hours of works on that day.

(2) The lists to be submitted by the Contractor under Clause 52.6(1) above must be submitted in duplicate.

(3) The Engineer must sign these lists submitted if they are correct, or when they are subsequently agreed with the Contractor and a copy of the signed lists will be given to the Contractor.

(4) The Contractor is entitled to include a priced statement of labours, materials and the Constructional Plant and Equipment used in the execution of any Variations in Interim Payment Applications submitted under Clause 58.1.

(5) The priced statements must be based on the signed lists returned by the Engineer under Clause 52.6(3), the corresponding rates and any relevant terms stated in the Day work Schedule.

53 PROCEDURE FOR CLAIMS

53.1 Notice of Claim

(1) If the Contractor intends to claim for Costs under any clause of these Conditions which expressly entitles him to do so, he must as a condition precedent to such a claim give notice of his intention to the Engineer.

(2) The notice of claim must be served to the Engineer as soon as the Contractor can reasonably foresee an event occurring which will give rise to the claim for Costs. The notice must be served not later than 28 days after the commencement of the event giving rise to the claim.

(3) The Contractor must include in his notice of claim for Costs the following:

(a) the clause of these Conditions which entitles him to the claim;

(b) the details of the circumstances which give rise to the claim;

(c) the details of the records which the Contractor intends to maintain to substantiate his entitlement to the claim; and

(d) the amount or estimated amount of the claim.

(4) Upon the receipt of the Contractor's notice, the Engineer must assign a designation number to the claim for the ease of tracking and monitoring. The Contractor must use and include such designated number in all his correspondence and submissions relating to the claim.

(5) The Engineer must, within 21 days of the receipt of the Contractor's notice, inform the Contractor if the Contractor is entitled to the claim for Costs.

53.2 Records Keeping

(1) The Engineer may instruct the Contractor to maintain any records that are not mentioned by the Contractor in his notice of claim under Clause 53.1(3)(c).

(2) The maintenance of these records instructed by the Engineer must be at the Contractor's expense.

(3) The mere fact of the Engineer's instruction to the Contractor to maintain any additional records does not by that fact alone suggest that the Contractor is entitled to the claim.

(4) The Contractor must permit the Engineer to inspect the records so instructed to be maintained at any time during office hours by the Engineer's giving prior notice of the intended inspection.

(5) The Contractor must make and deliver copies of all the records maintained by the Contractor to the Engineer for the purposes of the claim if the Engineer so instructs.

53.3 Substantiation of the Claim

(1) Within 30 days of the completion of the event giving rise to the claim, or such other longer period as the Engineer may allow, the Contractor must submit to the Engineer an account of the claim.

(2) The account submitted by the Contractor must include all particulars and substantiations which the Contractor believes will prove his entitlement together with a summary of the amount claimed.

(3) If however the event giving rise to the claim has a continuing effect, this does not on that fact alone preclude the Contractor from submitting to the Engineer an account of the claim provided that this account must be considered as an interim account. This interim account must include all particulars and substantiations which the Contractor believes will prove his entitlement of the claim.

(4) The Contractor may send at intervals to be agreed with the Engineer further interim accounts giving in all cases the accumulated amount of all the interim accounts.

(5) The Contractor must submit a final account to the Engineer 30 days after the completion of all the works relating to the claim or the event giving rise to the claim stops being operative.

(6) The Contractor must state in all the accounts submitted the relevant claim number designated by the Engineer and whether the account is a final or an interim account.

(7) The Engineer must, within 28 days of receipt of any final account, determine the amount which the Contractor is entitled for the claim.

(8) The Engineer may also determine any provisional value of any interim accounts submitted provided that the Engineer must not approve a value less than the provisional value when he makes a final determination.

53.4 Payment of the Claim

(1) The Contractor is entitled to include the accounts of the claim (either interim or final) in his Interim Payment Applications submitted under Clause 58.1.

53.5 Engineer's Authority

(1) The Engineer retains the power to determine the amount of the claims even if he considers that the Contractor has not complied in full with the provisions of this Clause. The Engineer may make a determination with whatever information he has at the time of making the determination.

54 ASSIGNMENT AND SUB-CONTRACTING

54.1 Assignment

(1) The Employer or the Contractor cannot assign the benefits or interests of the Contract unless the assigning party requests and receives written permission from the other party to do so.

(2) If permission is requested by one party according to Clause 54.1(1), the other party must not unreasonably withhold giving the permission unless there are good reasons for him to do so.

54.2 Sub-Contracting

(1) The Contractor must obtain the Engineer's written approval if he wants to sub-contract identified parts of the Works.

(2) The Engineer may request the Contractor to provide details of the proposed sub-contractors including their experiences, technical competence, financial standing and other relevant information before he considers giving approval in Clause 54.2(1).

(3) The Contractor does not need to obtain the approval of the Engineer if he engages labour-only sub-contractors.

(4) The Contractor remains fully responsible for the works even if the Engineer has given his approval for those works to be carried out by sub-contractors.

(5) The Contractor is similarly fully responsible for all the acts, neglects or defaults of his sub-contractors.

(6) The Contractor must incorporate in all sub-contracts provisions to the effect that the sub-contracts are automatically terminated when the Contract is terminated.

55 LUMP SUM WORKS AND REMEASURED WORKS

55.1 Works Included in the Contract Sum

(1) "Lump Sum Works" means and includes those works to be performed or goods and services to be supplied which are referred to in the Schedule of Prices for Lump Sum Items and which are not Remeasured Works.

(2) "Remeasured Works" means and includes those works to be performed or goods and services to be supplied which are referred to and described in the Bills of Quantities for Remeasured Works.

(3) With the exception of the Bills of Quantities for Remeasured Works, all information and statements on any quantities of works do not form part of the Contract.

55.2 Contract Sum and Rates are All Inclusive

(1) The Contract Sum, the rates for the various items of Remeasured Works and the rates and prices in the Schedule of Rates for Lump Sum Works include all works, materials and expenditure which are indispensably necessary for the Contractor to complete the Works described in or inferred from the Contract.

55.3 Remeasured Works

(1) The quantities set out in the Bill of Quantities for Remeasured Works are estimated quantities only.

(2) The quantities indicated in the Bill of Quantities for Remeasured Works are not the actual quantities of Remeasured Works which the Contractor is required execute and complete for him to fulfil his obligations under the Contract in relation to the Remeasured Works.

(3) The actual quantities of the Remeasured Works executed by the Contractor, and the value of the Remeasured Works, will be measured, ascertained, determined and valued in accordance with the provisions of Clause 55.4.

55.4 Method of Measurement

(1) The method of calculating the actual quantity of Remeasured Work executed and completed by the Contractor must be carried out in accordance with the Method of Measurement.

(2) The Method of Measurement forms part of the Bills of Quantities.

(3) Except where the Engineer has instructed under Clause 55.4(4), all Remeasured Works must be measured in accordance with the measurements shown in the Working Drawings.

(4) If the Engineer or Contractor is of the opinion that physical measurement is necessary, the physical measurements must then be jointly carried out by the Engineer and the Contractor.

(5) The Engineer must give the Contractor reasonable notice to be present if he requires physical measurement of the Remeasured Works.

(6) If the Contractor fails to be present at the appointed time for physical measurement of the Remeasured Works despite notice having been given to him under Clause 55.4(5), the Contractor must then accept whatever measurement results obtained by the Engineer.

55.5 Variation of Rates

(1) Subject to Clause 52.1(2), the rates in the Bill of Quantities for Remeasured Works must not be increased or decreased in any way due to the actual executed quantities of work being greater or less than the estimated quantities shown in the Bill of Quantities for Remeasured Works.

(2) Clause 55.5(1) will apply even if the actual executed quantities of works are greater or less than the estimated quantities shown in the Bill of Quantities for Remeasured Works as a result of an instruction issued under Clause 51.1.

(3) Any rate revision as a result of an instruction issued under Clause 51.1 will be carried out in accordance with the provisions of Clause 52.1.

56 PRIME COST AND PROVISIONAL SUMS

56.1 Prime Cost Sum and Provisional Sum

(1) "Prime Cost Sum" means a sum provided in the Schedule of Prime Cost and Provisional Sums of the Bills of Quantities for works to be executed or materials and services to be supplied by a Nominated Sub-Contractor.

(2) "Provisional Sum" means a sum provided in the Schedule of Prime Cost and Provisional Sums of the Bills of Quantities for execution of works or supply of materials and services which are at the time of the Tender not designed, not confirmed to be required, not foreseen or is in such a way that the Contractor was not able to price it prior to the submission of the Tender.

56.2 Operation of the Prime Cost Sums

(1) In respect of every Prime Cost Sum in the Schedule of Prime Cost and Provisional Sums in the Bills of Quantities, the Engineer may instruct the Contractor to enter into a sub-contractor nominated by the Employer.

(2) The sub-contractor so nominated by the Employer under Clause 56.2(1) is the Nominated Sub-Contractor and the contract entered is the Nominated Sub-Contract for the purposes of the Contract.

(3) All Nominated Sub-Contracts must be modelled and based on the Form of Nominated Sub-Contracts published by The Institution of Engineers, Malaysia.

(4) The following principles apply to the Prime Cost Sums, the Nominated Sub-Contractors and the Nominated Sub-Contracts:

(a) the Engineer must issue instruction to omit the relevant Prime Cost Sum (together with any associated profit and attendance which the Contractor is entitled to) from the Contract;

(b) the omitted Prime Cost Sum will be substituted by the amount due to the Nominated Sub-Contractor under the Nominated Sub-Contract; and

(c) the corresponding amount due to the Contractor for profit and attendance will also have to be included.

(5) The Engineer may, with the consent of the Contractor and subject to any agreement with regard to rates and prices, instruct the Contractor himself in lieu of the Nominated Sub-Contractor to execute works or supply of materials and services in respect of a Prime Cost Sum. In this case, the Contractor will not be entitled to any profit and attendance.

(6) In the case of Clause 56.2(5), the value of the works executed must be determined and measured in accordance with the provisions of Clause 51 and Clause 55.

(7) The Engineer may in his discretion allow the Contractor to submit his tender for the works comprised in any Prime Cost Sums. If the Contractor's tender for the works of any Prime Cost Sum is accepted, the Contractor will not then be entitled to any profit and attendance charges which he would otherwise be entitled if a Nominated Sub-Contract is awarded.

56.3 Operation of the Provisional Sums

(1) In respect of every Provisional Sum in the Schedule of Prime Cost and Provisional Sums in the Bills of Quantities, the Engineer may instruct for its expenditure.

(2) When the Engineer issues an instruction for the expenditure of the Provisional Sum, the works executed must be valued as per the provisions of Clause 52.1 and the Contractor must be paid accordingly.

(3) The instruction issued for the expenditure of Provisional Sum is treated in the like manner as if it is issued under Clause 51. The instruction takes effect in omitting the Provisional Sum and substituting it with a Variation whose value is to be determined in accordance with Clause 52.

56.4 Conversion of Provisional Sum to Prime Cost Sum

(1) The Engineer may if he thinks fit and proper instruct that the Provisional Sum included in the Schedule of Prime Cost and Provisional Sums in the Bills of Quantities be treated and operated as if it is a Prime Cost Sum.

(2) If the Engineer so instructs in Clause 56.4(1), the provisions of Clause 56.2 will accordingly apply.

57 NOMINATED SUB-CONTRACTORS

57.1 Procedure for Nomination

(1) The Employer or the Engineer on his behalf may first obtain tenders or quotations from various contractors for the execution of works relating to the Prime Cost Sum included in the Schedule of Prime Cost and Provisional Sums in the Bills of Quantities.

(2) Upon the selection of the contractor either from the exercise in Clause 57.1(1) or otherwise, the Engineer will then instruct the Contractor to enter into a contract ("Nominated Sub-Contract") with the selected contractor ("Nominated Sub-Contractor").

(3) The Nominated Sub-Contract may be based on the IEM Form of Nominated Sub-Contract for Engineering Works to be published by The Institution of Engineers, Malaysia.

(4) The Contractor is not required to enter into the Nominated Sub-Contract with the Nominated Sub-Contractor if the Nominated Sub-Contractor refuses the Nominated Sub-Contract to be based on the IEM Form of Nominated Sub-Contract for Engineering Works to be published by The Institution of Engineers, Malaysia. The Contractor must report any such refusal to the Engineer.

57.2 Objections to Nomination

(1) The Contractor is not required to enter into a Nominated Sub-Contract if he has made reasonable objections on the following grounds which the Contractor considers that, having regard to the nature and extent of the works required,

(a) the Nominated Sub-Contractor is in poor financial standing or solvency;

(b) the Nominated Sub-Contractor lacks the required technical competence; or

(c) the Nominated Sub-Contractor lacks the necessary plant, machinery and specialist manpower.

(2) The Engineer may nevertheless instruct the Contractor to enter into a Nominated Sub-Contract despite reasonable objections have been raised by the Contractor under Clause 57.2(1).

(3) If the Engineer so instructs under Clause 57.2(2), the Employer must then indemnify the Contractor against any loss, expense, damages or claims incurred by the Contractor on the non-performance of the Nominated Sub-Contractor due to the ground or grounds on which the Contractor has raised objections.

(4) As an alternative remedy to the Contractor under Clause 57.2(3),

(a) the Engineer must take any delay into consideration in determining any extended Date for Completion which the Contractor may be entitled under Clause 44; and

(b) the Engineer must certify the additional Costs in accordance with the provisions of Clause 53.

(5) The Contractor is not allowed to make any objections against any Nominated Sub-Contractor if

(a) the Nominated Sub-Contractor is named in any of the documents comprising the Tender; or

(b) the Nominated Sub-Contractor is among the contractors agreed between the Employer or the Engineer and the Contractor before the call for tenders under Clause 57.1(1).

(6) If the Engineer considers that the Contractor has raised valid and reasonable objections under Clause 57.2(1), then the Engineer may do any of the following:

(a) nominate an alternative Nominated Sub-Contractor;

(b) invoke the operation of Clause 56.2(5); or

(c) where possible and practical, omit the Prime Cost Sum from the Contract.

(7) If the Engineer has chosen either of the options in Clause 57.2(6)(a) or (b), then

(a) the Engineer must take the delay into consideration in determining any extended Date for Completion which the Contractor may be entitled under Clause 44; and

(b) the Engineer must certify the additional Costs in accordance with the provisions of Clause 53.

57.3 Payment to Nominated Sub-Contractors

(1) The Contractor must include the amounts claimed by the Nominated Sub-Contractor in respect of any works executed and completed or materials and services supplied by the Nominated Sub-Contractor in the Interim Payment Application submitted under Clause 58.1.

(2) In respect of each of the Interim Payment Application which includes the amounts claimed by the Nominated Sub-Contractor, the Engineer must issue a certificate separately the amount due to each of the Nominated Sub-Contractor. This certificate will be known and referred to in this Contract as the NSC Payment Certificate.

(3) The Engineer must issue the NSC Payment Certificate to the relevant Nominated Sub-Contractor with a copy to the Employer and the Contractor.

(4) The Engineer must issue the relevant NSC Payment Certificate at the same time he issues the Contractor's Interim Payment Certificate.

(5) The Contractor must pay to the Nominated Sub-Contractor the amount certified on the NSC Payment Certificate within the period for honouring NSC Payment Certificate stated in the Nominated Sub-Contract.

(6) The Contractor is entitled to set-off or deduct from any amounts due to the Nominated Sub-Contractors on any NSC Payment Certificates if there are express provisions in the Nominated Sub-Contractor allowing him to do so.

(7) Before issuing each Interim Payment Certificate under Clause 58.2 and the Final Certificate under Clause 59.2, the Engineer is entitled to instruct the Contractor to show proof that the payments due on the previous NSC Payment Certificates have been paid to the various Nominated Sub-Contractors.

(8) If the Contractor has not paid to the Nominated Sub-Contractor on the previous NSC Payment Certificates, he may nevertheless explain to the Engineer in writing:

(a) that he has reasonable cause for withholding or refusing to make such payment; and

(b) he has in writing informed the Nominated Sub-Contractor of such withholding or refusal.

(9) If the Contractor has not given any proof after he has been so instructed by the Engineer under Clause 57.3(7), or the Engineer considers that the Contractor has no reasonable cause for withholding or refusing to make payment to the Nominated Sub-Contractor despite the explanation given under Clause 57.3(8), the Engineer may notify the Employer accordingly in writing with a copy of such notice given to the Contractor.

(10) Upon receipt of the Engineer's notice under Clause 57.3(9), and before making payment on any Interim Payment Certificate, the Employer is entitled (but is not under an obligation to do so) to make payments directly to the Nominated Sub-Contractor the amounts which remain not paid by the Contractor.

(11) The amounts so paid directly to the Nominated Sub-Contractor under Clause 57.3(10) by the Employer are to be deducted from any payment due or to become due from the Employer to the Contractor.

(12) The decision by the Employer to effect direct payment to a Nominated Sub-Contractor does not on that fact alone gives rise to any contract between the Employer and the Nominated Sub-Contractor.

57.4 Defaults of Nominated Sub-Contractor

(1) If an event arises and the Contractor is of the opinion that the event justifies the termination of the Nominated Sub-Contract, he must before starting any procedure to terminate the Nominated Sub-Contract notify the Engineer accordingly in writing.

(2) The Contractor must state in his written notice to the Engineer his justification for intending to terminate the Nominated Sub-Contract.

(3) If the Engineer agrees with the Contractor on his intended termination of the Nominated Sub-Contract, he must with despatch inform the Contractor in writing of his consent to such termination.

(4) With the consent from the Engineer given under Clause 57.4(3), the Contractor may then invoke the termination provision in the Nominated Sub-Contract.

(5) After the Nominated Sub-Contract has been terminated, the Contractor may proceed to complete the works of the Nominated Sub-Contract himself. Alternatively, the Contractor may request the Engineer to make another nomination.

(6) In any such termination, the Contractor will only be entitled to be paid the amount of the works in the Nominated Sub-Contract which are not completed together with any profit and attendance charges if he decides to complete those works himself.

(7) The Contractor must take all necessary steps and actions available to him to recover the Contractor's entitlement under the Nominated Sub-Contract including any performance security provided.

(8) Upon any termination of the Nominated Sub-Contract which the Engineer has given his consent,

(a) the Engineer must take the delay into consideration in determining any extended Date for Completion to which the Contractor may be entitled under Clause 45; and

(b) the Engineer must certify the additional Costs in accordance with the provisions of Clause 53.

57.5 Contractor's Responsibility

(1) The Contractor is responsible to the Employer for the works carried out and the services and the material supplied by the Nominated Sub-Contractors in the same way as if he himself has carried out the works and supplied the services and materials.

58 INTERIM PAYMENT CERTIFICATES AND PAYMENT

58.1 Contractor's Interim Payment Applications

(1) At regular intervals fixed in the Appendix to these Conditions, the Contractor may submit to the Engineer the Contractor's Interim Payment Application.

(2) The Engineer may decide the date on or before which all Works properly completed by the Contractor can be included in any Interim Payment Application. This date will be known and referred to in the Contract as the Valuation Date.

(3) The Engineer may prescribe the format and manner for the submission of the Interim Payment Applications.

(4) The Contractor must include where applicable in the Interim Payment Applications the following:

(a) cumulative values of all Works completed up to the Valuation Date;

(b) subject to Clause 36.2(4), the percentage (stated in the Appendix to these Conditions) in respect of the value of unfixed materials which the Contractor has delivered to the Site which are intended solely for incorporation into the Works;

(c) the cumulative values of all completed Variations which have been valued by the Engineer (including those for which provisional rates have been determined) and any Variations which the Engineer has instructed to be valued by Daywork ;

(d) any claims for Costs which the Contractor considers himself to be entitled under the Contract; and

(e) the cumulative amounts due to any Nominated Sub-Contractors together with any profit and attendance charges which the Contractor is entitled.

(5) With respect to Clause 58.1(4)(a), the Contractor must include all substantiations including but not limiting to measurement sheets, computations, quantities, sketches and other relevant information for all items included in the Interim Payment Applications. The items must correspond to the items in the Schedule of Prices for Lump Sum Works and Bill of Quantities for Remeasured Works.

(6) With respect to Clause 58.1(4)(b), the Contractor must not include in the Interim Payment Applications any materials which are prematurely delivered to the Site.

58.2 Interim Payment Certificates

(1) The Engineer must issue an Interim Payment Certificate within 21 days of receiving the corresponding Contractor's Interim Payment Application irrespective whether the Engineer agrees or disagrees with the amounts stated in the Contractor's Interim Payment Application.

(2) To each of the amounts valued by the Contractor in the Interim Payment Application, the Engineer must certify the amounts which in his opinion the Contractor is entitled.

(3) The Engineer must certify on the face of the Interim Payment Certificate deductions from the cumulative amounts certified the following:

(a) the cumulative amount which the Employer is entitled to retain, this amount is called in these Conditions the Retention Monies; and

(b) the cumulative amount certified in the preceding Interim Payment Certificate.

(5) The Engineer must issue at the same time to the Employer and the Contractor one copy each of all Interim Payment Certificates.

58.3 Period of Honouring Certificates

(1) The Employer must pay to the Contractor the amount due on Interim Payment Certificate in full on or before the end of the Period of Honouring Certificate stated in the Appendix.

(2) The Employer can only set-off or deduct from the payments due to the Contractor on any Interim Payment Certificates when there are express provisions in these Conditions which allow the Employer to do so.

(3) The Employer must give full details and the clause reference which he relies upon when he intends to set-off or deduct any payment due to the Contractor on any Interim Payment Certificate.

(4) If the Employer fails to pay the Contractor according to Clause 58.3(1), he must then pay to the Contractor an additional amount together with the amount certified on the Interim Payment Certificate.

(5) The additional amount in Clause 58.3(4) is calculated in the form of simple interest and is based on the rate stated in the Appendix.

(6) The Contractor's right to be paid additional amounts as interests for late payment of any certified sums must not be taken as the Contractor foregoing his rights under Clause 58.4 or Clause 62 of these Conditions.

58.4 Suspension of Works if no Payment

(1) If the Employer does not pay the Contractor the full amount certified on any Interim Payment Certificate and this non-payment continues for 14 days after the end of the Period for Honouring Certificate, the Contractor may then serve a written notice to the Employer with a copy to the Engineer expressing his intention to suspend the execution of the Works.

(2) If the Employer continues his failure to make payment after having been served with the notice which the Contractor has served upon him under Clause 58.4(1), the Contractor may then choose any of the following options:

(a) to suspend the execution of the whole of the Works;

(b) to reduce the rate of construction of the Works.

(3) The Contractor must inform the Employer and the Engineer in writing if he chooses either of the two options in Clause 58.4(2).

(4) If the Contractor chooses to suspend the execution of the whole of the Works, this is treated in this Contract as similar in effect to the Engineer having issued an instruction under Clause 42.1 to suspend the continuing performance of the Works and Clause 42.2(1) will be applicable.

(5) If the Contractor chooses to reduce the rate of construction of the Works,

(a) the Engineer must take any delay into consideration in determining any extended Date for Completion to which the Contractor may be entitled under Clause 44; and

(b) the Engineer must certify the additional Costs in accordance with the provisions of Clause 53.

(6) The Contractor's choice of either of the two options in Clause 58.4(2) must not on that fact alone be taken as the Contractor giving up his rights to claim for interest under Clause 58.3(4) or to terminate the Contract under Clause 62.

(7) The Contractor may also claim for interest or suspend the execution of the Works if the Engineer does not issue or delay in issuing any corresponding Interim Payment Certificate despite the Contractor having submitted the Interim Payment Application.

(8) The procedure for Clause 58.4(7) is similar to the procedure for suspending the execution of the Works for non-payment by the Employer.

58.5 Correction of Certificates

(1) The Engineer may make corrections to any Interim Payment Certificate which has already been issued. This certificate when issued will supersede the Interim Payment Certificate which was issued earlier.

(2) This certificate issued to correct an Interim Payment Certificate is called a Correction Certificate in these Conditions.

(3) A Correction Certificate must not prolong the Period of Honouring Certificate of the Interim Payment Certificate which it corrects.

(4) The Engineer must not issue any Correction Certificate 7 days before the end of the Period of Honouring Certificate of the Interim Payment Certificate which it corrects.

(5) A Correction Certificate must be given the same serial number as the Interim Payment Certificate which it corrects. Its serial number must however end with the letter 'C' in brackets, that is "(C)".

(6) A Correction Certificate may either increase or decrease the values certified in an Interim Payment Certificate.

58.6 Retention Monies

(1) The Engineer must certify on the face of Interim Payment Certificates the amount of Retention Monies.

(2) The Retention Monies must be calculated based on the percentage stated in the Appendix and applying it to the total amount certified by the Engineer for

(a) the value of Works;

(b) the value of all Variations; and

(c) total value of all works for all Nominated Sub-Contractors.

(3) The Retention Monies must not exceed the Limit of Retention.

(4) The Limit of Retention is the amount calculated as a percentage of the Contract Sum based on the percentage stated in the Appendix.

58.7 Rules Relating to Retention Monies

(1) The Contractor is at all times the beneficial owner of the Retention Monies.

(2) Notwithstanding the Contractor's beneficial interests in the Retention Monies, the Employer is entitled to set-off or deduct from the Retention Monies any direct costs, losses, expenses and damages which the Employer suffers as a consequence of the Contractor's breach of the Contract.

(3) The Employer can invoke Clause 58.7(2) only when there is no other source for any amounts due or to become due to the Contractor under the Contract when he makes the set-off or deduction.

(4) The Engineer must issue an Interim Payment Certificate for the release of half of the amount of the Limit of Retention at the same time he issues the Certificate of Completion to the Contractor.

(5) The Engineer must issue an Interim Payment Certificate for the release of the remaining half of the amount of the Limit of Retention at the same time he issues the Certificate of Making Good Defects.

58.8 Deemed Payment

(1) If the Employer makes a set-off or deduction from any amount due or to become due to the Contractor under the Contract, the amount set-off or deducted is regarded as having been paid by the Employer to the Contractor under this Contract

59 FINAL PAYMENT CERTIFICATE

59.1 Contractor's Final Payment Application

(1) Within 3 months after the issue of the Certificate of Making Good Defects, the Contractor must submit to the Engineer his proposed final account for the execution and completion of the whole of the Works. This proposed final account is referred to in these Conditions as the Final Payment Application.

(2) The Engineer may prescribe the format and manner for the submission of the Final Payment Application.

(3) The Contractor must include where applicable in the Interim Payment Application the following:

(a) cumulative values of all Works completed;

(b) the cumulative values of all Variations including all Variations which the Engineer has instructed to be valued by Daywork;

(c) where Option Module A is applicable, the amount of the Additional Sum;

(d) any claims for Costs which the Contractor considers himself to be entitled under the Contract; and

(e) the cumulative amounts due to all Nominated Sub-Contractors together with any profit and attendance charges which the Contractor is entitled.

(4) The Contractor must include all substantiations including but not limiting to measurement sheets, computations, quantities, sketches and other relevant information for all items included in the Final Payment Application. The items must correspond to the items in the Bills of Quantities.

(5) The Contractor may request for extension of time from the Engineer for the submission of the Final Payment Application and the Engineer must not unreasonably withhold giving the approval for such a request.

(6) If the Contractor does not submit the Final Account Application within the time limit stated in Clause 59.1 or within any extended time limit given under Clause 59.1(5), the Engineer may write to the Contractor instructing for it to be submitted.

(7) If the Contractor still does not submit the Final Account Application 14 days after having received the Engineer's instruction given to him under Clause 59.1(6), the Engineer may then proceed to issue Final Payment Certificate basing on whatever information in his possession.

59.2 Issue of Final Payment Certificate

(1) Within 2 months of receiving the Final Payment Application, the Engineer may issue to the Contractor a draft final account ("Draft Final Account") for the Contractor's agreement.

(2) If the Contractor agrees to the Draft Final Account, he must then inform the Engineer in writing of his agreement. If the Contractor does not respond to the Draft Final Account within 30 days of its receipt, it is then considered that the Contractor has agreed to it.

(3) If the Contractor does not agree to the Draft Final Account, he must then notify the Engineer in writing of his disagreement. He must in this notice also inform the items in the Draft Final Account which he disagrees.

(4) The Engineer may hold discussions with the Contractor with the only purpose of reaching agreement on the Draft Final Account. Unless extended by the Engineer, all the discussions must be held within a period of 60 days after the receipt of the Contractor's notice of disagreement given under Clause 59.2(3).

(5) In holding discussions with the Contractor under Clause 59.2(4), the Engineer must continue to exercise impartiality and independence in arriving at or maintaining the values of various items in the Draft Final Account.

(6) The Engineer must issue the Final Payment Certificate

(a) within 30 days of receiving the Contractor's written confirmation of his agreement of the Draft Final Account; or

(b) within 30 days of reaching agreement with the Contractor on the Draft Final Account; or

(c) when the Contractor fails to respond within 30 days to the Draft Final Account and no notice under Clause 59.2(2) is served to the Engineer by the Contractor.

(7) The Engineer must attach supporting documents to the Final Payment Certificate showing the Engineer's final valuation and certification of the Works including Variations, all claims that the Contractor is entitled under the Contract and all deductions or set-offs that the Employer is entitled to under the Contract.

(8) The Final Payment Certificate must state the balance between the final certified sum under the Contract and the certified cumulative value of the preceding penultimate certificate.

(9) The Employer must pay to the Contractor within the Period for Honouring Certificates the amount certified on the Final Payment Certificate. In making final payment to Final Payment Certificate, the Employer must also include full accounts of all payments and all deductions made (if any) from the beginning of the Contract.

(10) If the Employer considers that the Final Payment Certificate reveals that there is outstanding amount owed by the Contractor, the Employer must then inform the Contractor accordingly. The Contractor must pay to the Employer this outstanding amount.

60 EFFECT OF CERTIFICATES

60.1 Effect of Interim and Final Payment Certificates

(1) No Interim Payment Certificate or Final Payment Certificate issued by the Engineer is an indication or conclusive evidence of the acceptability of any design (if the design is the Contractor's responsibility under the Contract), or of any works, materials or workmanship.

(2) No Interim Payment Certificate or Final Payment Certificate issued by the Engineer can be considered to be final and binding in any dispute between the Employer and the Contractor if the dispute is brought before an arbitrator or the Court.

(3) The Contractor's obligation to make good defects in the Works is not waived by the issue of an Interim Payment Certificate which includes the defects.

61 TERMINATION BY THE EMPLOYER

61.1 Termination Due to Breaches of the Contractor

(1) The Engineer may issue to the Contractor a Certificate of Default if he is of the opinion that the Contractor has committed the following one or more of the following breaches of the Contract:

(a) wholly suspending the execution of the Works or part of the Works without reasonable cause;

(b) not proceeding with the construction of the Works regularly and diligently;

(c) not beginning the construction of the Works and there is no reason why he cannot do so;

(d) persistently neglects to carry out his obligations under the Contract;

(e) abandoning the Works and demobilising Constructional Plant and Equipment, labours and workers out of the Site;

(f) persistently ignores properly issued instructions issued by the Engineer;

(g) failing to provide the required performance security; or

(h) assigning the benefits of the Contract to a third party without the consent of the Employer.

(2) The Certificate of Default must specify the Contractor's breaches of the Contract which have prompted the Engineer to issue it. The Certificate of Default must also specify and state that the Contractor must make good the breaches complained of within 14 days of its receipt by the Contractor.

(3) The Engineer must not issue the Certificate of Default unreasonably or vexatiously.

(4) If the Contractor continues with the breaches specified in the Certificate of Default or he does not take any active steps to make good the breaches, the Employer may then 7 days after the 14-day period mentioned in Clause 61.1(2) serve a notice to the Contractor terminating the Contract. This notice is called the "Termination Notice" for the purposes of the Contract.

(5) The Employer must not issue the Termination Notice unreasonably or vexatiously.

(6) The Termination Notice takes effect as soon as it is received by the Contractor and the Contract is immediately terminated.

(7) Both the Certificate of Default and the Termination Notice may be served to the Contractor in either of the following manners:

(a) by AR Registered Post; or

(b) by delivering a copy of the Certificate of Default or Termination Notice to the Contractor's notified address, his registered office or his site office with the Contractor or the Site Manager acknowledging and confirming receipt.

(8) The effect of the Certificate of Default is considered to be temporarily suspended if the Contractor remedies or take active steps to remedy the breaches specified to the Engineer's satisfaction within a 14-day period or any extension of this period as may be agreed in writing by the Engineer.

(9) If however the Contractor repeats the same breaches for which a Certificate of Default has earlier been issued, the Employer may then serve to the Contractor the Termination Notice to terminate the Contract. The Termination Notice takes effect immediately when it is received by the Contractor.

(10) In invoking Clause 61.1 to terminate the Contract, the Employer is at the same time waiving his right to terminate the Contract by way of common law.

61.2 Termination Due to Bankruptcy or Insolvency of the Contractor

(1) If the Contractor

(a) (being an individual) commits an act of bankruptcy;

(b) (being a company) begins an application to the at law for a scheme of arrangement with his creditors except if the application relates to a scheme for the reconstruction or amalgamation of the Contractor and other company or companies;

(c) (being a company) has a winding up order issued against him by a court of competent jurisdiction;

the Employer may then by notice ("Termination Notice") to the Contractor terminating the Contract. No Certificate of Default is required to be issued by the Engineer in this case.

(2) The termination of the Contract takes effect as soon as the Termination Notice is served to and received by the Contractor and the Contract is immediately terminated.

(3) The Termination Notice must state the ground listed in Clause 61.2(1) which the Employer invokes to terminate the Contract.

(4) The Termination Notice may be served to the Contractor in either of the following manners:

(a) by AR Registered Post; or

(b) by delivering a copy of the Certificate of Default or Termination Notice to the Contractor's notified address, his registered office or his site office with the Contractor or the Site Manager acknowledging and confirming receipt.

61.3 Effects of the Termination

(1) Upon the termination of the Contract, and irrespective of the validity or otherwise of the termination, and irrespective if the Contractor intends to dispute or challenge the validity of the termination, the following rules will apply:

(a) The Employer is entitled to enter the Site and the Contractor can no longer be regarded as having possession of the Site.

(b) The Contractor must stop all his operations and move out of the Site together with his personnel and labour.

(c) The Contractor must not remove any of the Constructional Plant and Equipment and unfixed materials out of the Site.

(d) The Engineer must within 7 days after the Contract has been terminated write to the Contractor to attend a joint survey of the Works completed, the Constructional Plant and Equipment and unfixed materials remaining on the Site.

(e) The Contractor can only remove the Constructional Plant and Equipment and unfixed materials out of the Site after he has received instruction from the Engineer for their removal.

(f) If the Contractor fails or refuses to remove the Constructional Plant and Equipment and unfixed materials out of the Site after he has received an instruction from the Engineer to do so, the Employer may then remove and sell them in ways that the Employer sees fit and proper.

(g) The Employer must inform the Engineer in writing the value of the proceeds of sale made according to Clause 61.3(1)(f) and any reasonable administrative charges which he may want to impose.

(h) Liquidated Damages (if any) which continue to be deductable at the time of termination of the Contract will immediately stop being payable.

(2) After the termination of the Contract, the Employer may complete the remaining Works himself or the Employer may employ other contractor or contractors to complete the Works.

(3) The Employer or his chosen contractor or contractors may use the Constructional Plant and Equipment and unfixed materials but the use of these must be properly accounted to the Contractor.

61.4 Payment After Termination

(1) The Engineer must after the termination of the Contract issue a certificate on the financial position of the Contract. This certificate is referred to in these Conditions as the Certificate of Termination Cost.

(2) The Engineer must certify the values of the following items in the Certificate of Termination Cost:

(a) certified sum of all Works completed by the Contractor up to the date of the termination of the Contract based on the joint survey conducted according to Clause 61.3(1)(d);

(b) certified value of all Variations completed by the Contractor including all the Variations which are to be valued by Daywork;

(c) Costs which the Engineer considers that the Contractor is entitled under the Contract;

(d) cumulative amounts due to all Nominated Sub-Contractors together with any profit and attendance charges which the Contractor is entitled;

(e) value of the Performance Security that the Employer has made demand and been paid;

(f) amounts due to the Contractor for the use of the Constructional Plant and Equipment and unfixed materials under Clause 61.3(3); and

(g) sale proceeds (if any) for the sale of the Constructional Plant and Equipment and unfixed material according to Clause 61.3(1)(g).

(3) In addition to the items in Clause 61.4(2), the Engineer must also certify the values of the following items in the Certificate of Termination Cost:

(a) the costs of the Employer in completing the remaining Works;

(b) the costs of making good any defects in the Works;

(c) the administrative charges which the Employer may reasonably impose in selling the Constructional Plant and Equipment according to Clause 61.3(1)(g).

(d) any other costs which the Employer is entitled to claim from the Contractor under express provisions of the Contract.

(4) The Certificate of Termination Cost must state the difference in the total value certified in Clause 61.4(2) less the total value certified in Clause 61.4(3). The balance will be the value certified as payable by the Contractor to the Employer or by the Employer to the Contractor as the case may be.

(5) The payment due on the Certificate of Termination Cost must be paid within a period of 30 days of the issue of the Certificate.

(6) The Engineer must issue the Certificate of Termination Cost as soon as he can ascertain and certify all the applicable values in Clause 61.4(2) and Clause 61.4(3) or within a period of 6 months after the termination of the Contract whichever is later.

(7) The Contractor will not be entitled to any payment (if any) after the termination of the Contract until the Engineer has issued the Certificate of Termination Cost.

62 TERMINATION BY THE CONTRACTOR

62.1 Termination Due to Breaches of the Employer

(1) The Contractor may issue to the Employer a notice specifying that the Employer has committed one or more of the following breaches of the Contract:

(a) the Employer does not pay or does not pay to the Contractor in full the amounts certified in any Interim Payment Certificate;

(b) the Employer has interfered, influenced or in any other way obstructed the Engineer's certification process;

(c) the Employer does not have a replacement Engineer within 30 days of the Engineer stops being the Engineer for the purposes of the Contract.

(2) The notice given by the Contractor to the Employer is known in these Conditions as the "Notice of Default" and this must state the provision in Clause 62.1(1) which the Contractor intends to invoke to terminate the Contract.

(3) The Contractor must not issue the Notice of Default unreasonably or vexatiously.

(4) The Notice of Default must require the Employer to make good the specified breaches within a period of 14 days of its receipt.

(5) If the Employer continues with the breaches specified in the Notice of Default or does not take any active steps to remedy the specified breaches, the Contractor may then 7 days after the 14-day period mentioned in Clause 62.1(4) serve a notice to the Employer to terminate the Contract. This notice is called the "Contractor's Termination Notice" for the purposes of the Contract.

(6) The Contractor's Termination Notice takes effect as soon as it is received by the Employer and the Contract is at that time immediately terminated.

(7) The Contractor must not issue the Contractor's Termination Notice unreasonably or vexatiously.

(8) Both the Notice of Default and the Contractor's Termination Notice may be served to the Employer in either one of the following manners:

(f) by AR Registered Post; or

(g) by delivering a copy of the Notice of Default or Contractor's Termination Notice to the Employer's notified address, his registered office or his site office with the Employer or his agent acknowledging and confirming receipt.

(9) The effect of the Notice of Default is considered to be temporarily suspended if the Employer remedies the breaches specified within the 14-day period.

(10) If however the Employer repeats the same breaches for which a Notice of Default has earlier been issued, the Contractor may serve to the Employer the Contractor's Termination Notice. The Contractor's Termination Notice takes effect immediately when it is received by the Employer and the Contract is immediately terminated.

62.2 Termination Due to Bankruptcy or Insolvency of the Employer

(1) If the Employer

(a) (being an individual) commits an act of bankruptcy;

(b) (being a company) begins an application to the by law for a scheme of arrangement with his creditors except if the application relates to a scheme for the reconstruction or amalgamation of the Employer and other company or companies;

(c) (being a company) has a winding up order issued against him by a court of competent jurisdiction;

the Contractor may then by Contractor's Termination Notice to the Employer terminate the Contract immediately. No Notice of Default is required to be issued by the Contractor in this case.

(2) The termination of the Contract takes effect as soon as the Contractor's Termination Notice is served to and received by the Employer and the Contract is immediately terminated.

(3) The Contractor's Termination Notice must state the ground listed in Clause 62.2(1) which the Contractor invokes to terminate the Contract.

(4) The Contractor's Termination Notice may be served to the Employer in either of the following manners:

(a) by AR Registered Post; or

(b) by delivering a copy of the Contractor's Termination Notice to the Employer's notified address, his registered office or his site office with the Employer or his agent acknowledging and confirming receipt.

62.3 Effects of Termination of the Contract by the Contractor

(1) Upon the termination of the Contract, and irrespective of the validity or otherwise of the termination, and irrespective if the Employer intends to dispute or challenge the validity of the termination, the following rules will apply:

(a) The Employer is entitled to enter the Site and the Contractor can no longer be regarded as having possession of the Site.

(b) The Contractor must move out of the Site together with his personnel, labour and all the Constructional Plant and Equipment and unfixed materials.

(c) The Engineer must within 7 days after the Contract has been terminated write to the Contractor to attend a joint survey of the Works completed, the Constructional Plant and Equipment and unfixed materials remaining on the Site.

(2) After the termination of the Contract, the Employer may where possible complete the remaining Works himself or he may employ other contractor or contractors to complete the Works.

62.4 Payment After Termination

(1) The Engineer must after the termination of the Contract issue a certificate on the financial position of the Contract. This certificate is referred to in these Conditions as the Certificate of Termination Cost.

(2) The Engineer must certify the values of the following items in the Certificate of Termination Cost:

(a) certified sum of all Works completed by the Contractor up to the date of the termination of the Contract based on the joint survey conducted according to Clause 62.3(1)(c);

(b) certified value of all Variations completed by the Contractor including all the Variations which are to be valued by Daywork;

(c) Costs which the Engineer considers that the Contractor is entitled under the Contract;

(d) cumulative amounts due to all Nominated Sub-Contractors together with any profit and attendance charges which the Contractor is entitled;

(e) value of the Performance Security that the Employer has made a call according to Clause 10.4 of these Conditions;

(3) In addition to the items in Clause 62.4(2), the Engineer must also certify the values of the following items in the Certificate of Termination Cost:

(a) the costs of making good any defects in the Works;

(b) any other costs to the Employer which the Employer is entitled to claim from the Contractor according to express provisions of the Contract.

(4) The Certificate of Termination Cost must state the difference in the total values certified in Clause 62.4(2) less the total values certified in Clause 62.4(3). The balance will be the value certified as payable by the Contractor to the Employer or by the Employer to the Contractor as the case may be.

(5) The Engineer must issue the Certificate of Termination Cost as soon as he can ascertain and certify all the applicable values in Clause 62.4(2) and Clause 62.4(3) or within a period of 6 months after the termination has taken effect whichever is later.

(6) The Contractor will not be entitled to any payment (if any) after the termination of the Contract until the Engineer has issued the Certificate of Termination Cost.

(7) The payment due on the Certificate of Termination Cost must be paid within a period of 30 days of the issue of the Certificate.

63 DISPUTE RESOLUTION

63.1 Reference to Arbitration

(1) If there is any dispute between the Employer and the Contractor in any matters relating to or arising from the Contract, either the Employer or the Contractor must first refer the dispute or difference to arbitration for its resolution before starting any legal action in court.

(2) The reference to arbitration by either the Employer or the Contractor to arbitration is subject to the applicability of Option Module B. The provisions of Module C if they are applicable will have to be applied and Clause 63.1 can only be invoked when any of the following event first occurs:

(a) if the mediation does not result in a settlement agreement entered into between the Employer and the Contractor and the mediator decides to terminate the mediation process; or

(b) if either the Employer or the Contractor decides, after the commencement of mediation process, not to proceed with mediation and conveys this decision to the other party in writing; or

(c) both the Employer and the Contractor agree in writing between themselves not to proceed with mediation.

(3) The party that starts the reference to arbitration must first serve a notice ("Arbitration Notice") to the other party.

(4) The Arbitration Notice must be served in any of the method provided in Clause 9.1 of these Conditions.

(5) The Arbitration Notice can only be served after

(a) the termination of the Contract irrespective if the termination is challenged; or

(b) the issue of Certificate of Completion; or

(c) one party claims that the Works have been completed and this is denied by the other party; or

(d) both the Employer and the Contractor agree to refer the dispute or difference between them to arbitration.

(6) Where Module C applies, it is agreed that issues not raised in mediation process may be raised in arbitration by either of the parties.

(7) The arbitration between the Employer and the Contractor is governed by Arbitration Act 2005 and both the Employer and the Contractor agree that Part III of Arbitration Act 2005 applies to the arbitration.

(8) A dispute or difference is said to have arisen between the Employer and the Contractor when one party asserts a statement or makes a claim and it is denied, or ignored, by the other.

(9) The Employer and the Contractor agree to the seat of arbitration stated in the Appendix.

(10) The Arbitration Rules published by The Institution of Engineers, Malaysia apply to the arbitration between the Employer and the Contractor.

63.2 Appointment of Arbitrator

(1) The arbitration must be held before a single arbitrator.

(2) The parties may agree on the choice of the arbitrator among themselves. If they cannot agree on the choice of an arbitrator, the party who serves the Arbitration Notice must then apply to the President of The Institution of Engineers, Malaysia to appoint an arbitrator.

(3) If the President of The Institution of Engineers, Malaysia appoints the arbitrator, it is considered that the two parties have jointly agreed on the appointment unless there are considerations which prevent the appointed arbitrator from acting as the arbitrator.

63.3 Powers of the Arbitrator

(1) The arbitrator has the following powers:

(a) to open up, review and revise any certificate, decision or opinion of the Engineer;

(b) to determine and declare all disputes or differences which have been raised by both the Employer and the Contractor;

(c) to award interests including interests which are accrued before and after the publication of the award and the rate of these interests.

(2) The parties agree that the award published by the arbitrator is final and binding on them.

Option Module A: Termination without Default

A1 The Employer is entitled to terminate the Contract without the need to give any reason to the Contractor by giving the Contractor 14-day notice ("Termination Notice") that the Contract will be terminated in accordance with this Option Module. A copy of this notice must be given to the Engineer.

A2 The Employer can exercise his right in this Option Module at any time before the issue of the Certificate of Completion.

A3 The mode of service of the notice in Clause A1 can be either of the following:

(a) by AR Registered Post; or

(b) by delivering a copy of the notice to the Contractor's notified address, his registered office, his address as it appears in the Articles of Agreement, or his site office with the Site Manager acknowledging and confirming its receipt.

A4 The termination takes effect at the end of the 14-day period after the Contractor has received the notice.

A5 The Employer's right in this Option Module must be exercised in, and is subject to the principle of, good faith.

A6 The Employer must not terminate the Contract by invoking his right in this Option Module in order to execute the Works himself or to arrange for the Works to be executed by another contractor.

A7 The Contractor may as soon as practical after the receipt of the Termination Notice demobilise all his Constructional Plant and Equipment, unfixed materials, tools, labour and others from the Site.

A8 After this termination of the Contract, the provisions of Clause 61.3(1)(a), (b), (d), (f), (g) and (h) and Clause 61.4 will apply (with the necessary changes where applicable).

Option Module B: Mediation

B1 Where the provisions of Module B apply, Clause 63.1 can only be invoked after any of the following events first occurs:

(a) after the mediation does not result in a settlement agreement entered into by both the Employer and the Contractor and the mediator decides to terminate the mediation process; or

(b) if either the Employer and the Contractor decides, after the commencement of mediation process, not to proceed with mediation and conveys that decision to the other party in writing; or

(c) both the Employer and the Contractor agree in writing between themselves not to proceed with mediation.

B2 Either the Employer and the Contractor can start the mediation process by one party sending a notice to the other party of his intention of referring any dispute or difference between them to be resolved with the assistance of a mediator.

B3 The mode of service of the notice in Clause B2 can be either of the following:

(a) by AR Registered Post; or

(b) by delivering a copy of the notice to the address as it appears in the Articles of Agreement, or to the other party's registered office or the site office with an authorised representative acknowledging its receipt.

B4 The parties may mutually agree on the choice of a mediator. If they are unable to agree on the choice of a mediator, then the President of The Institution of Engineers, Malaysia may appoint the mediator on the request of the party who starts the mediation process.

B5 The parties among themselves or the chosen mediator with the agreement of the two parties may choose either of the following rules to govern the mediation process:

(a) the Mediation Rules published by The Institution of Engineers, Malaysia; or

(b) the Mediation Rules published by Construction Industry Development Board, Malaysia; or

(c) the Mediation Rules published by Bar Council, Malaysia.

B6 Any issue or difference which is the subject matter of a settlement agreement entered into between the Employer and the Contractor after the mediation process can no longer be considered as a dispute or difference between the two parties in Clause 63.1.

APPENDIX TO THE CONDITIONS OF CONTRACT

Brief Description	Clause	Provision
% of direct relevant costs and overhead costs representing head office overheads and financing costs	Clause 1.1(12) (c)	**.....% (6% if none is stated)**
Performance Security in % of Contract Sum	Clause 10.1(3)	**..... % (5% if none is stated)**
All Risks Insurance Policy Insured Sum	Clause 20A.1(4) or 20B.1(3)	**RM ..... (Contract Sum is the minimum value)**
Third Party Liability Insured Sum	Clause 20A.1(5) or 20B.1(4)	**RM 1,000,000.00 (If Contract Sum is less than RM 20,000,000.00, then coverage amount is RM 500,000.00, else coverage amount is RM 1,000,000.00)**
Date for Commencement	Clause 37.1(1)(a)	**AS PER ENGINEER'S INSTRUCTION**
Liquidated Damages	Clause 46.1(2)	**RM 0.1% of Contract Sum**
Defects Liability Period	Clause 48.1(1)	**..... months (12 months if none is stated)**
Contractor's Interim Payment Applications	Clause 58.1(1)	**..... (Monthly if none is stated)**
Contractor's Interim Payment Applications: % of the costs of materials on site	Clause 58.1(4) (b)	**..... % (75% if none is stated)**
Period of Honouring Certificate	Clause 58.3(1)	**..... days/months (30 days if none is stated)**
Rate of Interest for overdue payments	Clause 58.3(5)	**NIL .....% (6% if none is stated)**
Retention Monies in % of Certified Amount in Interim Payment Certificates	Clause 58.6(2)	**.....% (10% if none is stated)**

Limit of Retention in % of Contract Sum	Clause 58.6(4)	.....% **(5% if none is stated)**
Seat of Arbitration	Clause 63.1(9)	..... **(The Institution of Engineers, Malaysia at Petaling Jaya if none is stated)**
Option Modules	Clause 1.1(23)	**Not Applicable (N/A)**
Sections	Clauses 1.1(29) & 49.1	.....

Description	**Date for Completion**	**Liquidated Damages**
1.	.....	**RM ...../day**
2.	.....	**RM ...../day**
3.	.....	**RM ...../day**
4.	.....	**RM ...../day**
5.	.....	**RM ...../day**

IEM Form of Contract

for Mechanical and Electrical Engineering Works

PROFORMA OF PERFORMANCE BOND

This Agreement is dated .....

Parties to the Agreement

(1) ..... (Company No.) is a company incorporated in Malaysia and has its registered office at.....
.....
.....("Employer")

(2) ..... (Company No.) is a company incorporated in Malaysia and has its registered office at.....
.....
.....("Guarantor")

Background to Agreement

(A) The Employer has awarded a contract to ..... ("Contractor") for the construction and completion of the project known and referred to as
.....
.....
.....(called in this Agreement the "Contract").

(B) A requirement of the Contract is such that the Contractor will have to provide a guarantee to the Employer as security for the Contractor's performance of the Contract.

(C) The Guarantor is a licensed bank operating in Malaysia has agreed to guarantee the Contractor's performance of the Contract.

The Terms

Based on the background given above, the Guarantor agrees with the Employer as follows;

1. The Guarantor must pay to the Employer a sum of Ringgit Malaysia: .....
.....(RM.....)
only if and when there is a written demand made by the Employer to the Guarantor stating that the Contractor has failed in his performance of the Contract.

2. Subject to the requirement in Clause 3 below, the Guarantor must pay to the Employer upon the Employer's demand. This is so even if there is any protest or disagreement that the Guarantor must not make any payment to the Employer.

3. The only requirement that the Employer must exhibit in his written demand is that the written demand must be accompanied by a Certificate of Default (or a certified true copy of this) issued by the Engineer of the Contract.

4. The Guarantor is not discharged from his obligation stated in this Agreement even if there are changes to the Contract either with or without the knowledge or agreement of the Guarantor.

5. This Agreement cannot be revoked by the Guarantor.

6. This Agreement is valid and is binding on the Guarantor until ……..…… (date) or any extension given by the Guarantor to continue its validity.

7. The Employer must make any demand on this Agreement before the validity of this Agreement expires.

Signed by authorised representatives of the Guarantor:

……..……	……..……
( )	( )

Published by: **The Institution of Engineers, Malaysia**
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E-mail: sec@iem.org.my Homepage: http://myiem.org.my

APPENDIX TO THE CONDITIONS OF CONTRACT

Brief Description	**Clause**	**Provision**
% of direct relevant costs and overhead costs representing head office overheads and financing costs	Clause 1.1(12) (c) (6% if none is stated)	6%
Performance Security in % of Contract Sum	Clause I0.1(3) (5% if none is stated)	5%
All Risks Insurance Policy Insured Sum	Clause20A.1(4) or 20B.l(3) Contract Value (Contract Sum is the minimum value)	Contract sum is the minimum value
Third Party Liability Insured Sum	Clause 20A.1(5) or 20B.1(4) RM 100,000,000 (If Contract Sum is less than RM 20,000,000.00, then coverage amount is RM 500,000.00, else coverage amount is RM 1,000,000.00)	RM 1,000,000.00
Date for Commencement	Clause 37.l(l)(a)	As per Letter of Acceptance
Liquidated Damages	Clause 46.1(2)	TBA
Defects Liability Period	Clause 48.1(I) (12 months if none is stated)	12 months
Contractor's Interim Payment Applications	Clause 58.1(1) (Monthly if none is stated)	Monthly
Contractor's Interim Payment Applications: % of the costs of materials on site	Clause 58.1(4) (b) (75% if none is stated)	60 %
Period of Honouring Certificate	Clause 58.3(1) (30 days if none is stated)	30 days
Retention Monies in % of Certified Amount in Interim Payment Certificates	Clause 58.6(2) (10% if none is stated)	10% of work done up to maximum 5% of Contract Sum

Limit of Retention in % of Contract Sum	Clause 58.6(4) (5% if none is stated)	5% of Contract Sum
Seat of Arbitration	Clause 63	The Institution of Engineers, Malaysia at Petaling Jaya if none stated

5. PRELIMINARIES & GENERAL

1. GENERAL EQUIREMENTS

1.1 Extent of Contract

This Contract covers but not limited to **SUPPLY, DELIVERY EX-SITE, INSTALLATION, TESTING AND COMMISSIONING AND GUARANTEE OF CIVIL AND MECHANICAL WORKS OF ONE (1) UNIT 1500MT CRUDE PALM OIL (CPO) BULK STORAGE TANK (BST), DESPATCH BAY AND ANCILLARY WORKS AT KEMAMAN PALM OIL MILL, KEMAMAN, TERENGGANU** as described in specifications, drawings and Schedule of Prices. It covers the supply of all necessary materials, plant and labour; design and execution of temporary work; complete construction and maintenance for a period as specified and preparation of "as constructed/installed drawings" all as specified or directed by the Engineer and all to his approval and satisfaction. The work shall be complete with all minor and incidental items necessary for the proper functioning of the whole system, even though not specifically detailed or mentioned in the specifications and Schedule of Prices.

The Contractor shall include in the tender price for all duties, where applicable and for all builder's work necessary for the execution of the complete works, such as supports, cutting, trimming, vermin-proofing, flashing, sleeves, making good etc. No extra to the Contract will be entertained in respect of any such work not allowed for in the tender but necessary for the proper execution of the Works.

1.2 Works to be completed

It is not the intent to specify herein completely all details of design and construction of the works involved. However the works executed shall be completed in all respects and conforms to high standards of Engineering design and workmanship.

2. WORKS INVOLVED

2.1 Scope of Works

The Works envisaged under the Contract are but not limited to the construction and completion of civil, mechanical and electrical engineering works as specified in and shown on the tender drawings and amplified in the Bill of Quantities in the order forming the Contract.

2.2 Order of Works

All phase of the Works are to proceed simultaneously in so far as normal construction methods permit. Save in so far as it is legally or physically impossible, the Contractor shall execute, complete and maintain the Works in strict accordance with the Contract and to the satisfaction of the Engineer, and shall comply with and adhere strictly to the Engineer's instruction and directions on any matter (whether mentioned in the Contract or not) touching on or concerning the Works. The Contractor shall take instructions and directions only from the Engineer.

2.3 Progress of Works

(a) The Contractor shall provide such plant, equipment, materials, labour, key personnel for supervision and shall organise, schedule and co-ordinate the works to maintain the planned progress in accordance with an agreed programme and to meet the deadlines for various phase of works to be completed.

(b) When work in the opinion of the Engineer is behind schedule, additional input and deployment of plant, equipment, materials, labour and personnel will be required to keep up with the agreed programme. No extra cost to the Employer will be allowed on this account.

3. SITE OFFICES AND TEMPORARY BUILDINGS

Within 1 weeks of the Engineers' order to commence the Works the Contractor shall proceed to construct expeditiously all the necessary temporary buildings and establish Contractor's site office at locations approved by the Engineer, and remove same, make good and clean up the affected areas on completion of the Works. Such buildings shall include the Contractor's site office, stores and etc., all to comply with the requirements of the relevant authorities and to the satisfaction of the Engineer. The Contractor shall make all the necessary arrangements including submitting plans with the authorities to obtain permit and pay all costs, fees and charges in connection with these works.

4. EQUIPMENT AND SERVICE FOR ENGINEER'S SITE STAFF

The Contractor shall provide and maintain during the currency of the Contract, to the approval of the Engineer or his Representative and for the sole use of the Engineer's site staff all the necessary measuring instruments, materials, labour as the Engineer or his Representative may require in connection with the Works.

5. ALLOCATION OF OPEN SPACE

The Employer will provide open space at the site for the site offices and for storage of the Contractor's equipment and materials. The area of the open space allotted to the Contractor shall be at the discretion of the Employer.

6. ACCOMMODATION

The Contractor shall make his own arrangements at his cost for residential accommodation of his labour and supervisory personnel.

7. CONSTRUCTION WATER AND POWER SUPPLY

The Contractor shall provide and arrange at his own cost all water, lighting and electric power required for the satisfactory execution of the Works and shall pay all costs, fees and charges in connection therewith. The capacity and distribution arrangement proposed by the Contractor shall be subject to the approval of the Engineer and shall comply with the requirements and regulations of all authorities having jurisdiction over such supplies and installations.

8. TEMPORARY WORKS

The design, supply, installation, maintenance and final removal of all temporary works of whatsoever nature required for the execution of the Works shall be the sole responsibility of the contractor. Any temporary works provided by the Contractor shall be adequate for the purpose and shall be properly designed and constructed. The Contractor shall submit complete details of such temporary work to the Engineer for this approval at least 7 days prior to the start of the construction of such temporary works and no work shall commence without the approval of the Engineer. The Engineer's approval shall not in any way relieve the Contractor of his responsibility for the proper construction and functioning of the temporary works.

9. DAMAGE TO EXISTING ROADS, ETC.

The Contractor shall arrange for the conveyance of materials, plant, etc., so as to cause a minimum of damage to existing roads and culverts. The Contractor shall be responsible for any damage caused by his constructional plant, transport or workmen to any existing roads, culverts, etc., from whatsoever cause arising and shall maintain, repair and reinstate same to their original conditions to the satisfaction of the Engineer or alternatively, shall bear the cost of such maintenance and restoration as a deduction from money due or to become due to the Contractor under this Contract.

10. RESTRICTION OF WORKMEN TO SITE

10.1 The Contractor shall be responsible for restricting all persons under his control, including those employed by sub-contractor, merchants and hauliers to the Site of the works and shall take all necessary precautions to prevent damage and nuisance of any kind and shall indemnify the Employer against any claims arising therefrom.

10.2 The Contractor shall, when required by the Engineer afford all reasonable opportunities for other contractors employed by the Employer, the workmen of the Employer and any other duly constituted authorities for carrying out their work at the site and within the work area of the Contractor.

11. WATCHING AND LIGHTING

11.1 The Contractor shall provide all necessary watching by day and night (including warning lamps if required by the Engineer or other authorities) for the whole period of the works that are in hand.

11.2 The Contractor shall be responsible for his own properties and works executed by him until such works are being completed and taken over by the Employer.

12. OBSTRUCTION, CARE AND PROTECTION

The Contractor shall ensure that all his plants, materials, temporary workshops, stores, offices, etc., shall be kept within the area allocated to him by the Engineer. If it should be necessary to utilise land outside the confines of land approved for these purposes the Contractor shall be responsible for any rent or hire incurred. The Contractor shall avoid causing any unnecessary inconvenience or obstruction to other contractors or to the Employer's workmen who may be working in the area or vicinity of the Works.

13. SAFETY FACILITIES

The Contractor shall provide and maintain proper and adequate medical services and first aid facilities with qualified attendants suitable to the size and composition of his staff and labour force. The Contractor shall afford the site staff of the Employer/Engineer full use of the facilities when required, including provisions of approved safety helmets (of designated colour), and shoes to his own staff and labour (including sub-contractor's labour).

14. ACCESS FOR INSPECTION BY ENGINEER

The Contractor is to provide at all times during the progress of the works and the maintenance period, proper means of access with ladders, gangways, etc., and the necessary attendance to move and adapt as directed, for their inspection or measurement of the works by the Engineer.

15. CLEANING SITE AND MAKING GOOD ON COMPLETION

Progressively removing from the site all debris, rubbish, superfluous materials and other objectionable matter and disposing off far away from the site and leaving the site clean on completion of the works. Leave every part of the works completed in clean, sound and perfect condition, and leaving all services in proper working condition, etc., to the satisfaction of the Engineer.

16. SHOP DRAWINGS

The Contractor shall prepare all shop drawings for the works where required. All costs incurred shall be included in the Tender.

17. WEEKLY AND MONTHLY REPORTS

The Contractor shall submit to the Engineer weekly report of the Works reporting on the exact number of types of plant working, hours of actual working of each plant, hours of breakdown or idling plant with reasons for such, the actual number of men including all grades and trades working.

18. WEEKLY AND MONTHLY REPORTS

Weather conditions, the occurrence of accidents or the like and any other relevant information related to the progress and execution of the works. Such weekly report shall be submitted and delivered to the Engineer on the first day of the following week. At the end of each calendar month, the Contractor shall summarise all weekly reports (2 sets) of the month concerned, submit and deliver each monthly report to the Engineer not later than the 3rd day of the month. The Engineer reserves the right and power to direct the Contractor to include any other additional information, as he deems necessary in these reports. All monthly report shall include minimum 6 copies of photographs documenting works done during the month of the report.

19. PROGRESS MEETINGS

A responsible representative of the Contractor shall attend, without fail the progress meetings as and when called for by the Engineer at site and keenly participate in the discussions with the sole purpose of executing the work in a satisfactory manner and in time. Such meetings will be jointly recorded and due action shall be taken by the Contractor on the decisions reached during the meetings. The frequency of the meeting is once a week or when requested by the Engineer.

20. CONTRACTOR'S REPRESENTATIVE

20.1 The name of the person proposed shall be given to the Engineer and he shall be made available for interview by the Engineer before appointment. The Contractor's representative, following acceptance by the Engineer, shall not be changed other than with the Engineer's concurrence.

20.2 The Contractor's representative shall be contactable outside normal working hours.

21. CHECKING OF WORK

If required by the Employer, the Contractor shall check the mechanical connections to all Plant supplied under the Contract before such Plant is brought into commission and shall be responsible for the correctness of such connections in accordance with the Drawings and the Specifications.

22. COMMISSIONING OF PLANT

The method of procedure for commission of Plant shall be mutually agreed between the Contractor and the Employer (or his duly authorised agent).

23. MODIFICATIONS

The Contractor shall carry out modification works as directed by the Engineer and as covered by the General Conditions of Contract.

24. WEATHER CONDITIONS

The Contractor shall be deemed to have taken all possible weather conditions into account when preparing his tender and he shall not be entitled to extra payment or an extension of the contract period by the occurrence or effect of excessive rainfall, high winds, or any other weather conditions provided that the Engineer may in certain exceptional circumstances, consider an extension of time by Contractor if it can be shown that he has been adversely affected in the carrying out of the works by a condition of the weather which, on the basis of past records, could be considered as having less than a 5% chance of occurring in any one year. The Contractor shall include in his tender an approved rain gauge to be installed at a protected area to be decided by the Engineer. Any extension of time approved arising from adverse weather shall not be subjected to claim for extra costs by the Contractor.

25. CLAIMS FOR EXTRA COST

If the Contractor claims that any instructions by drawings or otherwise involve extra cost under this Contract, he shall give the Engineer written notice within five days after the receipt of such instructions. All claims covering items involving additional cost shall set out the detailed claims clearly. No claims for extra will be recognised unless the work has been authorised in writing and the estimated cost has been approved by the Employer.

26. OTHER WORKS

All works incidental to the foregoing (including supply of all materials), the necessity for which may reasonably be implied or inferred from the Technical Specification, the Bill of Quantities and the Drawings, or which are essential or usual for the completion of the works in every respect.

27. ADVERTISING

The Employer reserves the sole right of advertising upon or adjacent to the Works. The Contractor shall not allow and must ensure that no advertisement is displayed without the written consent of the Engineer. Permission will only be given for the erection of signboard by Sub- Contractors and Suppliers and all such signs shall be to the approval of the Engineer.

28. ANTIQUES

Any treasure throve, coins relics, objects of antiquity, etc. which be found on the site are to be the property of the Employer and to be handed to the Engineer. The Engineer is to be notified prior to the opening up or demolition of any ancient masonry, pavements of other old work of interest.

29. CLEARING AWAY

Clean and cart away all rubbish and waste materials that may accumulate from time to time arising from Contractor's works during the progress of the Works and at completion.

30. RUBBISH CLEARANCE

The Contractor shall pay to the Authority the deposit or fees for rubbish clearance during construction and at the completion of the works as required by the Local Authority. This deposit will be refunded to the Contractor on condition that the site is left in a clean and perfect condition, free from all rubbish. The Contractor is to ensure this is done at completion of the works and failing to do so, will cause forfeiture of the deposit.

31. TIME OF COMPLETION

31.1 General

Time is the essence of this Contract. The Contractor shall take up the procurement and fabrication (based on Construction Drawings) immediately on receipt of the 'Letter of Acceptance' issued by the Employer or on receipt of work order, whichever is earlier. The permanent works at site shall start within 1 week after the site is handed over and the entire work included in the scope of this Contract should be completed within the specified overall time all calculated from the date of commencement stated of 'Letter of Acceptance' or Engineer's order to commence work.

31.2 Contractor's Program for Execution of Works

Within one weeks from the award of Contract or issued of 'Letter of Acceptance', whichever is earlier, the Contractor shall prepare and submit to the Engineer for his approval a detailed Schedule Construction Programme showing his proposals and specific time periods for carrying out the various sections of the Works and the time for overall completion, taking into consideration the strict adherence of the target date for completion of the Works, the priorities of construction required.

31.3 Approved Program

After receiving the approval of the Engineer to the Programme, it shall become the Approved Programme of Works and no deviation therefrom shall be made by the Contractor without the approval of the Engineer.

31.4 Master Program

The Contractor shall, when directed by the Engineer, incorporate in this Approved Programme the programme prepared by his Sub-Contractors and the Erection Contractors and agreed by all parties concerned. This shall then become the Master Programme of Works, two copies of which are to he distributed to all concerned. All cost incurred in this connection shall be deemed to be included in the tender.

31.5 Review of Master Program

The Master Programme is to be reviewed periodically with the Engineer to ensure the completion date will be met or to institute such corrective measures by the Contractor as the Engineer may consider necessary in order to maintain the completion date. Should at any time progress falls behind his period shown in this Master Programme of Works, the Contractor shall, on the instruction of the Engineer, take such steps and employ such methods as will enable him to catch up on his programme all to be in accordance with the requirements and to the approval of the Engineer and at no extra cost to the Employer.

32. BID DRAWINGS

32.1 The bid drawings to be issued are as listed and they shall form part of the Tender Documents for the purpose of bid only.

32.2 The bid drawings listed above are preliminary in nature and are intended to give the Tenderer a general idea of the type and extent of work involved being as such indicative and having the purpose of providing a common basis for evaluation of Tender.

33. CONSTRUCTION DRAWINGS

The contractor shall use only construction drawings issued by the Engineer. The construction drawings shall be issued in stages within a period of two weeks from the Commencement of Works.

34. DRAWINGS BY CONTRACTOR

The cost of preparation, printing and submission of all drawings, calculations and other information to be supplied by the Contractor under the terms of Contract shall be deemed to be included in the Contractor's quoted rates and prices for the works.

35. CONTRACT DOCUMENTS

The Contract Documents shall comprise of the Tender, From of Agreement and Schedule of Conditions of Contractor including any Supplementary Conditions thereto, Special Conditions of Contract, Form of Performance Bond, Technical Specifications, Bill of Quantities, Annexures, Drawings as listed including any modifications thereof and any other drawing which may be issued during the duration of the Contract and Tender Amendments if any issued during the Tender.

36. SPECIFICATIONS

The Specification shall comprise of the Technical Specifications hereof and all relevant British Standard Specifications and Codes of Practice as stated therein including all latest amendments, and any other National Standard and Code of Practice which may be approved by the Engineer.

37. DISCREPANCIES IN CONTRACT DOCUMENTS

37.1 Wherever in this Contract discrepancies arise between the several documents and/or drawings, the following precedence shall be observed:

(a) The Conditions of Contract shall take precedence before all other documents.

(b) Printed specifications or descriptions shall take precedence before drawings or notes on drawings.

(c) Detailed drawings shall take precedence over small-scale drawings.

(d) Larger dimension shall take precedence over small-scale drawings and higher specifications shall take precedence over lesser specifications.

(e) Dimensions in drawings shall take precedence (No scaling from Drawings is allowed).

37.2 The Contractor shall check and inform the Engineer or his appointed representative within one week in writing of any discrepancies that arise.

37.3 Should discrepancies arise which cannot be resolved by observing the above precedence, the Engineer's decision shall be final and binding.

38. TEST ON COMPLETION

38.1 Tests shall be conducted on completion of the constructional and erection works. These tests shall include trial running and performance operation of all plant and equipment supplied in order to ascertain the following:-

(a) Erection/Installation of Employer's Supply Items Accuracy of inter-connections and external connections, machinery alignment, soundness and rigidity of the installation.

(b) For contractor's supply items the requirements are as for above, and also quality of fabrication and site assembly, and confirmation of specified functional dimensions. The performance of the Contractor's supply items shall conform to Technical Specifications. The contractor shall be present during these tests.

(c) For the purpose of these tests the contractor shall be responsible for the first filling of all lubrication oils and grease for the plant supplied by him and elsewhere as stipulated in the Contract.

38.2 Before conducting these tests, the Contractor shall produce Test Certificate evidence showing:-

(a) Approval from the Machinery Department and other local authorities for the installation and operation of the plant supplied in this contract.

(b) That the plant conforms to the prevailing standard and regulations of the Factories and Machinery Act 1967 (Act. 64 to 67) and other standards by other local authorities.

38.3 In addition to the tests mentioned the mechanical commissioning shall include, but not be limited to the supervision and acceptance of the items of works detailed below:-

(a) Hydrostatic test of fabricated equipment supplied by the contractor after installation to ensure mechanical soundness. Such test shall not be mandatory for shop fabricated equipment already tested in the fabrication shops.

(b) Hydrostatic and/or pneumatic testing, where necessary, of piping installation in accordance with the piping standards and specifications relevant to the contract.

(c) Coupling, alignment, checking direction of rotation, realignment and lubrication of driven equipment.

(d) Supply and installations of commissioning strainers/screens, in pump suctions and delivery etc. The commissioning strainers/screen shall be made of stainless steel mesh c/w stainless steel ring and holders made from 3mm thick stainless steel mesh and are deemed to be included in the Contract Price.

(e) Cleaning, blowing and washing out of equipment and pipelines as may be required under specification for equipment and pipelines.

(f) Placing of all blinds in position where necessary.

39. GUARANTEE AND DEFECT OF PLANT

39.1 The contractor shall guarantee all plant supplied fulfil the design capacity and quality of the product produced.

39.2 The contractor shall guarantee all plant and materials supplied by him for incorporation into the works to be brand new, of first quality and first class workmanship.

39.3 The contractor shall also guarantee the efficient, good and safe working of all plant supplied under the contract for a minimum period of one year from the date on which the employer takes over the plant in accordance with the General Conditions and Technical Specifications of the Contract.

39.4 The contractor shall make good and rectify all failures, which occur in any item of any plant due to or arising from defective or faulty materials and workmanship under his responsibility during the Tests on Completion or Period of Guarantee. The onus of proving that any failure is NOT due to defective or faulty materials and workmanship shall lie with the Contractor.

40. ALTERNATIVE MAKES

Wherever brand names are specified herein the contractor may propose alternative makes, in which case such items must be:-

a) Of equal quality, and where applicable.
b) Of relevant proven performance, and
c) Of equivalent capacity rating.

However, the contractor must offer the items specified along with his alternative proposals if any. The proposal is subject to Employer's acceptance.

41. SPECIFICATION INTER-RELATED

The specification shall be read as a whole notwithstanding its division into parts. Works specified under any part shall also govern the works under another part where applicable. Where discrepancies in dimensions exist between the Technical specifications and drawing, the larger dimension shall be deemed to prevail over the smaller dimensions.

42. AUTHORITIES APPROVAL

The tenderer shall be responsible in securing the necessary authorities approvals for works under his scope and the costs shall be deemed to be included in the contract.

43. EMPLOYER'S SUPPLIED EQUIPMENT

43.1 For equipment supplied by the employer ex-site, the contractor shall be responsible for unloading, store in designated area and installation of such machinery.

43.2 Under no circumstances shall equipment be opened from their packing or crates except in the presence of the Engineer or his Representative unless instructed otherwise by the Engineer in writing.

44. CONTRACTOR'S RESPONSIBILITIES

44.1 All work at the site is to be carried out in such a manner as not to obstruct the operation of any other contractor on the Site.

44.2 The execution of all work included in the Contract is to be supervised by a sufficient number of qualified representatives of the Contractor, and full facilities and assistance are to be afforded by the Contractor to the Engineer and his Representative to inspect and check the work at all stages of erection.

44.3 The Contractor is to obtain for the Engineer, details of the parts or plant, which he wishes to inspect, but such inspection shall in no way exonerate the Contractor from any of his obligation. The Contractor, if requested by the Engineer, is to open up for inspection before erection of any equipment, which has been delivered to the site partly assembled.

45. BRITISH STANDARD SPECIFICATIONS

45.1 Although British Standard Specifications have been used as reference in this specification, plant meeting other authoritative standards, which ensure as equal or higher quality, will also be accepted, subject to the approval of the Employer.

45.2 In the case where no Standards are mentioned, it shall be assumed that the British Standard Specifications shall be used.

46. PRESSURE VESSELS, PLANT AND HEADERS

The contractor shall, for all pressure vessels, plants and headers submit the necessary drawings/calculation and application for the approval of DOSH prior to Commencement of works.

47. MAINTENANCE AND MODIFICATION SERVICE DURING COMMISSIONING AND POST COMMISSIONING

47.1 The contractor shall make available to the Employer the services of one site supervisor, one welder and three fitters during the mechanical commissioning and process- commissioning period. The total commissioning period shall be at least **14** full working days.

47.2 The cost of service provided during the commissioning period is deemed to have been included in the tender price while the cost of service provided after period mentioned above shall be chargeable at the rates quoted in the schedule of rates.

47.3 The duties of the site supervisor, welder and fitter shall include the maintenance, modifications and rectification of minor defects of the works and teething troubles, under the responsibility of Employer as directed by the Engineer/Engineer's Representative or any other authorised officer of the Employer.

47.4 During the commissioning period, the contractor shall make available for use by the Employer one diesel powered welding set and necessary welding equipment, one set of oxy-acetylene cutting torch and adequate oxygen and acetylene gases if requested, and the balance of all stock materials at site which shall not be withdrawn from the site without the approval of the Employer. The cost for providing the above mentioned facilities during the commissioning period shall be deemed to be included in the contract price. However the use of the above mentioned facilities after the commissioning period if so directed by the Engineer shall be chargeable at a rate quoted in the Schedule of Rate.

47.5 The contractor shall not make use of the site supervisor, welder and fitters assigned to the Employer during the mechanical and process commissioning period for work under his responsibility.

47.6 All works at site involving the opening and operating of any system, valves and etc. during commissioning shall be under the instruction of the commissioning Engineer.

48. TERMINATION POINTS

All Termination points for piping connection for equipment shall be flanged unless otherwise specified.

49. INSURANCE COVERAGE

The contractor shall in joint name with the Employer take up the following insurance:-

a) Workmen Compensation for minimum coverage of 20% of the Contract Price.

b) Erection All Risk Policy to cover full Contract Price plus RM 500,000.00 for existing Employer’s properties.

c) Third Party Liability for Indonesia RM 1,000,000.00 for unlimited number of incidents.

d) Policies shall include cross liability clause.

50. COPYRIGHT

50.1 All Drawings and any other documents of either a technical or management administrative nature as produced by the contractor pursuant to the provisions hereunder shall become the Employer's property in the first instance. That any and all such Drawings and/or documents are produced and whether such Drawings and/or documents as produced and issued by the Contractor and/or any Sub-Contractor, in their respective company names or otherwise, as a service under the Contract Documents; the sole copyright in such documents as a condition of this Agreement shall in the first instance that the said items are produced become the property of the Employer.

50.2 In the event that any Drawings and/or documents produced by the Contractor and/or Sub-Contractor shall become lost or damaged by the Contractor the same shall be reproduced by the Contractor and supplied to the Employer at the cost of the Contractor.

50.3 Upon termination or cancellation of this Agreement, the Contractor shall deliver all copies of Drawings, Employer's Documents and any other documents produced during the course of this Agreement to the Employer at the Contractor's expense and under no circumstances shall any such Drawings, Employer's Documents and any other documents or copies thereof be retained by the Contractor/or Sub-Contractor.

51. BREACH OF PATENT RIGHTS/COPYRIGHTS

The Contractor shall fully indemnity the Employer against all actions, claims, charges, losses and expenses arising from or incurred by reason of any infringement or alleged infringement by the Contractor in the performance of its obligations under this Agreement of letters patent, designs or copyright protected in Malaysia and other countries. In the event of such infringement or alleged infringement the Employer shall have the right to terminate this Agreement, without prejudice to any rights that the Employer may have against the Contractor by reason of such infringement or alleged infringement as accrued under this Agreement at the time of such termination.

52. CONDITION OF TENDERING

The Employer's conditions of tendering are the only conditions, which shall be recognised. Any condition, which the Tenderer imposes in his tender, is null and void unless specifically agreed to by the Employer in writing.

53. SITE VISIT

The tenderer shall make a compulsory site visit to satisfy him on the site condition before tendering.

54. SITE POSSESSION

The Employer shall hand over the site not later than **2 weeks** from Commencment Date. The Contractor shall mobilise not later than 1 week from site possession.

55. COMPLETION PERIOD

The completion period for the whole works shall be **4 months** from date of Commencement or whichever that has been agreed upon.

56. AS-BUILT DRAWINGS

The contractor shall supply as-built drawings in ACAD format within one month from the completion of works.

57. OCCUPATIONAL SAFETY AND HEALTH AND ENVIROMENTAL QUALITY ACT

57.1 Inline with Employer's Environmental Policy and Occupational Safety and Health Policy, the contractor shall adhere to standards on health, safety and environment.

57.2 The Contractor shall comply with the Occupational Safety And Health Act 2004 ("OSHA"), the Environmental Quality Act 1974 ("EQA") and any other relevant enactment or by laws pertaining to occupational safety, health and the environmental or any subsequent modification or re-enactment thereof. The owner shall be entitled to terminate this agreement without any preceding notice, in the event that the contractor fails to comply with any of the relevant provisions pertaining to occupational safety, health and the environment and the contractor shall keep the owner indemnified against all penalties, liabilities, loses, damages and/or costs imposed on or incurred by the owner as a result of any breach of such provision.

57.3 The owner shall also be entitled to add, impose or include other regulations, guidelines, conditions, policies, instructions or any other form of additional provisions to this agreement, which are related to the occupational safety, health and the environment to be complied with by the contractor.

58. TERM OF PAYMENTS

58.1 The Employer shall pay to the Contractor in the following manner the Contract Price adjusted to give effect to such additions thereto and such deduction therefrom as are provided for in these Conditions:

a) 20% of Contract Price as down payment on signing LETTER OF ACCEPTANCE OF OFFER subject to submission of Bank Guarantee of similar amount. The Bank Guarantee can be replaced with 5% Performance Bond upon delivery of next progress payment.

b) Up to 70 % of the Contract Price on delivery of fabricated materials to site subject to adequate protection, storage less 10% of total work done as interim retention.

c) Up to maximum 95 % of the Contract Price certified progressively therein in respect of site installation until full completion less 10% of total work done as interim retention and less previous payment.

d) Up 100% of the Contract Price on successful commissioning, commercial operation and after presentation of the Taking - Over Certificate less 5% of the Contract Price as retention for Defect Liability Period and less previous payment.

e) The balance 5% of the Contract Price (as retention sum throughout Defect Liability Period) after presentation of the final certificate of payment.

6. SPECIFICATIONS

6.1 - TECHNICAL SPECIFICATIONS (CIVIL & STRUCTURAL)

A. GENERALLY

B. SITE CLEARANCE

C. EARTHWORKS

D. CONCRETE

E. BRICKLAYER

F. DRAIN LAYER

G. ROOFER AND SHEETING METAL WORK

H. CARPENTER, JOINER AND IRONMONGER

I. PLASTENER, PAVIOR AND TILER

J. PAINTER

K. STRUCTURAL STEELWORK

L. EXTERNAL WORKS

M. PLUMBING AND SANITARY SERVICES PIPEWORKS, VALVES AND FITTINGS

N. IRONMONGERY

O. SANITARY FITTINGS

P. PILING

Q. STANDARD WIRING SPECIFICATIONS FOR OFFICE ABD AMENITIES BUILDINGS

R. EXCAVATOR

A. GENERALLY

1.0 ABBREVIATION

The following abbreviations have been used in the Schedule of Works and / or Specifications:-

CF	-	Cubic Foot
SF	-	Square Foot
LF	-	Linear Foot
NO	-	Number
LB	-	Pound
MM	-	Millimeter
SWG	-	Standard Wire Gauge

The following abbreviations have been used in the Specification:-

BS	-	British Standard Specification issued by the British Standard Institution.
CP	-	British Standard Code of Practice issued by the Council of Codes of Practice.
PC	-	Prime Cost
ASTM	-	The American Society for Testing and Materials
SIRIM	-	Standards and Industrial Research Institute of Malaysia
JKR	-	Jabatan Kerja Raya
AS	-	Australian Specification
SAA	-	Standards Association of Australia

2.0 STANDARD SPECIFICATIONS

The Specification is a standard Specification and item specified which are not shown on the Drawings or are not included in the Schedule of Prices are not applicable.

Reference to published Standards, manufacturer's catalogues etc. shall imply the latest amendment in each case.

3.0 INSTRUCTION ON PRICING

Specification are descriptions of materials and workmanship and other matters relating to the work measured in the Schedule of Prices and apply to the whole of the work regardless of the conjunction with the Schedule of Prices.

The rates inserted in the Schedule of Prices shall be held to include for all costs, expenses, changes and expenditure arising for complying with the Specification and Trade Preambles.
Unless otherwise described, each item of measured work shall include the cost of supplying and delivering materials to site, unloading, storing, distributing about the site, cutting and waste on materials, all labour, hoisting, setting, fitting and fixing in position, covering up and protecting finished work, clearing away debris and waste, return of packing, carriage paid, use of plant and equipment, supervision, establishment and overhead charges and profit.

The term “as described” as used in the Schedule of Prices shall mean “as described in the Specification and Preambles to All Trades”.

The Contractor is advised to study the Specification and Trade Preambles before pricing the Schedule of Prices and before submitting his tender, as no claim for extra payments on the ground of neglect in this respect will be entertained.

4.0 MATERIALS

Unless otherwise described, all materials shall be new and in accordance with the British Standard Specifications and the Contractor shall produce the necessary certificates to substantiate this fact if required by the Engineer.

5.0 WORKMANSHIP

Workmanship generally is to be of the highest standard. Where a British Standard Code of Practise exists and is applicable to any portion of the Works, the workmanship shall comply with the recommended practice unless such procedure would directly conflict with requirements stated elsewhere in these documents.

6.0 PROPRIETARY MATERIALS

Materials of proprietary manufacture specified hereafter may be substituted by materials of a different manufacture provided that such changers are in all respect equal to the original specification and that the Engineer’s prior written approval is obtained.

7.0 P.C. UNIT RATES

P.C. unit rates for materials wherever used in the Schedule of Prices are for materials to be supplied by a firm to be nominated by the Engineer and shall mean the cost of the material supplied and delivered to site inclusive of all taxes and duties and adjusted for trade discounts for the nett quantity required to be fixed on site.

The Contractor shall use the P.C. unit rates provided and calculated his overall rate to insert against such item of measured work.

Additional requirement for wastage, loss, entering into a contract of sale etc., labour for fixing, overheads, profit and any other charges shall be covered by the Contractor’s overall rate for the item.

P.C. unit rates for works wherever used in the Schedule of Prices are for works to be executed complete by a firm to be nominated by the Engineer and shall mean the cost of the work for the nett quantity required.
The Contractor shall use the P.C. unit rates provided and calculated his overall rate to insert against such item of measured work.

The Contractor's overall rate shall cover for all other items including attending upon the firm and providing attendance as if this firm was a "Nominated Sub-Contractor".

The Contractor's overall rate shall cover for entering into a contract with the selected nominated firm, overheads, profit and all other charges.

Adjustment of P.C. unit rate items in the final account will be effected by substituting the invoiced unit rate in lieu of the P.C. unit rate.

In other words the difference between the invoiced unit rate and P.C. unit rate shall be added to or deducted from the overall rate inserted by the Contractor. No other adjustment will be made.

In event of any discrepancy between the Contractor's overall rates for similar P.C. unit rate items in different sections or parts of the Schedule of Prices then the lowest rate shall prevail and shall be used for adjustments of P.C. unit rate items in the final account.

The Contractor shall note that any contra matters between the supplier or firm nominated and the Contractor shall be matters solely concerning the Contractor and no claim whatsoever shall be made against the Employer.

8.0 ANOMALIES BETWEEN DOCUMENTS

In the event of any discrepancy between the Specification and the Drawings, the notes on the drawings shall take precedence without any additional cost to the Employer.

9.0 IMPERIAL / METRIC

Where a material is not available in the imperial size specified, the Contractor shall provide this in the equivalent metric size subject to the approval of the Engineer.

The soft conversion method shall be used for the conversion of dimensions and the actual product, materials or structure being manufactured shall remain physically unaltered.

Minimal rounding to the nearest integer or sensible number shall be used.

The Contractor shall be deemed to have allowed for this in his rates and no claim will later be entertained in this respect.

B. SITE CLEARANCE

1.0 GENERALLY

A programme for site clearance shall be submitted by the Contractor for the approval by the Engineer prior to the commencement of work.

All Clearing shall be carried out in the order and manner as set out in the approved programme or as directed by the Engineer.

Indiscriminate clearing of natural vegetation shall not be allowed.

2.0 SETTING OUT

The Contractor shall set out the boundaries of clearing in accordance with the Drawings. He shall be responsible for verifying the correctness of the position, alignment and dimensions of all parts of the Works.

The setting out shall be approved by the Engineer before work on clearing commences.

3.0 CLEARING, FELLING AND GRUBBING

The site where designated by the Engineer shall be cleared of trees, logs, undergrowth and other vegetation and objectionable materials by felling or other mechanical means.

All roots and stumps shall be removed by grubbing, digging or such other means as approved by the Engineer.

The Contractor shall exercise such care and attention as required to ensure that the clearing operation is confined within the areas to be cleared.

The Contractor shall be responsible and pay at his own cost for any remedial works required resulting from any clearing not authorised by the Engineer or for clearing beyond the area required.

4.0 DISPOSAL OF TREES AND VEGETATION ETC.

No unwanted tree trunks, stumps, roots, vegetation and other debris on site or arising out of site clearance, shall be removed off the site to a spoilt tip to be provided by the Contractor at his own expense.

On no account shall timber and stumps to be burnt or to be removed from site to be pushed to the ravines, valleys, or ponds.

The site for disposal shall be determined by the Engineer.

No burning shall be carried out without the permission of the Engineer and all burning shall be carried out with the knowledge of and in accordance with the regulation of the Fire Authority.

All burning of felled trees etc. must be carried out in areas designated by the Engineer under the constant attendance of the Contractor's employees.

The Contractor shall make certain such burning will not endanger life or property or the natural vegetation and shall be responsible for any damage caused by the fire whatever the reasons.

5.0 PRESERVATION OF EXISTING TREES

The contractor shall verify with the Engineer if any of the trees at site are to be preserved and the Contractor shall be held responsible for the execution of the Works.

Trees to be preserved will be selected on site by the Engineer before with the work commences.

If any such trees are damaged during the course of the Works, the Contractor is to replace them with trees of similar species, growth and girth and shall maintain the trees until they are fully established and accepted by the Engineer, all at the Contractor's own expense.

6.0 DAMAGE TO ADJACENT PROPERTY

All care shall be taken to ensure that neighbouring properties shall not be damaged or destroyed during the site clearing and any claims for compensation by others shall be the responsibility of the Contractor.

7.0 CLEARING EXISTING WATER COURSES

All existing natural water courses shall be cleared of all obstructions and kept open throughout the Works. Earth bunds or mounds formed during clearing by mechanical means shall be levelled off to permit drainage of water into the existing natural water courses.

8.0 PROTECTION OF EXISTING BENCHMARKS AND OTHER SURVEY MARKS

The Contractor shall ensure that existing benchmarks and any other survey marks located within the area to be cleared are not disturbed or destroyed during clearing operations.

Any existing benchmarks or survey marks disturbed or destroyed as a result of the clearing operations shall be re-established to the satisfaction of the Engineer, as soon as practicable, by the Contractor at his own expense.

C. EARTHWORKS

1.0 STRIPPING TOP SOIL.

Unless otherwise directed by the Engineer, all top soil should be removed from the areas within cuttings and embankments and stockpiled for re-use for any purpose such as soiling of slopes of cutting and embankments and benches.

Topsoil shall be regarded as soil which on visual examination can be said to have been broken down by agricultural cultivation.

Topsoil shall be removed to an average depth of 150 mm.

The contractor shall make his own arrangements for temporary storage sites for heaps of topsoil either inside or outside the site of the Works to suit his convenience.

All unsuitable soil comprising of underlying surface soil shall be excavated and disposed of to tips to be provided by the Contractor.

2.0 EARTHWORKS IN GENERAL

Unless otherwise specified herein all earthworks shall be carried out in accordance with the recommendation contained in Sections 11 to 15 of British Standard Code of Practice C.P. 2003: Earthworks and any other by-laws pertaining to the project area involved.

The Contractor shall immediately after clearing but before commencement and continuing to the next phase of earthworks construct and properly maintain adequate silt traps to the required details and locations as shown on the drawings or as required by the Approving Authorities.

The silt traps together with the earth drains and bunds shall be maintained by regular desilting until all earthworks for roads and platforms are completed, after which they shall be removed for the construction of the permanent drain/works.

The contractor shall at all times prevent any silt or foreign debris from encroaching into any neighbouring property or being drained out of the contract area.

The slopes of the silt traps should be protected at all times with suitable measures such as close turfing, rip-rap, etc.

The Contractor shall excavate soil from designated high areas to the required depths and levels in accordance with the drawings, for roads, roadside and main drains and for housing platforms within the limits of the Contract area or beyond with the Engineer's approvals.

Any over excavation shall be made good by backfilling in compacted layers to the satisfaction of the Engineer, at the Contractor's own expense.

Excavated soil from high areas and other approved sources shall be used for filling up of low areas to the required levels in accordance with the plans and compacted in 225 mm thick layers.

Before commencement of filling the original ground must be cleared and any trees or organic material removed to the satisfaction of the Engineer.

Where fill is to be placed against existing ground which has a slope greater than 1:6, benching or stepping of the slope has to be done prior to placement and compaction at the fill material.

The details of benching and stepping are as shown in the drawings.

Materials unsuitable as fill shall comprise:

i. Materials from swamps, marshes or bogs, running silt peat, logs, stumps, perishable material, slurry or mud.

ii. Any Material:

a) Consisting of highly organic clay or silt;

b) Which is clay having liquid limit exceeding 80 and/or a plasticity index exceeding 55;

c) Which is susceptible to spontaneous combustion;

d) Consisting or such clinkers, clinker ashes, fly ashes and domestic ashes which by virtue of their physical or chemical composition or of their moisture content will not compact to form a suitable fill.

The Contractor shall remove spoil from excavations and shall place it at a dumping point designated (or approved) by the Engineer which may be in embankments, in temporary dumps, or in permanent spoil tips, according to the quality of the spoil, the need of it for filling or other circumstances, as directed by the Engineer.

Suitable fill material shall comprise all that which is acceptable for use in the works which is capable of being compacted in the manner specified to form a stable fill having side slopes as indicated in the drawings.

Embankments and other areas of fill shall be formed of materials defined as suitable fill material. All fill material placed in or below embankments shall be deposited in layers not exceeding 225 mm lose depth and compacted as soon a practicable. Embankments shall be built up evenly over the full width and maintained at all times with a sufficient cross fall and even surface to enable surface water to drain readily. Fill embankments shall be made 1.2 m wider than the required as shown on the Drawings, to enable the compaction machines to work right up to the finished edges of the banks.

The excess 1.2 m of fill shall be cut away to leave a well compacted surface on the new-banks. This method of working shall be deemed to have been included in the Contractor's rates for earthworks.
Before commencement of filling the original ground must be cleared and any trees or organic material removed to the satisfaction of the Engineer.

Where fill is to be placed against existing ground which has a slope greater than 1:6, benching or stepping of the slope has to be done prior to placement and compaction at the fill material.

The details of benching and stepping are as shown in the drawings.

If the materials deposited as fill subsequently reaches a condition such that it cannot be compacted in accordance with the requirements of the contract, the contractor shall either:-

a) Make good by removing the material off the embankment either to tip or elsewhere until it is in a suitable physical condition for reuse and replacing it with suitable material; or

b) Make good the material by mechanical or chemical means to improve its stability; or

c) Cease work on the material until its physical condition is again such that it can be compacted as described in the contract.

If, because of the insufficiency of spoil suitable for use as filling, or if because of other circumstances the Engineer, so agrees or orders, the Contractor shall obtain the spoil for filling from borrow pits approved by the Engineer. On completion of the work the Contractor shall carry out the reinstatement of the borrow pit to the satisfaction of the Engineer by leaving it in a tidy, regular and self-draining state.

Where a slope is given in the Specification or on the Drawings as a ratio of horizontal and vertical components it shall be understood that the first component is horizontal in all cases, e.g. a "slope of 1:2" will mean 2 horizontal and 1 vertical and a "batter of 5:1" will mean 1 horizontal and 5 vertical.

This meaning will be attributed to all other terms such as "inclination" and "gradient".

Generally, fill material shall be spread in layers each not exceeding 225 mm loose thickness and be compacted by pneumatic multi-tyred rollers of minimum weight 8 tons each.

Smooth wheeled rollers of minimum 8 tons each may be used in which case the fill shall not exceed 150 mm loose thickness.

Where areas are not accessible to rollers, they shall be compacted by the use of mechanical rammers weighing not less than 100 kgs. Earthfill shall not be laid on debris from clearing.

All filling shall be carried out in dry conditions.

The contractor shall allow, in the relevant rates for filling, for the provision of pumps, for cutting temporary drainage channels and for backfilling of such channels with selected materials where necessary.

Any material which is, in the opinion of the Engineer, unfit for filling shall be removed from the works by the Contractor at his own expense.

The Contractor shall submit for the Engineer's prior approval details of the methods of compaction he intends to adopt and the number of rollers to be employed.

For fill material excavated from adjacent cuttings as defined, if the nature of the material is such that the method of compaction specified is not practicable the Contractor shall with the approval of the Engineer employ other methods of compaction provided that these will result in a dense and compact fill.

In building platforms compacted density shall be not less than 90% of optimum density.

After filling and compaction in 225 mm layers, tests shall be carried out at 30 metres centres or as directed by the Engineer to determine the density of soils and their moisture contents, and any areas not compacted to 90% of optimum density shall be recompacted or replaced with approved soil before further filling can proceed.

In road embankments compaction to 95 % of optimum density shall be required, and tests at 30 metres centres shall be carried out as the filling progresses or as directed by the Engineer.

The compacted fill materials shall have a dry density corresponding to the following at the moisture content of the sample in question:-

i) For building platforms:

   a. For the topmost 600 mm below formation level 95% of the maximum dry density obtained from B.S Standard Compaction Tests.

   b. For the remainder below formation level 90% of the maximum dry density obtained from B.S Standard Compaction Tests.

ii) For Roads:

   a. For the topmost 600mm below formation level 95% of the maximum dry density obtained from B.S Heavy Compaction Tests.

   b. For the remainder below foundation level 90% of the maximum dry density obtained from B.S Heavy Compaction Tests.

The Contractor shall where directed by the Engineer, carry out comparative field density tests determined in accordance with B.S 1377 on material which the Engineer considers has been inadequately compacted.

If the test results show the degree of compaction to be inadequate and this is held to be due to failure of the contractor to comply with the requirements of the specification, the contractor shall carry out such further work as the Engineer may decide is required to comply with the specification.

The cost of field density tests shall be deemed to be included in the contract price.

The Contractor shall provide where necessary temporary cofferdams, water courses, ditches, drains, pumping or other means of maintaining the earthworks free of water. Such provision shall include carrying out the work of forming the embankments in such a manner that their surfaces shall at all times be provided with a sufficient minimum crossfall and where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

The Contractor shall make good any damage or defects to the works caused by subsidence of fill, slips, due to erosion, consolidation or settlement and shall do all the necessary work to prevent the same.

The slopes of embankments, cuttings, margin areas and all excavated or fill surfaces shall at all stages of the work be kept adequately drained and protected from erosion.
The Contractor shall adopt such temporary measures to minimise soil erosion at all stages of the work as deemed necessary by the Engineer.

These temporary measures shall include construction of temporary drainage channels in earth or concrete, earth bunding, and covering with waterproof materials.

The Contractor shall allow for the cost of all temporary measures mentioned above in the relevant rates for excavation and filling.

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, subject only to such modifications as the Engineer may authorise in his instructions from time to time.

Over excavation of cuttings beyond the widths or depths shown on the drawings shall be made good by the Contractor, at his own expense, with approved materials and in manner as directed by the Engineer.

Excavated materials shall be used to form embankments or disposed of as the Engineer may direct.

Water-logged areas shall be defined as areas with wet or swampy ground conditions where special measures have to be undertaken during excavation and filling. Such areas may not be under water.

Prior to the commencement of any excavation or filling in water-logged areas, the Contractor shall form temporary drains in the form of earth trenches or concrete or other type of lined channels as approved by the Engineer.

The Contractor shall, when directed by the Engineer in writing, remove any soft, wet and unstable materials and replace with selected materials (sandy soil) before filling.

An initial blanket or selected material (sandy soil) not exceeding a loose depth of 900 mm or 300 mm above standing water level, whichever is greater, may be placed over the water-logged ground.

Thereafter suitable materials shall be placed, spread, levelled and compacted in layers of loose depth not exceeding 300 mm.

The Contractor shall allow in the relevant rates for excavation and filling, the cost of providing temporary drainage and removal of the same and the special method of carrying out filling as described.

All excavated materials not approved or not required for the permanent works shall be deposited as general filling on the site as directed by the Engineer. The Contractor shall make all arrangements for the loading, transport, dumping, spreading and compaction of removal of this material as above specified,

3.0 EXCAVATION IN ROCK

Rock is defined as material which in the opinion of the Engineer, is not practicable to excavate without the use of pneumatic tools or drilling and blasting.

Rock shall not include boulders less than 0.15 cubic meter in volume in open excavation and 0.15 cubic meter in volume in trench excavation.

In addition, rock in open excavation shall not include materials which in the opinion of the Engineer can be loosened with a tractor mounted and drawn ripping plant of the following output:-

a. Tractor Unit:

Equipment with a minimum weight of 24 tonnes and net horse power rating of 235 HP or more.

The tractor unit is to be in good condition and operated by experienced personnel skilled in the use of ripping equipment.

b. Ripping Unit:

The ripper attached to the tractor shall be the most efficient parallelogram type recommended by the tractor or ripper manufacturer.

The ripper shall have a single shank in first class condition with sharpened cutting point.

c. Output:

Rock shall not include materials excavated in bulk by the ripping plant specified above during trial run approved by the Engineer if the rate of excavation per hour exceed a net volume of 60 cubic meters or more.

Rock in trench or pit shall not include materials which in the opinion of the Engineer can be excavated at a rate of 4 cubic meters net volume per hour by a 50 HP backhoe in good order and efficiently operated.

Materials such as shale, decomposed rock and highly weathered shale, sand stone and all heavily fissured or jointed rock which can be broken up, rippable and removed by heavy duty rippers or rooters with D8 bulldozers or equivalent shall not be classified as "Rock".

Excavation in such materials shall mean common excavation.

Where the use of explosives are necessary for the execution of the Works, the Contractor shall be solely responsible for obtaining the necessary licences for the procurement, possession, transport, storage and handling of explosives and for ensuring the validity of such licences at all times.

Before starting work, the Contractor shall satisfy the Engineer that all the required permits are in order and that this category of work is adequately covered in the policies of insurance.

Proper building for magazines, with separate compartments for detonators in suitable positions for the storage of explosives in manner and quantities to be approved shall be provided. Separate vehicles or vessels for detonators shall also be used for the transportation of explosives. The prevention of any unauthorised issue or improper use of any explosives brought on the works shall be the responsibility of the Contractor and only experienced and responsible men shall be employed to handle the explosives for the purpose of the Works.

The relevant security regulations dealing with the storage, handling and transport of explosives shall be compiled with.

Explosives shall be used in the quantities and manner recommended by the manufacturers. Blasting shall be restricted to such periods as the Engineer may prescribe. If, in the opinion of the Engineer, blasting would be dangerous to persons or property to any finished work or is being carried out in a reckless manner he may prohibit, and order the rock to be excavated by other means. The use of explosives in large blast (exceeding 10 kg. of explosives), as in seams, drifits, shafts, pits or large holes, is prohibited unless in any way relieve the Contractor of his liabilities under Clause of the Conditions of Contract. In the event of wasting of rock through any such blasting an equivalent amount of approved materials for embankments, 1m3 of rock insitu being taken to equal 1.5m3 of materials in embankments shall be furnished by the Contractor if required by the Engineer.

When blasting is carried out adherence to proper safety distances and the use of heavy blasting mats where necessary to prevent the dispersal of material, shall be taken to ensure that no damage is caused to persons or property on or off site. Special care shall be taken in wet ground to ensure that individual explosions are reduced to such size as to preclude damage to any buildings and structures. Plaster shooting will not be permitted within 120 meters of any building or structure. The blasting shall be preceded by adequately given warning and the area shall be thoroughly cleared and cordoned off. The Contractor shall be responsible for arranging for police assistance in controlling traffic and security. Should blasting be carried out near the P.W.D.'s water pipelines, the contractor shall first consult the Engineer and P.W.D. for approval.

Rock obtained by blasting may be used for fill if this is deposited at a depth of not less than 1.8 meters below the fill formation level.

Rock of good quality may be used with the approval by the Engineer for rubble pitching or for randon fill in silt traps after breaking them down to suitable sizes.

4.0 EXCAVATION AND REFILLING OF FOUNDATION, PIT AND TRENCHES

The sides of pits and trenches shall be adequately supported at all times. Alternatively, except where the Contractor expressly requires otherwise, they may be suitably battered.

Bedding for the piles shall be carefully prepared to the correct falls. Where pipes are laid on the soil, the bedding shall be properly trimmed so that the pipes are supported along the full length of the barrel. Where concrete or hardcore foundations are specified, the top of the foundations shall be such that pipes are fully supported along the barrels when laid. Properly formed holes in the foundation shall be made at the correct intervals for any sockets or joints.

Foundations, pits and trenches 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 stepped 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 lean concrete. 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 pit or trench 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 surplus excavated materials form such excavations not required for refilling shall be deposited in embankments, or otherwise disposed of as directed. All excavations shall be kept dry.

All excavated materials from such excavations not required for refilling shall be disposed of or as directed by the Engineer.

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 greater depth than is directed shall be made good with lean concrete and excavation to a greater width than is necessary shall be filled and tightly packed with approved material.

The sides of pits and trenches shall where necessary be adequately supported to the satisfaction of the Engineer by timber or other approved means. Trenches and pits shall be kept free of water.

The Contractor shall prior to the commencement of excavation in any street, backlane or pavement make the necessary application to the Engineer and obtain written approval for such work. All trench excavation and other work carried out within the limits of any highway or street shall be completed as rapidly as possible and the Contractor shall make every effort to ensure that not more than half of the width of the carriageway shall be obstructed at one time. Road drains and curbs shall be kept free form obstruction.

The Engineer may direct that trench excavation in highways shall be located in footpaths or in verges rather than in the carriageway. If that is the case, trench excavation shall wherever practicable be carried out in such a way that every part of the excavation is at least 1.5 m clear of the existing edge of the carriageway. In any event the Contract shall take special precautions which shall include the continuous support of the sides of the excavation, from the time when excavation is begun until the refilling of the trench is completed, to ensure that there is no disturbances of the adjacent road or road foundation.

When excavation material has temporarily been deposited on an adjacent surface, the surface shall on completion of refilling the restored entirely to its original condition and left free of loose stones. Trench excavation in surfaces other than roads shall include all surfaces except those asphalt surfaces which require road reinstatement. These surfaces include but are not limited to fields, paddy fields, pasture land and the lake, footpaths, verges, non-asphalted roads, lanes, alleys, and all private lands.

Trench excavation located in fields shall if the Engineer so requires have temporary fencing erected around that length. Temporary fencing shall not be removed without the Engineer's permission, which will not normally be given until the trench excavation has been refilled and reinstated.

The Contractor is hereby notified that generally all sewer alignments not in streets are covered with a vegetation growth which must be removed and disposed off the site of work.

The Contractor shall have particular regard to the safety of livestock in fields or which may be introduced to the fields, and shall ensure that all open excavations, access routes and steep or lose slopes arising from the Contractor's operations in these fields are adequately fenced and protected.

After the erection of temporary fencing where required, the Contractor shall remove topsoil to such depth and over such area as may be necessary to provide sufficient material to ensure adequate surface reinstatement of the working areas occupied by the Contractor for construction of the pipelines.

Refilling of foundation pits and trenches shall be carried out only after the foundation and structural works within the excavation have been inspected and approved by the Engineer.

Unless otherwise directed by the Engineer, all fillings shall consist of approved excavate materials which shall be deposited and compacted, using approved plant, in layers not exceeding 225 mm loose depth to a dry density not less than that of the adjoining soil.

Timber sheeting and other excavation supports shall be carefully removed as the filling proceeds except as otherwise specified by the removal of such supports will not relieve the Contractor of his responsibility for the stability of the works.

Timber sheeting, piles and other excavation supports shall be carefully removed as the filling proceeds except where they are required by the Contract to be left in position.

The removal of any supports whether or not approved by the Engineer will not relieve the Contractor of his responsibility for the stability of the works.

5.0 FILLING ADJACENT TO ABUTMENTS

Filling adjacent to abutments shall consist of approved granular material which is free from dirt, vegetable matter or other foreign substance. The material shall be graded as follows:-

B.S. Sieve Size	**% by Weight Passing**
2.5 mm (1 in)	70 - 100%
5.0 mm (3/16 ins)	30 - 75%
2.4 mm (No. 7)	20 - 60%
420 microns (No. 36)	10 - 35%
75 microns (No. 200)	0 - 10%

The fraction passing the No. 36 sieve shall have a liquid limit not exceeding 25 and a plasticity index not greater than 6.

Prior to placement of selected granular backfill the area s to be backfilled shall be shaped to the lines and grades as shown on the plans and all loose or unsuitable sub grade material shall be stabilised and compacted as directed by the Engineer.

The selected granular backfill shall be placed in layers not exceeding 150 mm loose depth and fully compacted with vibrating plate compactor or power rammer to a dry density.

Each layer shall be completed over the whole area to be filled before the succeeding layer is deposited.

The fill shall be brought up equally at the abutment on both ends to prevent unbalanced earth pressure.

6.0 EXCAVATION FOR DRAINS

The earthwork excavation quantities for drains and culverts have been computed from the finished levels of roads and platforms in accordance with the Drawings.

The Contractor shall be responsible for the proper setting out of all drains, to grades and alignment as shown on the Drawings to the satisfaction of the Engineer, on completion of road formations in cut and fill and building platforms.

Unless otherwise directed by the Engineer the setting out works shall include the following:-

a. Demarcation of the reserves and centre line with boundary and centre line pags at not more that 30 metersintervals and at turning points.

b. Setting up of two or more permanent bench marks at selected sites to the requirements of the Engineer.

c. Setting out clearly the lines and levels of cut, including sight rails and boning rods for drain construction.

Where directed by the Engineer, bakau piles or hardwood sheet piles or shoring shall be driven along the toes and or slopes of embankments where these are unable to stand without support.

The Contractor shall execute the Works by such method or in such order so that existing drainage paths or other watercourses shall not be obstructed before the construction and completion of such permanent or temporary diversion works as are provided for in the Drawings and Specifications or as the Engineer may order as the Works proceed.

Excavation for structures and main drains shall be to the lines and levels in accordance with the Drawings, and all excavated spoil shall be deposited in approved dumps.

Backfilling shall only be carried out after the drains or structures have been correctly constructed and approved by the Engineer.

Backfilling shall be carried out in layers not exceeding 225 mm in thickness with approved soil and rammed with mechanical hammers uniformly from both sides and to the satisfaction of the Engineer.

The Contractor shall remove all excess spoil to suitable approved areas or as directed by the Engineer.

7.0 FINISHES AND TOLERANCES

Surfaces for the formation of roads and buildings platforms areas of fill shall be finished fair, free of potholes, gullies and depressions where water may accumulate.

The surface of slopes shall be trimmed to an even profile.

Permanently exposed slopes shall be finished fair as specified for the formations of roads and platforms.

Slopes to receive stone revetment or turfing may be left with minor irregularities which shall, however, be rectified at the Contractor's own expense by increasing the thickness of the revetment or turfing where necessary, in order that the final exposed surfaces shall be even in profile.

The linear dimensions of the constructed formations for roads and building platforms shall be within $\pm$ 75 mm of those shown on the Drawings or as directed by the Engineer.

The constructed levels of the formations for roads and building platforms or other areas of fill shall not be more than 25 mm and 75 mm respectively above and nowhere lower than those shown of the Contract Drawings, or such other Drawings issued by the Engineer for the purpose of the Works.

The requirements for surface finishes and tolerances shall be applicable at the following times:-

a. On completion of the Contract Works and before the issue of the Certificate of Completion of Works.

b. On expiration of the Maintenance Period and before the issue of the Maintenance Certificate.

The Contractor shall allow in his Contract Price providing the necessary make up filling for settlement, consolidation, displacement, erosion etc. in order to maintain the finished surface levels and slopes as shown on the Drawings during and at the completion of the Maintenance Period.

Where the Works fail to comply with the above requirements for finishes and tolerances, the Contractor shall execute the necessary rectification Works, all at his own expense.

8.0 TURFING

In general turfing shall be carried out on slopes of cuttings and embankments, verges and other such places as shown on the drawings or as directed by the Engineer.

All turfs shall be cut 300 mm square and 75 mm thick. They shall consists of healthy dense indigenous carpet grass firmly rooted into at least 50 mm of topsoil.

The turf shall be free from mimosa, lallang and any other objectionable plants and should be preferable laid on the day it is cut.

Turf which cannot be laid within three days of cutting may, at the discretion of the Engineer, be used as topsoil.

Turf shall be firmly bedded in freshly prepared topsoil dressing and where necessary shall be pegged down with wooden pegs.

The Contractor shall be deemed to have allowed in his rates for regular watering of newly laid turf during dry weather until such time as it is firmly established.

Any turf which dries through lack of water shall be replaced at the Contractor's expenses.

All turfing shall be finished to give a smooth compact surface.

Where grid and spot turfing is employed the turf shall not stand out above the level of the surrounding topsoil.

Turfing shall keep pace with spreading of topsoil.
Close turfing shall consist of 300 mm square turfs laid so that they cover the whole area without any space between them.

Spot turfing shall consist of 300 mm square turfs laid at 600 mm centres in two directions at right angles to each other or at such other spacing as directed by the Engineer.

Grid turfing shall consist of 300 mm square turfs laid in triangles of 1220 mm side on sides of cuttings and embankments as shown on the drawings or as directed by the Engineer. The turfs shall be pegged in place with 25 mm diameter pegs 225 mm long.

Strip turfing shall consist of 300 mm square turfs laid in 300 mm strips with a clear space of 600 mm between adjacent strips or such other spacing ad directed by the Engineer.

Where the area to be so turfed is on a slope, the strips shall be pegged in place with 25 mm diameter pegs 225 mm long.

Where turf is to be laid, a 100 mm thick layer of approved top soil shall be spread and compacted on the surface to be turfed.

Any turfed area damaged by the Contractor from whatever causes during the execution and maintenance of the works shall be replaced and make good with fresh turf at the Contractor's expense to the entire satisfaction of the Engineer.

Berms 1.524 meters in width shall be provided at every 4.572 meters depth in both cuttings and embankments as shown in the drawings.

The berms shall be formed with a 1:25 slope sloping outwards and grid turfed.

During the works and maintenance period, the contractor shall keep all turfed areas, mown or cut and cleaned of grass cuttings to the entire satisfaction of the Engineer.

D. CONCRETOR

1.0 REFERENCE TO BRITISH STANDARD

This Specification for concrete used in the Works is based upon the following British Standard with the latest amendments:

BS12 - Portland Cement
(Ordinary and Rapid Hardening)

BS 410 - Test Sieves

BS 812 - Methods for Sampling and Testing of Mineral aggregates, Sands and Fillers

BS 1881 - Methods of Testing Concrete

BS 3148 - Tests for Water for Making Concrete

This specification shall be interpreted, and all sampling and testing shall be carried out, in accordance with the relevant clauses in these Standards.

2.0 CEMENT

Cement shall comply with whichever of the following standards is relevant:-

Ordinary Portland Cement	BS 12
Rapid Hardening Portland Cement	BS 12
High Alumina Cement	BS 915
Sulphate Resisting Portland Cement	BS 4027

All cement used in the Works shall be Ordinary Portland Cement of approved manufacture and complying with the requirements of BS 12 and shall be supplied in original sealed and branded bags or manufacturer"s containers.

The Contractor shall submit to the Engineer for approval the name and address of the supplier and the brand of cement which he proposes to use in the Works at least two weeks before the delivery of cement to the site is allowed.

Normally the manufacturer"s test certificates will be accepted as proof of the quality of the cement; but the Engineer may at his discretion carry out further test on the cement stored at the site.

In the event of any sample being found to be not in accordance with BS 12 the whole consignment from which the sample comes shall be rejected and removed by the Contractor at his own expense from the site immediately notwithstanding any previous acceptance on the strength of the manufacturer"s certificate.

The Contractor will not be allowed to change the approved source of supply for the brand of cement at any time for whatever reason without the permission in writing of the Engineer.

Notwithstanding any previous acceptance any bag of cement containing materials which has hardened to otherwise deteriorated shall be rejected and removed from the site by the Contractor forthwith and at his own expense.

Any cement on transit or temporarily placed near the mixer or elsewhere, after removal from the store, shall be adequately protected from moisture and damaged by approved means.

3.0 STORAGE OF CEMENT

The Contractor shall provide at his own expense on the site a dry, well-ventilated and weather-proof cement store to the approval of the Engineer for proper storage of cement.

The floor of such store shall be raised at least 305mm (12") above ground level or above maximum flood level at the site whichever is the higher. Or, cement shall be stored in silos of approved design.

All storage facilities shall be subject to the approval of the Engineer and shall be such as to permit easy access for inspection and identification.

Batches of cement shall be used for the Works in the order in which they are delivered to the site and the method of storage shall be arranged so that this may be done.

Different types of cement shall be kept in clearly marked separate storage facilities.

4.0 AGGREGATES

Aggregates shall comply with the recommendations of BS 882 and testing according to BS 812. In special circumstances a deviation from BS 882 in respect of grading of aggregates may be accepted, subject to the approval of the Engineer.

5.0 FINE AGGREGATE

Fine aggregates for concrete work shall be hard, clean well graded natural sand, free from harmful quantities of clay and silt, saline and vegetable impurities, and other deleterious matter.

It shall be within the following grading limits:-

B.S. Sieve	4.69mm (3/16")	No. 7	No. 14	No. 25	No. 52	No. 100
% Passing	95 - 100	70 -95	45 - 85	25 - 60	5 - 30	

Field test shall be carried out on samples to be taken from each and every batch of sand supplied and delivered to the site.

Sand shall not contain more than 6% by volume of clay and/or fine silt; neither shall it contain organic impurities in sufficient quantity to show a darker colour than the standard depth of colour No. 3 when tested according to the standard methods given in BS 812.

Sand which does not comply with these requirements shall be rejected and removed from site forthwith at the Contractor"s own expense.

6.0 COARSE AGGREGATE

Coarse aggregate for concrete work shall be sound, hard, clean, roughly cubical shaped crushed granite particles free from harmful quantities of clay, crusher dust, organic impurities or other deleterious matters.

Coarse aggregate containing an excessive proportion of flat particles splinters or flakes will not be accepted.

The judgement of the Engineer in this matter shall be final and binding on the Contractor.

Limestone shall not be used as coarse aggregate without the permission in writing of the Engineer Under no circumstances shall limestone be used as aggregate in water retaining, water excluding or water conveying structures.

The grading of coarse aggregate shall be within the following limits:

GRADING OR COARSE AGGREGATES

B.S. Sieve Size mm (inches)	Percentage of weight passing B.S. Sieve		
	N O M I N A L S I Z E		
	38 mm - 4.5 mm (1.5" - 0.187")	19 mm - 4.5 mm (0.75" - 0.187")	13 mm - 4.5 mm (0.5" - 0.187")
64 mm (2.5")	100	-	-
38 mm (1.5")	95 – 100	100	-
19 mm (0.75")	30 – 70	95 – 100	100
13 mm (0.5")	-	-	90 - 100
9 mm (0.375")	10 – 35	25 – 55	40 - 85
4.5 mm (0.187")	0 – 5	0 – 10	0 - 10

7.0 SAMPLING AND TESTING OF AGGREGATES

The Contractor shall submit to the Engineer for approval the sources of supply and samples of fine and coarse aggregates which he proposes to use in the Works before the delivery of aggregates to the site is permitted. Samples of the fine and coarse aggregates approved by the Engineer shall be kept on the site.

The Contractor shall secure his entire supply of each material from the same source and ensure that all aggregates delivered to the site throughout the course of the Works are of the same quality and grading as the approved samples.

Should it become necessary to change the sources or characteristics of any aggregate this shall only be done after new samples have been tested and approved by the Engineer and subject to such safeguards as the Engineer may impose for the maintenance of the quality of the aggregate specified.

The method of sampling an amount of aggregate to be provided shall be in accordance with BS 812. The tests shall be those as laid down in BS 812 unless otherwise directed by the Engineer.

The tests shall be carried out by the Engineer and if a sample should fail in any of the tests the Engineer may at his discretion, either rejected by the Engineer shall be removed from the site forthwith at the Contractor‟s expense.

8.0 STORAGE OF AGGREGATES

The Contractor shall at his own expense provide proper and adequate storage of the fine and coarse aggregates on the site to the satisfaction of the Engineer

The fine and coarse aggregates shall be handled and stored separately and in such a manner the segregation of the various sized particles does not occur.

There shall be physical partition between the heaps of sand and the heaps of coarse aggregate to prevent intermixing of the aggregates.

The stock piles shall be formed on a platform of weak concrete, timber, or similar approved hard standing, the aggregates shall be kept clean and free from earth and foreign matter.

Aggregates which in the opinion of the Engineer are not clean or have become intermixed due to improper storage shall be removed from the site at the Contractor‟s expense.

9.0 WATER

All water used for the works to comply with the requirements of BS 3148 which when used for making and curing concrete and for testing the water tightness of structure shall be fresh, clean and not contain organic impurities in sufficient quantities likely to reduce the strength of the concrete or attack the concrete or the reinforcement.

The engineer‟s decision on the suitability or unsuitability of a source of water for this purpose shall be final.

Where possible, all water shall be obtained from the public supply mains. When such a supply is not available the Contractor shall make arrangements for obtaining water from a source approved by the Engineer.

In any case the Contractor shall provide sufficient storage tanks at the site to store enough water for 1.5 days‟ use in the Works. Water storage tanks shall be covered and insulated to the satisfaction of the Engineer against variation in its temperature.

10.0 STEEL REINFORCEMENT

Mild steel reinforcement shall comply with BS 4449. High yield stress steel reinforcement to be approved shall be:

a. either cold-worked deformed bars complying with BS 4461.

b. or hot-rolled deformed bars complying with the following requirements:-

Minimum yield stress: 42.27 kg/mm2 (60,000 lbs/sq. in)

Minimum Elongation : up to and including 21mm (7/8”) diameter nominal size 12% over 21mm (7/8”) diameter nominal flat sheets.

Provide manufacturer‟s certificate verifying compliance with this specification for each consignment from each source.

The manufacturer‟s certificates of test will be accepted as proof of the quality of the steel reinforcement but the Engineer may, at his discretion, require additional tests to be made on samples of steel reinforcement stored at the site.

In the event of any reinforcement being found to be not in accordance with the relevant Standard under these additional tests or in the course of being worked, the whole batch of reinforcement from which the faulty reinforcement comes may be rejected by the Engineer notwithstanding any previous acceptance by the strength of the manufacturer‟s certificate.

Any reinforcement rejected by the Engineer shall be removed from the site at the Contractor‟s expense.

All reinforcement shall be cleaned free from loose mill-scales, loose rust, oil, grease, earth and other harmful matters before being placed in the forms and shall be free from these at the time the concrete is placed.

11.0 BENDING, PLACING AND FIXING REINFORCEMENT

A reinforcement shall be bent cold using bar bending machines and appliances approved by the Engineer Unless otherwise specified in the Drawings the bending dimensions and tolerances and the dimensions of end anchorage, hooks binder, stirrups and the like shall be in accordance with BS 4466, “Bending Dimension and Scheduling of Bars for the Reinforcement of Concrete”.

The reinforcement shall be accurately assembled and firmly secured by wire ties of No. 16 gauge soft annealed galvanised wire so that the whole assembly is rigid and will not be displaced while concrete is being compacted around it.

The ends of the wire ties shall be turned inward away from the face of the forms and shall not be left projecting beyond the reinforcing bars.

Temporary bracing shall be provided to prevent movement of all steel projecting from the concrete during the course of construction.

The cover shown on the Drawing shall be maintained by precast spacing blocks securely wired to the bars or by other means approved by the Engineer Spacing blocks for the various cover dimensions shall be cast from cement mortar made from one part of cement and two parts of sand. The blocks shall be well compacted and shall receive full curing treatment before being used.

Where it is necessary to maintain two layers of reinforcement at the correct distance apart (e.g. to maintain the correct position of the top layer of reinforcement in the floor slab) steel riders bend from 13mm (0.5”) diameter mild steel bars shall be used. <u>The use of wooden battens for this purpose is prohibited.</u>

Starter bars to columns and walls, etc. must be securely fixed to the reinforcement of the parent concrete and not pushed into wet concrete after casting.

12.0 WELDING OF REINFORCMENT

Welding of reinforcement will not be permitted except in circumstances, which in the sole opinion of the Engineer are absolutely unavoidable.

Welding shall be electric arc and shall be performed by skilled operator. No welding shall be carried out except under the supervision of the Engineer

Welding and testing of welds shall be carried out in accordance with BS 5135.

Butt welds shall be of the double „V" type and the included angle between both slopes shall be between 70° and 100° for vertical and flat welding and the gap between the two bars shall not exceed 3mm (1/8").

The cut edges of the bars shall be clean and uniform and the bar shall be cleaned for a distance of at least 25mm (1") on each side of the joint.

Staging shall be provided if necessary to enable the operator to carry out the welding operations efficiently and the bars shall be held in the correct position and alignment.

The weld shall be deposited evenly and all slag removed. The finished surface shall be of even contour without cavities and/or under-cutting.

The diameter of the welded joint shall be at least 3mm (1/8") more than the bar diameters, the additional thickness being finished off to form a smooth joint. Faulty welds will be rejected.

The Engineer may require tensile tests and/or bend tests to be carried out on sample welded joints or on joints cut from bars already/welded. The Contractor shall bear any expenses involved in this connection.

The bend tests shall be carried out in accordance with BS 5135 which requires that the welded joint be machined to the same diameter as the bar and the joint then bent round a former of a diameter three times the bar diameter through an angle of 180°. The bar should stand this test without fracture other than very fine cracks on the outer surface.

13.0 FORMWORK

The formwork shall be constructed with any of the following materials:

1) Sound softwood tongued and grooved boards not less than 19mm (0.75") finished thickness, wrought on one side and two edges, accurately formed and securely fixed to softwood frames. The surface of the formwork shall be worked to a smooth finish after fabrication.

2) Sound softwood timber boards not less than 19mm (0.75") thick lined with galvanised metal sheet not less than 18 SWG. The boards supporting the metal lining shall be of uniform thickness and the formwork panels shall be made so that they butt closely together and grout cannot leak from the joints between adjacent panels.

3) Waterproof plywood of approved manufacture not less than 9mm (0.375") thick, securely fixed to timber frames.

4) An approved metal formwork system.

All formwork shall be erected true to line and level and shall be adequately secured and braced to prevent deflection of movement during the placing, tamping of vibrating of the concrete, and shall be sufficiently tight to prevent loss of liquid from the concrete. Provision shall be made to allow the formwork to be removed without shock or damage to the concrete it contains or to adjacent work.

Column formwork shall be arranged so that the concrete being placed does not have a free fall of more than 1524mm (5") and suitable openings shall be provided in the column forms to allow concrete to be deposited in stages not more than 1524mm (5")) high.

The use of wires passing through the concrete for the purpose of securing the formwork in position shall not be permitted. Bolts passing through the concrete may be used, but their number must be kept to the minimum required to secure the formwork reigidly.

The bolts shall be not less than 13mm (0.5") in diameter and of a type with detachable screw-off heads so that the barrels of the bolt remain cast in the concrete while the detachable heads can be removed with ease.

The conveying or water excluding structures shall have a waterstop in the mild-length of the bolt remain cast in the concrete while the detachable heads can be removed with ease.

The conveying or water excluding structures shall have a waterstop in the mid-length of the bolt. The welds shall be continuous round the barrels and on both sides of the washer.

Before any concrete is placed all rubbish shall be removed from the interior of the forms. Suitable openings shall be provided for this purpose and the openings shall be effectively plugged before concrete is placed.

The forms and all concrete joint surfaces withing the forms shall be thoroughly flushed with water.

The forms approval of the Engineer be treated with an approved composition. Care should be taken to ensure that such composition is kept out of contact with the reinforcement and concrete joint surfaces, and that there is not excess of such composition remainging on the forms prior to concreting.

Within four weeks of the acceptance of his tender the Contractor shall submit for the approval of the Engineer drawings and descriptions showing the methods he proposes to use for the erection and support of the formwork.

14.0 CONCRETE PROPORTIONS

i. Concrete for the several parts of the Works shall be proportioned as indicated in Table „A" or „B" (except as provided under the sub-clause (iii) below). Cement, fine aggregate and coarse aggregate shall be measured by weight; water by volume. The fine and coarse aggregate shall be measured separately. A weight batcher shall be used for the purpose of weighing cement, fine aggregate and coarse aggregate. The accuracy of the weights indicated by the weight batcher shall be regularly checked and shall be maintained within + 4.54 kg (10 lb) of the actual total weight of all aggregate and cement in one batch.

ii. The weights of the fine and coarse aggregates specified in Table „A" or „B" refer to the materials in the state when the particles are saturated but surface dry.

Tests shall be carried out twice daily or more frequently if considered necessary by the Engineer to determine the moisture contents of the fine aggregate. Allowance shall be made for the water contained in the aggregate when calculating the water to be added to the mix.

iii. While the proportions of the mixes are to be generally as specified in Table „A" or „B" the Engineer shall have the right to order variations in these proportions without extra cost to be the Employer should tests show variations to the necessary to produce a dense water tight concrete of the specified strength and of a consistency that will permit of its being worked into position and compacted satisfactorily into different parts specified in Table „A" or „B" are expected to produce work cube strengths in excess of those specified in Table „A" or „B" and a workability, sufficient to ensure that the concrete can be worked and fully compacted using the methods of vibration hereinafter specified in this Specification.

If however, it is shown during the course of the work that concrete mix is stiffer that can be placed satisfactorily an adjustment of up to 5% may be made in the water/cement ratio but any further adjustment of the mix shall be made by increasing the proportions of both the water and cement without increasing the water/cement ratio.

If the works cube strength fall below those specified, the cement proportions shall be increased.

15.0 MIXING OF CONCRETE BY MACHINE

The materials for the concrete to be carefully measured in proper proportions stated, measuring boxes of suitable size being made and used for the purpose The mixing of the concrete is to be done by power-driven batch mixers of the type approved by the Engineer.

The mixers shall be suitably protected from the wind to prevent loss of cement.

The aggregate and cement shall first be mixed dry and then after the addition of water, the concrete must be mixed for not less than two minutes and until it is of even colour and of uniform consistency throughout. The machine mixers and all handling plant must be thoroughly washed out when mixing ceases and also when recommencing the mixing. The batch sizes shall be such that only whole bags of cement are used.

16.0 MIXING OF CONCRETE BY HAND ONLY WHEN PERMISSION IS OBTAINED FROM ENGINEER.

Hand mixing will not be allowed for structural concrete. If permission for mixing by hand of non-structural concrete is given, the materials are to be mixed on a clean board platform and turned over at least three times in a dry state, once while water is added through a rose headed jet, if available, and once when wet and then transported to the place where it is to be laced. The cement content shall be increased by 10% for hand mixing.

17.0 ADMIXTURES

17.1 General

Suitable admixtures may be used in concrete mixes with the prior approval of the Engineer.

Both the amount added and method of use should be to the approval of the Engineer who should be provided with the following data:

1. manufacturer‟s name and brand name

2. the typical dosage and detrimental effects of under dosage and overdosage.

3. the chemical name (s) of the main active ingredient (s) in the admixture.

4. whether or not the admixture contains chloride and if so, the chloride content of the admixture expressed as a percentage of equivalent anhydrous calcium chloride by weight of admixture and

5. whether or not the mixture causes the entrainment of air when used at the manufacturer‟s recommended dosage.

Unless otherwise agreed an admixture should comply with one of the following British Standards: BS 1-14, BS 3587, BS 3892 and BS ..... *.

For admixture for which there is no British Standard the type and/or proprietory brand may be specified.

17.2 **Calcium Chloride**

Calcium chloride as an admixture shall only be used with the prior written consent of the Engineer.

Where calcium chloride is allowed as admixture for reinforced concrete, its content shall not exceed 1.5% by weight of the cement. The calcium chloride shall be thoroughly dissolved and mixed with the concrete to avoid any concentration of the chloride throughout the concrete.

No calcium chloride admixture shall be used in prestressed concrete or with high alumina cement of sulphate-resisting Portland cement or supersulphated cement.

17.3 **Air-entraining Agents**

The admixture shall be of such a type that the air-content can be maintained within the limits specified irrespective of extension of mixing time to 30 minutes.

* " Concrete admixture", in course of preparation

18.0 PRELIMINARY TEST MIXES

As soon as possible after possession of site, and before any concrete is placed, the Contractor shall prepare under the direction of the Engineer a series of trial mixes totalling not more than a cubic yards of concrete. The tests cubes will be made from sample of these trial mixes, cured and tested in accordance with the standard method laid down in Clause 601 b of the BS Code of Practice CP 114 to determine the cube strengths at 7 days and 28 days after casting. The cube strengths obtained shall be at least 50% greater than those specified in Table „A" - "Proportions & Strengths of Concrete" for works cube or as in Table „B".

The mix proportions specified in Table „A" or „B" of this section of Specification will be adjusted as necessary by the Engineer on the basis of these without extra cost to the Employer.

19.0 SAMPLING AND TESTING CONCRETE AND CONCRETE MATERIALS

All sampling and testing will be carried out in accordance with the standard methods laid down in Clause 601 of the BS Code of Practice CP 114.

The Contractor shall attend upon and provide all assistance to the Engineer when such sampling and tests are carried out , and shall supply all concrete samples and other materials and equipment required by the Engineer to carry out the tests.

20.0 FREQUENCY OF SAMPLING AND TESTING

a. Compacting Factor

The compacting factor of the mix will be tested.

i. daily while concrete is being placed.

ii. whenever samples for test cubes are taken, and

iii. whenever in the opinion of the S.O., the grading or condition of any of the aggregates has changed since the last test was made.

b. Test Cubes

A set of six 152mm x 152mm x 152mm (6" x 6" x 6") concrete test cubes three for testing 28 days after casting, will be made

i. every day while concrete is being placed, and

ii. whenever the mix or any of its constituents are changed either in quantity or quality.

c. Aggregate Grading and Purity

The grading of the aggregates and their freedom from organic matter will be tested.

i. when the first deliveries of these materials arrive on the site, and

ii. whenever, in the opinion of the Engineer., the grading or condition of these materials differs from that originally accepted for use in the work.

21.0 REJECTION OF CONCRETE

If any of the test cubes tested at seven days show the Engineer shall at his discretion, order all concreting work to stop until adequate measures have been taken to produce concrete which complies with this Specification.

If the cube strengths at 28 days are less than those specified, the work from which the concrete for the test cubes was taken will be rejected by the Engineer and will be broken out and rebuilt or otherwise made good as directed by him at the Contractor‟s own expense.

22.0 SUPERVISION

The Contractor shall keep constantly at the site while concrete is being mixed and placed at competent Malay/English speaking assistant for the purpose of supervising the batching of the concrete ingredients and the mixing, placing and compacting of the concrete. This assistant shall be employed solely for this purpose and the right is reserved to the Engineer or his representative at the site to order work on mixing or placing of concrete to cease if this assistant is not present.

23.0 MIXING CONCRETE

All concrete shall be mixed in an approved batch mixes of at least 14/10 capacity, with a power driven loading skip. The mixer shall be equipped with an automatic water measuring rank fitted with a device or locking the discharge setting so that the volume of water used in each batch of concrete is accurately measured and cannot be varied by the mixes operator after the device is set and checked by the S.O.‟s representative on the site.

The water gauge of the concrete mixer shall be inspected and tested weekly when concreting is in progress and if any fault is detected the fault shall be rectified to the satisfaction of the S.O. before any further use is made of the equipment. The mixer drum and the loading skip shall be kept clean at all times.

Each batch of the concrete shall contain one or more whole 51 kg (112 lb) bags of cement. The materials for each mix shall be placed in loading skip in the following order: coarse, aggregate, cement and fine aggregate. The water shall be added to the dry materials in the mixer drum.

The quantity of water specified in Table „A" or „B" of this section of Specification may be varied up to 5% in order to maintain a constant workability; but this tolerance shall not be exceeded without prior approval of the Engineer.

Each batch of concrete shall be mixed until there is a uniform distribution of the materials and the mass is uniform in colour and consistency. In no case shall the time of mixing be less than two minutes or more than five minutes after the water has been added to the batch. Any concrete surplus to requirements shall be thrown away. In no circumstances may surplus concrete be remixed for use later.

24.0 PLACING OF CONCRETE GENERALLY

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

The concrete shall be transported from the mixer to the position in which it is to be placed without delay and by means which will prevent loss of grout and/or segretation of the mix. Concrete may be conveyed by chite only with the permission of the Engineer.

Any concrete which has attained its initial set before being placed shall be discarded. Placing concrete shall be suspended during rain.

Concreting shall be carried out continuously between and up to the predetermined day"s work on construction joints in one sequence of operation.

All concrete shall be placed in the position in which it is to be compacted and the materials shall not be allowed to flow while it is being placed and compacted. Vibrators shall be used solely for compacting the concrete and not for distributing it into place.

The concrete shall be prevented from following laterally by the use of vertical stopping off boards or other vertical faces and the surface of the concrete shall be placed in the formwork in layers not exceeding 450mm (18") thick.

In the event of unavoidable stoppage in positions not predetermined the concrete shall be terminated on horizontal planes and against vertical surfaced and an additional day"s work joint formed.

A record shall be kept on the works site of the time and date of placing the concrete in each position of the structure.

25.0 COMPACTING CONCRETE

Concrete after placing shall be thoroughly compacted by both hand tamping and mechanical by both hand tamping and mechanical vibration. Concrete maintained between two walls of formwork shall be compacted by power driven vibrators of the immersion type and concrete is slabs with no formwork on the upper surface shall be compacted by power driven vibrators of the pan type or by vibrating screeds. The vibrators shall be of ample power operating at not less than 6,000 cycles per minute and of a kind approved by the Engineer. They shall be

operated by workman skilled in the use who shall be additional to the labourers employed on placing and tamping the concrete. The vibrators shall be used solely for compacting the concrete and not for distributing into places.

No concreting of water retaining, water conveying or water excluding structures shall begin until the required number of vibrators and also a spare vibrator are all available and have all been tested and found to be in good working condition at the works site.
Immersion vibrator shall be inserted and withdrawn slowly at a uniform rate of approximately 102mm (4") per second. Compacting shall be deemed to be completed when cement mortar appears in a circle round the vibrators.

Pan vibrators shall be placed on the surface of the concrete which shall have previously been tamped and levelled leaving an allowance in height for compaction until cement mortar appears under the pan.

The vibrators shall then be lifted and placed on the adjoining area and the operation shall be repeated until the whole surface has been compacted. Alternatively a vibrating screed spanning the full width of the panel shall be used.

In all cases the placing of concrete shall be sufficiently ahead of the vibrators so that the mass of concrete beyond the vibrators is sufficient to stand without flowing while vibration is in progress. On the other hand the concrete shall be fully compacted before initial set is attained.

26.0 CONSTRUCTION OF CONCRETE SCREED

As soon as the excavation has been approved by the Engineer the concrete screed wherever shown on the Drawings shall be laid in bays not exceeding 7620mm (25") square with open joints 25mm (1") wide in between the bays.

The joints shall be arranged to break joint with the joints in the concrete floor above. The screed shall be well rammed and worked to a densed smooth finish and cured by being kept damp under wet gunny bags for not less than 7 days.

After the screed has been cured the 25mm (1") wide joints shall be cleaned and filled with (1:3) cement and sand mortar and the whole surface allowed to dry out.

Should the surface of formation be cut up through excessive traffic or softened by the action of water due to delay on the part of the Contractor to lay the concrete screed he shall excavate such ground as may be affected and replace it by (1:3:6-1.5") aggregates) concrete all at his own expense and to the satisfaction of the Engineer before the screed is laid.

27.0 JOINTS

The Contractor shall make the joints in the floors, footings, walls and roofs strictly in accordance with the Drawings. Particular care shall be taken to ensure that the waterstop wherever shown on the Drawings are adequately secured so that they will not be displaced while concrete is being placed.

Under no circumstances shall waterstops be nailed through. Any waterstop which has been perforated shall be rejected and replaced at the Contractor"s expense.

Before fresh concrete in one segment in placed against hardened concrete of the adjacent segments, all loose and imperfect materials, cement scum or laitance shall be removed and the whole hardened concrete joint surface thoroughly hacked until a completely hacked roughened fresh surface is obtained.

The fresh joint surface shall then be brushed clean, and immediate before fresh concrete is placed on or against it, shall be thoroughly wetted and covered with a layer of cement and sand (1:1.5") mortar not less than 38mm (1.5") thick. The mortar shall have the consistency of condensed milk.

In the case of expansion joints, however, the hardened concrete joint surface shall not be hacked but shall be painted with two coats of approved bituminous paint.

All efforts must be made to ensure that concrete at joints is as dense as possible. Scarifying the joint surfaces while the concrete is still green is strictly prohibited.

28.0 DAY'S WORK JOINTS

Day"s work joints in floors, roofs and slab shall be formed against vertical boards and the concrete shall be well compacted against the boards.

No fresh concrete shall be placed against any concrete which has attained its initial set. Concrete is deemed to have attained its initial set 30 minutes after water has been added to the mix.

Provided that the set concrete has been properly placed and compacted and is acceptable to the S.O., it shall not be disturbed and shall be allowed to attain its final set and to harden sufficiently to enable a day"s work joint surface on it to be prepared by thorough hacking without damage. Concrete may be deemed to have hardened sufficiently for this purpose 72 hours after placing.

Any concrete which has been disturbed after it has attained its initial set shall be rejected and subsequently removed and replaced by the Contractor at his own expense.

When concreting must be suspended at any point because of inclement weather, or for any other unforseen cause, a day"s work joint shall be made.

The concrete at a day"s work joint shall be allowed to harden for 72 hours. Befire fresh concrete is placed against the day"s work joint, all loose and imperfect materials, cement scums or laitance shall be removed from the joint surface, which shall be thoroughly hacked until a completely hacked roughened fresh surface is obtained.

The fresh surface shall then be brushed clean, and immediately before fresh concrete is placed against it, it shall be thoroughly wetted and covered with a layer of cement and sand (1:1.5") mortar not less than 38mm (1.5") thick. The mortar shall be of creamy consistency.

29.0 SEALING COMPOUNDS

Only non-hardening sealing compounds approved by the Engineer shall be used for sealing the grooves provided at joints.

All sealing compounds shall be applied in strict accordance with the manufacturer"s instructions. The grooves for receiving the sealing compounds shall be thoroughly brushed to remove grit, soil and other loose particles.

The grooves and the surrounding concrete shall be thoroughly dried by such means as the Engineer shall direct, and the sealing compounds or primers shall be applied before dampness returns to the surface of the concrete.

30.0 WATERSTOPS

Only waterstops approved by the Engineer shall be used.

The Contractor shall carefully read the waterstop manufacturer‟s instructions before commencing any work, involving the incorporation of the waterstops and shall carry out all work in this connection as recommended by the manufacturer and to the approval of the Engineer.

Waterstops shall be securely held in position by the formwork or by means to be approved by the Engineer and the concrete shall be carefully worked around the waterstops to ensure that it is completely embedded and that air pockets will not exist.

31.0 PIPES, SPECIALS, FITTINGS, ETC., CAST INTO CONCRETE

Where shown in the Drawings the Contractor shall build pipes, specials, fittings,, plates, anchor hooks, brackets bolts and nuts, etc., into the concrete as the work progresses. The external coating of the pipes and specials shall be removed to the extend directed by the Engineer so that a proper bond may be obtained with the concrete.

These pipes, specials fittings etc., shall be accurately set and rigidly supported and their lines and levels shall be passed by the Engineer before concreting is commenced. No reinforcement shall be cut to allow such pipes, specials, fittings, etc., to be cast into the work without the approval of the Engineer.

Concrete shall be thoroughly worked around the pipes, specials, fittings etc., to ensure a complete bond so that no leakage will result from the presence of the pipes, specials, fittings etc.

If the pipes, specials, fittings, etc., to be built into the work are not available when concrete is to be placed openings shall be left in the concrete and the pipes, specials, fittings, etc., shall be concreted in as a separate operation. In such cases details of openings and casting of the specials shall be in accordance with the S.O.‟s instructions.

The openings left shall be of ample size to allow the concrete to be thoroughly compacted round the pipes, specials, fittings, etc. and shall be provided with waterstops if the Engineer so directs. Before concrete is placed in such openings, all loose or imperfect materials, cement scum or laitance shall be removed and the joint surfaces shall be thoroughly hacked until a completely roughened fresh surface is obtained.

The fresh joint surface shall then be brushed clean and immediately before concrete is placed, these surfaces shall be thoroughly wetted and covered with a layer of 38mm (1.5”) thickness of cement and sand (1:1.5) mortar and of which the mortar shall be of a creamy consistency.

32.0 CURING CONCRETE

As Soon as the freshly placed concrete has hardened sufficiently to withstand such treatment without damage, the exposed surfaces of roofs, floors, walls and columns shall be completely covered with wet gunny bags, which shall be kept thoroughly wet continuously be generous application of water every two hours for a period of 8 days.

The water shall be allowed to run down between the forms and the formed concrete surfaces. Flat slabs shall have water impounded on them for a period of at least 10 days after placing.

When all the concrete in the floor and the haunch of any water retaining, water conveying or water excluding structure have been placed and the concrete attained the final set, the whole of the floor shall be flooded with water to depth of not less than 75mm (3”). This depth of water shall maintained throughout the rest of the construction period.

The Contractor shall make provisions for distributing an adequate quantity of water to all parts of the works for his purpose.

33.0 STRIKING FORMWORK

No formwork shall be struck without the prior approval of the Engineer.

Formwork shall be removed in accordance with a programme agreed by the Engineer without such shock or vibration as would damage the concrete and without interruption to the curing of the concrete as herein before specified in this Specification. Normally formwork shall be struck after the following periods have elapsed.

From sides of beams, wall and column (unloaded)
- 3 days

From bottoms of slab (props left under)
- 7 days

From soffits of beams (props left under)
- 10 days

Removal of props under slab (unloaded)
- 14 days

Removal of props under beams (unloaded)
- 21 days

Concrete exposed by the removal of formwork shall be left untouched pending inspection by the Engineer.

34.0 SURFACE TREATMENT TO CONCRETE

After the concrete surface has been inspected the Engineer the surface shall be treated as described below.

All areas where the concrete has not been properly consolidated to a dense uniform surface shall be cut out, and made good to the satisfaction of the Engineer

All bolt holes left by the formwork bolts shall be plugged as described herein. The sides of the holes shall be rehamered with a hacksaw blade until the cement scum is removed.

The holes shall then be flushed with a strong jet of water to remove all loose materials. While the holes are still wet, the sides of the holes shall be dusted with neat cement using a suitable brush for this purpose.

Immediately following this the holes shall be plugged with a dry pack consisting of one part of cement and two parts of find sand.

The mixture of cement and sand shall be made only sufficiently damp with water to allow it to be rammed solid without excluding any liquid, and after thorough mixing shall be placed in the holes in thin layers and solidly compacted over the entire surface with a hardwood stick and a hammer, and finally struck off to a true surface.

Exposed concrete surfaces and surfaces to be in contact with water shall be treated as follows:

a) All projecting imperfections shall be carefully chipped off and rubbed down with carborundium blocks to a true surface, and the grit or dirt resulting therefrom thoroughly washed off with clean water.

b) Wherever necessary, the surfaces shall be made thoroughly wet, and cement grout composed of one part of cement and two parts of fine sand by volume shall be worked into the pores and holes over the surface with a fine carborundum float so that uniform smooth and dense surface throughout is finally presented.

All defects on concrete surfaces which will be permanently concealed in the finished structure shall be repaired and made good as directed.

35.0 STANDARD OF WORKMANSHIP

35.1 **Working Tolerance**

Unless otherwise indicated on the Drawings, the maximum tolerances within which concrete work shall be constructed are as follows:

Description	Maximum Tolerance
All setting out dimensions	+ 6mm (¼")
Sections of concrete members	+ 3mm (1/8")
Surface level of floor slabs	+ 13mm (½")
Plumb of columns and walls in storey height	+ 6mm (¼")
Plumb of columns and walls in full building	+ 19mm (3/4")
Inside faces of lift in storey height	+ 6mm (¼")
Insides faces of lift shafts in full building height	+ 13mm (½")
Plan position on perimeter beams, columns and floor slabs	+ 13mm (½")

35.2 **Defective Work**

Where in the opinion of the Engineer any of the materials or workmanship in the Works does not comply with the relevant requirements of this Specification that part of the Works shall be classed as defective work.

Work classed as defective work shall be cut out and removed from the Works and replaced to the satisfaction of the Engineer.

The extent of the work to be removed and the methods to be used in the removal and replacement of this work shall be in accordance with the Engineer"s directions.

In all cases cutting out of defective concrete work shall be carried back to a satisfactory construction joint before the replacement work and any other work thereby affected is commenced.

Removal and replacement of defective work and costs or charges arising form such removal or replacement shall be at the Contractor"s expense.

36.0 LOAD TEST

Load test of completed parts of the structure may be called for by the Engineer at anytime.

The Standards of acceptance for structural load test are stipulated in CP 110, the test procedure.

37.0 PRECAST CONCRETE UNITS

All precast concrete shall be (1:2:4-19 mm aggregates) as specified in Table „A" or „B".

Precast concrete pipes shall be manufactured by the centrifugal spinning process, and all other precast concrete units shall be manufactured in mechanically vibrated moulds.

If any of the precast concrete units is manufactured away from the site of the Works, the Contractor shall satisfy the Engineer that the concrete proportions, reinforcement, etc., are in accordance with the Drawings and this Specification, and if required, he shall produce samples for testing.

Should the Engineer wish to visit the Workshop to determine the standard of workmanship or make any progress payment the Contractor shall make way and take such precautionary measures for their safety.

All precast units shall be handled and stacked so as to avoid damage and ensure that no undue stress is imposed on them. The Contractor shall remove from the site and damage due to his own negligence or which are rejected by the Engineer.

Precast r.c. horizontal louvres shall be cast true to form and be uniform throughout in accordance with the Drawings.

38.0 R.C. LINTOLS AND CILLS

Precast reinforced concrete lintols shall be built to the full thickness of the walls in which they occur and with 229mm (9") bearing on either side of the opening which they span unless smaller bearings are indicated in the Drawings.

Precast reinforced concrete cills shall be cast to the dimensions as shown on the Drawings.

39.0 METRICATION FOR REINFORCING STEEL

Metrication - If the Contractor cannot procure such reinforcing steel in the imperial sizes as directed in the Drawings and/or Schedule of Prices in sufficient time to avoid delay in the performance of his obligations under the Contract but can obtain such steel in the metric sizes to the dimensions approximately to those described in the Drawings and/or Schedule of Prices in accordance with the following table, then the Contractor shall forthwith give notice to the Engineer of these facts stating the dimensions to which steel are procurable in the metric sizes.

Imperial Size (ins)	0.25	0.31	0.375	0.5	0.62	0.75	0.87	1.0	1.125	1.25	1.5
Metric Size (mm)	6	7.5	9	13	15	19	21	25	28	32	38

TABLE 'A'

PROPORTIONS & STRENGTHS OF CONCRETE

Type/ (Grade)	Nominal Mix Cement/Fine Aggregate/	Estimated Proportion of			Water Including Water In	Size of Coarse	Compacting Factor for	Minimum Compressive Strength of Works Cubes in lb./sq. in	
	Coarse Aggregate	Portland Cement (lb)	Fine Aggregate (lb)	Coarse Aggregate (lb)	Aggregate Gallon	Aggregate	Vibrated Concrete	at 7 days	at 28 days
Vibrated reinforced concrete	1:1:2	112	124	226	5.0	¾"	0.78 - 0.86	3,000	4,500
Vibrated reinforced concrete (Grade A)	1:11/2:3	112	187	340	6.0	¾"	0.86 - 0.90	2,500	3,500
Vibrated reinforced concrete	1:2:4	112	249	453	6.8	¾"	0.83 - 0.86	2,000	3,000
Mass Concrete	1:3:6	112	343	555	as directed	See note (ii) below	-	-	-
Concrete	1 to 9	112	336	672	"	¾"	-	-	-

NOTE:

1. When concrete is compacted by hand (and not vibrated) the compacting factor and the mix shall be determined by the S.O. when the Preliminary test mixes are made.

2. Not greater than 38mm (1.5") nor greater than 6mm (0.25") of the thickness of work whichever is the lesser.

TABLE 'B'

PROPORTIONS & STRENGTHS OF CONCRETE

Grade	Maximum Nominal Aggregate Size (mm)	Minimum Cement Content In Concrete (kg/m³)	Maximum Free Water/Cement Ratio	Minimum Compressive Strength of Test Cubes				Limits of Dry Aggregate	
				Preliminary Test		Works Cubes		Cement Ratio By Weight	
				7 days (N/mm²)	28 days (N/mm²)	7 days (N/mm²)	28 days (N/mm²)	Max.	Min.
45	40	340		37	55	30	45	6.5	3.5
45	20	355		37	55	30	45	6.5	3.5
45	14	390		37	55	30	45	6.5	3.5
40	20	360	0.45	35	52	27	40		
30	40	295		30	45	20	30	7.5	4.5
30	20	310		30	45	20	30	7.5	4.5
30	14	340		30	45	20	30	7.5	4.5
25	40	260	0.55	27	40	17	25		
25	20	290	0.55	27	40	17	25		
20	40	265	0.55	24	35	14	20	8.0	5.0
20	20	280	0.55	24	35	14	20	8.0	5.0
20	14	310	0.55	24	35	14	20	8.0	5.0

E. BRICKLAYER

1.0 GENERALLY

Bricks shall be hard, sound, square and clean.

Clay bricks shall be well burnt in respect of size and shall comply with the provisions of BS 3921 Section 1 and 2. Calcium silicate bricks (sand or flint lime) shall comply with BS 187. Special bricks shall comply with BS 4729 for shapes and dimensions in metric units.

The use of chipped bricks or blocks will not be permitted in face work.

Bricks are to be to the standard of a sample of each type to be approved by, and deposited with, the Engineer. The Contractor is to allow the Engineer to take additional samples of bricks of each type from each consigment free of charge for testing as required. Poor quality brick and blocks shall be rejected and carted away from site at the Contractor"s own expense.

Clay bricks are to be of the best quality local manufacturer or of equal quality made by the Contractor, and are to be well and evenly burnt and free from cracks and other defects. The average compressive strength, when tested in accordance with BS 6073 : Part I is to be not less than 0.7 kg/mm² (1,000 lbs/ins). Concrete bricks on site are to be covered to prevent excessive wetting.

Bricks for fair faced work shall be individually selected from consignment delivered to the site, with particular regard to uniformity of size and colour with perfect arises, true faces and absence of minor defects.

Facing bricks unless otherwise described shall be of a popular brand and make and to S.O. approval.

The engineering bricks where specified shall comply with BS 3921 Class A and shall be obtained from the approved manufacturer.

2.0 CEMENT, SAND AND WATER

Cement, sand and water are to be described in the CONCRETOR Section of this specification.

3.0 LIME

Hydrated lines for cement/lime mortar shall comply with BS 890 : Part 2 Semi-Hydraulic or Non-Hydraulic, Type (1), (2) or (3).

Quick lime is to be properly slaked and run to putty, and matured for at least two weeks before use in the case of non-hydraulic and semi-hydraulic limes for at least 36 hours in the case of hydraulic limes.

Hydrated lime is to be run to putty or mixed with sand and water and allowed to stand for at least 16 hours before use, or when of an approved type free from unslaked particles.

4.0 MORTAR PLASTICISERS

Mortar plasticisers based on Vinsol Resins shall comply with BS 4887 and shall be used strictly in accordance with the manufacturer"s instructions. Mortar plasticisers shall be used only with the written approval of the Engineer.

5.0 MORTAR

Unless otherwise specified, lime mortar is to consist of one part of lime to two to three parts of sand by volume. Cement mortar is to consist of one part of cement to three parts of sand by volume, and cement lime (or "compo") mortar is to consist of one part of cement to two parts of lime and eight to nine parts of sand by volume. The exact amount of sand required, where not fixed by the above, is to be varied between the limits stated according to the nature of the sand, so as to obtain adequate workability.

Mixing of mortar is to be done either by means of a mechanical batch mixer of an approved type or by hand on a clean water-tight platform of adequate size, the materials being turned over twice in a dry state and twice while water is added. The materials for mortar are to be measured in accurate gauge boxes, which are to be completed filled and the top struck off level. When hand mixing is used 10% extra cement shall be added to the mix.

No mortar containing cement is to be used later than 30 minutes after the addition of water to the cement or after is has commenced to set. No mortar which has commenced to set is to be knocked up for re-use. Lime mortar, or the lime and sand for cement-lime mortar, may be mixed and stored provided it is not allowed to dry out.

6.0 BRICKWORK

Clay bricks shall be well soaked in water for at least half an hour before being laid and constructed brickwork must be cured with water for five days and protected from the sun"s ray for two days after laying.

Bricks are to be well buttered with mortar and laid on a solid bed of mortar and joints are to be completely filled with mortar as the work proceeds. Single-frogged bricks are to be laid frog uppermost. Brickwork is to be laid to rise four courses to 305mm (12") unless otherwise directed.

Brickwork is to be carried out uniformly, no portion under construction being raised more than 914mm (3") above adjoining parts while being built and the working junctions to be raked back and not toothed up. All perpends, quoins etc., are to be kept strictly perpendicular true and square and every course is to be kept truly level and in line.

Tops of walls where work is left off shall be well wetted before work on them is resumed.

Overhand laying must not be used without the approval of the Engineer.

Predetermine betting out so that full bricks occur under lintel bearings.

7.0 HOLLOW WALLS

The inner and outer skins of hollow walls shall be built at the same time. Cavities including wall ties shall be kept clear of mortar droppings and shall be cleaned daily, holes being left for this purpose and subsequently to be bricked up on completion.
Skins shall be tied together with galvanised wire ties to BS 1243 walling. Extra ties shall be provided at reveals and end of walls, at not more than 229mm (9") centres.

8.0 KEY FOR PLASTER

Joints of brickwork to be plastered, rendered or screeded are to be raked out to form a dept of 13mm (0.5") to form a key as the work proceeds.

9.0 DAMP PROOF COURSE

Damp proof courses shall be one layer of two-ply purpose made bituminous sheeting with lead core, “Pluvex” or other equal and approved product, complying with the requirements of BS 743, laid with 152mm (6”) overlap at joints and angles on a 19mm (0.75”) bed of (1:3) cement mortar. A full coat of hot bitumen shall be applied over the mortar and again over the bitumen sheeting. Exposed edges of damp proof courses shall be neatly pointed.

10.0 DAMP PROOF MEMBRANE

This shall be approved heavy grade polythene sheet 500 gauge, with all joints twice 51mm (2”) folded and stapled together. Ensure that the polythene sheets are not torn or punctured during construction stage.

11.0 RESTRICTIONS ON BRICK LAYING

No brickwork is to be built off or supported on reinforced concrete beams, slab or concrete encased structural beams until a minimum of 7 days after formwork and props supporting the concrete have been removed. Avoid stacking of bricks which may induce excessive concentrated load on the structure.

12.0 BOND

Brickworks except half brickwalls shall be in English bond. Half brickwalls shall be in stretcher bond. No four courses shall rise more than 25mm (1”) above the same laid dry. Bats are to be used only where required for bond.

13.0 FACED WORK

Facing bricks and fair-faced brickwork shall be constructed with a uniform face as shown in the Drawings, carefully set in mortar with raked out joints and pointed with a neat weathered joint as work proceeds.

Coloured cement jointing will be used if so specified.

Fair faced brickwork or facing brickwall shall be protected by gunny sacks, “kajangs” or other suitable material from mortar droppings, rubbing, staining or other surface adhesions until such time as work is handed over as complete.

No rubbing down of brickwork shall be permitted.

No faced work shall be painted or shall be given any form of surface treatment until approved by the Engineer.

Samples panels of facing and/or faced brickwork shall be provided for each type of brick and pointing.

Panels shall be approved by the Engineer before general facing work commences. Panels shall be 914mm x 914mm (3‟ x 3‟). Retain on site for comparison and remove on completion.

14.0 BONDING TIES

Provide bonding ties consisting of 6mm (¼”) diameter mild steel rods 456mm (18”) long, hooked both ends cast into concrete columns and built into brickwork. Tie 456mm x

51mm (18" x 2") strips to Exmet to top of bars to form adequate brickwork bond and the Contractor shall include for this in his rates.

15.0 BRICK REINFORCEMENT

All 114mm (4.5") thick brickwalls or walls constructed of 76mm (3") thick brick-on-edge shall be reinforced with 64mm (2.5") wide „Exmet" or other equal and approved steel mesh reinforcement coated to prevent corrosion. For 114mm (4.5") thick walls, reinforcement shall be at every forth course, the bottom most reinforcement being 152mm (6") above floor.

For walls constructed of 76mm (3") thick brick-on-edge the reinforcement shall be at every third course, the bottom most reinforcement being 114mm (4.5") above floor.

For walls more than 114mm (4.5") thick mesh reinforcement shall be provided unless otherwise shown on the Drawings, the width of reinforcement shall be 51mm (2") less than width of wall in which it is placed and shall be at every fourth course, the bottom most reinforcement at second course above floor. Reinforcement to any thickness of wall shall be lapped minimum 152mm (6").

16.0 CONCRETE HOLLOW BLOCKS

Concrete hollow blocks shall comply to BS 6073 : Part 1 and shall be of the sizes shown on the Drawings. The blocks shall be manufactured from Ordinary Portland cement to BS 12 and aggregate complying with B.S. 882 and pressure-pressed in metal moulds. Blocks shall be obtained from an approved manufacturer or of equal quality made by the Contractor.

The relevant clauses for brickwork shall reply equally to blockwork.

a. All concrete hollow blocks for walls and partitions are to be machine made, pressure vibrated in (1:3) cement-sand and all surfaces of blocks to be finished to take cement paint or limewash etc. They must be made to the dimensions described with a maximum variation of 1.5mm (0.06") and are to be matured twenty eight (28) days before being used.

   It is pointed out that the blocks being used. It is pointed out that the blocks are to be manufactured in such a manner that no plastering is required i.e., there is no platering on either side of these blocks and accurate steel moulding is essential.

   Blocks which should courses to 152mm (6") may be obtained from approved sources. Contractor is to notify the S.O. or his representative of his source of supply before ordering.

b. All hollow blocks shall comply to BS 6073 : Part 1 and shall have minimum crashing strength of not less than 0.7 kg/mm² (1,000 Lbs/in²) of overall cross- sectional area and they shall be adequately rigid to support eccentric loads.

c. All hollow blocks in walls shall be laid in one stretch in perfectly level courses, with end of one block resting centrally on the web of the one below.

   All vertival and horizontal joints shall be 9mm (0.375") thick in mortar.

d. All hollow blocks must be on the site 2 weeks before they are being laid and properly stacked before being used on the site.

   All hollow blocks must be cured for a minimum of 28 days. The method of curing and storing must be approved by the S.O.

e. The blockwork generally is to be laid in stretcher bond. Three quarter, half, quarter size and special corner blocks are to be used for bonding where applicable.

Walls are to be carried up in a uniform manner, carefully levelled every third course and no one portion being raised more than 914mm (3") above another at any time.

Corners are to be well bonded plumb and true and all perpend and quoins to be kept strictly true and square. Broken or cracked blocks will not be permitted in all work.

f. Blocks shall be finished smooth for plant or have joints raked out to receive plastering. All fair-faced blockwork shall be pointed with neat flush joints or otherwise directed.

g. The course reinforcement for blockwork shall be similar to brick reinforcement but at every third course.

h. Separate samples of each type of hollow blocks taken at random from the batch shall be deposited with and approved by the Engineer before being used and subsequently deliveries shall be up to the standard of the sample approved.

17.0 CLEANING DOWN

On completion, make good any damaged bricks or joints on exposed faces of brickwork and blockwork and make good after all trades.

Clean down fair faced and facing brickwork or blockwork with a solution of diluted hydrochloric acid and clean water and afterwards rinse with clean water to remove surplus mortar, stains and dirt.

18.0 ASUNDRY ITEMS

Leave or form holes, mortises, chases etc., cut and fit brickwork or blockwork around steelwork and concrete, build in window and door frames and ends of cills, joists etc., and carry out other labours shown on the Drawings or as necessary for the execution of the work.

Bolts, brackets, lugs etc., are to be grouted or pinned in solidly with cement mortar, and holes and chases for pipes, conduits etc., are to be cut neatly and later packed solidly with cement mortar or fine concrete.

Use templates to form openings where doors and windows are not to be build-in. Where door and window frames are to be built in as the work proceeds bed in mortar similar to that for adjacent work.

19.0 CHASES

Form chases in walls for concealing pipes, conduits, etc. Such chases shall be of the smallest depth necessary for the purpose and excessive cutting shall be avoided.

Chases shall be formed by hand or machine cutting without cracking or splitting the brickwall or causing any damage.

The Contractor shall rectify any damage caused at his own expense and in the manner directed by the Engineer.

F. DRAINLAYER

1.0 GENERALLY

1.1 The requirements of the other sections of this Specifications are to apply to this section.

2.0 LOCAL AND OTHER AUTHORITIES

2.1 All of the work shall comply to the rules and regulations of the local and other authorities.

3.0 SETTING OUT

3.1 All trenches are to be set out accurately to straight lines and even falls as required, and the Contractor is to provide set up and maintain all necessary benchmarks, sight rails, boning rods, etc.

4.0 TRENCHES

4.1 Drain trenches are to be excavated of sufficient width to allow adequate working space for pipe jointing.

4.2 Pockets are to be cut in the bottom of trenches for the sockets of pipes laid without concrete beds, to allow the barrels of the pipes to rest solidly on the ground and to provide hand room for jointing.

4.3 Turf and topsoil are to be set aside and replace on completion of the backfilling, except where on the site of new buildings, paving, etc. Any existing pavings are to be reinstated as provided in “Excavator”.

4.4 Backfilling of trenches is to be as described in “Excavator” except the filling to a height of 305mm (12”) above the top of the pipes is to be with selected material carefully handpacked and well rammed on each side of the pipe.

5.0 MATTRESS

5.1 Piles for mattress piling are to be Bakau piles as specified in “Excavator” and are to be stacked and protected as stated therein.

5.2 Where mattress piling is specified it is to consist (unless otherwise specified or required) of two lines of piles along the line of the drain, laid on groups of piles approximately 1219mm (4‟) long across the line of drain. These groups are to be at 1829mm (6‟) centres, each consisting of three piles 305mm (12”) apart. All piles are to be 127mm (5”) diameter, sawn to half-round section.

6.0 CONCRETE BEDS ETC.

6.1 Concrete for drain beds, hunching or surrounds are to be Class „C" (1:3:6) as shown on drawings.

6.2 Concrete beds are to be provided for all glazed stoneware and concrete drainpipes unless so specified.

6.3 Vertical and steeply sloping drains, as in plumbing bays and like, are to be surrounded with concrete minimum 152mm (6") thick.

6.4 Gullies, traps and similar fittings are to be set on a bed of concrete 152mm (6") thick and hunched up all round. Bends at feet or vertical soil, waste or rainwater pipes are to be similarly treated.

7.0 LEVELS OF EXISTING DRAINS

7.1 The Contractor shall check the invert levels of existing drains, sewer and manholes before laying new drains and shall notify and Engineer immediately if declared invert levels are found to be inaccurate.

8.0 DRAINLAYING GENERALLY

8.1 Laying of each length of drain is to be commenced at the lower and thereof. Socketed pipes are to be laid with the socket at the higher end of the pipe. Each pipe is to be accurately levelled and securely held in position before the joint is made.

8.2 Pipes opening left temporarily in the drains at junctions, ends, manholes, etc. are to be sealed to prevent the entry of surface water, earth or any other matter.

8.3 After drains laid by the Contractor have been connected to any other new existing drainage of disposal system, care is to be taken to prevent damage to that system being used by surface water, earth or any other matter entering the new drains, and the Contractor is to be responsible for the cost of making good any damage so caused.

9.0 STONEWARE

9.1 Stoneware pipes and fittings are to be British Standard quality to comply with B.S. 65. Stoneware traps, gullies, branch beds and similar fittings are to be of the patterns and dimensions stated in B.S. 539 and are to be sound, well glazed, impervious and free from fine cracks and other defects.

9.2 Joints between stoneware pipes and fittings are to be made with gasket and cement mortar. The gasket is to be tarred hemp yarn or similar material, wound around the spigot before insertion and then tamped lightly into the socket so as to occupy not more than one quarter of the dept thereof. The socket is then to be filled with cement mortar (1:1) finished with a bold fillet at

9.0 STONEWARE (Cont'd)

an angle of 45° with the barrel of the pipe. After jointing, the inside of the joint is to be wiped clean.

9.3 Joints between stoneware and cast iron are to be similarly made.

10. 0 SURFACE WATER CHANNELS

10.1 Precast concrete surface water channels are to be 229mm (9") diameter half round internally and square splayed externally, minimum 50mm (2") thick, reinforced with light steel fabric, cast in 610mm (2‟) lengths with rebated joints and finished fail on exposed faces. Channels are to be bedded in sand to falls and jointed and pointed in cement mortar (1:3). Junctions, angles, stop ends, pipe inlets, etc. are to be formed with special precast units or cast in-situ.

10.2 In-situ concrete surface water channels are to have 75mm (3") sides and bottom and are to be rendered internally and on exposed faces while still green with cement and sand (1:3) 12mm (0.5") thick trowelled smooth, dubbed out in bottom to form 229mm (9") diameter half round channel. The bottom is to be laid to falls and the sides are to be continued up to the required level.

10.3 Cover slabs for surface water channels where specified are to be precast concrete in 610mm (2‟) lengths with notch at each end for hand-hold, finished fair on top and set loose in rebates formed in the channel. The bottom is to be laid to falls, and the sides are to be continued up to the required level.

10.4 Cover labs for surface water channels where specified are to be precast concrete in 610mm (2‟) lengths with notch at each end for hand-hold, finished fair on top and set loose in rebates formed in the channel sides. Cover slabs generally are to be 50mm (2") thick and reinforced with light steel fabric: those carrying wheeled traffic are to be at least 75mm (3") thick and reinforced and necessary.

11. 0 CONCRETE DRAINS

11.1 Concrete pipes and fittings are to comply with B.S. 56 and are to have spigot and sockets and Joints are to be made with gasket and cement mortar as described for stoneware pipes, except that spigots and sockets are to be well wetted before the joints are made.

12. 0 CAST IRON DRAINS

12.1 Cast iron drainpipes are to be cast iron Class B to comply with B.S. 1211 and are to have spigot and socket ends. Cast iron drain pipe bends, brunches, traps, gullies and other fittings are to be of the pattern and dimensions stated in B.S. 1130 and are to be sound, free from flaws and defects, and of not less in thickness than that required by B.S. 437 for pipes of corresponding size.

12.0 CAST IRON DRAINS (Cont'd)

12.2 All pipes and fittings are to be coated inside and out: the coating for fittings is to comply with the requirements for coating pipes given in B.S. 437 or B.S. 1211. Any damage to the coating is to be made good by painting with two coats of black bituminous paint.

12.3 Joins between cast iron pipes and/or fittings are to be made by one of the following methods: -

a. Run lead. White hemp yard or lead strip is to be caulked in to center the spigot in the socket and the molten lead is then to be run in the socket and the molten lead is then to be run in the well caulked. The minimum depth of socket filled with run lead is to be as follows: -

Pipe diameter:	50-127mm (2"-5")	152mm (6")	178-305mm (7"-12")
Depth of run:	31mm (1.25")	37mm (1.25")	

b. Lead wool. Leaded yarn or lead strip is to caulked in to center the spigot in the socket, and lead wool is then to be well caulked skein by skein. The minimum depth of socket filled with lead wool is to be as follows: -

Pipe diameter:	50-127mm (2"-5")	152-205mm (6"-12")
Depth of wool:	31mm (1.25")	37mm (1.25")

c. Caulking compound. Philplug "P.C". 100mm (4") or equal approved cementations caulking compound in rope from is to be well caulked in skein by skein with wetted caulking irons to fill the socket, all in accordance with the manufacturer‟s instructions.

13.0 MANHOLES

13.1 Manholes shall be to the dimensions and depth as shown in the drawings.

13.2 Channels in bottoms of manholes are to be glazed stoneware, half round for main channels and three-quarter section for branch channels or correct shape to suit the direction of the drain, bedded and jointed in cement mortar. Branch channels are to be benched up around the channels in concrete Class „B‟ (1:2:4) rendered with cement and sand (1:2) 12mm (0.5") thick finished perfectly smooth; the benching rising vertically 75mm (3") from the sides of the main channel and then sloping up to the walls with a slope of 1 in 6 and dished to the branched channels.

13.3 The sides of manholes are to be corbelled over as necessary in stages not exceeding 57mm (2.25") to receive the manholes covers, provided that where any side is corbelled over more than 114mm (4.5") the brickwork is

13.0 MANHOLES (Cont'd)

to be increased in thickness to keep the external face vertical, and that no side is to be corbelled over more than 229mm (9"). Where the size of the opening cannot be reduced sufficiently by corbelling, the manholes is to have instead of 100mm (4") suspended concrete Class „B" (1:2:4) cover reinforced with 9.5mm (0.375") diameter mild steel rods at 152mm (6") centres both ways, with rebated opening for manhole cover; the concrete cover is to be trowelled smooth on top.

14.0 MANHOLE COVERS

14.1 Each manhole is to have unless otherwise specified a cast iron coated manhole cover and frame to comply with B.S. 497. Covers and frames in roads are to be heavy duty (Grade A) double triangular type with 508mm (20") diameter clear opening, weighing 229kg (approx. 504 lbs) those in foot path paved areas, drives to domestic premises and inside buildings are to be medium duty (Grade B) single seal type with 610mm x 457mm (24" x 18") clear opening, weighing 143kg (approx. 315 lbs) and those occurring elsewhere are to be light duty (Grade C) single seal type with 610mm x 457mm (24" x 18") clear opening, weighing 37 kg.

14.2 Where concrete manhole covers are specified or required they are to be concrete Class „B" (1:2:4) 50mm (2") thick 711mm x 559mm (28" x 22") i.e. 610mm x 459mm (24" x 18") clear opening with 50mm (2") being reinforced with single layer or steel wire fabric. Covers are to be bedded in weak cement mortar (1:6) leaving the edge joint open. Where covers are to be set on brickwork 75mm x 50mm (3" x 2") concrete Class "B" (1:2:4) curb is to be cast around the opening to form a rebate, tied to brickwork under two steel dowels to each site.

15.0 STEP IRONS

15.1 Step irons are to be strong galvanised mild steel, U-shaped with 114mm (4.5") tails for building in with non-slip treads and weighing at least 1.4kg (3 lbs) each. Manholes exceeding 762mm (2"6") deep from cover to bench are to have step irons, built in at 305mm (12") intervals, the top step being 457mm (18") below the manhole cover, and the bottom step not more than 305mm (12") above the benching. The steps are to be in two vertical rows with centre lines 229mm (9") apart, one-steps in each row alternatively.

16.0 INTERCEPTING TRAPS

16.1 Intercepting traps are to be set on and surrounded with concrete Class „C" (1:3:6) 152mm (6") minimum thickness, and built into manhole sides and made good.

16.2 Intercepting traps are to have brass galvanised iron stopper and frames, each with level locking arm, chain and staple, the frame jointed to the socket as described for pipes and the staples built in to the manhole side.

17.0 FRESH AIR INLET

17.1 Fresh air inlets to be heavy galvanised iron with cast brass front, mica flap and mosquito proofing.

18.0 SEPTIC TANKS

18.1 Septic tanks are to be constructed as shown on the drawings and of the sizes specified. Unless otherwise specified or shown on the drawings the top of the tank at the inlet is to be finished ground level.

18.2 Reinforced concrete is to be Class „C" (1:2:4). Formwork is to be used for both faces of all walls; unless written approval of the Engineer is given for the omission of formwork to conceal external faces where the sides of the excavation are firm and regular building paper is used.

18.3 Walls, internally, baffle walls and bottoms of septic tanks are to be rendered 12mm (0.5") thick in cement and sand (1:2) waterproofed with "Pudic" or equal approved waterproofing compound used in accordance with the manufacturer"s instructions, trowelled hard and smooth.

18.4 Exposed concrete sides of tanks are to be fair faced as described in "Reinforced Concrete". Top of concrete is to be trowelled smooth.

18.5 Openings incovers of septic tanks are to be 610mm x 457mm (24" x 18") in clear, rebated and with cast-iron covers and frames as specified for manholes.

18.6 Square junctions are to be built in as dip as pipes as shown on the drawings.

18.7 Intercepting chambers where required are to be constructed as specified above for manholes.

19.0 EFFLUENT DRAINS

19.1 Unless required to be formed with jointed pipes as described above, effluent drains are to be formed with open jointed pipes and fubble filling. Pipes are to be sound clayware or precast concrete field drain pipes laid with 12mm (0.5") open joints and to fall away from the septic tank. Trenches are to be at least 380mm (1"3") wide and 305mm (1") deeper than the pipe, and are to be filled up to 152mm (6") above the pipe with broken stone, of 751mm - 100mm (3" - 4") size below and round the pipe and 4.8mm to 37mm (0.19" to 1.5") size above the pipe. Above that level excavated materials is to be backfilled as specified.

20.0 DRAIN LEVELS

20.1 Unless otherwise specified or shown on the drawings the invert levels at the heads of each branch of the drains is to be 451mm (18") below finished ground of paving level, and the drains are to fail evenly from than pint.

21.0 INSPECTION AND TESTING

21.1 Excavations are to be inspected before being covered in.

21.2 All other drains are to be tested before being hunched or surrounded with concrete, or before the trenches are backfilled in the case of drains without beds, and are to be tested again on completion of the contract if required.

21.3 Drains and manholes are to be tested by filling with water, carried out to the satisfaction of the Engineer Any defects disclosed are to be made good and that section re-tested.

The Contractor is to provide all necessary stoppers and other apparatus, water and labour necessary for the testing, and is to pump or, drain the system out on completion.

21.4 Concrete septic tanks are to be tested as described in “Reinforced Concrete” - Testing of Liquid - retaining structure.

G. ROOFER AND SHEETING METAL WORK

1.0 CORRUGATED ASBESTOS CEMENT SHEETING

1.1 Corrugated asbestos cement sheet roofing is to be laid in accordance with the manufacturer's instructions, using all the recommended accessories and fixing devices.

1.2 Unless otherwise provided sheets are to be laid with an end lap of 152mm (6") and side lap of one full corrugation (half corrugation for "Big Six" and similar sheeting with both edges turned down). Fixing holes are to be drilled and not punched unless otherwise recommended by the manufacturers, and mitres are to be neatly sawn.

1.3 For light-weight asbestos-cement roofing ("Ardex" or similar) each sheet is to be fixed on to each main purlin (at horizontal laps) but not to intermediate purlins. Each sheet at eaves is to be fixed twice to the eaves purlin, and each sheet at verges is to be fixed also to the intermediate purlin. Sheets exceeding standard width 229mm (21") are to have additional fixings in accordance with manufacturer's instructions. Fixing to wood is to be with galvanised American or spring head roofing nails 63mm (2.5" x 10 S.G) and bituminous felt washers; fixing to steel is to be with 6.4mm (0.25") diameter galvanised hook-bolts and nuts with lead cupped or galvanised diamond washers and asbestos washers.

1.4 For standard weight asbestos-cement roofing ("Standard", "Big Six" or similar) each sheet is to be fixed twice to each purlic. Fixing to wood is to be galvanised drive-screws 75mm x 6.4mm (3" x 0.25") diameter and lead cupped washers and asbestos washer; fixing to steel is to be with hook-bolts and washers as above.

1.5 Ridges and hips for light-weight asbestos-cement roofing are to be finished with tapered half-round asbestos-cement tiles lapped 70mm (2.75") and fixed to the ridge with roofing nails or hook-bolts as above or to the roofing sheets with galvanised toggle bolts and washers. Edges of tiles are to be bedded and pointed in cement mortar (1:3). Tiles are to be neatly cut at intersections, and bedded solid in cement mortar (1:3) at open ends.

1.6 Ridges and hips for standard weight asbestos-cement roofing are to be finished with two-piece cappings with corrugated wings, fixed with drive- screws or book-bolts as above, or fixed to the roofing sheets with galvanised seam bolts and washers. Tiles are to be neatly cut at inter-sections and fitted with asbestos-cement finishes at open ends.

2.0 CORRUGATED STEEL SHEETING

2.1 Corrugated steel sheeting is to be galvanised and is to comply with B.S. 3083. Unless otherwise specified, sheets are to be No. 22 S.W.G.

2.2 Sheets are to be laid with an end lap of 152mm (6") and side lap of one full corrugation. Each sheet is to be fixed to each purlin at not exceeding 305mm

(12") centres with galvanised drive screws (14 gauge) or hook-bolts 6.4mm (0.25") and galvanised washers.

2.3 Ridges are to be finished with purpose-made cappings of similar material, with corrugated wings to match the roofing, fixed to the ridge with screws or hook-bolts as above, or stitched to the roofing sheets with 6.4mm (0.25") diameter galvanised bolts and rivets.

2.4 This clause applies also to sheeting used for vertical cladding.

3.0 CONCRETE TILES

3.1 Concrete single-lap roofing tiles are to be "Redland", "Alexandra" or equal approved, of approved colour.

3.2 Tiles are to be laid with 75mm (3") minimum lap and properly set out to suit the various roof slopes, abutments, etc. with the minimum of cutting and to allow the use of a full tile at eaves and ridges. Each tile in every second course, and at eaves, ridges, verges, vallesy and hips, is to be nailed with one 44mm (1.75") galvanised iron nail or wired with 18 S.W.G. galvanised iron wire. Tiles are to be laid on 50mm x 25mm (2" x 1") hardwood battens (see "Carpenter") fixed to rafters with approved wire nails.

3.3 Ridges and hips are to be finished with half round tiles to match the roof tiles, bedded at the edges and pointed in cement mortar tinted to match. End tiles are to be bedded solid.

4.0 METAL DECKING ROOFING

4.1 Metal deck roofing shall be in continuous lengths Lysaght "Spandek" or "Klip-lok" zinc coated steel sheet of the thickness specified on the drawings.

4.2 The whole of the roof including the flashing, soakers, cappings, gutter, stop ends, outlets, expansion joints, saddle flashings, etc., shall be supplied and fixed by an approved roofing Contractor, strictly in accordance with the Engineer's and Manufacturer's details.

4.3 The roofing Contractor shall provide all necessary accessories for fixing and sealing off as recommended by the Manufacturer. Lay decks to pitches as indicated on the drawings. Turn up troughs to form stop ends are required and press down all trays into gutters. Fasteners shall be made with (0.048") galvanised steel duplex clips (one clop per purlin) each secured to the tops of timber purlins by two 8.5g x 56.4mm (2.25") galvanised steel drive screw nails. No iron, brass or copper materials are to be fixed in contact with zinc. After all sheets have been laid and clipped, sheets shall be batten punched at not greater than 914mm (3'0") centres.

5.0 ALUMINIUM ROOF SHEETING

5.1 Roofing shall be GP-0.7mm or 0.55mm thick Alcom Aluminium as specified thickness, or approved equal.

5.2 Roofing sheets shall be fastened with Alclip fastening system consisting of 6.4mm (0.25") diameter roofing bolt with a neoprene gasket, 82.4mm (3.25") aluminium clip and aluminium cleats.

5.3 Roof to be support by 50mm x 50mm (2" x 2") Rasak or approved equal purlins at 910mm (3') centre to centre.

5.4 Side lap fasteneres shall be Alclip self tapping screws fixed through the tops of the ribs at 610mm (2') centres, unless otherwise specified.

As soon as practicable after receipt of any such notice the S.O. shall give an order to the Contractor which shall either:

a. direct the Contractor to supply the steel to the dimensions stated in his said notice to be procurable instead of the dimensions described in the Drawings and/or Schedule of Prices provided that:-

   i. the quality of such steel comply with the requirements of BS 4449; and that

   ii. any extra cost so arising in the variation is absorbed by the Contractor; or

b. direct the Contractor to make some order variations whereby the need to supply such steel to the dimensions described in the Drawings and Schedule of Prices will be avoided. Any extra cost arising out of such instruction shall be borne by the Contractor.

5.5 Each screw has a concealed noeprene gasket in the head similar in appearance to the Alclip bolt.

5.6 Sheets to be supplied in full lengths.

5.7 The roof structure must be square and all purlins straight before securing cleat strips to them.

5.8 Stretch a string between two corresponding ridge and gutter cleats. Set out intermediate cleat strips from this line. Only cleats to which clips will be attached need be secured to the purlins.

5.9 6.4mm (0.25") diameter holes in centre lines of ribs of sheets are to be drilled to which clips are to be attached. Attach clips to sheet with Alclip roofing bolts and tighten with broad bladded screw driver to ensure a water tight seal.

5.10 Position sheet accurately so that clips are over the cleats before snapping roofing sheets on. Care must be taken to tread the clips down firmly so that they are properly snapped over the heads of the cleats.

5.11 Water stops at ends opposite to gutter is formed by turning up each trough with a special hand tool.

5.12 One fastening at every second corrugation is sufficient.

5.13 Fix “Alclad Aluminium” or approved equal flashing where indicated on drawings.

6.0 INSULATION AND SARKING

6.1 Insulation and sarking to roofs other than car port roof shall be Sisalation 430 Fire Resistant ALUMINIUM FOILT, unless otherwise specified.

6.2 Rolls are to be laid horizontally along the roof slope and lapped 152mm (6”) at joints unless on boarded roofs, when horizontally laps may be 75mm (3”). End laps are to occur at rafters or other supports unless on boarded roofs, and are to be nailed at 75mm (3”) centres.

6.3 The felt is to be laid under battens, carried over the fascia boards, turned up at abutments and openings and arranged generally so as to allow the safe disposal of any water which may penetrate it. Any torn or damage part are to be replace or covered.

6.4 Nails where required are to be clout nails, or are to have folded felt washers.

7.0 ROOF LIGHTS

7.1 All roof light sheets are to be “Acrylie Roof Lights” type Perspex or other equal approved manufacture. Roof lights shall be clean, free from dust and grim oil stains and other dirt before installation.

7.2 All fixing, laying and installation of Roof Lights shall be strictly in accordance with the requirements of C.P. 153 or the manufacturer’s instructions where appropriate. All lapped joints to roof lights shall be adequately and tightly sealed with a 25mm (1”) ribbon of an approved sealer applied with a squeeze gun.

8.0 CAST IRON RAINWATER GOODS

8.1 Cast iron rainwater pipes and fittings are to comply with B.S. 460 medium grade 5mm (0.19” metal) with painted finish.

8.2 Pipes and fittings with ears are to be fixed 37mm (1.5”) clear of walls with galvanised tube distance pieces and 8mm (0.31”) galvanised pipe nails (to plug in brickwork or concrete) or galvanised screws (to timber). Pipes and fittings without ears are to be fixed with galvanised steel or cast iron two-piece bolted holderbats or brackets, one to each length, with lugs cut and pinned to brickwork or concrete or with ears fixed with galvanised screws to timber. Joints are to be caulked with yarn and red lead putty.

8.3 Cast iron eaves, gutters and fittings are to comply with B.S. 1205, with painted finish. Gutters are to be laid to even falls of 25mm in 3048mm (1” to 10’) and are to be fixed on galvanised brackets not more than 1829mm (6’) apart fixed

with galvanised screws. Joints are to be made in rod lead putty or approved composition and bolted with galvanised nuts and bolts.

8.4 Pipes and gutters are to be fixed complete with all necessary offsets, shoes, angles, outlets, stop-ends and other fittings.

9.0 GALVANISED STEEL RAINWATER GOODS

9.1 Galvanised steel for gutters and pipes is to be No. 20 S.W.G., well galvanised and free from imperfections. Gutters, pipes and fittings are to be of the size and shape specified, neatly and soundly welded or soldered. No iron, brass or copper materials are to be used in contact with galvanised steel. Nails and screws are to be galvanised.

9.2 Pipes are to be fixed with 19mm x 3.2mm (0.75" x 1.8") galvanised mild steel straps or with stout galvanised pipe clips one to each length, fixed with pipe nails (to plug in brickwork of concrete) or steel screws (to timber), with galvanised tube distance piece where necessary to keep the pipes 37mm (1.5") clear of walls. Joints are to be made by tapering and telescoping the pipes in the direction of flow with at least 75mm (3") overlap.

9.3 Gutters are to be laid to even falls of 25mm in 3046mm (1" in 10') and are to be fixed on stout galvanised brackets not more than 1829mm (6') apart fixed with galvanised screws. Joints are, to be lapped in the direction of flow and made in composition recommended by the manufacturers and bolted with galvanised nuts and bolts.

10.0 ASBESTOS CEMENT RAINWTER GOODS

10.1 Asbestos-cement rainwater goods are to comply with B.S. 569 and are to be obtained from an approved manufacturer's instructions, including all necessary offsets, shoes, angles, outlets, stop-ends and other fittings.

10.2 Pipes are to be fixed as described for galvanised steel pipes and are to be left unjointed unless otherwise specified.

10.3 Gutters are to be laid to even falls of 25mm in 3048mm (1" in 10') and are to be fixed on stout galvanised brackets not more than 1829mm (6') apart fixed with galvanised screws. Joints are to be lapped in the direction of flow and made in composition recommended by the manufacturers and bolted with galvanised nuts and bolts.

10.4 All gutters outlets are to be fitted with stout galvanised iron wire domical gratings.

11.0 GALVANISED STEEL SHEET

11.1 Galvanised steel sheets for flashings, aprons, drips, ridges, hips, etc., is to be No. 24 S.W.G. well galvanised and free from imperfections.

11.2 Sheets are to be adequately lapped at joints and are to be soldered at angles where necessary.

11.3 No iron, brass or copper materials are to be fixed in contact with galvanised sheeting; nails or screws are to be galvanised.

11.4 Flashings, etc., against brickwork are to be turned in 25mm (1") deep and wedged with Belian wedges.

12.0 SHEET LEAD

12.1 Sheet lead for roofs, flashings, aprons, drips, gutters, etc. is to be 1.81 kg (4 lbs) weight, complying with B.S. 1178.

12.2 Sheets are to be laid in lengths not exceeding 3048mm (10') and adequate provision for expansion and construction is to be made, solder being used only where strictly necessary. Leadwork is to be carefully dressed and bossed as required, and adequately lapped at joints. Nails for use with lead sheet are to be copper.

12.3 Edges of flashings, aprons, etc. are to be secured at laps and at not less than 762mm (2'6") centres with 1.81 kg (4 lbs) lead tacks 50mm (2") wide under the flashing and turned 25mm (1") over the bottom edge. Flashing, etc., against brickwork are to be turned in 25mm (1") deep and wedged with folded lead strip.

12.4 Zinc for roofs, flashings, aprons, drips, gutters, etc., is to be No. 14 Zinc Gauge (No. 22 S.W.G), free from imperfections. Sheets are to be adequately lapped at joints. Zinc is to be soldered only where possible, edges of flashings, aprons, etc., are to be stiffened by forming a 12mm (0.5") diameter bead or 12mm (0.5") flat fold set out slightly from the wall.

12.5 Flashings, etc., against brickwork are to be turned in 25mm (1") deep and wedged with zinc wedges.

12.6 No iron, brass or copper materials are to be fixed in contact with zinc nails or screws are to be zinc or heavily galvanised.

13.0 RIDGES AND HIPS

13.1 Ridges and hips of Belian shingle roofs are to be covered with galvanised steel preformed cappings with 229mm (9") wings, lapped 100mm (4") at joints.

14.0 VALLEYS

14.1 Valleys in pitched roofs are to be finished with sheet zinc laid on the valley boards or lier board and dressed over and nailed to the tilting fillets (see "Carpenter"). Laps are to be single welted (i.e. folded with four thickness).

15.0 ABUTMENTS AND TOP

15.1 Abutments and top edges of pitch shingle or corrugated sheet roots against walls at chimney stacks, parapet, etc., are to be finished with zinc flashings dressed over the roofing for a width of 152mm (6") and turned up at least 75mm (3") against the wall. Sloping flashings are to be neatly stepped to brick courses, the 75mm (3") minimum turn-up being measured to the bottom line of the cut steppings.

15.2 Flashings to abutments and top edges of single-lap roof tiling are to be as last but in sheet lead, dressed closely to the tiling.

16.0 GUTTERS

16.1 Gutters are to be formed on pitched roofs above chimney stacks and similar features in sheet zinc, laid on the gutter boarding (see "Carpenter") turned up at least 75mm (3") against the wall and carried up the roof slope to a vertical height of 75mm (3") and dressed over and nailed to the tiling fillet.

16.2 Gutters to chimney stacks, etc., in tiled roofs where the adjacent flashing are in lead are also to be lead, instead of zinc.

17.0 LEAD SLATES

17.1 Pitched roofs are to be made watertight around pipes passing through with lead slates size 457mm x 457mm (18" x 18") or 381mm x 381mm (15" x 15" diameter), with collars 152mm (6") minimum height soldered or burn on. The slate is to be closely dressed over the roofing and under the upper courses thereof and the collar is to be tightly wire with copper wire around the pipe.

17.2 Similar slates are to be used for pipes passing through flat roofs, being laid under the final layer of roof finish.

18.0 TANK TRAYS

18.1 Where tank trays are specified or shown on the drawings they are to be lined with sheet zinc turned over and nailed to the curb all round (see "Carpenter") and soldered or folded at angles and soldered at joints. A 37mm (1.5") diameter galvanised steel outlet pipe (as specified in "Plumbing") is to be soldered to the tray and run to falls to discharge through the eaves or as otherwise specified.

19.0 WATERROOFED SCREEDS

19.1 Where cement and sand screed is described as waterproof it shall be incorporated with "Aduapel 3 cc" or other equal and approved waterproofing compound and mixed in accordance with the manufacturer's instructions.

19.2 Screeded flat roofs are to remain without traffic for two days after laying and to be immediately protected by laying clean gunny bags over the area. On no account shall sand be spread over.

19.3 The thickness, gradients and falls shall be previously specified or as shown on the Drawings and the Contractor is to be execute the work accordingly.

H. CARPENTER, JOINER AND IRONMONGER

1.0 TIMBER

All timber shall be fully seasoned and cut to full dimensions without undue allowance for sawing margins; it shall be straight and unwrapped and free from sap wood, shakes and loose or dead knots. It shall be delivered to the site as early as possible in the course of the work and shall be stacked under cover but open to the atmosphere to ensure the maximum possible degree of seasoning.

2.0 VARIETIES

Except where otherwise stated the grades of timber for the Works shall be as follows: -

All timber in structural and concealed carpentry work shall be of Grade B. Floor boards, door and window frames and wrot carpentry shall be first quality of Grade A. Timber for joinery shall be of Grade C.

3.0 TIMBER CLASSIFICATIONS

All timber for carpenter‟s work, except where specially otherwise described, shall be in accordance with the following schedule;

Grade A	Merbau, Chengal, Balau, Resak
Grade B	Kapor, Kempas, Keruing, Kulim, Damar Minyak
Grade C	Dark Red Meranti, Nyatoh, Merawan, Mersawa, Melunak, Medang, Mengkulang

4.0 DEFECTS

All timber is to be sawn die square with the slope of the grain not exceeding one in eight, and is to be free from sap wood, twist, splits, cracks, large, loose or dead knots, large resin pockets, waney edges, live or extensive insect attack or other defects except to such extent as may be permitted by the Engineer where the strength, durability or appearance of the work will not be affected.

5.0 SEASONING

Timber for structural purposes and other carpentry is to be adequately seasoned before use so as to prevent undue shrinkage, distortion or splitting, and any timber which subsequently develops before the end of the Defects Liability Period such defects so as, in the opinion of the Engineer., to affect unduly the strength, durability or appearance of the Works is to be replace at the Contractor‟s own expense.
If fully seasoned timber is not available the Contractor is to be use only those types of timber which are less liable to develop seasoning defects, but fully seasoned timber is to be used whenever available.

5.0 SEASONING (Cont'd)

Timber for joinery is to be well-seasoned before use for a period of at least 3 months, either before or after delivery to site, and the Contractor is to allow for programming his work accordingly. Any seasoning defect occurring before the end of the Defects Liability Period and which, in the opinion of the Engineer, affects the Works adversely is to be replacing at the Contractor‟s own expense.

All timber required for the Works is to be purchased as soon as possible after the contract is signed and is to be delivered to the site or to the Contractor‟s woodworking shops and properly stored under cover and stacked to the satisfaction of the Engineer.

6.0 WROT TIMBER

Wrot timber shall be sawn, planed, drilled or machined to correct size and shape. All sizes for wrot timber given in the Bills of Quantities are finished sizes and not nominal sizes. The Contractor is deemed to have allowed for scantling in the tenderer rates.

7.0 PRESSURE IMPREGNATION OF TIMBER

Timber described as „Pressure-Treated‟ shall be impregnated under vacuum and pressure with an approved proprietary wood preservative (Tanalith „C‟ or Celcure „A‟ and the like). The net dry salt retention for interior structural timber and joinery shall be not less than 5.6 kg/m3 (0.35 lb/ft3), whereas for exterior timber such as weather boarding, door and window frame and still, the salt retention shall be not less than 8.03 kg/m3 (0.50 lb/ft3).

The Contractor shall produce certificates from supplier for the Engineer‟s inspection showing proof of the above requirement.

End of pressure-treated timber which are cut shall be sealed with Celcure „B‟ or other equal and approved proprietary preservative applied strictly in accordance with the manufacturer‟s instruction.

8.0 FINISHES

Wrot faces are to be sanded to perfectly smooth surfaces with slightly rounded exposed arises before receiving decorative finishes. Timber for joinery with natural finish, varnished or polished finish is to be selected to match grain and colour and to be void of defects.

9.0 NAILS, BOLTS, ETC

All nails, screws, bolts and other fastenings are to be of a suitable type and size and in sufficient number. Where necessary to avoid splitting, hole for nails are to be prebored of a diameter not exceeding four-fifths that of the nail. Holes for bolts are to be bored from both surfaces of the timber and are to be of a diameter equal to

9.0 NAILS, BOLTS, ETC (Cont'd)

1.06 times that of the bolt. Washers are to be used under all nuts and bolt heads. Nuts are to be brought up tight but not so as to crush the timber.

Timber connectors shall be as specified and the teeth or rings are to be fully embedded in the timber.

Where fixing with cups and screws is specified the cups are to be brass turned or heavy pressed pattern.

10.0 GLUE

Glue is to be approved resin-based or synthetic resin-based adhesive to appropriate type, and is to be used in accordance with the manufacturer‟s instructions.

11.0 CARPENTARY FRAMING

Joints in carpentry timber are to be accurately formed and of appropriate type to transmit the loading and resist the stresses to which they are subjected. Abutting surfaces in timber exposed to the weather are to be thickly coated with priming paint immediately before assembly, unless required to be glued.

Joints in plate, heads and cills of partition and similar members are to be halved 152mm (6”) long or, at angles, for the width of the member. Joints in purlins, ridges and similar members are to be scarfed for a length equal to twice the depth of the members, and tightly wedged. Rafters or joints trimmed around openings are to be correctly framed with tust-tenon joints and dovetailed housings. Studs in partitions are to be stud-tenoned at head and cill.

For roof trusses all joints in the framework shall be of the most appropriate type accurately formed and adequately secured with bolts. All members are to be of dimensions shown on the Drawings. The arrangement of the separate members and the construction of all joints shall be in accordance with the Drawings and the Specification.

12.0 TIMBERS TO BE CONTINUOUS

Every post, beam, joist, rafter, purlin, stud, strut, tie and similar member is to extend in one piece between its supports or fixing unless otherwise specified or approved in writing, in which case it is to be adequately joined in an approved manner.

Plates, heads and cills of partitions, and similar members are to be in one piece between points of change of direction provided that halved joints may be used to avoid the use of timber exceeding 4878mm (16‟) long.

13.0 NOTCHING, HOLES ETC.

Where joists, rafters, etc. are notched over supports the depth of the notch is not to exceed two-fifths of the depth of the member.

Holes in joists etc. for pipes are to be as near to the neutral axis as possible and are not to exceed one quarter of the depth of the member.

14.0 PLUGGING

Plugging for fixing carpentry or joinery to brickwork or concrete is to be with wood plugs cut with a slightly twisted taper to fit tightly into the joint or mortise into which they are driven or dovetailed where cast in-situ or built-in. Wood plugs are to be treated with wood preservative. Alternatively, for screwed fixings, “Rawplugs” or similar fibrous plugs may be used.

15.0 NIL

The Contractor shall obtain, if required, all necessary licences required for the use of power driven fasteners and shall pay all fees in connection.

16.0 PLYWOOD

All plywood shall conform to the requirements of BS 1455 and shall be constructed of waterproof insoluble adhesive and be of approved manufacture, termite proof, with Red Meranti Veneer facing and with minimum thickness of 6mm (0.25”) and thereafter upwards as specified.

All external plywood shall be Marine quality. Wherever used plywood shall be finished with mouldings or beadings and no sawn plywood sections along either grain shall be exposed. It shall be treated with wood preservative as specified for wrot timber.

17.0 DOORS AND WINDOWS

All timber doors and windows shall, unless purpose made proprietary articles brand, be constructed with stiles and rails mortised, tenoned, glued and pinned together to receive panels or sheating as shown in the Drawings. All doors and windows when hung are to be perfectly vertical and accurately filling their openings. The maximum permissible gap below or above doors shall be 3mm (0.125”). All plywood-sheathed doors shall have a 13mm (0.5”) Grade B timber edging throughout or otherwise shown on the Drawings.
Flush doors shall be of the types and sizes indicated on the Drawings. Doors shall be delivered in polythene wrappers and shall be protected from subsequent damage.

18.0 FIXING FRAMES

Door and window frames are to be fixed to brick reveals with metal holdfasts and to thresholds with dowels.

Where against concrete columns or walls, frames are to be screwed at 457mm (1“6”) centres to plugs cast or driven into the concrete, with screws heads sunk and pelted if exposed.

19.0 FIXING AND FASTENERS

Timber shall be fixed to brickwall or reinforced concrete structure by means of "Rawlplugs", hardwood plugs and screws. "Ramsets" or other approved fixing devices at such centres as will provide secures fixing.

The Contractor shall obtain the required permission for the usage of "Ramset" fixing apparatus or other similar cartridges powered fixing gun and steel fasteners.

Timbers which are required to be secret-fixed shall be counter sunk-screwed and pelted.

All screws to be used shall be brass screws, and each shall be of the size necessary for proper fixing.

20.0 TIMBER TO BE VARNISHED ETC.

All timber which are to be varnished or applied with clear finish dressing, shall be of first quality grade, selected for grain and colour. Such timber shall also be well seasoned and free from all visible defects and shall be planed straight and true.

21.0 FLOOR BOARDS

Floorboards unless otherwise stated shall be Grade A timber laid in minimum cutting in rebated joints. The boards shall be kilns dried. The floorboards shall be well cramped and fixed to conceal.

22.0 ASBESTOS SHEETS

Asbestos cement sheets in ceiling and/or cladding shall comply with BS 690, secured with galvanised iron nails, with nail holes drilled and all sheets cut by sawing. Joints shall be covered with 38mm x 13mm (1.5" x 0.5") moulded beading or finished as shown on the Drawings. The sizes shown on the Drawings are minimum dimensions and any thickness in metric sizes shall be at least equal to these if not thicker.

23.0 CHIPBOARD

Chipboard to be approval and fixed in accordance with manufacturer‟s instructions. The fixing of the sheeting must be carefully executed to obtain a true and even surface and shall be fixed with countersunk galvanised nails and neatly stopped over.

24.0 CEILING PROGRAMMING SCHEDULE

The Contractor shall ascertain and co-ordinate with all nominated sub-contractors as to the sequence of their respective works so as to ensure that all installed suspended ceiling are not unnecessarily taken down altered or damaged in the event of having to facilitate forgotten work in the ceiling space.

25.0 IRONMONGERY

All ironmonger fittings shall be approved by the Engineer and shall be installed in accordance with the manufacturer‟s instructions and shall be fixed with appropriate screws to match. Samples of all ironmongers to be supplied shall be submitted for the Engineer‟s approval before ordering.

Ironmonger is to be oiled and adjusted as required and left in perfect working order. Screws or ironmonger damaged or scratched during fixing are to be replace at the Contractor‟s expense. Prior to actual handing over of the completed buildings, the Contractor shall provide plastic holder to each set of keys, all to be clearly tagged and identified as to which lockset it fits. All keys shall be mounted on a painted plywood keyboard and handed over to the Engineer.

I. PLASTENER, PAVIOR AND TILER

1.0 CEMENT AND WATER

Cement and water to be described in the CONCRETOR Section of this Specification.

2.0 SAND

Sand generally is to be described in the CONCRETOR Section of this Specification but that for finishing coats of plaster is to be of a finer grading, with 100% passing a No. 7 B.S. Sieve.

3.0 MORTAR

Mortar for bedding and jointing, and all paving containing cement, are to be mixed as described in BRICKLAYER Section of this Specification and used fresh as provided therein.

4.0 MIXING

Plastering materials are to be mixed as described for mortar in the BRICKLAYER Section of this Specification and are to be used fresh as provided therein.

5.0 PREPARATION

Before plastered or paved finishes are applied, all brick and concrete surfaces shall be thoroughly cleaned, free from loose materials or unwanted adhesions; washed down and subsequently wetted immediately before surfacing.

Brick/block faces are to be raked out or hacked for plastering as described in the BRICKLAYER Section of this Specification.

Concrete floors and roofs to be screeded or paved are to be well cleaned and wetted, (and for paving only, wire brushed or hacked to expose the aggregate) and washed over with neat cement grout. This preparation may be omitted if the screed or paving is laid while the concrete is still „green".

6.0 PLASTERING GENERALLY

All surfaces to be plastered or screeded, including previous coats, are to be brushed to remove all dust and loose materials and are to be well wetted.

All undercoats and screeds to receive tiling, paving etc., are to be well scratched with a wire comb or trowel to form a key.

Each coat of plaster or screed is to be prevented from drying out too rapidly where necessary by spraying with water or other means as directed by the Engineer.

Undercoats and screeds are to be allowed to set for at least two weeks before application of the following coat or of tiling, paving etc.

Finishing coats are to be perfectly even and true, and of consistent finish.

7.0 INTERNAL PLASTER

Internal plaster, unless otherwise stated, shall be finished smooth with steel trowel as follows: -

a) Concrete:

- 13mm (0.5") thick in single coat of cement and sand (1:3)

b) Brickwork/Blockwork:
- 19mm (0.75") thick in two coat work consisting of
  i. a 13mm (0.5") thick base coats of cement and sand (1:3)

  ii. a 6mm (0.25") thick finishing coat of cement, lime and sand (1:1:4)

In all cases of two-coat work, the base coat shall be roughened for bonding purpose. A period of two weeks shall lapse between the two coats and the base coat shall be thoroughly wetted before the application of the finishing coat.

8.0 EXTERNAL PLASTER

All external plaster, unless otherwise stated, shall be in two coat work, each of cement and sand (1:3) with an approved plasticiser and finished with a wood float as follows:

i. a 13mm (0.5") thick base coat and

ii. a 6mm (0.25") thick finishing coat

The base coat shall be roughened before it sets. A period of two weeks shall lapse in between the two coats and the base coat shall be thoroughly wetted before the application of the finishing coat.

9.0 TYROLEAN RENDERING

Tyrolean rendering shall consist of 9mm (0.375") cement and sand (1:3) with plasticiser plaster backing ruled in to a plain and level surface and finished with "Tyrolean" rendering.

The Tyrolean rendering shall consist of one part cement of two parts sand by volume applied to the backing coat by means of a "Tyrolean" machine in accordance with the Manufacturer"s Instructions. The finish is to be built up in three layers to a total thickness not less than 6mm (0.25"). Each coat shall be allowed to dry thoroughly before the application of subsequent coats.

10.0 PLATES, ETC.

Edges of timber plates, frames etc., in walls to be plastered or screeded are to be covered with a strip of expanded metal latching projecting at least 51mm (2") either side of the timber and fixed with galvanised staples.

11.0 ANGLES

External angles on internal or external plaster are to be slightly rounded, and internal angles are to be slightly covered.

12.0 MOULDING, QUIRK, ETC.

All moulding and other features are to be even and true with all mitred angles, stops, ends etc., neatly formed.

All plaster abutting projecting (fair-faced) columns, timber posts or similar members is to be finished with a neat splay or quirk.

13.0 MAKING GOOD

Where defects in plaster or rendering have to be made good the complete area of the wall or panel in which the defect occurs shall be cut out and replaced. Should this be impracticable the defective area shall be cut out to rectangular shape as directed, the edge undercut to form a key and patch finished flush with surrounding plaster rubbed down smooth with fine sandpaper.

14.0 CEMENT PAVING

Cement paving shall consist of cement and sand (1:3) to 25mm(1") thickness as specified, laid in alternate bays to match joints of concrete floor or otherwise in alternate bays of not more than 3658mm (12" square) in either case timber battens shall be used to define each bay.

Paving shall unless otherwise stated, be brought to a smooth and even finish with a steel float.

To apron slab or as required, cement paving shall be finished to an even finish with wood float.

In the case of flat concrete surfaces and where a fall is necessary (e.g. flat apron slab) this shall be achieved by varying the thickness from one end to the achieved by varying the thickness from one end to the other. However, the minimum thickness shall not be less than 13mm (0.5") at the lower end.

Where coloured paving is specified, coloured cement shall be used in the mix in lieu of Ordinary Portland cement. In no case shall the colouring be achieved by sprinkling over the unset cement paving with coloured compound.

Excessive travelling shall be avoided to prevent. All paving shall be kept damp and free from heavy traffic for at least seven days. Damp curing shall be carried out by covering the paving with wet sand, sawdust or gunnysacks.

15.0 CEMENT SKIRTING

Cement skirting where stated is to be formed in cement and sand (1:3) for the height and profile specified, and are to be trowelled smooth. On flush skirting a 13mm (0.5") wide V-joint is to be formed at the junction with the plaster over and protecting skirting are to be finished with a rounded top edge. Skirting over cement paving is to have a 13mm (0.5") diameter cove at the junction with the paving.

All mitred angles, stop ends etc., are to be neatly formed.

Coloured cement skirting are to be coloured as described above for paving.

16.0 DIVISION TRIPS

Provide and lay brass division strip flushed with the floor finished between finishes of different materials or as directed by the Engineer.

Division strips shall be indented, perforated or deep scratched for key and shall be laid to accurate line and level. For curved work or where so stated, black ebonite strips of approved pattern may be used instead.
The Contractor shall take note the cost of division strip shall be included in his rates.

17.0 SCREEDS

Screed as backing for floor, wall, roof and gutter etc., to receive tiles and other finishes shall be composed of one part cement to three parts of sand by volume, finished even and true to exact line, level or falls required.

Screeds to receive tiles bedded in mortar shall be scratched to form key and where adhesive is to be used for fixing, the screed shall be steel trowelled to a smooth even surface, unless otherwise stated. The water content in the screed mix shall be the minimum required to give workability.

Screeds for paving shall be slightly adjusted in thickness to allow for different adjacent floor finishes to finish at the same level.

Where falls are stated or required, these shall be achieved by varying the screed thickness from one end to the other. However, the minimum thickness shall not be less than 13mm (0.5”) at the lower end unless approved by the Engineer.

18.0 WATER-PROOF SCREED/RENDERING

Refer ROOFER Section of this Specification.

19.0 UNGLAZED MOSAIC TILING

All mosaic tiles shall be approved 19mm x 19mm (¾” x ¾”) fully vitreous mosaic tiles 5 millimetre (mm) thick with colour and pattern to be selected by the Engineer.

Tiles or paper-mounted panels of tiles are to be bedded on a cement and sand screed (1:3) and levelled. The paving is to be cleaned immediately to remove all mortar from the surface of the tiles.

Tiles are to set symmetrically within each area and laid to regular line and pattern as required. Tiles in patterned mounted panels are to be adjusted as necessary at margins of paying to avoid a broken pattern and to reduce cutting. All cuttings are to be neatly carried out. Joints are not to exceed 1.5mm (0.06”) wide and joints between adjacent panels of tiles are to match those between individual tiles. Unless otherwise specified the edge row of tiles against walls is to be tiled at an angle 45 to form a small splayed internal angle and the screed or bedding is to be dubbed out to receive this.

Clean off all dirt, stains, etc., and make good/or replace all damaged and defective tiles and polish with hydrochloric acid to an approved finish.

102mm (4”) tile skirting of the same materials with angle tiles at base is to be provided where required.

20.0 PARQUET FLOORING

Parquet flooring shall be constructed of 9mm (3/8") thick kiln dried tanalised Kempas, Keranji and Meranti butt jointed tiles. Samples of the tiles shall be submitted for approval by the Engineer as and when directed. All samples which are approved shall indicate the standard to the maintained in the execution of the Works. The tiles shall be regular well defined arises matching colour texture and grain and free from splits, chips and blemishes.

No tiles shall be laid until the base surface is completely dry, clean and free of loose materials to provide a good key surface to receive the tiles. The screeded surface to receive the tiles shall be finished with a steel float and must be absolutely level. The tiles shall be laid to an approved pattern with an approved adhesive.

Following upon application of the above-mentioned coating, the surfaces shall be treated with slurry composed of one (1) part of cement to one (1) part of sand.

Until sufficiently hardened, the paving must be protected from premature drying and from vibrating and overloading.

The surfaces of the topping shall be graded to the levels indicated and shall be ruled out and jointed into area as directed with 6mm (0.25") jointing trowels unless specified.

Cure granolithic topping for 7 days and no traffic shall be allowed over paving during the curing period.

21.0 METALLIC FLOOR HARDENER

Metallic floor hardener shall be applied on freshly floated concrete surface strictly in accordance with the supplier‟s manufacturer‟s specifications.

After completion the floor hardener shall be cured with an approved curing compound. The metallic floor hardener shall be "Masterplate 200" marketed by Master Builders (Malaysia) Sdn Bhd or other brand approved by the Engineer.

22.0 ALTERNATIVE TO BRANDS SPECIFIED

Tenderisers may offer other equal and approve alternative to those items with proprietary brands specified but their offer must be subject to the final approval of the Engineer.

23.0 SUNDRY LABOURS

Plaster, screeds, paving and tiling are to be neatly made good around pipe, brackets, stays etc. Where plaster, etc. has to be cut away from these, the hole is to be formed to a regular outline, with the edges of the plaster undercut to form a key, the plaster in making good is to be finished flush with the surrounding plaster and later rubbed down.

Screeds and paving are to be formed to channels as required and dished to outlets.

Following upon application of the above-mentioned coating the surfaces shall be treated with slurry composed of one (1) part of cement to one (1) part of sand.

Until sufficiently hardened, the paving must be protected from premature drying and from vibrating and overloading.

23.0 SUNDRY LABOURS (Cont'd)

The surfaces of the topping shall be graded to the levels indicated and shall be ruled out and jointed into area as directed with 6mm (0.25") jointing trowels unless specified.

Cure granolithic topping for 7 days and no traffic shall be allowed over paving during the curing period.

24.0 PROTECTIONS

No traffic is to be allowed on any paving until it has set or hardened sufficiently to allow this without damage. All paving is to be covered up and protected as necessary.

J. PAINTER

1.0 MATERIALS GENERALLY

1.1 All paints, distempers and other materials are to be of an approved brand or brands in good conditions delivered to site in unopened drums or packages, and are to be used strictly in accordance with the manufacturer's instructions. All materials for successive coats of the same process, including primers and sealers are to be obtained from the same manufacturer.

1.2 Materials of anti-fungus quality are to be used where available from the manufacturer's proposal.

1.3 No paints, etc. are to be thinned or otherwise added to except as directed by the manufacturers or Engineer.

1.4 All finishing coats are to be to tints specified or approved by the Engineer.

2.0 DISTEMPER

2.1 Unless otherwise specified, distemper is to be an oil-bound washable water paint.

3.0 OIL PAINT

3.1 Unless otherwise specified, the final coat of oil paint on any surface is to be gloss-finishing paint, and all other coats are to be undercoats.

4.0 APPROVAL AND INSPECTION

4.1 Painting shall not be commenced until the date of commencement has been approved by the Engineer.

4.2 The final coats of external paint shall not be applied earlier than 8 weeks before the estimated date of completion of all trades. Interior painting shall not be commenced in any section until all trades are substantially complete or until the section has been thoroughly cleaned. The final paint shall not be applied in rooms to have floor coverings until the floor coverings have been laid.

5.0 WORKMANSHIP GENERALLY

5.1 All paintings or decoration is to be carried out by skilled workmen according to the best current practice and in accordance with the manufacturer's instructions.

5.2 All materials are to apply by brush unless otherwise specified or approved. The correct type and size of brush is to be used according to the surface and item being treated and to the materials being applied. Brushes are to be well cleaned after use.

5.0 WORKMANSHIP GENERALLY (Cont'd)

5.3 Each coat of paint or distemper, etc., is to be a different tint from that to which it is applied, except in the case of white.

5.4 Each coat or distemper, etc. is to be allowed to harden before the next is applied.

5.5 Each coat of oil paint is to be lightly rubbed down with glass paper and dusted off before the next is applied. Where two finishing coats are applied, the first is to be rubbed down sufficiently to remove the gloss.

5.6 No painting or decoration is to be carried out externally during wet weather, and any surface damaged by rain before it is dried is to be made good or repainted as necessary at the Contractor's expense. Priming coats and undercoats are not to be left exposed to the weather for undue periods.

5.7 No finishing coats are to be applied until all dust and rubbish has been removed from the area.

5.8 Unless otherwise specified or directed and surfaces or ducts, pipe casings, piers, columns, beams and plastered surfaces inside cupboards shall be finished as scheduled for adjoining surfaces. Edges of shelves and vertical dimensions shall be finished to match finish schedule for adjacent woodwork.

6.0 FINISHED QUALITY

6.1 All finished paintwork and decoration is to be of uniform finished and colour, free from blemishes, bruchmarks and tackiness.

6.2 Edges of paintwork are to be accurately cut into line, and disfigurement of adjacent surfaces is to be avoided. Painting of sashes, etc., glazed with putty is to overlap the putty onto the glass, to finish exactly on the slight line of the rebate.

7.0 SURFACE PERFECTION GENERALLY

7.1 All surfaces are to be thoroughly dry and free of dust, dirt and loose material before being painted or decorated.

7.2 All bolts, handles, escutcheons and other surface ironmonger and all over plates and removable fittings are to be removed before painting or decoration is carried out and subsequently replaced.

8.0 SURFACE PREPARATION PLASTER, ETC

8.1 Plastered, rendered, concrete, brick and similar surface are to be prepared for decoration as follows: -

a. Cracks and other imperfections are to be pointed or cut out and made good.

8.0 SURFACE PREPARATION PLASTER, ETC (Cont'd)

b. Surface is to be allowed to dry out for as long as possible, and in no case less than 7 days for distempers, cement paints and plastic emulsion paints, or less than one month for oil paints.

c. Any efflorescent is to be removed by dry brushing followed by a damp cloth. This is to be repeated until no further efflorescence appears within 48 hours.

d. Surfaces are to be rubbed down to remove all plaster nibs and other irregularities and brush down to remove dust.

8.2 For surfaces to be finished with cement paint the following additional treatment is required.

a. Surface is to be well wetted immediately before the finish is applied, and allowed to dry partially until it no longer shines.

9.0 SURFACE PREPARATION METAL WORK

9.1 Metal surfaces are to be prepared for decoration as follows: -

a. All dirt and grease is to be removed by wiping or washing.

b. All rust, scale or loose priming painting is to be removed back to bare metal by wire brushing or chipping as required.

c. Surface is to be rubbed down to remove all irregularities.

d. Bare patches in metal work delivered primed are to be brought forward with the appropriate primer before receiving the treatment specified.

10.0 SURFACE PREPARATION WOODWORK

10.1 Surface of woodwork are to be prepared for decorations as follows: -

a. All dirt, grease, etc. is to be cleaned off.

b. Surface is to be rubbed down with glass paper to remove all projecting fibres, particular attention being paid to mouldings. All dust is to be removed.

10.2 For woodwork to be painted (not varnished or polished) the following additional treatment is required: -

a. All knots and resin pockets are to be scraped and given two thin coats of patent knotting consisting to shellac dissolved in methylated spirits, free from resin.

b. After priming (see below) all cracks, nail holes, open joints and other imperfections are to be made good with hard stopping consisting of paste

white lead and gold sizes stiffened with whiting. Linseed oil putty is not to be used.

11.0 SEALERS AND PRIMERS

11.1 All surfaces to be oil painted are to be treated with appropriate sealer or primer, as follows: -

a. Plastered, rendered, concrete, brick, asbestos cement and similar surfaces: apply one coat of alkali-resisting primer.

b. Hardboard, fibreboard, etc: apply one coat of plaster primer.

c. Plastic surfaces: each with abrasive paper and white spirit.

d. Steel and iron surfaces: apply one coat of red lead primer or zinc chromate primer. Edges are to be primed first and allowed drying, and then the whole surface primed.

e. Galvanised or zinc surfaces: either applies one coat of calcium plumbate primer or etch with appropriately solution and apply one coat of zinc chromate primer. Etching solution is to be kept away from plasterer, and is to be well washed off and the metal dried before priming.

f. Copper, aluminium and lead surfaces: each with abrasive paper and white spirit.

g. Coated soil pipes, etc: apply one coat of aluminium primer.

h. Woodwork: apply one coat of aluminium primer or in the case of coarse grain timber, one coat of white-lead based primer thinned 10% with white spirit. Two coats of primer are to be applied to end-grain surfaces.

11.2 No sealer of primer is required on surfaces to be distempered or emulsion painted unless so specified.

12.0 PRIMING JOINERY

12.1 All joinery to be painted is to be primed before delivery to be site or, in the case of joinery prepared on site, as soon as possible after preparation. Surfaces subsequently cut or damaged are to be re-primed.

12.2 All hidden faces of joinery, including the back of hoarding, frames, skirting, architrave's, etc., and bottom edges of doors, are to be primed before fixing. Approved clear wood preservative is to be used instead, where adjacent faces have polished or natural finish.

13.0 PRIMING METAL WORK

13.1 All steel and ironwork to be painted, except plumbing pipework and electrical conduit, is to be primed before assemble or fixing, including laps, ends for building in, and other concealed parts.

14.0 NAIL HEADS IN WALLS LININGS, ETC.

14.1 Head of nails or pins in hardboard, fibreboard and similar linings to be distempered or emulsion painted are to be spotted with one coat of primer and one undercoat of oil paint before the lining is decorated.

15.0 NUMBER OF COATS

15.1 Unless otherwise specified, the required finishes are to consist of the following treatments, in addition to the preparation, priming, etc., described above: -

a)	Distempering	two coats
b)	Emulsion painting	two coats
c)	Oil painting	three coats on woodwork, two coats elsewhere

16.0 VARNISHING

16.1 Woodwork is to be prepared for varnishing as described above, particular attention being paid to cleanliness of the timber where clear varnish is required. Brushes and containers are to be kept scrupulously clean. Formation of froth and air bubbles is to be avoided.

17.0 WAX POLISHING

17.1 Woodworks is to be prepared for wax polishing as described above, particular attention being paid to cleanliness of timber. Polish is to be an approved proprietary wax polish, applied in two coats, each coat well worked in and polished.

18.0 WOOD PRESERVATIVE

18.1 Timber for Carpenter's work is to be treated before fixing with wood preservative as provided in "Carpenter" unless otherwise specified.

19.0 PAINTING

19.1 a) All external plastered surfaces in wall etc:

1 coat approved pigmented sealer and
2-coat cement based paint (Super Snowcem or equal)

b) Shanghai Plaster or rough cast cement rendering:

1 coat "Driwal" R2H or equal approved silicone anti-fungus treatment.
1 coat approved pigmented sealer and
2 coats cement based paint.

19.0 PAINTING (Cont'd)

c) All external and internal ferrous metal works:

1 coat zinc chromate primer
1 coat undercoat and
2 coats synthetic resin glass finish (Dulex or equal)

d) All galvanised surfaces:

1 coat treatment with approved each primer
(Mordant Solution or equal)
Washed off and followed by (c) above.

e) All external and internal woodwork where not polished.

1 coat aluminium wood primer
1 coat exterior undercoat and
2 coats synthetic resin gloss finish (Dulex or equal)

In case of joinery works in door and window frame and timber fascia, the priming coat and undercoat shall be applied prior to fixing.

f) All internal joinery woodwork handrails, internal doors except on bathroom and kitchen side where not painted.

Satin with approved oil stainer and apply two (2) coats of clear satin lacquer varnish and wax polish.

g) All internal timber flooring:

1 coat sealer
1 coat wood stain and
3 coat Scissions Floor Dressing or approved equal.

h) All internal plaster surfaces and ceiling to be painted.

1 coat sealer and
2 coats of ICI Pentalite.

Emulsion paint matt or eggshell finish (or approved equal) or 2 coats vinyl wall finish (Scissions Vinyl Wall finish or equal).

20.0 PROTECTION

20.1 All other works, fittings, paving, etc., are to be covered up and protected as necessary during decoration and all splashes and paint marks are to be removed on completion.

K. STRUCTURAL STEELWORK

1.0 BRITISH STANDARDS

1.1 The whole of the structural steelwork and testing shall comply with the relevant Clauses of the following current British Standards and Codes of Practice unless otherwise specified in the following clauses:-

B.S.	4	Structural Steel Sections
B.S.	84	Parallel Screw Threads of Whiteworth Form
B.S.	449	The use of Structural Steel in Building
B.S.	639	Covered Electrodes
B.S.	648	Schedule of Weights of Building Materials
B.S.	916	Black Bolts, Screws and Nuts
B.S.	1580	Unified Screw Threads
B.S.	1719	Covered Electrodes for Metal Arc Welding
B.S.	1775	Steel Tubes for Mechanical, Structural, General Engineering Purposes
B.S.	1856	Metal-Arc Welding of Mild Steel
B.S.	2642	General Requirements for the Welding of Carbon Manganese Steels
B.S.	2708	Bolts, Screws, Nuts and Plain Washers
B.S.	3139	High Strength Friction Grip Bolts
B.S.	3294	The Use of High Strength Friction Grip Bolts
B.S.	3410	Metal Washers for General Engineering Purposes
B.S.	4320	Metal Washers for General Engineering Purposes
B.S.	4360	Weldable Structural Steels
B.S.	2008	Protection of Iron and Steel against Corrosion.

2.0 QUALITY OF MATERIALS

2.1 All steel shall be new and shall be well and cleanly rolled to the dimensions, sections and weights specified. It shall be sound and free from cracks, surface flaws, laminations and other defects and shall be finished in a workman like manner.

3.0 MARKING OF STEEL

3.1 Each piece of steel shall be legible marked with the manufacturer's name or trade mark and with cast number by which the steel can be traced to the cast from which it was made in addition designation and shall bear such other identification marks as will facilitate erection. Two copies of the marking drawings will be supply by the Contractor to Engineer. A copy to the Engineer by the Contractor at the time of ordering for identification purposes.

4.0 STORAGE AND HANDLING

4.1 All structural steel shall be stored and handled so that members are not subject to excessive stresses or damage.

5.0 FABRICATION

5.1 The Contractor's workmen fabricating the steelwork shall be subject ot prior approval by the Engineer. As much of the fabrication of the steelwork as is reasonably practicable shall be completed in the fabricator's workshop.

5.2 Prior to fabrication, the steel shall be wirebrushed, cleaned of loose mill scale and rush, and straightened by methods which will not adversely stess or affect the integrity of the steel.

6.0 SHOP DRAWINGS

6.1 The Contractor shall include for the preparation of all necessary schedules of members, shop details and erection drawings needed in addition to the drawings applied by the Engineer. All such details shall have been approved in writing to the Engineer before the work is put in hand.

6.2 The Contractor shall be responsible for the correctness of his shop detials and for shop fittings and site connections.

7.0 AS-BUILT DRAWINGS

7.1 After the erection of the works, the Sub-Contractors shall revise and correct where needed the original approved shop and erection drawings to correspond with the changes made in the fields, and shall submit such drawings in duplicate to the Engineer before the end of the Contract.

8.0 JOINTS AND CONNECTIONS

8.1 No variation of the number, type or position of the joints or connection shown on the drawings shall be without the consent of the Engineer. If such consent is desired the Contractor shall submit detailed drawings of the proposed joints for the approval of the Engineer and no extra cost incurred by reason of such additions or alterations will be allowed to the Contractor.

8.2 Members and section shall be to accurate dimensions and positions, to enable proper connection in the fields. Drifting to enlarge mismatching holes and heating of sections to be connected in the field shall not be carried out.

9.0 WORKMANSHIP AND GENERALLY

9.1 All steelwork before and after fabrication shall be straight and free from twist. All component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and forcible connection to fit the members together shall not be used. All steelwork shall be cut and fabricated to a tolerance of = 1.5mm in its length. End plates shall be truly at right angles to the longitudinal axis of the section. No work manufacturer's works until it has been tested and complies with or has been certified to comply with all the tests and requirements of the standard applicable to the material specified and until it has been inspected and passed by the Engineer or his representative.

10.0 HOLING

10.1 Holes through connection plates and end plates of adjoining units shall be drilled after the members are assembled and tightly clamped or bolted together. The plates which have been so drilled shall be separated after drilling and the burrs removed. The matching holes shall register with each other so that a gauge 1.5mm in diameter less through them. Finished holes shall not be more than 1.5mm in diameter larger than the diameter of the bolt passing through them, unless otherwise specified by the Engineer.

11.0 PUNCHING, DRILLING AND REAMING

11.1 Material may be punched 1.5mm larger than the nominal diameter of the bolt, whenever the thickness is equal to or less than the diameter of the diameter of the bolt plus 3mm. Where the sub-punched and reamed. The diameter of the sub-punched holes and the drilled holes shall be 1.5mm smaller than the nominal diameter of the bolt to be accommodated. Finished holes shall be precisely located to ensure passage of bolts through the holes without drifting. Enlargement of holes necessary to receive bolts shall be done by reaming. Poor matching of holes shall be sufficient cause for rejection.

12.0 BOLTING

12.1 Every bolt shall butt along the unthreaded part of its shank against connected member. The threaded position of each bolt shall project through the nut at least one thread after tightening up. All bolts shall be provided with circular washers which shall be plane or tapered as applicable. The tightening of high strength friction grip bolts shall be by approved methods and shall be carried out only when the Engineer's representative is present. Load indicating washers shall be used, for all high strength friction grip bolts.

12.2 All bolts, holding down bolts and tacking bolts shall be mild steel black bolt unless otherwise stated.

13.0 GAS CUTTING

13.1 Use of a cutting torch will be allowed where the metal being cut is not stressed during the operation, and provided stresses will not be transmitted through a flame cut surface. Gas cuts shall be smooth and regular in contour. The effect width of member so cut shall be taken to be 3mm less at each gas cut edge.

14.0 PAINTING

14.1 All steel stanchions or columns, beams, stiffeners, brackets, bolts, nuts, washers, plates, etc., which are to be encased in concrete should not be painted.

14.0 PAINTING (Cont'd)

14.2 All parts of the steelwork which will be exposed in the finished construction shall be painted or dipped with one priming coat of approved zinc chromate priming paint before leaving the manufacturer's works. Steel surfaces to be in contact with one another shall not be painted but shall be cleaned of oil or grease by means of approved solvents and cleaned of dirt and other foreign matter by wire brushing.

All rust, scale, grease, dirt or other harmful matter shall be carefully removed by thorough brushing with a stiff wire brush and subsequent de-rusting with "Deovydine" manufactured by I.C.I. or similar and approved, before the surface shall have a removal of rust, the surface shall have a pronounced metallic sheen and correspond to grade St/3 and defined in Swedish Standard SIS055900 - 1967 and in "Surface Preparation Standards for Painting Steel Surfaces" approved by ASTM and the Steel Structures Painting Council of U.S.A. Oil and grease deposited shall be removed by means of approved solvents.

15.0 REJECTION

15.1 Any steelwork which, in the opinion of the Engineer, is not in accordance with the Specification shall be rejected either before or after delivery to the site and if delivered shall be removed from the site at the Contractor's expense within 24 hours from receipt of such notice of rejection. Any delay caused by such rejection will not in any way relieve the Contractor from his responsibilities with regard to the provisions of the Contract.

15.2 In the event of any material proving defective subsequent to delivery, such material shall be rejected notwithstanding any previous certificate of satisfactory testing.

16.0 TESTING AND INSPECTION

16.1 Manufacturer's Mill Test Certificates for all structural steel shall be supplied to the Engineer. The certificates shall state the process of manufacture and shall include a test sheet signed by the manufacturer giving the results of the mechanical tests applied to the steel purchased and its chemical composition. Should the Engineer required structural steel to be tested samples shall be tested at an independent testing station for compliance with the B.S. 4360.

16.2 Should the results of either test be unsatisfactory the whole consignment of steel which the sample represents shall be rejected and shall be replace by other material or proper quality.

16.3 The Engineer or his representative shall at all reasonable times be given free access to the site and the Sub-Contractor shall provide all the necessary facilities for inspection during any stage of the fabrication and for witnessing the required tests. The Sub-Contractor shall supply free of charge all labour and tools required in connection with the inspection and testing of the steelwork.

17.0 SITE DIMENSIONS

17.1 The Contractor shall take the dimensions from the building in which the steelwork is to be erected and he shall verify all dimensions given on the drawings and inform the Engineer of any errors or omissions in them before the work is put in hand.

18.0 ERECTION

18.1 Before delivery the steelwork shall if required by the Engineer be temporarily erected at the manufacturer's works either wholly or in such portions to ensure that site erection can be carried out without major amendments. After the fabrication work has been completed and before it is dismantled, each part shall be carefully marked for erection with distinguishing marks and stamped with durable markings. Drawings, showing these marks shall be supplied to the Engineer. Marking shall be such as not to damage the material. No work shall be painted or packed for delivery to work site until it has been inspected and passed.

18.2 Prior to erection the Contractor shall submit to the Engineer if required for approval, drawings, showing the proposed erection scheme, which shall include a detailed sequence of operations together with all calculations for erection stresses, etc.

18.3 The suitability of all plant and equipment used for erection shall be subject to the approval of the Engineer.

18.4 Approval by the Engineer of any the construction methods or plant shall not in any way relieve the Contractor from his responsibilities under the Contract.

18.5 The positioning and levelling of all steelwork, the plumbing of stanchions and the placing of every part of the structure with accuracy shall be in accordance with the drawings and to the satisfaction of the Engineer. No permanent bolting or alignment has been obtained.

18.6 During erection the work shall be securely bolted or otherwise fastened, and if necessary temporarily braced, so as to make adequate provision for all erection equipment and its operation. Neither permanent bolting nor field welding shall be done until the proper alignment has been obtained.

18.7 The Contractor shall supply all necessary falsework and stagings, labour, tools, erection plant, drifts, service bolts, nuts and washers and other materials necessary to carry out the work and shall remove same as the progress of the erection permits.

18.8 Any damage to materials on the site due to inadequate precautions being taken during the erection of the steelwork shall be made good to the satisfaction of the Engineer at the Contractor's expense.

19.0 TOUCHING UP

19.1 After erection of the steelwork, all exposed bolt heads shall be cleaned and shall be painted as specified. The existing priming coat wherever damaged or deteriorated shall be touched up and made good by the Contractor.

20.0 PAINTING UP AFTER ERECTION

20.1 After erection all exposed steelwork shall be painted with one additional coat of approval primer (e.g. micaceous iron oxide) followed by one coat of approved weather resistant oil based paint, in accordance with manufacturer's instructions. If the finishing paint fails to hide the primer completely one additional coat of finishing paint shall be applied at the Contractor's expenses.

20.2 All structural members which are not exposed in the finished construction (e.g. fascia framing, framings supporting gutters and ceiling etc.) shall be painted with two coats of micaceous iron oxide.

20.3 Each coat of paint shall be of a different colour, to the prior approval of the Engineer.

20.4 On the parts of structural members which are completely inaccessible after erection, the second priming coat shall be applied before assembly.

21.0 BEDDING OF STANCHION BASES

21.1 For stanchions having solid bloom bases, the blooms shall be wedged up roughly to their correct position and level at their four corners and the stanchions are to be erected and fixed to them and all connecting girders are to be fixed. The stanchions are then to be very carefully levelled, positioned and plumbed and all spaces between the bloom bases and the concrete sub- basses are to be filled up solid with fine concrete. Alternatively the blooms may be attached to the stanchions prior to erection. The wedging space is approximately 30mm (1.5") deep for all blooms up to 610mm (2') square and approximately 64mm (2.5") deep for all larger blooms.

21.2 In the above cases the grouting up may be done in one of the following ways:

a) The mortar as above specified shall be mixed as thickly as possible consistent with fluidity. It shall be poured under a pressure head of not less than 76mm (3") and holes shall be provided where necessary through the stanchion base for the escape of air; ramming and tamping shall be continued until the base is solid mortar.

b) The mortar shall be mixed as dry as possible and shall be properly consolidated by thoroughly ramming against properly fixed supports.

21.3 In special cases subject to the approval of the Engineer the wedging space may be reduced by 25mm (1") when a neat cement grounting mixed as thickly as possible consistent with fluidity shall be used as in method (a) Item 21.1 above.

21.0 BEDDING OF STANCHION BASES (Cont'd)

21.4 In all cases, immediately before filling, the grouting space under the steel shall be thoroughly cleaned and free from excessive moisture.

22.0 WELDING

22.1 General

All welding shall be carried out at the shop except where indicated otherwise in the drawings and all welding shall be 6mm (0.25") fillet weld for full length unless otherwise stated.

For welding any particular type of joint, welders shall give evidence acceptable to the Engineer of having satisfactorily completed appropriate tests as specified.

All welding plant shall conform to the requirements of the manufacturers of the electrodes used and be suitable for its purpose. They shall be fitted with instruments for accurately measuring the current and voltages. All welding cables, earth leads, accessories and connection shall be suitable for the maximum current to be used. They shall be situated as closely as possible to the operator depositing the welds, so that he may have at hand the means of adjusting the current.

No joints or welds shall be made in any position except where shown on the drawings or as directed by the Engineer.

Welding shall not be done when surface are wet or exposed to rain or high wind or when welders are exposed to inclement weather conditions.

The sizes and lengths of welds shall not be less than those shown on the drawings nor shall they be substantially in excess of those requirements without approval. The location of welds shall not change without approval by the Engineer.

22.2 Electrodes

Welding electrodes for manual operations shall comply with B.S. 639 and shall be as recommended by the manufacturers for the location and the type of weld required.

Electrodes shall be to the approval of the Engineer, be stored in their original cartons or packets in a dry place, adequately protected from weather effects. When special protection during storage is recommended by manufacturer of the electrodes they shall be stored accordance with the conditions detailed by the manufacturer. Electrodes which have been wet shall not be used.

22.0 WELDING (Cont'd)

22.3 Preparation of Materials

Surfaces and edges to be welded shall be smooth, uniform and free from fins, tears, cracks and other defects which may adversely affects the quality or strength of the weld. Surfaces to be welded and surfaces adjacent to a weld shall also be free from mill scale, slag, rust grease, paint or other foreign matter that will prevent proper welding or produce objectionable fumes.

In all oxygen cutting, the cutting flame shall be so adjusted and manipulated as to avoid cutting beyond or inside the prescribed lines as applicable. Cut surfaces shall be smooth and any roughness and occasional notches or gouges not more than 5mm deep, on otherwise satisfactory surfaces, shall be removed by machining or grinding. Cut surfaces and edges shall be left free of slag. Correction of defects shall be faired to the oxygen cut edges with a slope not exceeding 1 in 10. Defects in oxygen cut edges shall not be repaired by welding, except with the approval of the Engineer for occasional notches or gouges less than 10mm deep. Such weld repairs shall be made by suitably preparing the defect, welding with electrodes not exceeding 8mm in diameter, and grinding the completed weld smooth and flush with the adjacent surface to produce a workmanlike finish.

Re-entrant corners, except for the corners of weld access cope holes adjacent to a flange, shall be filleted to a radius of not less than 12mm. The fillet and its continuous cuts shall meet without offset of cutting past the point of tangency.

Machining, air-carbon-arc oxygen cutting or oxygen gouging, chipping or grinding may be used for joint preparation, back gouging, or the removal of the defective work or material.

22.4 Assembly

The parts to be joined by fillet welds shall be brought into as close contact as practicable. The gap between parts shall not exceed 3mm. If the separation is 1mm or greater, the leg of the fillet weld shall be increased by the amount of the separation or the Contractor shall demonstrate to the Engineer.'s satisfaction that the required throat thickness has been obtained. The separation between contact sufaces of lap joints and of butt welds landing on a backing shall not exceed 1.5mm. Fillets shall not be used except as shown on the drawings.

Abutting parts to be joined by butt welds shall be carefully aligned. Where the parts are effectively restrained against bending due to eccentricity in alignment, any offset from the theoretical alignment shall not exceed 10 per cent of whichever is the lesser. In correcting misalignment in such cases, the parts shall not be drawn into a greater slope than 1 in 24. Measurement of offset shall be based upon centre line of parts unless otherwise shown on the drawings.

22.0 WELDING (Cont'd)

Dimensions of the cross section of groove welded joints shall not vary from those shown on the drawings by more than the following workmanship tolerances:-

		Root Not Gauge	Root Gauge
a)	Root face of joint	+ 1.5 mm	Not limited
b)	Root opening of joints without steel backing	+ 1.5 mm	+ 1.5 mm - 3 mm
c)	Root opening of joints with steel backing	+ 6 mm - 1.5 mm	
d)	Groove angle of joint	+ 5 deg -	+ 10 deg - 5 deg

Members to be welded shall be brought into correct alignment and held in position by bolts, clamps, wedges, guy lines, struts, other suitable devices or by tack welds until welding has been completed. Jigs and fixtures shall be used where practicable. Suitable allowance shall be made for warpage and shrinkage.

Tack welds shall be subject to the same quality requirement as the final welds. Tack welds which are not incorporated into the final welds shall be removed. Tack welds which are incorporated into the final welds shall be thoroughly cleaned prior to the final welding. Multiple pass tack welds shall have cascaded ends.

Temporary welds shall be subject to the same welding procedure required as the final welds. They shall be removed unless otherwise permitted by the Engineer When they are removed, the surface shall be made flush with the original surface. There shall be no temporary welds in tension zones except at locations more than 1/6 of the depth of the web from tension flanges of beams of or girders. Temporary welds at other locations shall be shown on shop drawings.

22.5 Arc Strikes

Arc strikes outside the area of permanent welds shall be avoided on any material. Crackes of blemishes resulting from arc strikes shall be ground to a smooth contour and checked to ensure soundness.

22.6 Preheat and Interpass Temperatures

Where specified, parts to be welded shall be preheated by means of gas flames, induction heating or other means to bring to the specified preheat temperature the surface of the base metal for a distance equal to the thickness of the part being welded, but no less than 75mm from the point of

22.0 WELDING (Cont'd)

welding. The specified preheat temperature shall be maintained as minimum interpass temperature as welding.

Welding preheat temperatures shall be in accordance with the following table:-

Thickness of thickness part at point of welding	Welding with other low hudrogen electrodes
Up to 19mm	None
Over 19mm up to 38mm	150ºC
Over 38mm	225ºF

The measurement of temperature shall be by means of temperature – indicating crayons or pellets that melt at the specified temperature.

22.7 Welding Procedures

The work shall be positioned for flat position welding whenever practicable.

The classifications and size of electrodes, arc length, voltage and amperage shall be suited to the thickness of the material, type of groove, welding positions and other circumstances attending the work.

The maximum size of electrode shall be as follows:-

a) 8mm for all welds made in the flat position, except root passes.

b) 6mm for horizontal fillet welds

c) 6mm for root passes of fillet welds made in the flat position and of groove welds made in the flat position with backing and with a root opening of 6mm or more.

d) 4mm for welds made with low hydrogen electrodes in the vertical and overhead positions.

e) 5mm for root passes of groove welds and for all other welds not included in (a), (b), (c) and (d) above.

On parts 3mm and over in thickness, the minimum size of a root pass shall be such as to prevent cracking.

The maximum size of fillet welds which may be used in one pass shall be:-

a) 9mm in the flat position

b) 8mm in the horizontal or overhead positions

c) 12mm in the vertical position

In welding in the vertical position the progression for all passes shall be upward.

22.0 WELDING (Cont'd)

22.8 Groove Welds

Groove welds shall be terminated at the ends of a joint using extensions bars or run-off plates to ensure sound welds. Such bars or plates shall be removal after the welds have cooled.

Groove welds made with the use of backing shall have the metal thoroughly fused with the backing.

The ends of the welds shall be ground smooth and flush with edges of the abutting parts.

22.9 Multiple-Pass Welds

Before welding over previously deposited metal all 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.

Groove welds made without the use of backing shall have the roof of the initial weld gouged, chipped or otherwise removed to solid metal before welding is started from the second side.

22.10 Control of Distortion and Shrinkage Stresses

In assembling and joining parts of a structure or of built-up members and in welding reinforcing parts to members, the procedure and sequence shall be such as will minimize distortion and shrinkage.

In so far as practicable, all welds shall be deposited, in a sequence that will balance the applied heat of welding while the welding progresses.

Welding of members shall progress from relatively fixed points towards where parts have greater relative freedom of movement. Closing welds shall be made in compression elements only.

The Contractor shall develop welding procedures which in conjunction with the overall fabrication methods will produce members and structures meeting the quality requirements of these specifications. These procedures and any revisions necessary in the course of the work shall be submitted to the Engineer for his information and comment.

Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage and with as little restraint as possible.

All shop splices in each component part of a coverplated beam or buit-up members shall be made before such component part is welded to other component parts of the member.

22.0 WELDING (Cont'd)

22.10 Control of Distortion and Shrinkage Stresses (cont'd)

All welding shall be carried out continuously to completion or to a point that will ensure freedom from cracking before the joint is allowed to cool below the minimum specified preheat and interpass temperature.

21.11 Dimensional Tolerances

The dimensions of welded structural members shall be within the following special tolerances:-

Deviation from straightness of welded members where there is no specified camber or sweep:-

3mm x No. of metres of total length/but not over 9mm.

Deviation from specified camber of welded members:-

0.8mm x No. of metres of total length or = 6mm, whichever is greater

Out of flatness of sets or bases:-

To be sent on grout : - 3mm max.

22.12 Weld Profiles

The faces of fillet welds may be slightly convex, flat or slightly concave. Except at outside corners the convexity shall not exceed the value 2.55 + 1mm, where is the actual size of the fillet weld in mm.

Groove welds shall be made with a slight or minimum reinforcement, except as may be otherwise provided. Reinforcement, shall not exceed 3mm in height and shall have a gradual transition to the plane of the base metal surface.

Surfaces of butt joints required to be flushed shall be finished so as not to reduce the thickness of the thinner base metal or weld metal by more than 0.7mm or 5% of the thickness, whichever is the smaller, or leave reinforcement that exceeds 0.7mm. All reinforcement shall be removed where the mild forms part of a contact surface. All reinforcement shall blend smoothly into the plate surfaces with transition area free from edge weld undercuts. Chipping may be used provided it is followed by grinding.

22.13 Ends Returns

Fillet welds terminating at the ends of sides of parts or members shall be returned continuously around the corners for a distance of not less than twice the size of the weld.

22.0 WELDING (Cont'd)

22.14 Quality of Welds

Welds shall be uniform and of the specified sizes throughout their entire lengths. They shall fuse thoroughly with the base metal and with successive layers of weld metal, and shall be free from incomplete penetration, slag inclusions, under-cutting, burn throughts, voids, cracks, porosity and other defects except as permitted hereunder in the specifications.

All craters shall be filled to the full cross section of the welds.

Undercut shall not be more than 0.2mm deep.

Welds shall be free from overlap.

The sum of diameters of piping porosity shall not exceed 9mm in any linear 25mm of weld and shall not exceed 19mm in any 300mm length of weld.

Regardless of the methods of testing, welds shall have not cracks and shall be rejected if they have porosity of fusion type defects when:-

a) Individual defects, having a greater dimensions of 2.5mm or greater if:-

   i. The greatest dimensions of the defects is larger than 2/3 of the effective throat thickness or weld size of 19mm.

   ii. The defect is closer than three times its greatest dimensions to the ends of groove weld subject to primary tensile strees.

   iii. A group of such defects in a line when

      - the sum of the greatest dimensions of all such defects is larger than the effective joint thickness or weld size in any length of six times the effective throat thickness or weld size. When the length of the weld being examined is less than six times the effective throat thickness or weld size, the permissible sum of the greatest dimensions shall be proportionally less than the effective throat thickness or weld size.

b) Individual defects having a greatest dimensions of less than 2.5mm if the sum of their greater dimensions exceeds 9mm in any linear 2.5mm of weld.

22.15 Testing of Welds

The Contractor shall supply the materials for and carry out dye-penetrant less on such welds as the Engineer may require, using the standard methods set out in ASTM Specification E165, for compliance with this Specification.

22.0 WELDING (Cont'd)

22.15 Testing of Welds (cont'd)

In addition the Contractor shall carry out ultrasonic and/or radiographic tests on butt/groove welds as laid down in Section 6, Parts II and III of the American Welding Society Structural Welding Code (1972), if required by the Engineer.

The cost of such ultrasonic or radiographic tests shall be borne by the Contractor where the tests indicate non-compliance with this Specification.

22.16 Corrections

A piece or member containing welding which is unsatisfactory or which indicates interior workmanship shall be rejected or corrected by measures listed hereunder at the sole discretion of the Engineer.

Defective or unsound welds or base metal shall be corrected as directed either by removing and replacing the entire weld, or as follows:-

a) Overlap or excessive convexity: reduce by removal of excess weld metal by grinding.

b) Excessive concavity of weld or crater, undersize welds, undercutting: clean and deposit additional weld metal to its full cross section.

c) Excessive weld porosity, excessive slag inclusions, incomplete fusion: remove defective portions and reweld.

The removal of weld metal or portions of the base metal may be done by machining, grinding, chipping, oxygen gouging, or air carbon-arc gouging and in such a manner that the remaining weld metal or base metal is not nicked or undercut. Defective portions of the weld shall be removed without substantial removal of the base metal.

Additional weld metal to compensate for deficiency in size shall be deposited using an electrodes smaller than that such for making the original weld and in any case not more than 4mm in diameter. The surfaces shall be cleaned thoroughly before welding.

Where work performed subsequent to the making of a deficient weld has rendered the weld inaccessible has caused new condition which would make the correction of the deficiency dangerous or ineffectual, the original conditions shall be restored by removing welds of members or both before making the corrections, or else the deficiency shall be compensated for and by additional work done according to an approved revised design.

Welds shall not caulked.

22.0 WELDING (Cont'd)

22.16 Corrections (cont'd)

Improperly fitted parts shall be cut apart and rewelded as directed. Members distorted by welding shall be straightened by mechanical means or by application of a limited amount of localised heat in the presence of the Engineer site representative.

The temperature of heated areas as measured by approved methods shall not exceed 1200ºF (a dull red colour). Parts to be heated for straightening shall be substantially free of stress and from external forces except those stresses resulting from mechanical means used in conjunction with the application of heat.

Prior approval shall be obtained for repairs to the base metals, major or delayed cracks, or for a redesign to compensate for deficiencies.

The Engineer shall be advised prior to cutting apart improperly fitted and welded members.

22.17 Peening

Intermediate weld layers must be peened using a round-nose tool and light blows from a power hammer after the weld has cooled to a temperature warm to the hand, for the control of shrinkage stresses in thick welds to prevent cracking.

No peening shall be done on the root or surface layer of the weld or in the base material at the edges of the weld. Care shall be taken to prevent overlapping, scaling, flaking or cracking of the weld or base material from over-peening.

22.18 Removal of Slag

After the welds have been completed, all slag shall be removed. The metal shall not be painted or otherwise treated externally until the joints have been completed, inspected and accepted by the Engineer or his site representative. Before paint or other external treatment is applied, spatter, rust, loose scale, oil and dirt shall be removed.

23.0 QUALIFICATION OF WELDERS

23.1 Test Welds

In making the tests to quality for fillet welds, test plates shall be welded in the positions outlined below:-

23.0 QUALIFICATION OF WELDERS (Cont'd)

23.1 Test Welds

a) Horizontal position – the test plates shall be so placed that each fillet weld is deposited on the upper side of the horizontal surface and against the vertical surface.

b) Vertical position – the test plates shall be placed that each fillet weld is deposited vertically.

23.2 Joint Types

The joints to be tested shall be T-shaped, form of 2 nos. 200mm x 100mm x 12mm plates 200mm fillet weld on one side only, to stop and re-start near centre of 200mm length. Two test welds shall be made for each position to be used in construction. For each type of test weld, one shall be made with the maximum size single-pass fillet weld and one with minimum size multiples fillet weld that will be used in construction.

23.4 Base Metal and Electrodes

The base metal and electrodes shall comply with the welding specification.

23.5 Welding Procedure

The welding procedure shall comply in all respects with the welding specifications.

A sealing run on the reverse side of welds is not permitted.

23.6 Test Specimens - Number, Type and Preparation

One break test specimen 150mm shall be cut by machining from each joint.

After welding, reinforcement shall be removed flush with base metal, by machinery of grinding.

23.7 Testing Specimens

Before grinding down for mechanical testing, the weld shall be examined by the Engineer's representative for the following:-

a) Shape of Profile – the profile of the weld shall be uniform, slightly convex and free from overlap at the toes of the weld. The amount of reinforcement shall not exceed 3mm.

23.0 QUALIFICATION OF WELDERS (Cont'd)

23.7 Testing Specimens (cont'd)

b) Uniformity of Surface – the weld face shall be uniform in appearance throughout its length.

c) Degree of Undercut – the welded joint shall be free from undercut.

d) Smoothness of joints where welding is recommended – the joints in the weld run where welding has recommended shall be as smooth as practicable and shall show no pronounced hump or cracker in the weld surface.

e) Freedom from surface defects – the surface of the weld shall be free from porosity, cavities and trapped slag.

After cutting out the specimen by machining, one of the cut surfaces of the test speciment shall be prepared and attached in accordance with Appendix C BS 2645 Part 1 (1965) and visually examined for the following:-

a) Degree of fusion – complete side fusion between the weld metal and the bevelled edges of the plates shall have been obtained.

b) Degree of root penetration – there shall be no penetration into the root face.

23.8 Root and Side Band Specimens

Each specimen shall be bent through 180 angle around a jig of 40mm diameter. Root bend and fillet welded soundness specimens shall be placed with the root of the weld directed inwards. Side bend specimens shall be placed with that side showing the greater defects if any onwards.

The convex surface of the specimen shall be examined for the appearance of cracks or other open defects. Any specimen in which a crack or other open defect is present after the bending exceeding 3mm measured in any didrection shall be considered as having failed. Cracks occuring on the corners of the specimen during testing shall not be considered.

The fracture shall have a clean appearance and two weld metal free from oxide slag inclusions and oxide films.

23.9 Fillet-Weld-Break Test

The entire length of the fillet weld shall be examined visually and the 150mm long specimen shall be loaded in such a way that the root of the weld is in tension. The load shall be steadily increased until the specimen fractures or bends flat upon itself.

The specimen shall pass the test if it bends flat upon itself. If the fillet weld fractures, the fractured surface shall show complete penetration into the root of the joint and shall exhibit no incomplete fusion to the base metal or

23.0 QUALIFICATION OF WELDERS (Cont'd)

any inclusion or porosity larger than 2.4mm in greatest dimension. The sum of the greatest dimensions of all inclusions and porosity shall not exceed 10mm in the 150mm specimen.

23.10 Additional Tests

In addition to plate tests, tests on tube/plate assemble shall be carried out by the Contractor to the Engineer's instructions.

Radiographic ultrasonic and penetrant dye tests shall be applicable to the test welds, as required by the Engineer. The cost of such testing shall be deemed to be included in the rates.

23.11 Records

Full records shall be kept of each test, and of the type and size of electrodes used and shall be submitted to Engineer within 24 hours of each test.

L. EXTERNAL WORKS

1.0 GENERALLY

1.1 The external works stipulated under this section refer to the Infrastructure Work and Services outside of the Buildings and within the project boundary. They exclude electrical and water reticulation works; telephone ducting and fire protection services.

2.0 EARTHWORKS

2.1 The Contractor is to note that earthworks has been carried out by others, in forming ready platform levels.

2.2 During the execution of works, the Contractor shall take utmost care to ensure that the ready platform levels are not damaged. The Contractor shall reinstate or make good to the Engineer."s satisfaction at the Contractor"s expense if the platform levels are damaged.

2.3 The Contractor is to maintain all such existing prepared platform levels and surfaces, together with any embankments, slopes and road levels and he shall reinstate or make good at his expense by filling with earth or hardcore as directed any such works for the preservation of the earth embankments and slopes.

3.0 TURFING

3.1 Clean Up Site

Remove and cart away from site to be turfed all brickbats, stones, concrete waste, tins and such like rubbish.

Grub up all tree roots, rake up weeds, collect all timber waste and stack all and burn or remove from site to leave all areas clean and ready for turfing.

3.2 Ground Preparation

All irregularities and hollows on existing ground shall be levelled and slightly sloped where directed for drainage purpose. The whole area shall be ploughed and raked to a depth of about 102mm (4") and all buried rubbish and obstacles thus brought up shall be removed from site. All lumps of soil shall be broken down and reduced to a granular size. All lumps of hard substances (shale, etc) shall be removed.

3.3 Top Soil and Fertiliser

The Contractor shall supply approved quality top soil and sludge. The top soil shall be mixed thoroughly and spread and level to a 51mm (2") thickness to all areas to be turfed. Prior to turfing, spread throw evenly rock phosphate fertiliser to established brand at the rate of 0.05 kg/mm2 (0.25 ib/yd2) to top soil and rake in.

3.0 TURFING (Cont'd)

3.4 Grass Variety

Turves to be used shall consist basically of "KAMPAU" grass and shall be free from weeds and other tall grass. Other ground-hugging variety of grass not exceeding 20% in the composition of each turf will be acceptable.

3.5 Turves

Turves supplied shall each be in size of approximately 305mm x 305mm (12" x 12") which together with attached soil shall be to a minimum thickness of 38mm (1.5"). Turves supplied shall be inspected and all weeds together with their roots complete shall be removed before the turves are used. All turves supplied sahll be properly stacked, covered from strong direct sunlight and copiously watered. All turves shall be laid as soon as possible.

3.6 Spot Turfing

Spot turfing to areas shown in the drawings. Turves shall be about 305mm x 305mm (12" x 12") in size and laid at 610mm (2") centres both ways.

3.7 Grid Turfing

Grid turfing shall be laid in triangles of 914mm (3") sides to the areas shown on the drawings.

3.8 Close Turfing

Close turfing to areas shown in the drawings with edges abutting and breaking joint one way.

3.9 Watering

All turfing shall be copiously watered and spray applied once daily and twice during dry period until the roots are firmly established. Therefore, water once in every 3-4 days depending on the weather.

3.10 Fertilizing

As soon as the turves have started to grow, sulphate of amonia of established shall be spread at the rate of 1 oz. per 3 square yards to all turfed areas, followed immediately by generous sprays of water.

3.11 Grass Cutting

Grass cutting shall only be carried out after about two months after planting and threrefore once every month.

3.0 TURFING(Cont'd)

3.11 Grass Cutting(cont"d)

Grass cutting shall be carried out by a diesel-operated lawn mover with cutting blades adjusted to not less than 25mm (1") above ground level. When moving on spot turfed areas, care shall be exercised to see that the growing roots or shoots are not cut or damaged. All cut off grasses shall be distributed and left on the turfed areas. Cut off grasses arising from subsequent month moving shall be lightly raked together and removed from site.

3.12 Rolling

Following each grass cutting, the turf shall be rolled over with a smooth roller not exceeding 182 kg (400 lbs) in weight.

3.13 Maintenance

The Contractor shall be responsible for tending the turves until the end of the Defects Liability Period. Any turves that dried up and failed to thrive shall be removed and replaced at no extra cost with similar new turves. Weed out regularly all wild grasses including their roots.

4.0 SURFACE WATER DRAINAGE

4.1 Refer to Section "DRAINLAYER" of this Specifications.

5.0 FOUL DRAINAGE

5.1 Refer to Section "DRAINLAYER" of this Specifications.

6.0 FLEXIBLE ROAD PAVEMENT

6.1 General

The Contractor is to note that the preparation of formation levels has been carried out by others.

The Contractor shall refer to the drawings for details on the Construction.

The finished surfaces of the roads shall have widths as shown on the Engineer."s drawings. All radil for curves and curve distance shall be as specified on the drawings.

6.0 FLEXIBLE ROAD PAVEMENT(Cont'd)

6.2 Blanket Course

a) Material

Blanket course material shall be coarse river sand, quarry waste or other approved granular materials, clean, free from silt, clay, dust and organic impurities and well graded from 6mm (0.25") down and shall be laid and compacted at a moisture content within the range 5 to 8 per cent at such other moisture content, as may be directed by the Engineer.

b) Tests

The Contractor shall carry out tests as directed by the Engineer to determine the proportion of organic impurities in samples of blanket course material. The sampling and tests shall comply with B.S. 882. Materials with a combined clay, silt and dust content of more than 10 per cent by weight and with organic impurities sufficient to make a standard solution of sodium hydroxide draker than the standard colour No. 3 in the graduated colour chart in B.S. 882 shall be rejected.

c) Spreading

The materials shall be laid in one layer and spread evenly to the full width of the formation by approved means.

d) Compaction

Compaction shall be by means of an 8-10 ton roller or by a vibratory tendem roller having a weight exceeding 3 ton until a state of compaction is achieved such that not more that one field dry density determination in 10 is less than the average dry density achieved during compaction trials with 10 passes of such a roller or vibratory roller.

e) Dry Bound Macadam Base Course

i. *General*

The base course shall consists of „crusher run" stone laid in one or more layers each not less than 76mm (3") or more than 152mm (6") in thickness after compaction so as to give the specified total compacted

thickness to the width, correct thickness to the width, correct line and levels as shown in the drawings.

ii. *Tests*

The Contractor shall, as and when directed by the S.O., take samples of base course materials for testing. The sampling and tests shall comply with B.S. 812 and ASTM tests for Sodium Sulphate.

6.0 FLEXIBLE ROAD PAVEMENT(Cont'd)

6.2 Blanket Course

iii. *Construction*

The coarse aggregate shall be laid by spreader box or other means approved by the Engineer to an even depth which, after compaction will produce a layer of not more than 127mm (5") thickness after two passes of 2,500 kg (2.5 ton) roller. The fine aggregate shall then be spread on it to a thickness of approximately 25mm (1") by a suitable spreading machine, to be approved by the Engineer and vibrated into the voids of the coarse aggregate by means of an approved vibrating plate compactor or other approved vibrating plant.

The operation of spreading and vibrating the fine aggregate shall be repeated as necessary until no more will penetrate into the layer of coarse aggregate and no hungry patches are visible on the surface. The layer shall then be broomed to remove the excess fine material and compacted with a 8 to 10 ton roller until movement of the surface ceases.

The whole operation shall be repeated as necessary to provide the full specified thickness of the base course. The finished surface shall be even, free from irregularities or loose material and true to cross section, line and level.

6.3 Bituminous Tack Coat

a) General

A bituminous tack coat shall be applied to the top of the completed crusher run base before the laying of the bituminous macadam binder course.

b) Materials

The bituminous materials for the tack coat shall be either rapid curing cut back given in B.S. 3690 or rapid breaking emulsion. Bitumen emulsion shall be of the anionic type unless the cationic type is explicitly required.

Anionic emulsified bitumen shall conform to the requirements for the appropriate grade in B.S. 434.

Cationic emulsified bitumen shall conform to the requirements for the appropriate grade given in B.S. 434 in respect of general properties.

The grade and use of either type of emulsion shall be in accordance with B.S. 2542.

6.0 FLEXIBLE ROAD PAVEMENT(Cont'd)

6.3 Bituminous Tack Coat

c) Preparation of Bitumen Tack Coat

The Contractor shall apply the tack coat on the completed portion of the granular base as soon as practical. However, he shall not apply the prime coat if the moisture content in the top 51mm (2") of the aggregate base course exceeds the higher of either:-

i. the average of the optimum moisture compaction as determined by the standard compaction test, and the absorption of the plus 4.5mm (0.19") sieve fraction, or

ii. two-third of the optimum moisture content as determined by the standard compaction test.

The surface shall be cleaned immediately prior to the application of the tack coat. The bituminous materials shall be applied by means of a distributor at the rates directed by the Engineer., but not to be less than 4.2 litres/m2 (0.8 gallons/yd2) and at the temperature within the range shown in Table 1 for the particular material being used.

TABLE 1 : SPRAYING TEMPERATURE FOR BITUMEN

CUT BACKS	GRADE		TEMPERATURE	
	Old Grade	New Grade (Approx.)	Deg. F	Deg. C
R.C.or M.C.	0	30	100-135	38-37
	1	70	135-160	57-71
	2	250	170-200	77-94
	3		190-220	84-104
	4	800	210-235	99-113
	5	3000	245-270	118-132
Emulsion			Ambient temperature or hotter as necessary and satisfactory penetration	

6.0 FLEXIBLE ROAD PAVEMENT(Cont'd)

6.4 Bituminous Macadam Binder and Wearing Course

a) Thickness

The bituminous binder course shall be 44mm (1.75") thick and the wearing course shall be 32mm (1.25") unless otherwise indicated on the drawings.

b) Coarse Aggregate

The coarse aggregate shall be natural aggregate substantially free from the material passing and 3mm (0.125") B.S. Sieve.

It shall be hard, clean, durable crushed rock of granite or of any other rock group as may be approved by the Engineer.

c) Fine Aggregate

i. The fine aggregate shall consists of crushed rock of clean sand, substantially all of which shall pass and 3mm (0.125") B.S. Sieve.

If sand is used the content of silt, loam and clay shall not exceed 3 per cent by weight of the fine aggregate, determined in accordance with B.S. 812, method A or B.

ii. If added filler is used in the bitumen macadam it shall consist of crushed rock, hydrated lime, Portland cement, or other material approved by the Engineer.

At least 75 per cent of it shall pass a No. 200 B.S. Sieve.

d) Binder

The binder shall be straight run bitumen, which shall have a penetration of 25°C between 80 and 100.

e) Composition of Mixtures

The composition of freshly mixed materials for the bitumen macadam shall comply on analysis with the following requirements:-

6.0 FLEXIBLE ROAD PAVEMENT(Cont'd)

Nominal Size Of Aggregate	Single Course 1.5" (38 mm)	Base Course 1.5" (38mm)	Wearing Course 1.5" (12 mm)
PassingB.S. Sieve	Percentage By Weight		
2 in (50 mm)	100	100	-
1½" (38 mm)	90 -100	90 – 100	-
1 in (25 mm)	50 – 85	50 – 80	-
¾ in (19 mm)	-	-	100
½ in (12 mm)	30 – 50	10 – 30	90 – 100
¼ in (6 mm)	20 – 30	-	20 – 40
1/8 in (3mm)	10 – 20	0 – 10	10 – 20
No. 52 (300 microns)	2 – 10	-	-
No. 200 (75 microns)	-	-	2 – 6
Binder content as round by analysis:			
Granite	3.5 – 4.3	3.0 – 3.8	4.0 – 5.0
Limestone	3.0 – 4.0	2.8 – 3.8	4.0 – 5.0

f) Mixing

The aggregate shall be surface dry and the aggregate and binder separately heated to the following temperatures before entering the mixer:-

Aggregate 150°F - 300°F

Binder 200°F - 325°F

It is particular important to avoid excessive heating of the binder and excessively high temperatures of the aggregates at the time of mixing, as these will adversely affect the quality of the resultant macadam.

The materials, including any added filler, shall be weighed or measured into a mechanical mixer and thoroughly mixed in such a manner that all particulars of the aggregate are completely and uniformly coated.

g) Transport

The bitumen macadam shall be transported from the manufacturing plant to the site of the work in clean vehicles and shall be protected against adverse weather conditions by means of tarpaulin. The use of dust, coated dust, oil or water on the interior of vehicles to facilitate discharge of the bitumen macadam is permissible, but the amount shall be kept to a minimum and any excess shall be removed by tipping or brushing.

6.0 FLEXIBLE ROAD PAVEMENT(Cont'd)

It is particularly important that bitumen macadam which is to be laid warm shall be protected to minimise loss of heat during transit so that all materials is delivered in a condition suitable for spreading and compacting.

h) Sampling and Testing

Sampling and testing of the aggregate and mixed materials carried out shall be in accordance with the following British Standards as appropriate:-

B.S. 812 „Method for the sampling and testing of mineral aggregates, sand and fillers"

B.S. 598 „Sampling and examination of bituminous mixtures for roads and buildings".

B.S. 3235 „Test methods for bitumen".

i) Laying of Bitumen Macadam

The bitumen macadam course shall be laid by machine in single course and the average compacted thickness of the course should be within the limits specified below:-

Compacted thickness for Binder Course: 38mm to 51mm (1.5" to 2")

Compacted thickness for Wearing Course: 38mm to 38mm (1.5" to 1.5")

The accuracy of finish in the longitudinal direction shall be determined by measuring the gap under a 3048mm (10") straight edge, placed in any position on the road surface parallel to the centre line, the gap at any place between the points at which the straight edge is in contact with the road should not exceed 13mm (0.5").

The transverse profile should conform to a similar standard of accuracy, using a correctly shaped template instead of a straight edge.

The bitumen macadam shall be laid by machine. Work shall not proceed under unsuitable weather conditions, etc. The machine shall be of a type preferable self-propelled and capable of laying bitumen macadam continuously so as to produce automatically an even, smooth and compact surface to the requied widths, thickness and cross-falls without segregation of the bitumen macadam.

A fully trained and experienced operator shall be in direct charge of the machine.

The bitumen macadam shall be supplied continuously to the machine. Material supplied to the machine shall be laid as soon as possible after delivery.

6.0 FLEXIBLE ROAD PAVEMENT(Cont'd)

The machine shall be used only when it is in a serviceable condition. Bituminous material remaining in the hoppers, conveying and spreading mechanisms, tempers and screeds, shall be cleaned off at the end of each working day. On no account shall cleaning solvent be allowed to come into contract with any road surfacing material. Accumulations of materials not of the specified quality shall not be deposited on the site. The machine shall be operated to avoid, as far as possible, dragging of the bitumen machine.

On carriageway narrow strips remaining alongside machine work shall be as far as possible, hand laid and rolled at the same time as the machine laid work and allowance should be made for extra compaction of hand laid strips.

Continuous inspection of the finished surfaces as it is laid shall be carried out and any defects immediately rectified before any rolling takes place.

j) Joints

Where a transverse construction joint is to be made, the materials shall be cut back to a vertical face of the full depth of the course being laid and painted with bitumen or bitumen emulsion before any new material is laid.

On longitudinal joints a complete bond of the two strips, after compaction should be ensured. If this is not possible, the edge shall be cut back and painted as above.

k) Laying Around Manhole Covers

When laying around manhole covers and similar fittings, those parts against which the bitumen, those parts against which the bitumen macadam is to a but should be cleaned and painted with bitumen or bitumen emulsion macadam shall be tamped so that after final compaction, the finished surface is level with or slightly prod of such fittings.

l) Compaction

As soon as rolling can be affected without causing undue displacement, the bitumen macadam shall be uniformly compacted by rolling. Compaction should be carried out with a roller or rollers of weight not less than 6,000 kg (6 tons) nor exceed 10,000 kg (10 tons) and the width of a roll shall not be less than 457mm (18"). The bitumen macadam working from the sides to the centre of the carriageway, overlapping on successive passes by at least one half of the width of the rear roll. The roller should be fitted with a quick reverse and smooth acting clutch.

Rollers should not be allowed to stand on newly laid bitumen macadam while there is a risk that the surface will be deformed thereby.

Traffic shall not be allowed to pass over the surface until the bitumen macadam has been compacted and is adequately set.

6.0 FLEXIBLE ROAD PAVEMENT(Cont'd)

6.5 Use of Surface by Constructional Plant

The movement and use of constructional plant over a finished pavement course shall be to the prior consent of the Engineer and in any case at the sole risk of the Contractor who shall be responsible for any making good of damaged surfaces. The passage of a plant shall be carefully considered in relation to the thickness of the pavement course to the traversed the speed of travel and the weight of the plant so that the progress of the works may not be hindered by an serious damaged to the pavement course. The wheel tracks of plant moving over the various pavement courses shall be kept free from deleterious materials such as mud, clay, etc.

6.6 Opening to Traffic

The pavement may be used as soon as compaction of the surface is completed or as when permitted by the Engineer.

6.7 Scarifying Existing Surface and Making Good

Where the new carriageway abuts on to the existing carriageway and the Engineer so directs the surface of the latter shall be scarified adjusted and reshaped to conform with existing and new cambers or cross-falls. Materials from the existing road shall be used or disposed of as directed by the Engineer.

7.0 CONCRETE ROAD PAVEMENT

7.1 General

The relevant items in Section "CONCRETE" of this Specification apply to this item.

7.2 The construction of the concrete slab has to be divided into bays by means of joints. The width of a bay should not exceed 4.5 metres as larger bay width can make construction operations more difficult and lead to inferior slabs. For unreinforced slabs the length of the bay must not exceed 6 metres.

7.3 The slab shall be constructed in long strips. Generally alternate strips are first constructed continuously the full length of the pavement or up a main movement joint or to an end-of-day construction joint. The strips may be divided into bays by means of induced transverse joints either formed in the plastic concrete, or more usually by sawing slots in the surface two or three days after concrete has hardened.

The slab then cracks at the weekend section to form the joint in the predetermined position. Infill strips shall be placed two or more days later when the adjacent concrete has hardened sufficiently to withstand the effects of the compacting beam. An edge strip 600mm to 1 metre wide should be

provided adjacent to walls to allow unhindered use of a compacting beam on a full-width strip.

8.0 CHAIN LINK FENCING AND GATES

8.1 Scope of Works

Scope construct and erect security fencing main entrance gate to an overall height as stated on the drawings and include and complete with all angle posts, gate posts, concrete foundations, angle bracings, etc. all as shown in the drawings.

8.2 Foundations

Foundations for the security fencing shall be unreinforced concrete 1:3:6 – 19mm (0.75" aggregates) with all top surface to finish flush with the ground level as shown and detailed on the drawings.

8.3 Fence Post

Each fence post shall be 64mm x 64mm x 15mm (2.5" x 2.5" x 0.62") thick mild steel angle to the length as stated on the drawings and cast 457mm (1.6") deep into concrete footing.

Fence post shall be spaced at 3,048mm (10") centres or less as at corners and awkward length of fence.

8.4 Bracings

Bracing for gate and fence posts shall be 64mm x 64mm x 15mm (2.5" x 2.5" x 0.62") thick mild steel angle with the length as shown and detailed on the drawings inclined and cast 610mm (2") deep into concrete 1:3:6 – 19mm (0.75") aggregates footing set with an approved distance away from footing of fence post. The top end is to be splayed out and welded to post.

Fencing shall be braced on both sides at all corners and at every 24,384mm (80") along straight length.

8.5 Mild Steel Plates

To al corner steel angle fence posts and also to all other fence post at every 24,384mm (80") along straight lengths of fence, provide 25mm x 3mm (1" x 0.125") thick mild steel flats each of lengths as indicated on the drawings. The steel flats are used to sandwich and retain chain link mesh to steel angle posts and fixed with 7.5mm (0.31") diameter galvanised seam bolts at 610mm (2") centres including all drilling for holes.

8.6 Chain Link Mesh and Straining Wire

Fencing materials shall be 51mm x 51mm (2" x 2") x 10 gauge galvanised chain link mesh. The mesh shall be executed 51mm (2") above ground level and shall be threaded through with 3 lines of 8 gauge galvanised wires. The

8.0 CHAIN LINK FENCING AND GATES (Cont'd)

chain link mesh are fixed with steel seam bolts steel flats or by threading the 8 gauge galvanised wire through galvanised steel pins. The pin shall be small thick steel strip inserted through predrilled holes of fence posts and with both ends bent up.

8.7 Turn Buckle

Provide turn buckles at position as directed by the Engineer for tensioning and tightening up all galvanised straining wires where necessary.

8.8 Gates

Supply and install main entrance gates as detailed on the drawings. The gate installed is to leave 76mm (3") gap above the ground.

Each leaf of the gate shall consist of 76mm x 38mm (3" x 1.5") mild steel hollow section as stiles, top and bottom rails. The top shall be cranked up same as the fencing.

Provide gate handle, drop bolt cum socket and locking bar all as detailed on the drawings.

8.9 Painting

Prior to painting the Contractor shall ensure all surfaces of the fencing including the posts, flats, struts, etc. shall be thoroughly cleaned down and all dirt and grease removed. Surfaces shall then be lightly rubbed down with steel wool, wire brush or abrasive paper and cleaned down.

Apply one coat of zinc chromate primer and two coats of aluminium paint to all surfaces of fence.

Material and workmanship of painting to mild steel gates and posts shall be as described in "PAINTER" Section of this Specification.

M. PLUMBING AND SANITARY SERVICES PIPEWORKS, VALVES AND FITTINGS

1.0 GENERAL

1.1 The exact location of pipe runs shall be ascertained on site by the Contractor in collaboration with other services. Pipes shall run straight and true aligned and graded as required for positive flow.

1.2 Pipework, valves and fittings shall be new, clean and undamaged by corrosion or physical force. Old or damaged materials shall be rejected whether installed or other wise. Any delay of work due to such rejection of materials shall be the responsibility of the Contractor.

1.3 Diameters given are the clear internal diameters of the pipe.

2.0 INSTALLATION

2.1 All pipework, valves and fittings shall be cleaned just prior to installation. All exposed ends shall be adequately sealed against ingress of dirt, etc.

2.2 Cutting of pipework shall be carried out with pipe cutters and thread tapping shall be carried out with dies. Improperly threaded pipework installed with excessive compound shall be rejected.

2.3 Straight pipe runs shall be in continuous lengths as far as practical with the number of joints kept to the absolute minimum. On all changes of direction, easy sweep bends, long elbows or tee fittings shall be used. Short elbows may only be used where physical problems warrants it.

2.4 A minimum clearance of 51mm (2") between pipework a nearest obstruction shall be maintained, unless otherwise approved.

2.5 For Cold Water Pipework below 51mm (2"0 diameter joints may be by means of screwed type union. For pipework 51mm (2") diameter and above, joints shall be made by means of flanges. All screwed joints shall be sealed with Teflon sealing compound. Hemp or similar organic substances shall not be used.

2.6 All pipework running along walls below ceiling, along floors or exposed ceiling slabs shall be concealed.

Exposed pipework could be allowed in all plant rooms, above false ceilings, behind false walls or paneling with the approved of the Engineer.

2.7 Welding of galvanised steel pipework are generally not permitted. Where welding on galvanised pipework is deemed absolutely necessary prior permission must be obtained from the Engineer. The types of welded joints and welding procedures shall be carried out in accordance with the accepted welding trade practices. Welders fail to meet the required standards, they shall be replaced.

2.8 All bends and junctions shall be provided with a cleaning eye secured air tight by means of a washer and bolted cover for proper inspection and cleaning of the entire length of pipe.

2.9 Anchor blocks shall be provided at every bend branch and dead end in buried pipework to resist hydraulic thrust. The depth of cover measured from the top of buried pipework to the finished surface of the ground should be not less than 762mm (2'6").

2.10 The installation of soil, waste and vent pipes method of jointing and fixing shall comply in all respects to the manufacturer's sitework instructions.

Expansion joints shall be provided at a maximum of 3,658mm (12') centres for soil 1,829mm (6') centres for waste and between fixed points over 914mm (3') centres.

The method of joining to be employed shall be that of solvent welding using the manufacturer's where necessary to accommodate thermal movement or the sockets of standard fittings shall be converted to seal ring joints by the addition of a seal ring adopter.

The grade of UPVC used for the soil pipes shall have a minimum softening point of 82°C and for waste pipes 94°C when tested by British Standards.

The grade of UPVC used for the soil fittings shall have a minimum softening point of 79°C and for waste fittings 80°C when tested by British Standards.

The pipes and fittings shall be colour gray or white.

The rubber seals for seal rings shall be of a section that gives more than one point of contact with the pipe.

Waste boss connections when fitted to pipes shall consist of 2 parts with inner and outer flange solvent welded as a complete unit with in-built gradients for the waste pipes of 32mm (1.25"). Where it is not possible to fain access to the bore of the soil pipe self locking bosses with integral clamping action maybe used provided that the mating surfaces are suitable for an used with solvent weld cement.

Holder bats for UPVC shall have a 2 position fixing suitable for either acting as a pipe support but allowing thermal movement or as a clamp fit on a fitting creating a fixed point.

Access shall be provided where necessary either by means of an integrally moulded door in an access secured with 2 galvanised bolts and nuts or alternatively by a two piece clamp door fitted into the pipe run.

3.0 PIPE SUPPORT AND HANGERS

3.1 Pipe supports and hanger shall be of galvanised mild steel and finished with black enamel paint. They shall be adjustable in height.

3.2 The maximum spacing of pipe supports and hangers and the minimum diameter of the hanger rods shall be as follows:-

Pipe Sizes		Horizontal Run		Vertical Run		Rod Sizes	
Mm	ins	m	ft.	m	ft.	mm	ins
13	0.5	1.8	6	2.4	8	6	0.25
19	0.75	2.4	8	3.0	10	6	0.25
25	1.0	2.4	8	3.0	10	9	0.375
32	1.25	2.7	9	3.0	10	9	0.375
38	1.5	3.0	10	3.6	12	9	0.375
51	2.0	3.0	10	3.6	12	9	0.375
64	2.5	3.6	12	4.6	15	15	0.63
76	3.0	3.6	12	4.6	15	15	0.63
102	4.0	4.0	13	4.6	15	15	0.63
152	6.0	4.6	15	5.5	18	19	0.75

3.3 Where hanger rods are over 457mm (18") in length lateral bracing every fourth hanger shall be provided.

3.4 All bends before connection to any equipment shall be suitably anchored.

3.5 All supports, guides, brackets, etc. shall be adequately fastened to the structure by means of concrete inserts or expansion type devices. The use of explosive anchoring devices is specifically prohibited unless permission is obtained from the Engineer.

3.6 No steel cast iron or galvanised metal shall be permitted in direct contact with copper lines. All such supports shall be provided with adequate insulation to prevent electrolysis.

4.0 FLEXIBLE CONNECTOR

4.1 The flexible connector shall be of wire and fabric with high pressure moulded rubber construction. The flanges shall be an integral part of the isolator which shall be an integral part of the isolator which shall be clamped in place using split steel flanges.

4.2 For pipes of 32mm (1.25") diameter and below a length of hose of similar construction may be used in lieu of the above described. The hose shall be sealed with mastic and fixed with suitable circular clips.

5.0 VALVES

5.1 All gate valves, strainers and check valves up to 51mm (2") diameter shall be bronze body types with screwed connection. All gate valves, strainers and check valves above 51mm (2") diameter shall be cast iron body types with flanged connection.

5.2 The nominal bore of any valve shall not be less than the bore of the pipe to which it is fitted unless otherwise stated.

5.3 Check valves shall be of the non-slam type and shall have flaps of light construction. The valves shall be fitted with stops to prevent under movement of the flap and shall be as silent as possible in operation. The valve shall be constructed so that minimum resistance is offered to gravity flow.

6.0 COLD WATER SERVICES

6.1 Pipework above ground shall be medium grade galvanised mild steel complying with B.S. 1387.

6.2 Pipework buried in ground shall be C.I. Class 'C' type.

6.3 Other pipework shall be as indicated in the accompanying drawings.

7.0 SANITARY SERVICES

7.1 Soil, anti-syphonage and ventilation pipeworks and fittings shall be Unplasticized Polyvinyl Chloride (UPVC) complying with B.S. 4514.

7.2 Waste pipework and fittings shall be Unplasticized Polyvinyl Chloride (UPVC) complying with B.S. 5255.

7.3 Buried underground anti-syphonage, ventilation, soil and waste pipework and fittings shall be heavy grade cast iron complying to B.S. 416.

7.4 Sewer pipework and fittings shall be heavy grade Glazed Vitrified Clay (VC) complying with B.S. 65.

8.0 WATER METER

8.1 The water meter shall be of size diameter 75mm and be of approved make. The meter shall be acceptable to the relevant government authorities.

8.2 Reducers shall be selected according to the size of the incoming pipe.

9.0 SANITARY FITTINGS

9.1 All fittings to be of Sime Inax Products or equivalent, approval by the Engineer.

N. IRONMONGERY

Unless otherwise shown in the Drawings, the Contractor shall supply and fix all ironmongery as listed.

1. SINGLE LEAF DOORS

a) 3 Nos. of 100 mm x 69 mm galvanized steel butt hinges with nylon ring.

b) 1 No. upright 3 lever mortice lockset with satin chrome lever handle furniture of approved manufacture with 2 Nos. chrome plated keys of different serial number for each building.

c) 1 No. rubber door stop.

2. DOUBLE LEAF DOORS

a) 6 Nos. of 100 mm x 69 mm galvanized steel butt hinges with nylon ring.

b) 1 No. upright 3 lever rebated mortice lockset with satin chrome lever handle furniture of approved manufacture with 2 Nos. chrome plated keys of different serial number for each building.

c) 1 No. 150 mm anodized aluminium barrel bolt.

d) 1 No. 250 mm ditto

e) 2 Nos. rubber door stops.

3. INTERNAL DOORS OF TOILET

a) 3 Nos. 100 mm x 69 mm anodized aluminium butt hinges.

b) Mortice bathroom lockset complete with locking device operated by turn from inside and lever handle furniture in satin chrome finish (for residential quarters only)

c) 1 No. indicating bolt (for non-residential buildings only e.g. Officer's Mess, Clinic, etc.)

d) Anodized aluminium hook with rubber buffer.

4. SINGLE LEAF FIRE RATED DOORS

a) 3 Nos. of 125 mm x 69 mm heavy duty stainless steel but hinges.

b) 1 No. upright 3 lever mortice lockset with satin chrome lever handle furniture of approved manufacture with 2 Nos. chrome plated keys of different serial number for each building.

c) 1 No. rubber door stop.

5. DOUBLE LEAF FIRE RATED DOORS

a) 6 Nos. of 100 mm x 69 mm heavy duty stainless steel butt hinges.

b) 1 No. upright 3 lever rebated mortice lockset with satin chrome lever handle furniture of approved manufacture with 2 Nos. chrome plated keys of different serial number for each building.

c) 1 No. 150 mm stainless steel barrel bolt.

d) 1 No. 200 mm ditto

e) 2 Nos. rubber door stops.

6. SINGLE LEAF FIRE ESCAPE DOORS

a) 3 Nos. of 100 mm x 69 mm heavy duty stainless steel butt hinges.

b) 1 Complete set of approved make panic bolts.

7. DOUBLE LEAF FIRE ESCAPE DOORS

a) 6 Nos. of 100 mm x 69 mm heavy duty stainless steel butt hinges.

b) 1 Complete set of approved make panic bolts.

8. KITCHEN CABINET DOORS/WORKBENCH

a) Galvanized steel continous 'piano' but hinges.

b) 1 No. 100 mm aluminium 'D' handle

c) 1 No. bales catch.

d) 1 No. galvanized steel cupboard lock in satin chrome finish.

9. WARDROBES

a) 3 Nos. of 75 mm brass butt hinges.

b) 2 Nos. 100 mm anodized aluminium barrel bolt (for double leaf doors)

c) 1 No. 100 mm aluminium 'D' handle.

d) Chromium plated steel clothes hanger rail.

e) Steel Cylinder cupboard lock in satin chrome finish.

10. DRAWER

a) 1 No. steel cylinder drawer lock in satin chrome finish.

b) 1 No. 100 mm aluminium 'D' handle.

11. SLIDING AND FOLDING DOOR PARTITIONS

a) Top or bottom running set sliding and folding door gear complete with tracks, channels, brackets, roller guides, hangers and all necessary butt hinges, flush bolts and flush door pulls, etc. as recommended by the manufacturers.

b) 1 No. upright 3 lever rebated mortice lockset for sliding and folding door with satin chrome lever handle furniture with 2 Nos. keys of different serial number for each building.

12. STRAIGHT SLIDING DOOR

a) Top or bottom running set straight sliding door gear complete with tracks, brackets, hangers, roller guides, channels, door stops, flush brass bolts, brass flush pulls, etc. as recommended by the manufacturers.

b) 1 No. upright 3 lever mortice lockset with satin chrome finish for straight sliding door with 2 Nos. keys of different serial number for each building.

13. TIMBER CSEMENT WINDOW

a) 2 Nos. 400 mm long approved electro-galvanized steel friction hinges.

b) 1 No. approved brass with satin chrome finish combination handle and fastener.

14. TOP HUNG CASEMENT TIMBER WINDOW

a) 2 Nos. 750 mm long approved electro-galvanized steel friction hinges.

b) 1 No. approved brass with satin chrome finish automatic locking fastener.

15. TOP HUNG VENT/SASHES

a) 2 Nos. 400 mm long approved electro-galvanized steel friction hinges.

b) 1 No. approved brass with satin chrome finish automatic locking fastener.

O. SANITARY FITTINGS

Unless otherwise shown in the Drawings, the Contractor shall supply and fix all sanitary fittings as listed.

1. WASH BASINS

a) 530 mm x 410 mm wash basin in white Vitreous China completed with chromium plated tap, blank tap hole stopper, 30 mm „p" or „s" trap with 40 mm seal, waste fitting, plug with chain and painted bracket support.

b) Ditto but with two chromium plated tap, marked "hot" and "cold" (for cold and hot water supply only)

2. SINK

a) 600 mm x 400 mm x 200 mm Earthenware plain edge sink shall be in white fireclay, complete with chromium plated tap 40 mm „p" or „s" trap, with 40 mm seal, waste fittings, plug with chain and cast iron brackets.

b) Metal sinks shall be in stainless steel to size and shape as shown in drawings. It shall be complete with chromium plated tap as required, 40 mm „p" or „s" trap with 40 mm seal, waste fittings, plug with chain and painted cast iron support.

3. WATER CLOSET

a) Pedestal closet shall be in white Vitreous China complete with pedestal pan with „p" or „s" trap and ventilation outlet, plastic hinged seat and rubber buffers.

b) Squatting closet shall be in white Vitreous China complete with pair of raised foot threads in white fireclay with „p" or „s" trap and 40 mm diameter galvanized iron flush-pipe.

4. CISTERN

a) 12 litre low level Vitreous China cistern with flush pipe, 12 mm diameter ball valve, 20 mm diameter overflow and chromium plated flushing lever.

b) 12 litre high level Vitreous China cistern with 12 mm diameter ball valve, 20 mm diameter overflow and galvanized chain and pull and brackets.

5. URINALS

a) Single urinal bowl in white Vitreous China complete with back inlets, hangers and steadying brackets, 40 mm outlet with hinged gratings, 50 mm painted cast iron waste pipe, 5 litres automatic flushing cistern in white fireclay and chromium plated flushing inlet pipe.

b) Urinal Range of 2 bowls as (a) but with white fireclay division between bowls and 1 No. 10 litres (two gallons) automatic flushing cistern in white fireclay and chromium plated flushing inlet pipe.

c) Urinal Range of 3 bowls as (b) but with 1 No. 15 litres (three gallons) automatic flushing cistern.

P. PILING WORKS

1.0 GENERALLY

The Contractor shall install piles where shown on the drawings or as directed by the Engineer.

2.0 APPROVAL OF PROPOSALS

Before any piles are installed, the Contractor shall submit to the Engineer for approval, a description accompanied by drawings and programme, of the methods he proposed to adopt for handling and driving piles, giving full particulars of all plant and equipment to be employed. Notwithstanding any approval of the Contractor's proposals by the Engineer the Contractor shall be and remain solely responsible for the successful installation of the piles.

3.0 WORKMANSHIP

Workmanship shall generally comply with the recommendations of the Civil Engineering Code of Practice 2004 (1972) 'Foundations', unless otherwise specified.

4.0 LABOUR

The Contractor shall maintain at the site a specially qualified foreman together with all the necessary gangs of trained labour experienced in the installation of piles.

5.0 PLANT

The Contractor shall provide all plant, appliances and temporary works required for boring, handling, pitching and driving and if required extraction of piles.

6.0 TOLERANCE

Any piles that deviates more than 75mm its correct position or more than 25mm in 3000mm out of the correct alignment will be liable to rejection. In the event that the pile is accepted at the discretion of the Engineer, all costs incurred in modifying the supported structure as a result of the inaccuracy in piling shall be borne by the Contractor.

7.0 SITE SURFACE

The Contractor is to allow for any special surfacing he may require for piling rigs. For the purpose of this tender, piling may be assumed to take place from the levels shown on the engineer's drawings. He shall maintain the ground in working condition with whatsoever means necessary to ensure the smooth operation if the whole work. All the works in this clause shall be allowed for in the installation of the piles.

8.0 ADDITIONAL PILES

If any piles is rejected either due to its incorrect position, poor workmanship or materials or due to any other cause, it shall be competent for the Engineer to order an additional or of necessary, two additional piles to be installed and incorporated in the pile cap re-designed to the approval of the S.O.

9.0 PAYMENT

If, at the direction of the Engineer the Contractor installs an additional pile or if necessary two additional pile the Contractor will not be paid for the rejected pile but he will be paid for one additional pile. The Contractor shall himself bear the costs of the second pile if two are ordered plus the additional cost of the pile cap over the amount for the designed pile cap allowed under the contract, and plus also all costs involved in amendments necessary to the supported structure as a result of the altered positions of the special design of the pile cap.

10.0 PILE PLACEMENT

Piles shall be placed accurately in the positions and the appropriate lines and levels. No pile which has deflected from its course or has wrongly aligned shall be forcibly brought back to correct alignment.

11.0 SETTING OUT

The Contractor shall have a licensed Surveyor set out positions and levels of each pile on accordance with the relevant pile layout drawings, from some given baselines with datum levels on the site agreed by the Engineer and shall be responsible for the accuracy of the setting out. The Contractor shall take care to preserve the setting out reference pegs and should any pegs be lost or the re-setting out by a licensed Surveyor.

12.0 CUT-OFF LEVEL

The cut-off level of the pile shall be 75mm above the pile cap base level as shown on the pile cap detail drawings.

13.0 PILE LENGTHS

For tender purposes, a basic pile length of an average anticipated penetration is assumed. This basic pile length is based in information obtained from site investigation and represents the dept to hard formation.

The Contractor is not to base his order for materials on the Bills of Quantities and he will not be reimbursed for materials delivered to site in excess of the total requirement on completion.

Specification On Precast-Reinforced Concrete Piles

1. Generally

Reinforced concrete piles shall be precast and shall conform exactly to the dimensions shown on the drawings. Main reinforcing bars shall be supplied in one complete length; should this prove impracticable, separate length; should this prove impracticable, separate lengths shall be effectively butt welded as specified. Spacer forks where used shall be of cast iron, mild steel or other materials type and shape approved by the Engineer.

2. Pile Shoe

Pile shoes shall consist of chill-hardened cast iron points and mild steel dowel bars cast into the points and be in accordance with the drawings.

3. Concrete Mix

The aggregates, cement and concrete mix to be used in casting the piles are to be as specified in Concretor.

4. Casting

The concreting of each pile shall be completed in one continuous operation and no interruption will be permitted. Lifting holes shall be formed during casting. In the event of any cracks, spalled edes or other defects arising the pile or concerned will be liable to rejection, in which vent, the Contractor shall at once break up the pile or piles and replace it or them at this own cost.

5. Curing, Stripping and Stacking

Piles made with ordinary Portland Cement shall be kept damp for a period of fourteen (14) days after casting. Side formworks may be stripped four (4) days and bottom boards twelve (12) days after casting, provided the piles are kept supported on level blocks spaced at no more than 600mm centres. After twenty-one (21) days, piles may be lifted and removed to a suitable stacking area but they may not be driven until they are at least four (4) weeks old. Each pile shall be clearly marked with a serial number and the date if casting and all stacks shall be arranged to facilities the removal of piles for driving in their correct order of edge. For piles made with Rapid-hardening Cement, the above period shall be modified as directed by the Engineer.

6. Pitching and Driving

Vertical pile shall be pitched accurately in the position and driven to the appropriate lines and levels shown on the drawings, piles may be suitable constrained to maintain their correct position by means of guys or guides but no pile which has been deflected from its course or has been wrongly aligned shall be forcibly brought back to correct alignment.

Where piles are driven below the level of the bottom of the leads of the pile frame, extension leads shall be fitted, the use of a follower will not be permitted except with written approval of the Engineer.

During driving, the heads of the piles shall be protected by a helmet if cast steel or mild steel fittings closely around the pile, a packing if coiled hemp or asbestos fibre 25mm thick covering the head if the pile shall be contained within the helmet and separate the helmet from the head if the pile. The top of the helmet shall be recessed and fitted with a timber stud dolly 300mm long.

The packing and stud dolly shall be renewed as often as necessary to prevent damage to the piles. The type of helmet specified above may be modified at the discretion of the Engineer.

Driving of each pile shall continue until the set is 10 blows per inch or such other set as the Engineer may require.

The Contractor shall supply to the Engineer in duplicate a complete record of all pile driving, giving the serial number and position if each pile, its dimension, dates if manufacture and driving and the depth to which it has been driven and the set for the last 10 blows.

Immediately after a pile has been completely driven, a record shall be made of the reduced level of the pile head and further checks shall be made on the level of the head after the driving of adjacent.

6. Pitching and Driving (cont'd)

Should any oil heave upwards, it shall be re-driven to its original level or, if necessary, until its specified set is again obtained.

All the provision of the above clause shall apply equally to the driving of raking piles with the additional provision that the rake of the pikes shall also confirm accurately to that shown on the drawings. Raking piles shall be driven by means of a properly constructed raking type of file frame.

7. Plant for Pile Driving

The plant used for pile driving shall be of such type and capacity as meets the approval of the Engineer the hammer to be used in driving shall be a drop hammer. The weight of this shall not to be less than 2½ tons with a which fall of 4'0".

8. Modification to Piling

As a result of measurement if the driving resistance or load bearing capacity of piles drive on the site, the Engineer may order the lengths of piles to be modified either by lengthening in the casting yard before driving or by increasing the length of pile initially cast.

9. Lengthening of Piles

Where piles have to be lengthened as directed by the Engineer, a splice joint shall be performed by fixing a 25mm mild steel flush fixing plate (male component) at the foot of the extension pile to a 25mm mild steel fixing plate (female component) at the top end of the pile or extension pile and welding with 70 degrees (minimum) but weld around the perimeter of the two plates and grouting in the tube of the female component with quick setting mortar (1:3), all to the details as shown in the drawings.

10. Stripping of Pile Heads

After the piles have been driven to the required set or level and to the satisfaction of the Engineer, the pile shall be cut-off generally at the levels shown on the drawings or as directed by the engineer and stripped of concrete for a length of 900mm and the concrete trimmed off square. All debris and cut-off section of piles shall be removed from the site at the Contractor's cost.

11. Piles Out of Alignment

During driving, guys may be used to assist in positioning the pile but no pile which has deviated more than 50mm out of position shall be forcibly constrained in an effort to rectify this. This Engineer may order the extraction and re-driving of any pile which has deviated more than the above amount from its correct position or which has, in the opinion of the Engineer., been driven at an angle too greatly diverging from the correct alignment. Alternatively, should circumstances require, the sub-structure over the piles shall be constructed to a modified design which takes account of the variation in the pile position or alignment.

The cost of such extraction and re-driving or any extra cost in a modified foundation shall be borne by the Contractor if, in the opinion of the Engineer, such extra work has been occasioned by the Engineer, such extra work has been occasioned by the negligence of the Contractor in the driving of the piles.

12. Records

The Contractor shall provide the Superintending Officer with four (4) copies of the records for each pile. These records shall be sent to the Superintending Officer in accordance with:-

a. Contract

b. Pile reference number (location)

c. Dimension of cross-section and type of pile.

d. Length

e. Date and time of driving

f. Type, weight and drop of hammer or equivalent information if other types of equipment are used.

g. Set in mm per 10 blows or number of lows to produce a penetration of 1".

h. If required by the Superintending Officer, the sets taken at intervals during the last 10' of driving.

i. Top level of pile

j. If required by the Superintending Officer, temporary compression if ground and pile from the time that there is a marked increase in driving resistance until the pile reached its final level.

k. Information on the number and type of packings used and type and condition of dolly during the driving of the pile.

l. Other relevant information regarding obstruction. Delays and other matters about which the Superintending Officer may require to be informed.

Records of piles shall be made and submitted in the order in which the piles has been driven.

PILE TESTING

1. Generally

The contractor shall carry out such pile test on preliminary test piles or any works piles as the Engineer may direct. Testing is allowed only on vertical piles. Instruction to test any works piles may be issued within fourteen (14) days after its installation in position. The Contractor shall allow in his rates for any delay which may arise in carrying out such tests.

2. Test Piles

Before installation of piles as a whole commences, the Contractor will be directed to install one or more test piles at position to be determined by the Engineer.

He shall install these piles as soon as practicable to the depth and set as directed. Loading if a test pile shall not commence until seven (7) days have elapsed after completion of its installation.

2. Test Piles(cont'd)

In the event of the first pile test proving to be unsatisfactory, the Contractor shall carry out a second test either on the first test pile after re-driving or on a second test pile as directed by the Superintending Officer.

3. Engineer's Instructions to Commence Piling

The Contractor shall not install any works piles other than the test pile which are to be subsequently incorporated in the works until he has received instructions from the Engineer on the required penetration or set or other criteria for determining the pile depth.
Such instructions will be given not later than seven (7) days after complete results of the successful pile test have been submitted to the Engineer. The contractor shall allow in his rates for piling for such delay.

4. Equipment

The Contractor shall provide and bring to site in due time fir the timely commencement of the preliminary pile test, all plant, equipment, staging, achorage, kentleedge, jacks and measuring devices to the approval of the Engineer for the application of test load by jacking against kentledge.

5. Calibration

The load measuring devices shall be capable of measuring directly to 1 ton load. The apparatus shall be calibrated at an approved laboratory immediately before use and two (2) copies of the calibration curves shall be lodged with the Engineer's representative before commencement of any pile test.

6. Dial Gauge

Settlement of the pile head shall be measured by means of at least three (3) dial gauges reading to 0.001"" firmly attached to rigid supports established at points clear off the area of influences of the test pile.

7. Bracing of Test Piles

The Contractor shall provide such bracing as necessary to the test piles to safely carry the test loads.

8. Application of Test Load

The test shall be carried out by the equal load increment method up to a test load equal to twice the working load, each increment of load being 12½ % of the test load. Settlement readings shall be taken immediately before and after each increment of load and thereafter at intervals of two, four, eight, fifteen and thirty minutes and subsequently at hourly intervals. No additional load shall be applied until average dial gauge readings do not vary by more than 0.005" in an hour.

9. Application of Test Load

When the load has reached the specified value of test load as stated in the drawings, it shall be maintained for a period of twenty-four (24) hours or such longer period as the Engineer may decide. Taking of settlement reading at hourly intervals shall be continued within the period.

The test load shall be released in stages to seventy-five, fifty, twenty-five and ten percent of its value and then removed. Settlement readings shall be carried out at intervals not less than one (1) hour and until recovery is less than 0.005 inch/gour. The final recovery twenty- four (24) hours after complete release of the load shall be measure.

10. Supervision

The Contractor shall provide an experienced supervisor to be present full-time during the duration of the pile tests to ensure that the loading sequences and method of taking settlement readings are strictly followed and that the true load is maintained at all times. Pile tests shall be carried out only in the presence of the Engineer or his representatives.

11. Abandoment of Pile Tests

Should any test have to be discontinued due to :-

a. Faulty jack or gauge

b. Instability of kentledge

c. Improper setting of datum

d. Unstable bench-marks or scales, and

e. Pre-jacking or pre-loading before commencement of the test, the Contractor shall entirely at his own expense carry out further test to the Engineer's instructions. The cost of the abandoned test shall be borne by the Contractor.

12. Pile Test Record

Within forty-eight (48) hours of completion of any pile test, the Contractor shall submit to the Engineer's representative two (2) copies of complete records of time, loads, settlement and any other relevant information together with graphs of load against time and settlement against time.

The time within which the Superintending Officer is required to issue instructions for the remaining works piles shall not commence until the requirement of this clause have been satisfied.

13. Preliminary Test Piles

The Contractor shall carry out one (1) preliminary pile test prior to installation of the working piles to confirm the setting criteria.

14. Preliminary Test Piles

The Engineer's interpretation and conclusions and arrived at on the test results shall be finals. When the piles tests have been carried out in accordance with the Engineer's instructions, the piles so tested shall be deemed to have failed if:-

a. The residual settlement after removal of the test load exceeds 0.25 inch.

b. The total settlement under Design Load exceeds 0.540".

c. The total settlement under Twice and Design Load exceeds 1.50 inches.

Should the preliminary test fail, the Contractor shall conduct the test again on another pile entirely at his own cost and this shall be repeated until a setting criteria is obtained that confirms the design requirement.

15. Working Pile Test

The Contractor shall carry out loading tests on two (2) working piles to be selected by the Engineer during the currency of the contract in accordance with the Engineer's instructions.

If any of the loading tests fail to meet the standards specified above, further additional tests shall be conducted by the Contractor at his own cost. For each loading test on a working pile that fails, the Contractor shall conduct two additional loading tests at his own cost. Additional testing may not be necessary if the Contractor agrees to carry out remedial work in completed piling and to revise subsequent piling to the satisfaction of the Engineer.

Also, the Contractor is to carry out such remedial work as will be directed by the Engineer. On the basis of such tests, the Engineer will direct that the defective pile shall be placed as required to provide a symmetrical cluster of piles which shall be jointed together by means of an approved pile cap. All additional cost including that for the enlarged pile caps shall be borne by the Contractor.

Q STANDARD WIRING SPECIFICATIONS FOR OFFICE ABD AMENITIES BUILDINGS

1.0 DISTRIBUTION BOARDS

1.1 The Contractor shall supply and install distribution boards.

1.2 The distribution boards shall be of the totally enclosed dust-proof, 16 gauge sheet metal, front connected type, and shall be fitted with removable stainless steel or non-ferrous type gland plates to facilities fixing of approved type cable gland for the cable entry.

1.3 The distribution boards and all other equipment shall be so arrange on the frameworks that they will present a flush appearance. All interconnecting cables shall be run in trunkings. The Contractor shall submit drawings for the arrangements of all electrical services for approval prior to installation.

1.4 Isolators and switchfuses used as main switches for the boards shall be the totally enclosed type and shall comply with the requirements further described.

1.5 All distribution boards shall have an isolators switchfuses or fuseswitch as an integrated unit.

1.6 The fuses shall be connected on the line side by means of high conductivity hard-drawn copper busbars or PVC insulated panel cables. Sufficient busbars or panels cable and studs shall be provided to accommodate future fuses.

1.7 Miscellaneous distribution board wiring shall be carried out using identification. Neutral bars and earth shall be of brass and of square or rectangular cross-section and shall be provided with adequate number of terminals, cable lugs and bolts.

1.8 The distribution boards shall be constructed in accordance with the current Electricity Supply Authority regulations and relevant British Standard specification and busbars shall be painted and marked to comply with standard codes and practice.

1.9 Each item of equipment shall be clearly labelled with engraved black perspex labels with white vertical lettering and a schedule of circuits is to be mounted on the back of the board covers. Each installation boards shall be painted with a primer and two coats of semi-glass gray or other approved colour.

1.10 All installation boards must be treated with a suitable player of anti-rust paint before applying the primer paint.

1.11 The Contractor shall submit drawings on samples of distribution boards for approval prior to installation.

1.12 The floor openings in the electrical ducts shall be covered with steel plates or other approved materials after the installation of electrical services by the Contractor.

2.0 FUSE SWITCHGEAR

2.1 Switch fuses, fuse-switches and isolators shall be of totally enclosed, metalclad, double air break and quick action type.

2.2 They shall comply fully with B.S. 3189 and shall have a breaking capacity of not less than 31 MVA at 380V at 50 Hertz certified by ASTA or other recognised testing authority.

2.3 The metal box shall be made of best quality mild steel of not less than 14 gauge. They shall be so arranged that the front face of the board the only permissible projection being an operating handle, which, however, shall preferably be of a type which, retract into the units when not in use. Each pole of the switch shall be double break.

2.4 An "ON-OFF" indicator shall be provided preferably operated directly by the moving contact assembly. Quick break action type shall be provided and the unit so arranged as to be accessible from the front of the panel for inspection and maintenance with the provision that the box cannot be opened while the switch closed and switch cannot be closed with the box open. Padlocking facilities shall also be provided.

3.0 FUSES

3.1 Fuses when specified for use in main current carrying circuits shall be of the cartridge type certified by ASTA or other recognised testing authority.

3.2 Fuses shall be of high rupturing capacity and shall comply with B.S. 88 with fuse- links marked to indicate a Class P or Class Q fusing factor.

3.3 Fuse units of rating 100 amps or less shall be of the air insulated back connecting black moulded type consisting of a base and separate fuse carrier. Fuse units with rating above 100 amps shall consists of fixed panel contacts (back connecting) with protecting shrouds and a separate fuse carrier the latter arranged with a clamping device operated from the front of the carrier to provide high contact pressure. Fuse units used shall be equivalent standard to English Electric make.

4.0 SWITCHES COVER PLATES AND BOXES

4.1 Generally all switches for lighting circuits shall be flush mounting rocker-operated type of not less than 5A rating of MK or MEM range.

4.2 All other make/brand can only be considered and production type approved by local authority.

4.3 In machine and plant rooms and the like, lighting switches shall be flush or surface mounted, metal-clad with insulated rocker and shall be similar to MK or MEM range or other approved make and shall be not less than 5A rating.

4.4 On roofs and in areas exposed to weather, switches shall be of weatherproof type.

4.5 Approved galvanised steel boxes similar to the MK Grid-Switch System shall be used for flush mounting type switches.

4.6 Coverplates for flush mounted switches shall be metal-clad with insulated rockers to suit similar to the MK Grid Switch System. Adjacent switches shall be mounted under one cover plate and all switch boxes to suit the various number of switches at any one point.

4.7 Generally switches for lighting shall be grouped and mounted at a height of 1.4m above finished floor level. However, due consideration must be given to heights of dadoes, tiling, painting, etc. and switches must not be placed across the junction of different finished or on demountable partitions.

4.8 The Contractor shall check the exact position of all switches with the Engineer and confirm the arrangement of all door swings and other fixtures with the Contractor before installing drops and switches.

4.9 Samples of all switches shall be submitted to the Engineer for approval prior to installation.

5.0 SWITCH SOCKET OUTLETS

5.1 Generally switch socket outlets shall be of 13 amp. Capacity and unless otherwise indicated shall consist of an ivory moulded 3 flat pin flush plug socket and 13A SP switch with ivory rocker mounted in a steel wall box with stainless steel overlapping coverplate similar to the MK or MEM range.

5.2 Power outlets shall generally by mounted 305mm above finished floor level or as directed on site by the Engineer, but where benches or desks are installed power outlets over these units shall be mounted 152mm above bench top. The Contractor to ascertain the placing of such benches.

5.3 Where power outlets occur in hazardous locations such outlets shall be 12amp. capacity "sparkles" interlocked mercury switch socket outlets mounted 1.5m F.F.L. as shown in the drawings.

5.4 Switch power outlets in plant and machine rooms shall be metal clad protected types. These outlets shall be flush types where practicable, otherwise surface mounted.

5.5 Switch sockets outlets of 15 amp. capacity shall be similar to MK or MEM range with stainless steel bevel edge cover plates.

5.6 Cooker outlets shall be similar to 30A MK double pole flush type with 15A socket contained in mild steel boxes and with stainless steel cover plates c/w pilot light.

5.7 Switch socket outlets connected to Essential Power Supply shall be provided with a red plastic button for identification.

6.0 CABLE TRAYS

6.1 Cable trays where required shall be of the perforated type and constructed of not less than 16 gauge galvanised mild steel supported at maximum 1.22m intervals by mild steel hangers fixed to walls, floors or ceiling in an approved manner.

6.2 The hangers shall be painted with a primer and two coats of semi-gloss grey or other approved colour.

7.0 STEEL TRUNKING

7.1 Trunking and connectors shall comply with B.S. 4678 Part 1. The nominal thickness of material for fittings shall accord with that specified for the associated trunking but shall be not less than 16 gauge.

7.2 Trunking systems mounted within a building shall have protection against corrosion according with Class 2.

7.3 Trunking systems mounted outside a building or run in floor trenches subject to continual dampness or accidental flooding shall have protection against corrosion according to Class 3. The whole of the trunking system shall be designed to be weatherproof and as such all fixings shall be external to the trunking or fittings.

7.4 Metal partitions in trunking and fittings shall be provided as indicated or as directed by the Engineer or as required by the I.E.E. Regulations. They shall be of the same

material and finish as those of the trunking and shall be of thickness 0.5mm less than that of the trunking with a minimum of 1mm.

7.5 Trunking shall be run neatly on the surface of the building(s) and truly vertical, horizontal or parallel with the features of the building.

7.6 Trunking runs shall be determined by the Contractor and agreed by the Engineer before any work is started. Trunking shall be run at least 150mm clear of plumbing and mechanical services.

7.7 Manufacturer‟s standard fittings shall be used. Only where there are inadequate to meet special local situations will fabricated fittings be accepted.

7.8 Standard flanged couplings shall be used to terminate trunking at apparatus ad adaptable boxes and at points where it is desired to connect one section of trunking to another where a standard fitting is obviously unwarranted. The practice of cutting and bending the material of the trunking to form flange attachments will not be accepted.

7.9 Connections between trunking and apparatus shall be by a screwed couplet and bush or a standard flange coupling or an adaptor neck fabricated or cast. Direct attachment of trunking to apparatus will only be permitted if cable entries are provided with smooth bore bushes or grommets and the return edge of the lid of the trunking is left intack.

7.10 Where connection is made between trunking and a distribution board the cable from all used and „spare‟ ways. Holes in trunking shall be drilled punched or cut by ring saw.

7.11 Individual pieces of trunking shall be independently supported. On straight runs fixing shall be regular intervals not exceeding 1.8m or as otherwise shown in the drawings and fixing screws shall be steel. Where weatherproof trunking is used fixing screw shall be zinc plated (electro-galvanised) complying with B.S. 1706 Class B coatings.

7.12 Trunking systems erected outside a building shall be weatherproof.

7.13 The wiring capacity of trunking shall be determined from the standard tables issued by the manufacturer of the trunking.

8.0 CONDUITS AND FITTINGS

8.1 Conduits and fittings shall be manufactured in accordance with B.S.S. 31 shall be Class „B‟ and 19mm I.D minimum except where otherwise specified. They shall be neatly run and securely saddled in position with approved type of saddles.

8.2 Conduit shall be clean true and free from all obstructions. Ends shall be cut squarely and burrs shall be removed by taper reamer or other suitable means and painted with aluminium paint before being screwed into sockets, boxes, etc.

8.3 Screwed conduit buried in concrete shall have the threads and coated with an approved jointing compound during assembly, and joints treated with rust inhibiting paint after joint. Conduit and box shall be made watertight before concrete is complete with draw in wire or cables.

Long radius bends shall be used. Junction‟s boxes shall be used instead of tees to facilitate the drawings in of cables and the possible subsequent removal and replacement of any one cable without disturbing others and conduit shall be sized to run parallel to walls, floors and ceiling wherever possible.

Multiple conduit draw in boxes shall be used wherever a number of conduits to follow the same route. Approved metal wall; wooden or fibre plugs shall not be used for this purpose.

Where more than one conduit runs parallel on walls or ceiling, metal brackets with multi-way saddles fixed by means of metal threads shall be used. The metal brackets shall be fixed to the surface by means of metal threads shall be used.

The metal brackets shall be fixed to the surface by means described above or alternately by threaded "Ramset" studs spring washer and nuts. Ends of conduit at metal clad apparatus shall be securely screwed or clamped thereto, except that final connections to motors or other equipment subject to movement or vibration may be made with short lengths of flexible conduit incorporating approved and suitable sized gland.

8.4 All free ends of conduits shall be fitted with bushes. All conduits shall be concealed to the approval of the Engineer, except where specified hereunder that exposed conduit may be used.

8.5 Where conduits are run external to the buildings they shall be galvanised and painted with two coats of oil base paint one coat prior to and one coat after erection colour to match surroundings except where otherwise specified. Exposed conduits inside the building shall be painted with two coats of the colour approved by the local authority.

8.6 Conduits shall not be laid across expansion joints and where these occur in the run of a line of conduit, the conduit shall be brought below the expansion joint and a length of flexible PVC conduit installed sufficient to allow for a total movement of +10mm.

9.0 CABLES

9.1 PVC, PVC/PVC and MICC cables for sub-mains/rising mains, general power and lighting wiring shall be of 380/220 volt or 660 volt grade as applicable and shall be manufactured and tested to relevant British Standard Specifications.

9.2 Test Certificate issued by a recognised testing authority shall be submitted to the Engineer for approval prior to installation.

9.3 Cables shall be delivered to the site in unbroken coils with the original wrapping intact. All wires or cables in which kinks or abrasions occur will be condemned and shall be replaced by the Contractor at his expense.

9.4 All cables shall be of distinguishing colours, red yellow and blue as applicable for phase conductors; black for neutral and green for insulated earth conductor when insulation is required.

9.5 All saddles and clips shall be of brass or copper. Aluminium material in lieu of brass or copper will not be accepted. All ferrous saddles and clips shall not be used without the permission of the Engineer.

9.6 Where PVC insulated cables are specified, they shall be run in steel trunkings or conduits as indicated in the drawings.

9.7 No jointing of cables are allowed. Continuous run of cable shall be connected between switchboard and distribution boards or equipment.

9.8 Cables shall be colour coded for identification.

10. 0 CABLE TERMINATION

10.1 Every connection at a cable termination shall be made by means of a terminal, soldering sockets, or compression type socket shall secure and contain all other wires of the conductor and shall not impose any appreciable mechanical strain on the terminal or socket.

10.2 For soldering sockets, non-corrosive flux being used and be neatly finished with approved insulating material.

10.3 Cable glands shall securely retain the outer sheath or armour of the cables without damage to these and where necessary shall incorporate adequate means of maintaining earth continuity between the sheath or armour and the threaded fixing component of the gland.

10.4 All MICC terminations shall be of standard temperature type (105 degree) using seals and sleeves as recommended by the cable manufacturer. As each permanent seal is made it shall be “megger” tested and the Contractor shall

not terminated any cable until an infinity reading has been obtained with 500V meggar. If the test indicator moisture is present, the Contractor shall heat the cable with a lamp, starting 0.3m back from the cut end of the cable working to the cut.

10.5 This procedure shall be continued until an infinity reading is obtained. Each MICC cable shall be tested at the time of the installation and again one-week later to ensure no moisture has penetrated any seal.

10.6 Cable termination for Paper-Insulated cables is specified in details in separate section.

11. 0 WIRING METHODS

11.1 Generally cables are to be run in concealed conduits. Exposed conduits could be used in all plant rooms, above false ceiling, behind false walls and lift wells with the approval of the Engineer Wiring below ceiling level to all lighting switches shall be in concealed conduit.

11.2 Wiring to motors and equipment from the switchboard shall be either by MICC cable or PVC insulated cable run in screwed conduit with flexible PVC conduit length not greater than 0.3m connected to the terminal boxes of the motors from the isolators/starters.

11.3 MICC cable shall be looped in at least one 360 loop to provide flexibility adjacent to the motor terminal box.

11.4 MICC cable shall be saddled to perforated metal trays by means of approved copper saddles and rustproofs belts and dressed to a straight and true alignment.

11.5 Any cable which in the opinion of the Engineer is poorly run shall be removed from site and new cables provided.

11.6 The cable routes shown in the drawings shall be used as a guide only. Tenderisers shall check the wiring system and provide adequate size and length of cable tray trunkings and conduit to cover the whole areas.

11.7 Prior to installation the Contractor shall submit drawings showing the proposed trunking and cable layout with all necessary dimensions indicated to the Engineer for approval.

11.8 All trunking conduits and cable trays located in the false ceiling space and other areas shall be such as to provide ample space for maintenance purposes of the electrical installation, air-conditioning ductwork and all other services.

11.9 The Contractor shall ensure that the positioning of trunking and conduits in relation to other services are satisfactory for installation and maintenance of the various services.

11.10 The Contractor shall be held responsible for the relocation of any trunkings, cable trays or conduit which may not be easily accessible after all other services are installed. A copy of air-conditioning ductwork plans and pipe layout will be made available for inspection if necessary and upon request by the Contractor.

11.11 Cables shall be minimum of 1.5 sq.mm for lighting and 2.5 s1.mm for general power. Cable sizes for final sub-circuits shall be checked for voltage drop of every circuit prior to installation and larger cables shall be used without extra cost if required.

11.12 Where outdoor wiring points are shown installation shall be of weatherproof type.

11.13 The exact location and mounting height of lighting power and meter points shall be commensurate with the site condition subject to the approval of the Engineer.

12.0 CONTACTORS

12.1 Contactors or changeover contactors where required for controlling lighting or power circuits shall be of approved make and type. They shall be adequately rated to take full load current of the circuits or equipment, which they control.

12.2 The coils shall operated on 240V A.C. and shall incorporate provisions for remote control push buttons.

12.3 Each pole of the contactors shall be double break with quick make and break action. Contactors shall be of the best quality material and be easily changeable.

12.4 Auxiliary contacts shall be provided for indication and other purposes.

12.5 Contactors shall be securely mounted in a duct-proof metal enclosure as described earlier for “Distribution Boards”.

12.6 They shall comply with relevant British Standard Specifications and ASTA tests.

13.0 LIGHT FITTINGS

13.1 General

a) The Contractors shall supply, install and connect light fittings. All fittings shall be suitable for non-stop operation.

b) Tenders shall be based on nominated makes. However, alternative offer of fittings of equivalent standard or better will be considered.

c) A sample of each type of the lighting fittings proposed shall be submitted to the Engineer on request.

13.2 Fluorescent Fittings

Fluorescent lighting fittings supplied shall comply with the following requirements.

a) Standard

The fluorescent fittings together with the lamps, lamp holders, switches, fuses, chokes, starters, auxiliary and other necessary equipment shall conform to the latest British Specifications in all respect with regards to design, construction, performance and tests as minimum requirements.

b) Voltage Grade

All equipment shall be suitable for operating at 220 volts single phase, 50 Hertz supply system.

c) Metal Housings and Reflectors

The housing and reflectors shall be manufactured by approved lighting manufacturers.

The reflectors shall be one-piece construction made form best quality mild steel sheet.

The entire reflector shall be specially treated to prevent rust corrosion. One rust resisting primer super white paint shall be applied.

d) Plastic Reflectors and Diffusers

Where plastic reflectors or diffusers are specified they shall be made of the best quality plastic materials recommended for lighting service equivalent to the plain opal "Perspex" by I.C.I. or other acrylic materials.
They shall be of adequate thickness and strength to prevent sag under normal operating conditions and shall not be less than 3mm thick. The diffuser shall be of pin spot pattern unless otherwise specified.

e) Metal Louver

Where metal louvers are specified they shall be made of the best quality materials recommended for lighting services.

f) Auxiliary of Control Gear

i. Ballasts

All ballasts shall comply with B.S. 2818: Part 1 and suitable fluorescent lamps, which shall comply with B.S. 1853. All fittings must be approved by the local authorities.

Separate ballast shall be used for each lamp.

The ballasts shall ensure correct preheating conditions during starting together with minimum distortation of lamp current and waveform during operation in order to ensure long lamp life.

The ballasts shall maintain the exact power supplied to the lap, which shall give full lumen output.

The ballasts shall be noiseless in operation and the dimensions shall be kept to the minimum. The polyester resin between coil and sheet-steel connister shall be cooled rapidly in order to ensure low working temperature.

The ballasts shall be either switch or rapid start as shown in the Schedule of Lighting Fittings.

ii. Capacitors

All capacitors shall comply with B.S. 2818: Part 2 and suitable for operating in circuit with tubular fluorescent lamp, which comply with B.S. 1853.

iii. Starters

All starters complete with bases shall comply with B.S. 3772 and suitable for use with lamps, which comply with B.S. 1853.

g) Tubular Fluorescent Lamps

These shall be the energy saving type and shall be as per Schedule of Lighting Fittings complying with B.S. 1853.

h) Lamp Holders

The lamp holders shall be of robust and well designed construction suitable for mounting the specified lamps. They shall not only provide firm lamp support and good electrical contact but shall also be so designed that the lamps can be easily removed for maintenance.

The lamp holders shall be arranged such that one additional tube if required can be added at site with the minimum operation and without disturbing existing circuitry.

i) Accessories

Terminal blocks, nickel plated spring clips, plastic sleeves and other necessary accessories which are required for the proper construction and safety operating of lighting fittings shall be provided for all fittings.

j) Suspension

The Contractor shall supply and install the lighting fittings complete with all necessary suspension rods and fixtures to the Engineer"s satisfaction.

k) Lighting Trunking

Generally the trunking shall be in accordance with the description elsewhere in this Specification for "Steel Trunking" and shall be not less than 16 s.w.g. galvanised sheet-steel. The trunking shall in addition provide structural support for the fittings with adequate through wiring capacity.

The close-top trunking shall be suspended by saddle brackets attached to down-drops from the ceiling or roof structure as shown in the drawings. Joint pieces shall be used to hold sections rigidly in line.

Brackets shall be provided to engage with the batten flanges of the trunking and to allow the fittings to be hinged during installation, maintenance or subsequence modification of the through wiring blocks shall be provided for interconnection and looping in.

Cable carriers shall be provided in each trunking section to retain the cables neatly in position.

Where fittings are not continuously mounted the gaps shall be closed by black snap-on PVC cover strip.

The trunking suspension span shall be as shown in the drawings. The maximum permissible mid-span deflection shall be 6mm. Additional struts/stays shall be used to reduce the reflection.

13.3 Incandescent Fittings

Incandescent fittings shall be manufactured by approved lighting manufacturers. The design shall be such that no overheating due to inadequate ventilation will be encountered. The lamps shall be properly rated in order to avoid malfunctioning of the fittings.

a) Standard

The incandescent fittings together with the lamps, lamp holders, switches, fuses, auxiliary and other necessary equipment shall conform to the latest British Standard Specifications in all respects with regards to design, construction, performance and tests as a minimum requirements.

b) Lamp Holders

Unless otherwise specified all fittings shall be provided with standard BC lamp holders.

c) Unless otherwise specified all fittings shall be designed to accommodate General Lighting Service (pearl) lamps and shall be supplied complete with lamps.

d) Finish

All steel parts shall be suitably treated to prevent rust. Such treatment shall include “phosphating”, one coat of metal primer and 2 coats of enamel. All enamel paint used shall be suitable for the temperature likely to be experienced under normal conditions of continuous operation of the fittings.

e) The Contractor shall supply and necessary lampshades of approved make where necessary to the Engineer‟s satisfaction.

f) The Contractor shall supply the protective gauge for fittings where required of the approved make and to the Engineer.‟s satisfaction.

R. EXCAVATOR

1.0 GENERALLY

The Contractor shall carry out works in connection with excavating, filling and backfilling including removal from site of all surplus excavated materials and debris from abandoned services and demolished structures where encountered in strict accordance with the requirements of the Drawings and Specifications as stated therein.

2.0 SILT RETENTION

The Contractor shall take note that silt traps have been constructed on site under a previous contract. The Contractor shall deemed to have visited the site to ascertain the type, number and location of the silt traps. The Contractor shall allow in his Tender Sum for the cost of maintaining the silt traps during the Contract period.

3.0 FORMATION LEVELS

The Contractor shall excavate or as the case may be, fill with earth available from site to required levels, prior to actual construction work. Where earth required for filling to make up the required formation levels are not sufficient, then he must get the same from an approved tip or borrow pits (refer Item 13 of this section of Specification).

4 .0 EXCAVATIONS AND EXCAVATION BELOW REQUIRED DEPTHS

All excavations shall be completed square, level and plumb and shall be to such width as may be necessary to carry out the work safely and properly. The bottoms shall be consolidated and shall be to the exact levels required.

The Contractor is to give notice to the S.O. and to any relevant Authorities when the excavations are ready to receive concrete or filling. Concrete or filling shall not be laid until the excavation shave been approved and the depths noted. Give the S.O. at least 24 hours notice of when excavations will be ready for inspection.

Should any excavation be made without authority to greater depths than stated in the Schedule of Prices and/or shown on the Drawings or as instructed, then the Contractor is to fill in to the correct level with concrete (1:3:6-1½" aggregate) at his own expense.

However, in the case of over-excavating under foundations to be carried on piles, no such filling is to be done. The piles are to be driven from the actual excavated level, and the foundation itself is to be increased in depth for its full width and length in concrete of the class specified and additional reinforcement being provided as directed, and all executed to the satisfaction of the S.O. Such additional work due to over excavation shall be at the Contractor‟s expense.

5.0 EXCAVATION IN ROCK

Rates for excavations will include for excavating any materials (including laterite or shale) with the exception of rock which in the opinion of the S.O. requires the use of compressor drills, explosives or other special methods of removal (i.e. rock not

removable by “changkol”, spade, pick or by hand). Such excavations will be measured as „Extra Over“ ordinary excavations and the S.O. will be the sole judge in deciding what is to be defined as „rock“.

6.0 EXPLOSIVE AND BLASTING

Explosive shall be used in the quantities and manner recommended by the manufacturers. The written permission of the S.O. shall be obtained for each location or series of locations where the Contractors wishes to use more than 20 lbs. of explosives in one blast. Such permission shall not in any way relieve the Contractor of his liabilities in any misuse of explosive.

The Contractor shall store explosives in a licensed store or magazine with a separate compartment for detonators. Explosives shall be handled only be currently licensed snotfirers. The Contractor shall ensure that there is no unauthorised issue or improper use of explosives on the site.

Excavation in rock may be carried out by blasting only with the permission of the S.O. The Contractor shall take all precautions and conform to the requirements of local ordinance for the use of explosives. The Contractor shall ensure the adherence to proper safety distances and by the use of heavy blasting mats where necessary to prevent dispersal or property on/or adjacent to the site. Special precaution shall be taken when blasting in wet ground. Blasting will be such that no building or structure will be damaged due to the explosion.

7.0 SURPLUS MATERIALS

All excavated materials suitable for filling shall be kept in an approved location on the site. All surplus excavated materials or unsuitable soils shall be removed from the site to a tip to be provided by the Contractor at his own expense. Clay or earth containing vegetable matter will not be permitted as fill.

8.0 PLANKING AND STRUTTING

Provide all planking, strutting and shoring where necessary to the sides of all excavations or desirable at the opinion of the S.O. and carefully remove and clear away on completion. The Contractor is to be absolutely responsible for the safety of the excavations. Prior to commencing any excavation, the Contractor is to submit to the S.O., his proposals for supporting the sides and methods for excavation.

9.0 RECORDING OF EXCAVATION DEPTHS

A complete record of the depths of all excavations shall be kept by the Contractor and certified by the S.O. or his authorised representative and the record shall be made available for checking prior to any work being placed in the excavations. Any authorised variations between these records and the dimensions shown on the Drawings shall be adjusted accordingly. A true copy of these records shall be used for all vertifications.

10.0 FILLING AND BACKFILLING

All quantities of fillings are measured nett after consolidation i.e. by taking the nett dimensions of the area filled in accordance with the width, lines and levels shown on the Drawings.

No works shall be backfilled until inspected and approved by the S.O. The Contractor shall give notice when it is ready for inspection.

Return, fill and well ram selected excavated materials around foundations, etc., up to original ground level or as required.

Fill in selected excavated materials to make up levels under floors, pavings, terraces etc., as required.
Filling to carry structure, floors or pavings is to be carried out in layers not exceeding 225mm thick before consolidation, each layer well rammed and consolidated with the addition of water if required. Other filling is to be similarly carried out but in layers not exceeding 305mm (12") thick before consolidation.

All mud, rubbish, timbers and similar materials are to be removed before filling is carried out.

11.0 IMPORTED FILLING

Where excavated materials is insufficient for the earth filling required the Contractor is to obtain this from borrow pit, for which he is to obtain the necessary license and pay all fees.

12.0 WATER IN EXCAVATIONS

No water is to be allowed to accumulate in the excavations, be is storm or percolating, which are to be kept dry by pumping, baling or otherwise and are to be protected against flooding. During the period of excavation, the Contractor is to provide pumps of sufficient capacity to remove any water which may enter excavations and will maintain the water level below the level of concreting work at all times.

No claim will be considered for any special pumpings or baling required in connection with work below the water table level.

13.0 HARDCORE

Hardcore is to be approved hard, dry stone, concrete, brick or other materials broken to pass a 100mm ring (or smaller as required for thin beds) graded sufficiently for adequate consolidation and free from dust.

Bricks will be approved for use as hardcore only if the site is permanently dry or if the bricks are well burnt and not liable to decompose in damp conditions.

Hardcore is to be laid and consolidated as described for filling, and the surface is to be levelled or graded as required and blinded with sand or other approved fine material to receive concrete or other finishes.

14.0 REMOVE DEBRIS ETC.

Remove all debris, fallen earth or collected water from surface of all concreted pile caps and/or footings, lift wells, etc., and clean all steel starter bars including removing all rust.

15.0 PROTECTION OF EXISTING BENCHMARKS AND THER SURVEY MARKS

The Contractor shall ensure that existing benchmarks and any other survey marks located within the area are not disturbed or destroyed during the Works. Any existing benchmarks or survey marks distrubed or destroyed shall be reestablished to the satisfaction of the S.O., as soon as practicable by the Contractor at his own expense.

16.0 EXISTING FORMATION LEVELS

The major earthworks is currently been carried out by another Contractor and the Contractor is to allow in his Tender Sum after inspection of the site the additional work of cutting, filling, shaping, trimming and compacting at the site to not exceeding 150mm (6") deep to bring the level to the required building platform all to the satisfaction of the S.O.

6.2 - TECHNICAL SPECIFICATIONS (MECHANICAL)

1. GENERAL

1.1 Brand New Machinery

Tenderers shall submit on the basis of using all brand new equipment.

1.2 Foundations

i) All foundations, concrete floor, fittings, trenches with floor covers for pipes, cables, etc. will be provided by others unless otherwise specified.

ii) The Contractor shall submit details of machinery footings and loading diagram for equipment designed and supplied by him to enable the Engineer to design the necessary foundations.

iii) The Contractor shall be responsible for the accuracy of the details supplied by him and for ensuring that the positions, levels and dimensions of the works are correct. For this purpose, the foundation drawings after completion by the Engineer shall be sent to the Contractor for final checking of such positions, levels and dimensions that shall satisfy him as to the accuracy thereof, as no claim for extra payment on this account will be entertained. The Contractor is to level, adjust and grout all the plant and the holding down bolts onto the foundation.

iv) If sufficient information and the necessary drawings, data etc., are not delivered together with the Tender, alteration or additions to such foundations, walls, floor ducts, pipes and trenched etc., made during the course of the Contract will be made at the expense of the Contractor.

1.3 Vibration and Balance

All moving parts of machinery shall operate without undue noise or vibration. Rotating parts shall be balanced before and after erection and any apparent vibration rectified.

1.4 Protection of Parts

All bright metal parts are to be covered before shipment with Shell Ensis Grade 256 or a similar approved protective compound and protected adequately during shipment to Site. After erection these parts are to be cleaned with a correct solvent and polished bright where required.

1.5 Grouting of Base plate

The Contractor shall grout all machinery supplied by him and equipment supplied by the Employer and installed by him. The base-plate shall be firmly fixed and packed with steel plates before grouting. The non-shrink and self-flowing grout shall then be poured in to the bolt pockets and shall thereafter be rammed in under the base-plate until the space is completely packed.

1.6 Accuracy and Safety

i) It is the responsibility of the Contractor to ensure the accuracy and correct setting out of the steelworks and pipework and the detailing and fitting of all members. Any assistance given by the Engineer shall be not absolving the Contractor from this responsibility.

ii) The Contractor shall be responsible for the safety of the steelworks and pipework at all times and he shall supply and erect adequate ties, scaffolding, shoring or bracing as may be necessary to ensure the safety of the steelworks, machinery and pipework and of such persons as may have access to the site.

1.7 Quality of Work

The Engineer has the right to take all steps necessary that in his opinion (including the rejection and making of some or all of the steelworks and pipework) are required to ensure that all steelworks machinery and pipework is fabricated and erected in accordance with the specifications and drawings.

1.8 Quality of Steel

i) All structural steel and plates shall comply with BS 4360 or equivalent except that steel of better quality may be used subject to satisfactory proof of its original and approval by the Engineer as to its use.

ii) All steelworks shall be fabricated from new sections, true to shape and free from twist and warping.

1.9 Fabrication Requirements

i) All structural steelworks and platework shall be fabricated and assembled in accordance with BS 449 or equivalent. Welding shall comply with BS 5135 or equivalent.

ii) All holes are to be drilled and burning gear is not to be used for making new holes or enlarging existing holes.

iii) All holes shall be left free from burrs and sharp edges. All plates, bars, angles and other rolled sections shall be carefully levelled and straightened by pressure and not be hammering before and after they are drilled.

iv) Drift pins or podges shall not be used in such a way as to enlarge holes or distort the work.

v) The longitudinal and transverse edges of all plates and the ends of all bars, angles and other rolled sections shall be machined and all burrs satisfactorily removed before the work is joined together.

vi) Surfaces, which will be in permanent contact after assembling, shall be previously coated with metal protective primer.

vii) All fusion welded pressure vessels shall be constructed in accordance with BS 1500 or equivalent.

1.10 Design Requirements

All machinery supplied shall be built to prevent the ingress of all vermin, accidental contact with live or moving parts and to minimise the entry of dirt and other contaminants. The use of materials, which may suffer damage from the attack of termites or other insects, shall be avoided

1.11 Scaffolding

The Contractor is to provide all scaffolding, ladders, platforms with toe boards and handrails essential for proper access of workmen and inspectors, cover or rail off all dangerous openings or holes in floors and afford adequate protection against materials falling from a higher level on the personnel below.

1.12 Electric Motors

All electric motors fitted to machinery shall be of the totally enclosed fan cooled type (TEFC) squirrel cage (SC), IP 54 or higher, 415V, three phase and 50Hz unless otherwise stated.

All electric motors shall have a power factor of at least 0.8, and conform to B.S.S. 2613/1957.

1.13 Access of Personnel

The Contractor is to provide the scaffolding, ladders, platforms with the boards and handrails essential for proper access of workmen and inspectors and shall cover or rail off all dangerous openings or holes in floors and afford adequate protection against materials falling from a higher level onto personnel below.

1.14 Flushing and Lubrication

i) The Contract is to include the supply of flushing oil for each lubrication system when the item of plant is ready for preliminary running, and also the first filling of approved lubricants for the commercial operation of the Plant.

ii) A complete schedule of recommended oils and other lubricants required for all components of the Plant is to be furnished by the Contractor. The number of different types of lubricant is to be kept to a minimum. The schedule and the names of the local supplier(s) of the lubricant are to be submitted to the Engineer for approval in time for incorporation in the Operating and Maintenance instruction required under these Specifications.

iii) Where lubrication is effected by means of grease, preference will be given to a grease guns system. Where necessary for accessibility, the nipple is to be placed at the end of extension piping and when a number of such points can be grouped conveniently the nipples are to be brought by small bore piping of approved material to a battery plate mounted in a convenient position. Nipples in accordance with B.S. 1486 (Part 2) type numbers 21A and 21B or better with adapters or bushings if necessary or equivalent is preferably to be used for normal grease and temperature up to 121 C.

1.15 Fire Precautions

The Contractor shall make every effort to minimise the risk of fire and any damage, which may be caused by fire during the construction, assembly, and running of machinery.

1.16 Standard and Regulations

Unless another standard is specifically mentioned in these specifications, all materials and machinery used and provided under the Contract and all design calculations and tests, must be in accordance with Regulations issued by the Chief Inspector of Machinery Malaysia.

1.17 Rating Plates, Name Plates and Label

Each main and auxiliary item of Plant is to have permanently attached to it in a conspicuous position a plate of non-corrodible material upon which is to be engraved any identifying name, type or serial number, together with details of the loading conditions under which the item of Plant in question has been designed to operate, and such description plates as may be required by the Engineer. Each nameplate or label engraved in English shall be clearly legible. Size of letter or number shall not be less than 200mm height. Typical name plate is as follows:-

CONVEYOR NO.1

Direction of flow of medium in pipelines shall also be indicated by arrow as shown in the following example with size of the letter 100mm high:-

STEAM 

2. EQUIPMENT AND MACHINERY

Detailed specifications for equipment and machinery are as per **SPECIFICATION SHEETS**.

3. STRUCTURAL AND MACHINERY STEELWORK

3.1 Quality of Steel

i) All steel shall be in accordance with British Standard No. 15/1961 or other approved equivalent standard and shall be obtained from an approved manufacturer.

ii) All fabrication shall generally be in accordance with the latest B.S. 449 and shall be in accordance with the best modern practice and to the Engineer's approval.

iii) Ends of beams, channels, angles, and other parts abutting against or upon other parts shall be cut to exact lengths and true and square so as to provide a good bed or joint as the case may be.

iv) Both ends of each length of a column shall be properly prepared and perfectly square over the whole surface of the ends. Column joints shall be closed butted and caps, base plates and joint-sheeting plates shall be in effective contract over the whole of the column end.

v) Edge of gusset plates shall be flushed with the faces of the flange angles, except where shown otherwise on the drawings and stiffeners should fit closely against the flange.

vi) As much of the work of fabrication of all steelworks as is reasonably practicable shall be completed in the workshop where the steelworks is fabricated.

3.2 Joint

No joints shall be made in any plate, bar, angle or other rolled sections, except where shown on the Drawings.

3.3 Bending

When any plate, angle, etc. is bent, it must conform throughout with the surfaces to which it is to be fixed. Should any parts be bent, or cracked, over-heated, distorted in the process, they will be rejected and must be replaced with sound work.

3.4 Machining

All plates, bars, angles, or other rolled sections, shall be carefully levelled and straightened by pressure and not by hammering, before and after they are drilled. The edges of all plates and the ends of all bars, angles or other rolled sections shall be and all burrs satisfactorily removed before the work is connected.

3.5 Holding Down Bolts

i) Generally holding down bolts shall be cast into the foundations. They shall consist of a bolt inside a length of tube with a large washer plate at the base for anchorage. The pipe and the bolt shall be welded to the washer plate to ensure that the bolt remains rigidly fixed in the centre of the tube.

ii) The materials shall conform to B.S. 15 and the bolts shall be new materials with the thread out to the specified length. The bolts shall be held firmly and rigidly in position in the pour during concreting and care must be taken to ensure that no concrete flows down the space between the tube and the bolt. The threads shall be protected at all times until the bolt is tightened with a nut and washers.

3.6 Holes

All holes shall be accurately marked off from template or corresponding plates, and drilled. Holes should be cleaned of burrs, or rough edges and countersunk where required. No drifting shall be allowed. The diameter of all holes should not exceed the diameter of the bolt or rivet by more than 1.5 mm.

3.7 Bolts and Nuts

For steel work the bolts and nuts shall be of best quality with metric threads. Bolts and nuts to have hexagonal heads and round shanks unless otherwise specified, and furnished with spring washers of an outside diameter equal to two and a half times the diameter of the bolt. For flanges of joints and similar positions tapered washers should be used. Bolts should be of such length as to protrude neither less than 3 mm nor more than 12 mm beyond the nut when tightened up. All bolts are to be tightened 'dead tight'.

3.8 High Strength Friction Grip Bolts

All bolts for structural steel work are to be High Strength Friction Grip Bolts as specified in BS 3139 or BS 4395 for dimensions and BS 1983 or BS 1768 for material.

3.9 Welding

All surfaces to be welded shall be free of dirt and rust. All welding shall be in accordance with B.S. 1856:1952 General Requirements for the Metal-Arc Welding of Mild Steel. Only selected welders shall be employed on the site.

3.10 Erection of All Steelworks

i) When lifting and fitting steelworks into position care shall be taken that the parts thereof are not strained, twisted, bent or damaged in any manner whatsoever. Any parts that, in the opinion of the Engineer are badly damaged shall be replaced with new material at the expense of the Contractor.

ii) Proper suitable lifting appliances and blocking should be provided. The stacking of materials prior to erection or during erection in a manner or in such a position as may, in the opinion of the Engineer cause damage to the materials so stacked or to the permanent works so loaded will not be permitted.

iii) No cladding on thereof or sides of building which is to be supported by the structural steelworks shall be fixed, placed in positions or stacked on the structural steelworks until the relevant position of the latter including all bracing, sub-structural wind girders etc. has been erected, the stanchions levelled, plumbed and grouted in.

3.11 Inspection of Steelworks

i) The works must at all time be opened to the Engineer or his representative and any portion of the work not to his satisfaction shall be subjected to rejection and shall be replaced at the Contractor's own expense.

ii) The Engineer must be informed of the completion of the work in the shop so that an inspection may be carried out prior to undercoating and delivery to site.

3.12 Steel Flooring

Solid steel floor plating (chequered plate) shall be supplied for all platforms. Fixing shall be by countersunk steel screws. Holes of the correct taper being drilled in the plate during fabrication.

3.13 Hand railing and Standards

Handrailing and standards to be 40 mm nominal bore black steel pipe to B.S. 1387, Class `A' except for top rail shall be stainless steel decorative tube. Kicking plates of 100 mm minimum depth to be fitted all round open sided platforms. All the necessary fittings and fixings for the handrailing and kicking plates etc. to be provided.

3.14 Stairways

Stairways to be fitted with hand railing and standards as specified above. The steps shall be fabricated from 6mm thick mild steel chequered plate.

3.15 Vertical Steel Access Ladders (Not allowed unless otherwise stated)

i) These shall be fabricated from 6 mm inch diameter M.S. bars welded to M.S. strips 12 mm thick. The rungs shall be 300 mm wide at a spacing of 300 mm. The M.S. strips shall be extended above the topmost rung for a height of 900 mm to serve as handholds.

ii) Adequate ties complete with bolts nuts anchor plates etc. shall be providing for fixing to steel tanks or concrete structures rigidly. The base of the ladder shall be bolted to a concrete plinth 450 mm x 200 mm x 100 mm high.

iii) Safety loops shall be provided over the length of access ladders, more than 2.1 m above floor or ground level.

4. PIPE, PIPE FITTINGS AND INSULATION

4.1 Specifications

Pipes, fittings and valves shall be as per **LINE SPECIFICATIONS.**

4.2 Piping Installation

i) All pipes supplied shall be straight, concentric and of uniform thickness and diameter.

ii) Bolted flanged joints or screwed socket connection (for the case of galvanised pipes) shall be fitted for connections as necessary for easy cleaning and maintenance and at every 12 metres of straight pipe run.

iii) During erection suitable supports are to be provided to ensure no undue stresses are placed on piping, or adjoining equipment.

iv) Care shall be taken to avoid undue stress being placed on any vessel or equipment by unsupported lengths of piping.

v) Piping connected to equipment shall be supported so that minor equipment valves etc., can be removed without additional supports and with a minimum of dismantling.

vi) All branches from steam piping shall be taken off the top of the main.

vii) No welded connection for galvanised piping is allowed. All fittings shall be as per line specifications attached. In case welded connections are unavoidable, the welded portions shall be cold galvanised to protect against corrosion.

viii) Eccentric reducers shall be used on horizontal run of pipe to maintain the bottom of pipe level throughout.

ix) Steam pipes shall be provided with fixed and movable supports to allow for expansion and contraction.

x) At moving points the pipes shall be allowed to slide as shown in the relevant drawings.

xi) Expansion joints and steam traps shall be installed at appropriate positions in the piping systems. Steam traps should be installed at every 30 metres of straight pipe run.

xii) Steam traps assembly shall have one by-pass valve, two isolating valves, a sight glass and a strainer.

xiii) Union couplings for pipes less than 50mm diameter must be installed where necessary such that valves, bends, etc. can be easily removed.

xiv) Where piping must pass through walls, a short spool piece or length of pipe of the same bore, approximately flanged shall be built into the wall.

4.3 Supports

i) Pipe supports and stanchions shall be spaced not more than 3000mm on the straight run and at closer spacing if necessary. No pipes shall be allowed to sag. These shall be deemed to be included in the Contract Price.

ii) Major supports shall be fabricated and erected as shown on the drawings.

iii) Minor supports as found necessary by the Engineer during erection, shall be installed at his discretion. These shall be deemed to be included in the contract price.

iv) Supporting piping from vessels or equipment is not allowed unless specifically shown on the drawings, or approved by the Engineer.

4.4 Use of Copper or Copper Alloy

It should be noted that no copper or copper alloy is to be used where it may come into contact with the palm oil. Valves, fittings, instrumentation and pipes used in contact with palm oil should be of mild steel, cast iron, wrought iron or stainless steel.

4.5 Flange Connection

Flanged connection shall be provided at valves, bends, equipment and where necessary for maintenance of the pipelines.

4.6 Pipe Fittings

i) Union Couplings

Union Couplings shall be restricted only to pipes, which are 40 mm diameter below. Flanges shall be for pipe 50 mm diameters and above.

ii) Expansion joints and steam traps

a) Expansion joints and steam traps shall be installed at appropriate positions in the piping systems.

b) Steam traps should be installed at every 30m of straight pipe run. Steam trap assembly shall have one by pass valve two isolating valve, a sight glass and a strainer.

iii) All water meters shall be of makes approved by local authorities and installed as in the drawings.

iv) Pressure gauges shall be installed where indicated in the drawings.

v) Temperature gauges shall be installed where indicated in the drawings.

vi) Sniffer valves are required for all steam pipelines and installed at highest points at every 50m.

vii) Safety/Relief is required as shown in the drawings.

4.7 Road Crossing

Where pipes are to be laid underground and crossing the mill roads, the contractor has to hack the roads. After having buried the pipes the contractor shall make good all the damages on the roads caused by him to the satisfaction of Engineer or his representative. 80/100 bitumen shall be applied to a lightly compacted layer of 19 mm metal at a rate of 4 litres per m.

4.8 Testing Of Piping

i) All piping shall be tested as specified on the drawings and/or specifications and the test to be approved by the Engineer.

ii) Gauges used for testing shall be accurate and they shall be regularly tested.

iii) After hydrostatic testing of a system has been completed and approved by the Engineer, care must be taken to completely drain the lines. System shall be vented during draining.

4.9 Insulation

i) Heat Insulation - Piping

a) All heat insulation shall be pre-formed sections of calcium silicate having minimum K value of 0.034 W/m^2K at 20 deg.C mean temperature and nominal density of 80kg/m3 unless otherwise stated.

b) The pipe to be insulated shall be clean, dry and free of grease, loose rust, etc.

c) The section of pipe insulation shall be placed in position on the pipe ensuring that each section is tightly butted against the adjacent one.

d) The pipe insulation shall be secured in position by two loops per section of 0.9mm galvanised steel wire, tightened by twitching, excess wire shall be cut off and the cut end twisted to embed in the insulation surface.

e) Cladding shall be aluminium of 0.7mm thickness.

f) Metal cladding shall be cut and rolled to provide minimum end laps of 75mm and 50mm longitudinal laps. The edges to be exposed at all lap joints shall be swedged to shed water.

g) The cladding shall be fitted to the insulated pipe, lapping the swedged edges. On horizontal pipes the longitudinal laps shall be located at 4 o'clock or 8 o'clock. On vertical pipes, they shall be located in the most sheltered position.

h) Where exposure to extreme conditions is unavoidable, the laps behind the swedged edges shall be sealed with mastic sealant.

i) All laps in the cladding shall be secured/riveted at no greater than 150mm centres for longitudinal laps and 100mm for circumferential laps.

j) Adjacent to bends and at sufficient points in straight run, provision shall be made for thermal expansion of the pipe by increasing the width of the end laps in the cladding by omitting the circumferential screws/rivets at these points.

k) All valves, flanges, in-line fittings, etc. shall also be insulated and boxed up. The insulation boxes for control valves and other and in-line fittings that require regular checking and maintenance shall be of openable type and secured with quick-release toggle type fasteners.

ii) Heat Insulation - Vessels And Tanks

a) The insulation material shall be Rockwool having minimum K value of 0.034 W/m^2K at 20 deg.C mean temperature and nominal density of 120kg/m3 unless otherwise stated.

b) The surface to be insulated shall be clean, dry and free from grease, loose rust and etc.

c) The insulation material shall be retained in position by means of circumferential galvanised steel bands 19mm wide x 0.5mm thick at no less than 450mm centres, mechanically tensioned and clamped.

d) For vertical tanks and vessels, the insulation shall be supported at no greater than 3600mm centres by means of rings welded to the vessels.

e) Cladding shall be aluminium of 0.7mm thickness.

f) Longitudinal laps shall be no less than 100mm, screwed/riveted at no less than 150mm centres.

g) Circumferential laps shall be no less than 75mm, screwed/riveted at no less than 100mm centres.

h) Vertical laps shall be no less than 100mm.

i) The edges to be exposed at all lap joints shall be swedged and the laps shall be fixed to shed water.

j) For outdoor tanks and vessels, the cladding shall be retained by circumferential metal bands 50mm wide at no greater than 1800mm centres.

k) All penetrations through the cladding for pipe connections, manhole and etc. shall be flashed to shed water.

l) Where necessary removable flanges boxes shall be provided for ease of access when inspection/maintenance is required.

4.10 Valves and Other Fittings

i) All valves shall conform to relevant British Standard Specification or other Authoritative Standard, which ensure equal or higher quality.

ii) All valves supplied shall conform to B.S. or other relevant standard for valves and shall be of make that are of proven reliability and well known in Malaysia. The valves supplied shall have well-established local agents/stockist with good stocks of units and spare parts.

iii) Valve sealing surfaces such as the valve disc and seat shall be of such material and design that the valve will remain tight over reasonable service period.

iv) All other pipe fittings such as strainers, water meters, sight glasses, expansion bellows, flexible joints, steam trap, pressure gauges, temperature gauges, orifice plates etc. shall be installed where indicated in the drawings.

5. PAINTING

5.1 Paints

i) The paints shall be delivered to site in the original sealed containers and shall be used strictly in accordance with the manufacturer's instructions.

ii) Oil stains shall conform to B.S. 1215.

iii) Each coat of paint shall be properly dry before the next coat is applied.

iv) The method of application shall be in accordance with the paint manufacturer's recommendation.

5.2 Surface Preparation

i) Surfaces to be painted shall be thoroughly cleaned to be free of oil, grease and other foreign matter.

ii) Any sand/grit blasting required shall be performed in accordance with the General Technical Specification.

iii) The surface preparation shall in any case be in accordance with the paint manufacturer's recommendation.

5.3 Painting Schedule

i) Machinery of Mild Steel Construction

Primer - Two coats of zinc chromate (external) before delivery to site equivalent to 40 microns dry film per coat

Finishing - Two coats of gloss finish equivalent to 40 microns dry film per coat (only for un-insulated vessels)

Total Average Minimum Dry Film Thickness shall be 160 microns.

ii) Carbon Steel Pipes

Primer - Two coats of zinc chromate (external) before delivery to site equivalent to 40 microns dry film per coat

Finishing - Two coats of gloss finish equivalent to 40 microns dry film per coat (only for un-insulated lines). One coat of colour band at 1000mm distant for insulated line

Total Average Minimum Dry Film Thickness shall be 160 microns.

5.4 Colour for Finishing Coat

The Engineer shall confirm the colours of finishing coat.

5.5 Approved Makes

Nippon, ICI

1 FOUNDATIONS

1.1 Levels around the perimeter of the foundation in the way of the 1st course shell plates shall be within ± 9mm, and be maintained within this tolerance during the course of erection.

1.2 Temporary mild steel plates should be placed in position, across the edge of the tank foundation, in order to prevent damage to the waterproof seal coat of sand bitumen mix on the foundation when dragging the bottom plates into position.

2 PLATE MATERIAL

All steel plates shall be of Japan, Brazil or South Korea origin manufactured to JIS SS41 G3101 or BS 4360 Gr 43A.

3 SITE ERECTION OF PLATES

3.1 The 1st course shell plates shall be held in position by metal clamps or other devices attached to the bottom plates whilst being plumbed and checked for circularity.

3.2 The shell plates shall be tack welded or welded to the bottom.

3.3 All lap joint plates shall be thoroughly cleaned and held in close contact during the welding operation.

3.4 Lugs attached by welding to the tanks for purposes of erection shall be removed and any noticeable projections of weld metal carefully ground or chipped from the plate.

3.5 Care shall be taken to minimize distortion or lack of circularity due to welding or any other reason. Any tank having excessive shell plate buckling shall be rejected unless the defect is rectified to Engineer's satisfaction.

3.6 Plates to be jointed by butt-welding shall be matched accurately and retained in position during the welding operation. Misalignment shall not exceed the following limits: -

3.6.1 Completed vertical joints

10% of plate thickness or 1.5mm for plates 19mm thick and below, 3mm for plates over 19mm thick whichever is the larger

3.6.2 Completed horizontal joints

20% of upper plate thickness subject to a maximum of 1.5mm for the plates 8mm thick and below and 3mm for plates over 8mm thick

3.7 Prior to final welding of the bottom course of shell plates, a check should be made to ensure that the alignment of the plates and the width of the gaps between them are correct, and that any deviations are within the permissible tolerance specified above. If the tolerances are exceeded, the plates shall be realigned before final welding begins.

3.8 After welding the bottom course, the distance from a common centre to any two points on the inside of the tank shell plates at the tank bottom shall not differ by more than 1mm per meter of the tank diameter, and shall never exceed 25 mm.

4 WELDING PROCESSES

4.1 Method

Welding shall be by metal-arc or submerge-arc process using suitable equipment.

4.2 Welders

Only qualified and certified welders shall be employed on site.

4.3 Weather condition and Pre-Heating

Welding shall not be done when the surfaces of the parts are wet, or during periods of high winds unless the welder and work are properly shielded. The surfaces on both sides of the joint shall be pre-heated to a temperature warm to the hand, and to a distance of not less than 4 times the plate thickness or 75mm, whichever is the greater, in any direction.

4.4 Electrodes

Welding electrodes shall be in accordance with B.S. 639 Parts 1 and 2.

4.5 Tack Welds

Tack Welds at vertical joints and those for assembling tank shell to the bottom shall be removed and not be allowed to remain in the finished joint. Tack welds at other joints (e.g. bottom, roof and circumferential joints of the tank shell) need not be removed provided they are sound and subsequent weld beads are thoroughly fused into tack welds.

4.6 Cleaning of Welds

Each layer of weld metal of multi-layer welding shall be cleaned of slag and other deposits before the next layer is applied. Slag shall also be removed from finished welds before inspection.

4.7 Back Gouging & Chipping

The reverse side of full penetration butt welds shall be cleaned thoroughly prior to the application of the first bead to this side in a manner that will leave the exposed surface suitable for proper interfusion with the deposited weld metal.

4.8 Welding Sequence

Either one of the following two different sequences is acceptable.

4.8.1 Progressive assembly

1. The bottom plates are first assembled and welded.
2. The shell plates are then erected, held in place, tacked and completely welded course by course, working upwards to the top curb angle.
3. This is followed by the erection and completion of the roof framing.

4.8.2 Complete assembly followed by welding

1. The bottom plates are completely assembled and welded first.
2. The shell plates are then erected to the full height of the tank and temporarily held in position by means of key plates, wedges, shims, etc. The vertical seams are welded completely as each course is erected, the horizontal seams being tack welded only.
3. This is followed by the erection of the roof framing and sheeting.
4. Finally after completion of the roof structure, the horizontal seams are welded, working upwards from the bottom course. (Final welding of the

horizontal seams by working downwards from the top curb angle is also acceptable).

Note:

A variation to the above method is to weld 3 courses of shell plates at time, i.e. the vertical seams of each course are completely welded, the horizontal seams being tack welded. After every 3 course, the horizontal seams are completely welded. This process is repeated for the next 3 courses and so on.

4.9 Wire Guys or Cables

Tank shell shall be safeguarded from damage due to wind by provision of steel wire guys or cables until completion of the roof framing.

4.10 Weld Test

All weld joints are subjected to 10% radiography except for T-joints shall be 100%.

5 GRIT OR SAND BLASTING (NOT APPLICABLE)

5.1 Guarantee

5.1.1 The Contractor shall in conjunction with the paint supplier, provide one (1) year's guarantee covering the performance of the epoxy coating system applied to the tanks. The guarantee shall cover the reimbursement of the application cost as may be necessary to repair all the defective areas only. The provision of replacement coating materials shall be borne by the paint supplier.

5.1.2 The guarantee period shall commence on the date the completed application is accepted by and handed over to the Superintending Officer.

5.1.3 In connection with the joint guarantee provided, the paint supplier will be providing a coating inspector to be stationed at the Installation to provide continuous surveillance over the surface preparation, mixing of epoxy products, application of coating, dry film thickness and the like, throughout the operation. The coating inspector shall act as an authorized representative of the Employer and all instructions and requirements forthcoming from him shall be deemed to have come from the Employer and shall be complied with strictly, provided they are not unreasonable. All work rejected by the coating inspector shall be immediately repaired by the Contractor and all costs incurred in repairing the defective coated areas including all coating material shall be borne by him.

5.2 Specifications

5.2.1 The Contractor shall provide good quality grit to Mesh G24.

5.2.2 For sand blasting, good quality, hard and dry silica sand shall be provided by the contractor for the surface preparation work. Properly graded sand of size 16/20 mesh shall be used. The used sand is not allowed to be recycled and shall be removed from the site.

5.2.3 For blasting using crushed copper slag abrasives, good quality, oil and moisture free abrasives shall be provided by the Contractor for the surface preparation work. The copper slag abrasives shall not be coarser than 16 mesh in size.

5.2.4 Copper slag abrasives found to be contaminated with oil deposits shall not be allowed to be used and shall be removed from the site.

5.2.5 Proper scaffolding of the fixed steel type shall only be provided. Sufficient quantity of scaffolding shall be provided in each tank so that all areas of the tanks are readily accessible and are within arms reach. The scaffolding provided shall conform to relevant Safety Regulations. As a general guide, sufficient hand-rails and boards to fully board out each level of the scaffolding shall be provided to enable Superintending Officer or authorized representative(s) to move about with ease and safely.

5.2.6 Moisture free compressed air shall be provided for both girt blasting and airless spraying.

5.2.7 The following equipment and facilities shall be provided for the surface preparation and coating of each tank:-

a) Clean and moisture free compressed air at a minimum pressure and capacity of 100 psig and 600 cfm respectively.

b) Ventilation equipment with the necessary trunking capable of producing at least 10 air changes.

c) Adequate and safe lighting of 24 or 48 volts shall be used.

d) Properly earthed armoured cable shall be used for spot lighting.

e) Flame proof and spark free equipment shall be used for works within the tanks.

f) Efficient mechanical paint stirrers.

g) Suitable shelter to protect the mixed paint from inclement weather as well as air-borne debris.

h) Suitable airless spray equipment capable of giving satisfactory spray characteristics.

i) Tips suitable for the epoxy paint shall be used. They should not be in a worn out condition.

j) Suitable industrial vacuum cleaners for removal of girt and dust.

k) Dehumidification equipment of adequate capacity to keep the ambient conditions in the tank within suitable limits, if surface preparation and painting are carried out during periods of unfavourable conditions.

l) The above-recommended list of equipment and facilities is not binding on the Employer. The contractor shall decide for himself or herself, whether some of the above equipment can be dispensed with and also whether additional equipment, plant and facilities need to be provided to comply with the specifications, coating procedure and time schedule.

6 PAINTING

6.1 Specifications

6.1.1 Contractor shall supply the epoxy paint suitable for the coating of mild steel tanks and chemically resistant to the contents stored in the tanks.

6.1.2 All necessary epoxy paint Manufacturer's Product Information such as the coverage maximum and minimum over coating times, pot life etc., shall be furnished by the Contractor to enable proper mixing and application of the paint.

6.2 External Surfaces Including Railing, Piping & Pipe Gantry

The following painting schedules shall be used unless otherwise stated:-

Coating Sequence	No Of Coats	Type Of Paint	Dry Film Thickness (Microns)
Primer coat	1	Alkyd Zinc Phosphate Rust Inhibitive Primer (Nippon 8048 Zinc Phosphate Primer)	50
Intermediate coat	1	Alkyd Base Micaceous Iron Oxide (Nippon Micaceous Iron Oxide – Dark Grey)	50
Finishing coat	1	Alkyd Base Micaceous Iron Oxide (Nippon Micaceous Iron Oxide – Silver)	50
OR			
Primer coat	1	Alkyd Zinc Phosphate Rust Inhibitive Primer	50

		(Nippon 8048 Zinc Phosphate Primer)	
Intermediate coat	1	Alkyd Resin Finish (Nippon Protective Finish / Nippon 9000 Gloss Finish)	50
Finishing coat	1	Alkyd Resin Finish (Nippon Protective Finish / Nippon 9000 Gloss Finish)	50
Total Average Minimum Dry Film Thickness			150

6.3 Tank Bottom Underside

6.3.1 Surface Preparation

The surface to be painted shall be wire brushed to obtain a finished surface of **St 3 ISO 8501-1:1988.** It must be dry and free from dirt, grease, oil and other contaminants before application of the following paint.

6.3.2 Painting Application

Coating Sequence	No Of Coats	Type Of Paint	Dry Film Thickness (Microns)
Primer coat	1	Two pack epoxy zinc rich primer (Nippon Zinc Rich Primer HS)	50
Intermediate coat	1	Coal tar epoxy (Nippon Arocoat Brown)	150
Finishing coat	1	Coal tar epoxy (Nippon Arocoat Black)	150
Total Average Minimum Dry Film Thickness			350

6.4 Internal Surfaces

Remove rust and spray with 1 layer of CPO

7 WATER TESTING

7.1 Water testing shall be carried out upon completion of tanks by filling the tank with water under controlled conditions to full level to ensure that foundation failure does not occur during filling.

7.2 All tank tests will be carried out to provide adequate measured load/settlement records.

7.3 A minimum of four points on tanks under 25m diameter and eight points on tanks over 25 m diameter should be marked around the base of the tank for subsequent leveling reference. A greater number of points may be required for large tanks and/or where a complex settlement pattern is expected. Before water is added to the tank, the levels at each reference point should be recorded. Permanent reference levels have to be established in locations unaffected by tank loading.

7.4 As a guide, when ground conditions are good and settlement is expected to be negligible, the tank may be half filled with water as quickly as practicable, having regard to its size, the pumping facilities and water supply available. No further filling should

proceed until levels have been taken and checked against the readings when empty to ensure that no uneven settlement is occurring in which case filling can proceed until the tanks is three-quarters full, when level readings should be taken again. Provided the tank remains level with only slight settlement due to load, filling can then proceed until the tank is full, when level readings are again repeated. The full water load should be maintained for 45 hours and provided levels remain sensibly consistent, the tank can be offloaded prior to calibration for service. On weak ground where significant settlements may be expected or where the initial factor of safety against slip failure is low, the rate of filling should be greatly reduced. Some guidance on the safe heights for initial filling and where pauses in filling are required may be deduced from the soil investigation and from piezometric monitoring of pore water pressures.

7.5 Typically, where settlements of over 300 mm may be expected, water should be added to the tank at about 0.6 m per day until about 3 m of water is stored. At such a head, filling should cease and levels at the reference points should be recorded daily. Daily reference point levels should be plotted on a timescale to follow the pattern of settlement.

7.6 When the daily rate of settlement begins to decrease, water should be added to the tank in decreasing increments of head when the settlement graph shows that the rate of settlement under each new increment of load is reducing. As the water load nears the full capacity of the tank, water should preferably be added after an early morning check of reference levels so that further readings ca be taken during the day and the tank offloaded should the rate of settlement increases unduly. On very weak soils, these tests may extend over considerable periods and where such conditions apply, the contractor should be advised so that adequate provisions can be made in his programme for the necessary testing and acceptance procedure.

7.7 Some guidance on safe heights for initial filling and where pauses are desirable may be deduced from the shear strength data and strata thickness of the underlying soil.

7.8 In carrying out such test procedures adequate arrangements should be made for the emergency disposal of water if off loading became necessary. Discharge should be to a safe area, clear of all foundations and structures and such that no danger of erosion can occur.

8 CALIBRATION OF STORAGE TANKS

8.1 After completion, the contractor shall be required to engage a licensed calibrator approved by the Engineer to calibrate the storage tanks for ullage dipping against reference works on the dip hatch.

8.2 The calibration shall be carried out in accordance to API Chapter 2 Section 2B and API Standard 2550.

8.3 Calibration tables shall be prepared in metres and millimetres.

8.4 All the calibration works shall be witnessed by SIRIM. The Contractor shall make all necessary arrangement for SIRIM to witness the works. All costs incurred are deemed to be included in the Contract Price.

8.5 Six (6) copies of the calibration tables laminated with protective water proof plastic duly singed by the calibrator and approved by SIRIM shall be provided to the Employer.

7. SCHEDULE OF PRICE

TDM PLANTATION SDN BHD

SUPPLY, DELIVERY EX-SITE, INSTALLATION, TESTING AND COMMISSIONING AND GUARANTEE OF CIVIL AND MECHANICAL WORKS OF ONE (1) UNIT 1500 MT,CRUDE PALM OIL (CPO) BULK STORAGE TANK AND ANCILLARY WORKS FOR KEMAMAN PALM OIL MILL

PRICE SUMMARY

ITEM	DESCRIPTIONS	PRICE (RM)
1	BILL 1 - PRELIMINARIES & GENERAL	
2	BILL 2 - BUILDER'S WORKS	
3	BILL 3 - EXTERNAL WORKS	
4	BILL 4 - STORAGE TANK	
	TOTAL PRICE C/W TO FORM OF TENDER	

Name: …….

Signature: ……..

Stamp: ……

BILL 1 - PRELIMINARIES & GENERAL

ITEM	DESCRIPTIONS	PRICE (RM)
1	Preliminaries and General consists of but not limited to:- i) Mobilisation & demobilisation ii) Survey, investigation and setting out iii) Authorities Approval & Licences iv) Site supervision v) Services for workmen e.g. accommodation, water and electricity vi) Site office, stores and etc. for Contractor's own use vii) Temporary works viii) Damage to existing roads and etc. ix) Security of the Site x) First aid kid xi) All other items mentioned in Section 5 - Preliminaries & General	
2	Cost of Insurances	
3	Cost of Performance Security	
4	Stamp Duty Contractor is required to stamp the formal Contract by submitting application of the Digital Certificate Stamp Assessment and Payment System (STAMPS) with “Inland Revenue Board of Malaysia” or Lembaga Hasil Dalam Negeri, Malaysia and the stamping cost shall be as per following; 1) Stamp Duty for Original Copy is 0.1% of Contract Amount, PLUS 2) 2 copies of the Contract Document (RM20.00)	
5	Payment Levy to CIDB (Construction Industry Development Board) The contractor shall comply to part VIII of the Lembaga Pembangunan Industri Pembinaan Malaysia Act 1994 and the construction industry (levy collection) regulation 1996 and shall submit a notification on Form CIDB L1/96 to the Lembaga not later than 14 days the issuance of the letter of acceptance / letter of award / of any document that is the acceptance of contract works or not less than 14 days before the commencement of the works, whichever date is earlier.	
6	Shop Drawings, As-built Drawings & Records	
7	Operation and Maintenance Manuals	
8	Safety, health and enviroment (SHE) *- Full time JKKP licensed site safety supervisor* *- Licensed scaffolding inspector* *- Entry supervisor for confined working space monitoring* *- Necessary PPE for workers/ staff*	
9	Other items not indicated in the tender documents but needed for the complete installation and operation (please specify)	
	TOTAL BILL 1 C/F TO SUMMARY OF PRICES	

BILL 2 - BUILDER'S WORKS

NO	DESCRIPTION	UNIT	QTY	RATE (RM)	TOTAL (RM)
1.0	**DESPATCH SHED**				
	Work Below Floor Finish Level				
1.1	Excavate over site to reduce level commencing from formation level, cart away excavated materials, deposit, spread and level within site or disposed off .	L.Sum			
1.2	Supply and construction of reinforced concrete gred G30 footing, stumps and ground beams as per detail drawings and specifications. Rate to include excavation and cart away excavated materials.	L.Sum			
1.3	Supply and construction of reinforced concrete floor and apron as per detail drawings and specifications.	L.Sum			
	Frame				
1.4	Supply and erection fo steel column as per detail drawing and specifications.	L.Sum			
	Roof Structure & Roof covering				
1.5	Supply and erection of steel truss, purlins & sag rod as per detail drawings and specifications	L.Sum			
1.6	Supply and fixing of 0.48mm Spendek Hi-Ten Colorbond Metal roofing sheets c/w standard ridge capping and rain gutter and down pipe where indicate as per detail drawings and manufacture's specifications	L.Sum			
	Paint works				
1.7	All external masonry and concrete surfaces of buildings shall be painted with 2 coats of ICI Weathershield or Nippon Weatherbond emulsion	L.Sum			
	Internal masonry and concrete surfaces shall be one coat of Vinilex 5100 wall scaler followed by 2 coats of Nippon Super Matex emulsion paint or Maxilite Super emulsion. Timber surfaces shall be painted with one coat aluminium wood primer followed by one coat of Bodelac 9000 undercoat and 2 coats of Nippon Bodelac 9000 gloss paint.				
	Painting works to all steel surfaces with one coat of ICI zinc chromate primer and two coats of ICI Micacious Iron oxide (every coat to be of different colour) all in accordance with specifications				

NO	DESCRIPTION	UNIT	QTY	RATE (RM)	TOTAL (RM)
	Inspection Platform				
1.8	Construction of steel Inspection Platform complete with handrail and all acessories as per detail drawings and specifcations	L.Sum			
	Staircase				
1.9	Construction of steel staircase where indicated on drawing complete with handrail as per detail drawings and all in accordance with specifications.	L.Sum			
	Safety harness				
2.0	Supply and install safety harness consisting of rail, roller and safety belt for operator as per	L.Sum			
	Any other item which are shown in drawing or required to complete the above works but not mention any where in this Bill Of Quantities (Contractor to specify)				
2.0	**GUARD HOUSE**				
	Works Below Floor Finish Level				
2.1	Excavate over site to reduce level commencing from formation level, cart away excavated materials, deposit, spread and level within site or disposed off .	L.Sum			
2.2	Supply and construction of reinforced concrete gred G30 footing, stumps and ground beams as per detail drawings and specifications. Rate to include excavation and cart away excavated materials.	L.Sum			
2.3	Supply and construction of reinforced concrete floor and apron as per detail drawings and specifications.	L.Sum			
	Drains & Sumps				
2.4	Construction of perimeter drain and sumps c/w cover where indicated as per detail drawings and specifications.	L.Sum			
	Frame				
2.5	Construction of r.c column of concrete gred G30 as per detail drawings and specifications.	L.Sum			
2.6	Construction of r.c roof beam of concrete gred G30 as per detail drawings and specifications.	L.Sum			

NO	DESCRIPTION	UNIT	QTY	RATE (RM)	TOTAL (RM)
2.7	Construction of roof r.c. slab of concrete G30 as per detail drawings and specifications.	L.Sum			
	Roof Structure & Roof covering				
2.8	Supply and erection of steel truss, purlins & sag rod as per detail drawings and specifications.	L.Sum			
2.9	Supply and fixing of 0.48mm Spendek Hi-Ten Colorbond Metal roofing sheets c/w standard ridge capping and rain gutter and down pipe where indicate as per detail drawings and manufacture's specifications.	L.Sum			
	Ceiling works				
2.10	Construction of ceiling works as per detail drawings and specifications.	L.Sum			
	External Wall				
2.11	Construction of brick wall and finishes as per detail drawings and specifications.	L.Sum			
	Internal wall				
2.12	Construction of brick wall and finishes as per detail drawings and specifications.	L.Sum			
	Door & Windows				
2.13	Supply and fixed door & windows complete with fittings as shown in drawing all in accordance with detail drawings and specifications.	L.Sum			
	Floor finishes				
2.14	Supply and lay floor finishes as per detaill drawing and specification.	L.Sum			
	Sanitary/toilet fittings/sink etc.				
2.15	Supply and install Internal piping for water and sanitary and installation of aprroved brand and make, all sanitary/toilet fittings/sink as shown in drawings and as per specifications.	L.Sum			
	Roof tanks as specified.				
	Septic Tank				
2.16	Supply and install 6PE Super Sept or equivalent	L.Sum			

NO	DESCRIPTION	UNIT	QTY	RATE (RM)	TOTAL (RM)
	Paint works				
2.17	All external masonry and concrete surfaces of buildings shall be painted with 2 coats of ICI Weathershield or Nippon Weatherbond emulsion paint. Internal masonry and concrete surfaces shall be one coat of Vinilex 5100 wall scaler followed by 2 coats of Nippon Super Matex emulsion paint or Maxilite Super emulsion. Timber surfaces shall be painted with one coat aluminium wood primer followed by one coat of Bodelac 9000 undercoat and 2 coats of Nippon Bodelac 9000 gloss paint. Painting works to all steel surfaces with one coat of ICI zinc chromate primer and two coats of ICI Micacious Iron oxide (every coat to be of different colour) all in accordance with specifications	L.Sum			
2.18	**Any Other item which are shown in drawing or required to complete the above works but not mention any where in this Bill of Quantity (Contractor to specify)**				
3.0	**PUMP SHED**				
	Work Below Lowest Floor Finish				
3.1	Excavate over site to reduce level commencing from formation level, cart away excavated materials, deposit, spread and level within site or disposed off.	L.Sum			
3.2	Construction of reinforced concrete pile cap, stumps and ground beams as per detail drawings and specifications. Rate to include excavation and cart away excavated materials.All concrete use to be of grade G30.	L.Sum			
3.3	Construction of reinforced concrete floor and apron gred G30 as per detail drawings and specifications.	L.Sum			
	Drains & Sumps				
3.4	Construction of perimeter drain and sumps c/w cover where shown in drawings.	L.Sum			
	Frame				
3.5	Supply and erection of steel columns as per detail drawings and specifications.	L.Sum			

NO	DESCRIPTION	UNIT	QTY	RATE (RM)	TOTAL (RM)
	Roof Structure & Roof covering				
3.6	Supply and erection of steel truss, purlins & sag rod as per detail drawings and specifications.	L.Sum			
3.7	Supply and erection of cantilever roof/canopy steel structure as per detail drawings and specifications.	L.Sum			
3.8	Supply and fixing of 0.48mm Spendek Hi-Ten Colorbond Metal roofing sheets c/w standard ridge capping as per detail drawings and manufacture's specifications.	L.Sum			
	Paint works				
3.10	Painting works to all steel surfaces of buildings, railing, doors, steel supports, steps, etc with one coat of ICI zinc chromate primer and two coats of ICI Micacious Iron oxide (every coat to be of different colour) all in accordance with specifications.	L.Sum			
3.11	All external masonry and concrete surfaces of buildings shall be painted with 2 coats of ICI Weathershield or Nippon Weatherbond emulsion paint. Internal surfaces shall be one coat of Vinilex 5100 wall scaler followed by 2 coats of Nippon Super Matex emulsion paint or Maxilite Super emulsion.	L.Sum			
	Pump Plinth				
3.12	Construction of pump plinths as shown in lay out drawings.	L.Sum			
3.13	**Any Other item which are shown in drawing or required to complete the above works but not mention any where in this Bill of Quantity (Contractor to specify)**				
4.0	**EXTERNAL MACHINERIES FOUNDATIONS & PIPE SUPPORTS**				
4.1	To construct reinforce concrete of grade G30 as per detail drawings and specification for the followings:-				
	Bulk storage tank foundations				
	for 1500	nos	1		

NO	DESCRIPTION	UNIT	QTY	RATE (RM)	TOTAL (RM)
	Fat Trap				
4.2	Construction of Fat Trap Foundation as per detail drawings and specifications	nos	1		
	Oil Drain Pit				
4.3	Construction of Oil Drain Pit as per drawing and specification.	L.Sum			
4.4	Construction of Oil Drain Pump Foundation as per drawing and specification.	L.Sum			
	TOTAL BILL 2 C/F TO SUMMARY OF PRICES				

BILL 3 - EXTERNAL WORKS

NO	DESCRIPTION	UNIT	QTY	RATE (RM)	TOTAL (RM)
	Provisional quantities allowed in this section are subject to final measurement.				
1	**SITE CLEARING**				
1.1	Clearing site of tall grass, shrubs, bushes, trees, palm trees including grubbing up roots and removing from site to a tip to be provided by the contractor Note: 1. Open burning is prohibited 2. All the palm trees trunks to be shereeded and transport to Client approved	L.Sum			
2	**DISMANTLING AND DEMOLISHING WORKS**				
2.1	Allow for dismantling and demolishing works of any structure or object obstructing required to make way for new construction. Rate to include disposal dismantled/ unused material to contractors dumping site. Any temporary works such proping, temporary re-routing of existing facilities that requires re-installation to original location for the execution of new works shall be deemed to be included in the price.	L.Sum			
3	**EARTHWORKS**				
3.1	Excavate in cutting to formation level in all material other than solid rock	L.Sum			
3.2	Ditto for excavation in Soft Rock		Rate Only		
3.3	Ditto for excavation in Hard Rock		Rate Only		
3.4	Transport excavated suitable material to construct embankments and/or earth fills as per specification or as directed by the Engineer within the site	L.Sum			
4.0	**ROADWORKS**				
4.1	**Premix Road**				
	Preparation of sub-grade formation as specified.				
	Suppy, lay and compact				
	50 mm thick sand sub-base	m^2	3500		
	450 mm thick crushed rock road base	m^2	3500		

NO	DESCRIPTION	UNIT	QTY	RATE (RM)	TOTAL (RM)
	Supply and spray prime coat	m^2	3500		
	60 mm thick binding course	m^2	3500		
	Supply and spray tuck coat	m^2	3500		
	40 mm thick bituminous premix wearing course.	m^2	3500		
5.0	**CRUSHER RUN**				
5.1	Supply and lay 250mm well compacted crusher run as base course and 50 mm sand bedding as per drawing and Specification	m^2	800		
6	**CONCRETE HARDSTAND**				
6.1	Construction of 75 mm thk concrete with BRC A6 as per detail drawing and specification.	m^2	100		
7.0	**SURFACE WATER DRAINAGE**				
	For construction of drain, culvert and sump below, rate to include excavation, back filling and removal of the surplus from the site.				
	DRAIN WORKS AND BRICK SUMP				
7.1	Supply and laid to fall 450mm cast insitu drain. Rate to include excavation, lean concrete, BRC and concrete base as per detail drawings and specifications.	m	200		
7.2	Make good existing drain	L.Sum			
7.3	Construction of 225mm brikwall to make up side drain not excedding 1.5 meter depth. Rate to include 20mm plastering on internal side.	m^2	300		
7.4	Construction of 600 x 600mm brick sump complete with M.S Grating not exceeding 1.5m deep. Rate to include excavation, 40mm thk lean concrete,150mm thk concrete base with BRC A142, 230mm thk brickwall with 20 complete with plastering internally as per detail drawings and specifications.	Nos	4		
8.0	**PIPE CULVERT**				
8.1	Construction of 600mm x 600mm pipe culvert c/w sump as per detail drawings and specifications.	m	30		
9.0	**TURFING**				
9.1	To touch up and make good existing turfing which affected during the construction period.	m^2	770		

NO	DESCRIPTION	UNIT	QTY	RATE (RM)	TOTAL (RM)
10.0	**Any Other item which are shown in drawing or required to complete the above works but not mention any where in this shedule of prices (Contractor to specify)**				
	TOTAL BILL 3 C/F TO SUMMARY OF PRICES				

BILL 4 - STORAGE TANK

Preamble

1 The prices as set out hereunder are deemed to apply to the whole of the works as shown on the Drawings and/or described in the Specification. The Contractor shall allow for any cost in connection therewith. The prices are for the supply, fabricate, delivery, installation, painting, labelling, testing, commissioning and guarantee of the whole works

ITEM	DESCRIPTION	QTY	UNIT	RATE (RM)	TOTAL (RM)
1	**1500MT CPO Storage tank** **(Tank Nozzles & Accessories to Refer Drawing, TDM-POM-M-ST-25-01 & Specification)**				
1.1	1500 MT MS S275JR storage tank c/w:- - Nozzles with matching flanges - Spare Nozzles c/w blind flanges - Internal pipes - API 5L Gr B Sch 40 internal heating coils - Ullage port & sampling point - Handrail with safety guard & steel wire mesh - Rain water down pipes - Relief vent - Tank fitting Nozzles - Shell manhole - Roof manhole c/w steel mesh - Tank external & Internal pipe support - Tank nameplates & warning plates - Tank manual level indicator - Tank Labelling - Asbestos free & oil resistant type gasket for all manholes and nozzles (Max Temperature 80°C) - Vacuum pressure test on all bottom plate welding joints c/w test accessories, vacuum box, etc. - Dye pen test on all bottom plate to shell plate welding joints c/w test accessories - Painting of all external MS parts surfaces including handrails, platform, etc c/w:- - 2x MIO Primer - 2x Gloss - Tank hydrotest c/w:- - Supply of water for HT - Piping & accessories connection for water testing - Tank verticality & settlement report - SIRIM certified tank calibration c/w test report - Other accessories mentioned in drawing & specification	1	Nr		
1.2	Tank side stirrer c/w:- -SS304 shaft & impeller -Mounting bracket -Rain cover for stirrer motor -Contractor to quote no of stirrer based on manufacturer recommendation for each tank Stirrer specification:- -Type: Tank side mounted -Operating Temperature: 28 - 70°C -Minimum Cycle in 8 hours: 5 times -Media Viscosity @ 30°C: 75 cP -Media Density: 890 - 900 kg/m³	1	Nr		

ITEM	DESCRIPTION	QTY	UNIT	RATE (RM)	TOTAL (RM)
	-Frame: Welded steel construction -Shaft: SS304 -Impeller: SS304 -Seal: Outboard mech Seal of special chrome steel/carbon/viton and with shut-off device for easy maintenance without emptying the tank				
2	**TANK INTERCONNECTING PLATFORM (REFER DWG NO TDM-POM-M-ST-25-03)**				
2.1	Tank spiral staircase, roof walking platform & tank interconnecting platform c/w:- - Supporting structure - Handrails - Kicker plate - Non-slip expanded metal walking platform (roof) - Stairs steps - Supporting structure - Handrails for interconnecting platform including tank roof parameter - Kicker plate for interconnecting platform including tank roof parameter - interconnecting platform between tanks - structure paintings & make good of existing - Contractor to suit installation during construction at site - Contractor to provide shop drawings based on site condition	1	Nr		
3	CONTINGENCY to be used wholly or partly as instructed by the Engineer or deducted if not used				
4	Other items not indicated in the specifications or drawing but needed for the complete installation and operation or indicated in the drawings/ specifications but not stated in the Schedule of Prices (please specify); Notes: If Contractor failed to state it shall be deemed to be included in the price				
a)					
b)					
c)					
	TOTAL BILL 4 C/F TO SUMMARY OF PRICES				

8. SCHEDULE OF RATES

8.2 - SCHEDULE OF RATES (MECHANICAL WORKS)

SCHEDULE OF RATES FOR STEELWORKS AND DAYWORKS - SRM 1

Preamble

Any addition to and deduction from the Contract Price shall be calculated from the rates listed below. The rates shall be for supply be for supply, delivery, installation and painting including tools, safety harness and consumables. This rate only applicable if they are absence from the main contract price

Item	Description	Unit	Rate (RM)
1	Supply, fabrication, delivery and erection of structures and steel works (structural steel sections, angles, m.s plates, etc.). The rate shall be based on weight only.	mt	
2	SS304 structures, tanks, vessels (e.i. structural steel sections, plates etc)	mt	
3	Provision of services of one site supervisor	man-day	
4	Provision of services of one general welder	man-day	
5	Provision of services of one TIG welder	man-day	
6	Provision of services of one 6G welder	man-day	
7	Provision of services of one painter	man-day	
8	Provision of services of one fitter	man-day	
9	Provision of services of one general worker	man-day	
10	Provision of one diesel powered welding set c/w all necessary welding equipment and consumables	day	
11	Provision of one set of oxy- acetylene cutting torch c/w oxygen and acetylene gases	day	
12	Provision of one 20T mobile crane c/w driver and consumable	day	
13	Supply, deliver, paint 1 coat of Alkyd Base Micaceous Iron Oxide (Nippon Micaceous Iron Oxide – Dark Grey)	m2	
14	Supply, deliver, paint 1 coat of Alkyd Base Micaceous Iron Oxide (Nippon Micaceous Iron Oxide – Silver)	m2	
15	Supply, deliver, paint 1 coat of Alkyd Resin Finish (Nippon Protective Finish / Nippon 9000 Gloss Finish)	m2	

8.2 - SCHEDULE OF RATES (MECHANICAL WORKS)

SCHEDULE OF RATES FOR VALVES - SRM 2

Preamble

Any addition to and deduction from the Contract Price shall be calculated from the rates listed below. The rates shall be for supply be for supply, delivery, installation and painting including matching flange, gasket, bolts & nuts. This rate only applicable if they are absence from the main contract price

NB (mm)	TD Steam Assembly c/w By-pass valve, Sight Glass, 2 isolating CS Globe valve, Flanged PN 40	FT Steam Assembly c/w By pass valve, Sight Glass, 2 isolating CS Globe valve, Flanged PN 40	CS body SS trim Globe Valve PN 40, flanged	SS body SS304 disc Butterfly Valve PN 16, flanged	CI body CI disc Check Valve PN 16, flanged	SS body SS304 disc Check Valve PN 16, flanged	SS body SS304 disc Gate Valve PN 16, flanged	Full SS 304 BALL VALVE PN 16, 3-pc body, flanged	CI Body & SS ball Ball Valve PN 16, 3-pc body, flanged
600	N/A	N/A							
500	N/A	N/A							
400	N/A	N/A							
300	N/A	N/A							
250	N/A	N/A							
200	N/A	N/A							
150	N/A	N/A							
125	N/A	N/A							
100	N/A	N/A							
80									
65									
50									
40									
32									
25									
20									
15									

8.2 - SCHEDULE OF RATES (MECHANICAL WORKS)

SCHEDULE OF RATES FOR PIPES - SRM 3

Preamble

Any addition to and deduction from the Contract Price shall be calculated from the rates listed below. The rates shall be for supply be for supply, delivery, installation and painting. This rate only applicable if they are absence from the main contract price

NB (mm)	G.I Class "C" BS 1387 Pipe	API 5L Gr B Sch 40 Seamless Pipe	SS 304 Sch 10S Pipe	Pipe Insulation with 0.7mm thk Al Sheet & Rockwool	
	RM/m	RM/m	RM/m	Thick (mm)	RM/m
600				50	
500				50	
350				50	
250				50	
200				50	
150				50	
125				50	
100				50	
80				50	
65				50	
50				25	
40				25	
25				15	
20				15	
15				15	

8.2 - SCHEDULE OF RATES (MECHANICAL WORKS)

SCHEDULE OF RATES FOR PIPE ELBOW AND EQUAL TEE - SRM 4

Preamble

Any addition to and deduction from the Contract Price shall be calculated from the rates listed below. The rates shall be for supply be for supply, delivery, installation and painting. This rate only applicable if they are absence from the main contract price

NB (mm)	G.I Class "C" BS 1387		API 5L Gr B Sch 40 Seamless		SS 304 Sch 10S Pipe	
	Elbow	Equal Tee	Elbow	Equal Tee	Elbow	Equal Tee
	RM/pc	RM/pc	RM/pc	RM/pc	RM/pc	RM/pc
600						
500						
350						
250						
200						
150						
125						
100						
80						
65						
50						
40						
32						
25						
20						
15						
10						

8.2 - SCHEDULE OF RATES (MECHANICAL WORKS)

SCHEDULE OF RATES FOR PIPE UNEQUAL TEE AND REDUCER - SRM 5

Preamble

Any addition to and deduction from the Contract Price shall be calculated from the rates listed below. The rates shall be for supply be for supply, delivery, installation and painting. This rate only applicable if they are absence from the main contract price

NB (mm)	G.I Class "C" BS 1387		API 5L Gr B Sch 40 Seamless Pipe		SS 304 Sch 10S Pipe	
	Reducer	Unequal Tee	Reducer	Unequal Tee	Reducer	Unequal Tee
	RM/pc	RM/pc	RM/pc	RM/pc	RM/pc	RM/pc
400x300						
400x250						
300x250						
300x200						
250x200						
250x150						
200x150						
200x100						
150x100						
150x80						
100x80						
100x50						
80x50						
65x25						
50x25						
40x25						
40x20						
32x20						
32x15						
25x20						
20x15						

9. SCHEDULE OF FORMS

It is compulsory to the Tenderer to visit the site for better understanding of the proposed project.

SUPPLY, DELIVERY EX-SITE, INSTALLATION, TESTING, COMMISSIONING AND GUARANTEE OF CIVIL AND MECHANICAL WORKS OF TWO (1) UNIT 1500MT CRUDE PALM OIL (CPO) BULK STORAGE TANK (BST), DESPATCH BAY AND ANCILLARY WORKS AT KEMAMAN PALM OIL MILL, KEMAMAN, TERENGGANU

COMPANY NAME : _____

DATE OF VISIT : _____

TIME OF VISIT :

SIGNATURE OF CONTRACTOR :

NAME : _____

DESIGNATION : _____

I/C NO. : _____

COMPANY STAMP : _____

SIGNATURE OF **TDM PLANTATION SDN BHD**'S REPRESENTATIVE :

NAME : _____

DESIGNATION : _____

I/C NO. : _____

COMPANY STAMP : _____

(To be dully filled up by Tenderer)

1.0 INFORMATION ON TENDERER'S ORGANISATION

1.1 Company Particulars

(a) Registered Business Name: .....

.....

(b) Registered Business Address: .....

.....

.....

(c) Head Office Address:.....

.....

.....

(d) Correspondence Address (if different from all the above):

.....

.....

(e) Nature of Company whether Corporation/Public Ltd./Private Ltd./Partnership/Sole Proprietor:

.....
(Attach Memorandum and Articles of Association, Deed of Partnership or other relevant documents)

(f) Company Registration Number:.....

(g) Date and Country of Incorporation:.....

(h) E-mail Address:.....

(i) Telephone Number:.....

(j) Fax Number:.....

1.2 Number of Years In Business Under Present Name:.....….....

2.0 FINANCIAL POSITION

2.1 Capital

(a) Paid-Up Capital
(State Whether Limited Or Unlimited):* RM:.....….....

(b) Working Capital (if applicable): RM:.....

*Attach a certified true copy of the relevant documents/certificates.

3.0 STATEMENT OF DECLARATION

I/We hereby declare that all information stated in this document is true to the best of my/our knowledge and belief.

I/We hereby authorise TDM PLANTATION SDN BHD and the Consultant to make direct enquiries and references to any person, firm, authority, public official or organization named in this document in order to verify all information on the technical and financial aspects submitted herein and regarding the competence and general reputation of my/our Company.

Signature ……

Name ……

I/C No. ……

Designation ……

Address ……

……

Date ……

Bank Guarantee Agreement No:.....

This Agreement is made the _____ day of _____2025 between _____(hereinafter called the "Guarantor") of the one part and **XXX SDN BHD** (hereinafter called the "Employer") of the other part

WHEREAS

(1) This Agreement is supplemental to a Contract Number _____ (hereinafter called the 'Contract') dated the _____ day of _____2025 and made between _____ (hereinafter called the Contractor') of the one part and the Employer of the other part whereby the Contractor agreed and undertook to _____ for the sum of Malaysian Ringgit _____ (RM)

(2) The Guarantor has agreed to guarantee the due performance of the said contract in the manner hereinafter appearing.

NOW the Guarantor hereby agrees with the Employer as follows:

1. If the Contractor (unless relieved from the performance by any clause the Contractor or by statute or by the decision of a tribunal of competent jurisdiction) shall in any respect fail to execute the Contract or commit any breach of his obligations there under then the Guarantor shall pay to the Employer up to and not exceeding the sum of Malaysian Ringgit._____ _____(RM._____) representing 5% of the Contract value or such part thereof, on the Employer's demand notwithstanding any contest or protest by the Contractor or by the Guarantor or by any other third party. Provided always that the total of all partial demands so made shall not exceed the sum stated herein and that the Guarantor's liability to pay the Employer as aforesaid shall correspond kingly be reduced proportionate to any partial demand having been made as aforesaid.

2. The Guarantor shall not be discharged or released from this Agreement by any arrangement between the Contractor and the Employer with or without the consent of the Guarantor or by any alteration in the obligations undertaken by the Contractor or by any forbearance whether as to payment, time, performance or otherwise, but the Guarantor shall be entitled to be informed of such arrangement of alteration.

3. This Guarantee shall be irrevocable and shall remain in force and effect until 2 weeks after the expire date of the Defects Liability Period as provided for in the said Contract, and in the case of the Contract being determined, one calendar year after the date of the determination. Claims, if any, must be received by the Guarantor within the period of the guarantee.

IN WITNESS WHEREOF

The hand of the Employer has been hereunto set the day and year first above written in the presence of :-

Signature _____

Name _____

Designation _____

Company's Stamp _____

In the presence of: -

Signature _____

Name _____

Designation _____

IN WITNESS WHEREOF

The hand of the Guarantor has been hereunto set the day and year first above written in the presence of:

Signature _____

Name _____

Designation _____

Company's Stamp _____

In the presence of: -

Signature _____

Name _____

Designation _____

This Agreement made the .....…….. day of.....2025 between TDM PLANTATION SDN BHD of 24010 Kemaman, Terengganu (hereinafter called the "Employer") of the one part, and

.....

of .....

……(hereinafter called "the Contractor") of the other part.

WHEREAS the Employer wishes to have certain Works executed by the Contractor, viz:-

SUPPLY, DELIVERY EX-SITE, INSTALLATION, TESTING, COMMISSIONING AND GUARANTEE OF CIVIL AND MECHANICAL WORKS OF ONE (1) UNIT 1500MT CRUDE PALM OIL (CPO) BULK STORAGE TANK (BST), DESPATCH BAY AND ANCILLARY WORKS AT KEMAMAN PALM OIL MILL, KEMAMAN, TERENGGANU

and has appointed **PERUNDING AME SDN BHD** of 65-3, Block E Platinum Walk, Jalan Langkawi, Setapak, 53300 Kuala Lumpur as the Engineer for the purposes thereof (hereinafter called "the Engineer') and has accepted a Tender by the Contractor for the design, manufacture, delivery to Site, erection, testing and completion thereof and the remedying of defects therein in accordance with the General Conditions and Special Provisions hereinafter referred to under the direction of the Engineer in the sum of ..... (hereinafter called "the Contract Price").

NOW IT IS A AGREED as follows:

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

2. The following documents shall be deemed to form this Agreement:

   a) The letter of Acceptance

   b) The Appendix to the Conditions of Contract

   c) The Special Provisions to the Conditions of Contract

   d) The General Conditions of Contract

   e) The Specifications

   f) The Schedules

   g) The Drawings

   h) The Tender

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned the Contractor agrees to design, manufacture, deliver to Site, erect, test and complete the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer shall 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 hereto caused this Agreement to be entered into in the manner required by their respective constitutions.

IN WITNESS WHEREOF

The hand of the Employer has been hereunto set the day and year first above written in the presence of :-

Signature .....

Name .....

Designation .....

Company's Stamp .....

In the presence of :-

Signature .....

Name .....

Designation .....

IN WITNESS WHEREOF

The hand of the Contractor has been hereunto set the day and year first above written in the presence of :-

Signature .....

Name .....

Designation .....

Company's Stamp .....

In the presence of :-

Signature .....

Name .....

Designation .....

10. LIST OF DRAWINGS