RE-TENDER FOR RECTIFICATION WORKS AT 275KV TRANSMISSION LINE TOWER SO6 AT SAMALAJU, BINTULU DIVISION, SARAWAK

SARAWAK ENERGY REF. NO.: SLOPE-SO6-TL2018

PART I – TENDER PROCEDURES

SECTION 1 – INTRODUCTION

This Introduction should be read in conjunction with Tender Appendix A [*Scope of Works / Specifications*] set out in Part II, Section 2 of the Tender Documents.

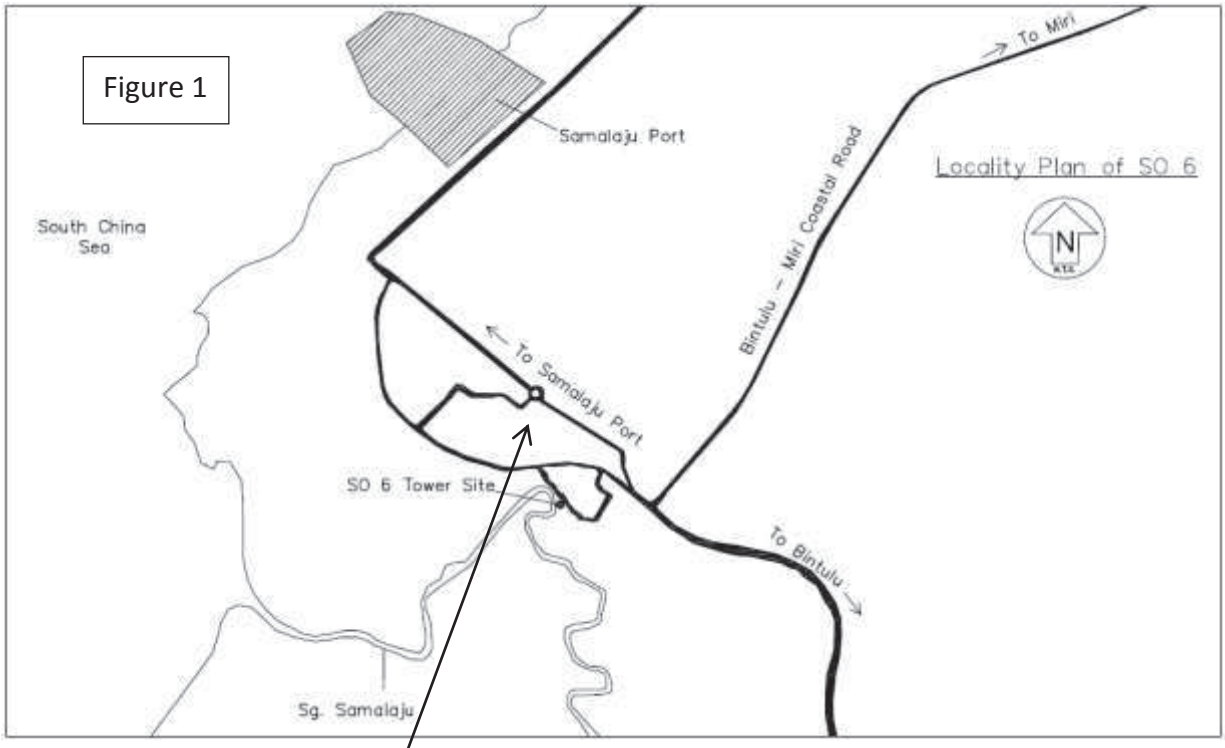
INTRODUCTION

Sarawak Energy Berhad intends to construct permanent remedial works for the slope failures at Tower SO6, which is located in Samalaju Industrial Park, situated next to Sg. Samalaju, about a kilometre east of OM Materials plant.

The tower site is accessible by road as shown in Figure 1.

Tower SO6 is located in Samalaju Industrial Park, about 50 km northeast of Bintulu. The tower is situated next to Sg. Samalaju, about a kilometre east of OM Materials plant (refer Figure 1). It is currently supplying electric power to the Samalaju Industrial Park and forms part of the Miri - Bintulu 275kV Line.

Figure 1



Aerial view of tower SO6 *(Photo taken by SEB in September 2016).*

Location	Coordinate	
SO 6	*2404680 E*	*5390061 N*

SCOPE OF WORKS / SPECIFICATIONS

The Works to be performed by the Contractor include but not limited to the followings:

(1) Rectify SO6 tower site by constructing steel sheet piled wall complete with reinforced concrete capping beam and slab, and associated works.

(2) Temporary protection to the existing transmission tower during rectification works.

(3) Reinstatement works upon completion of rectification works.

and

(4) Any other items deemed necessary for the proper completion of the Works.

The Contractor shall at his own risk and provide all materials, labour, supervision, full-time Construction Site Safety Supervisor (certified by CIDB), scaffolding, tools, plants, transport, water, light and everything else necessary (whether described or not), including temporary works of any nature, for the proper execution and completion of: the Works in conformity with the Drawings, Specifications and Conditions of Contract.

Sarawak Energy shall provide to the Contractor the following, for the purposes of performing the Works:

Annexure A - Preliminaries and General;

Annexure B - Technical Specifications;

Annexure C - Borehole Logs;

Annexure D - Health and Safety Environment (HSE); and

Annexure E - List of Tender Drawings.

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SECTION 1 – INTRODUCTION

ANNEXURE A – PRELIMINARIES AND GENERAL

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1. PRELIMINARY ITEMS

The preliminary items included hereunder apply to the whole of the Works contained in this document and the Contractor must allow for complying with same and for any cost incurred in connection therewith. The prices/rates inserted by the Contractor for preliminary items shall be deemed to apply to the whole of the Works carried out under the Contract. The monetary value of any item which is left unpriced shall be deemed to have been included in the rates for each item of work in the Summary of Tender.

2. DEFINITION OF TERMS

Wherever the following terms appear in these Part 1, Section 1 – Introduction and Part II, Tender Appendix B, shall have the meanings herein under assigned.

"**Employer**" or "**Government**" shall mean Sarawak Energy Berhad.

"**Superintending Officer**" or "**S.O.**" shall mean the Project Director, Sarawak Energy Berhad or any other person for the time being duly appointed in writing by the Employer and notified in writing to the Contractor to act as Superintending Officer for the purpose of this Contract.

"**Consultant**" or "**C&S Engineer**" shall mean KTA (Sarawak) Sdn. Bhd., (Company No. 53003-D), Lot 8650-3, Section 64, Jalan Simpang Tiga, 93350 Kuching, Sarawak.

"**Contractor**" means the person, persons or firm contracting for these works whose tender has been accepted by the Employer including his or their heir, executors or administrators.

"**Site**" means the land or other places or under in or through which the works are to be executed and any other land or places provided by the Employer for the purposes of this Contract.

"**Works**" means the whole of the materials, labour, plant and other things necessary and requisite for the proper execution of the Contract as shown on the drawings and in the Contract Documents and as are required of the Main Contractor to complete the Contract.

"**Approved**" means approved and/or selected by the Superintending Officer or his authorised representative.

"**As Directed**" means as directed by the Superintending Officer or his authorised representative.

"**Instructed**" means instructed by means of drawings, correspondence or other documents issued by the Superintending Officer.

"**As Required**" means as required in this Contract Documents or as required to carry out the works in accordance with the drawings and Contract Documents.

"**As Shown**" means as shown in the drawings.

"**Month**" means calendar month.

"**Ringgit**" or "**$**" or "**RM**" shall mean Ringgit Malaysia.

"**Satisfactory**" means to the satisfaction of the Superintending Officer.

"**Manufacturers' Instruction**" means all instructions, recommendations and advices issued by the Manufacturers or their agents.

"**Provisional**" or "**All Provisional**" means "**Provisional Quantities**" and may be varied at the discretion of the Superintending Officer where circumstances rendered it necessary and the Contractor will have no claim whatsoever for allowance of profit in respect of the work so varied or omitted completely.

Whenever the word "**Allow**" occurs in this document, the cost of the item shall be entirely at the risk of the Contractor.

3. NOTES, ABBREVIATIONS AND UNITS OF MEASUREMENT

3.1 Notes

i) Any clause in this Specification, which relates to work or materials not included in the Works, shall be deemed not applicable.

ii) Unless stated to the contrary, any dimension of material described means the finished or fully compacted dimension.

iii) All Standards and Codes of Practice referred to in this Specification shall be deemed to be the editions current at the time of Tender. If the Malaysian Standard exists, which the S.O. deems to be equivalent to the British or other Standard specified, then the Malaysian Standard shall be followed.

In the event of any discrepancy between the provision of this Specification and the provision within the relevant Standards or Codes of Practice as mentioned in this Specification, then the provision of this Specification shall take precedence.

3.2 Abbreviations

M.S. means Malaysian Standards published by the Scientific and Industrial Research Institute of Malaysia (SIRIM).

B.S. means British Standards published by the British Standard Institution.

A.A.S.H.T.O. means The American Association of State Highway and Transportation Officials.

A.S.T.M. means The American Society for Testing and Materials.

M.D.D. means Maximum Dry Density.

O.M.C. means Optimum Moisture Content.

C.B.R. means California Bearing Ratio.

3.3 Units of Measurement

All units of measurement used in this Specification and in the Schedule of Prices shall be in accordance with the metric system unless otherwise stated.

Where British Imperial units are shown or stated the following conversions shall apply:

1 inch	=	25.40 millimetres
1 foot	=	0.3048 metres
1 lb	=	0.4536 kilograms
1 gallon	=	4.5461 litres
1 lb/sq. in.	=	6.895×10^{-3} N/sq.mm.

4. TYPE OF CONTRACT

This contract is based on a firm price lump sum tender, for the execution of the whole of the Works and no adjustments shall be made to the Contract Sum for any 'fluctuations'. The Contractor will not be reimbursed for rises and falls in:-

(a) Cost of wages and/or emoluments and expenses of any kind, payable to work people engaged for the execution of, or connected with the works,

(b) Cost of materials and goods and any duty or tax by whomsoever payable which is payable under or by virtue of any Act of Parliament on the import, purchases, sale, appropriation, processing or use of materials and goods,

(c) Any cost arising out of any amendment to existing legislation or subsequent enactment, irrespective of such rises or falls coming into effect after the submission of tenders or during the progress of the works.

5. PRIORITY OF DOCUMENTS

The documents forming the Contract shall be taken as mutually explanatory of each other and in the case of any discrepancies or inconsistency, the following rules shall apply:

(1) Appendix and Addendum of Form of Contract shall take precedence over Form of Contract.

(2) In drawings, large-scale details are to take preference over smaller scale details.

(3) Figured or written dimensions on the drawings prevail over scaled dimensions.

(4) Contract Drawings shall take precedence over Specification and Schedule of Prices.

(5) The lump sum amount shown in the Form of Tender shall prevail over that shown in the Summary of Tender.

Any discrepancies shall be referred as soon as possible to the S.O., who shall decide which shall be followed.

6. CONTRACTOR TO VISIT SITE OF WORKS

The Contractor shall visit the site of the Works and shall by independent inquiry and observation to ascertain and satisfy them before tendering the following in connection with the Works:

(1) The nature, character and extent of the works and site.

(2) Local conditions.

(3) The means of access to and from and within the site of the works.

(4) The extent of working space available.

(5) The conditions affecting labour and materials.

(6) The conditions affecting the storage of materials, the positioning of sheds, stores, site offices, temporary buildings and plants.

(7) The location of all primary services, including electric cables, water mains, telephone services, storm and soil water drains and sewers in or above ground; the presence of artificial obstruction, boulders and the like.

(8) The nearest points from which electricity, water and other like temporary services can be connected.

(9) The character of the soil or strata and the nature of subsoil upon which the works are to be executed.

(10) All other information which may in any way is relevant or necessary to enable the Contractor to estimate accurately the cost of the works.

No claims made on the ground of failure to visit the site and/or of want of any of the aforesaid matters or others like information which might financially affect the Contract, will be considered.

7. ACCESS TO AND WITHIN SITE

The Contractor at his own expense, contract and make necessary arrangement or agreements with the owners of private properties at the Site for the use of such

properties in the execution of work required under the Contract, and shall be abide by the terms of such agreements. The S.O. will offer all possible assistance to the Contractor for securing permission to enter upon such private properties for his work. The cost of use and restoration of public or private property for any reason whatsoever in connection with this clause herein shall be borne solely by the Contractor.

8. SETTING OUT

The Contractor shall be responsible for all setting out of the Works for construction purposes and shall provide a competent Engineering Surveyor to carry out such setting out. The name and qualifications of the Engineering Surveyor shall be submitted to the S.O. for approval within 14 days from the day of acceptance of this tender.

All setting out shall be in accordance with the lines and levels shown on the drawings, computer print-out or any other form in which the survey information is provided, and any required variation therefrom shall first be approved by the S.O.

Before commencing work at any location, the Contractor shall give the S.O. not less than 24-hour notice of his intention to set out or give levels for any of the Works in order that arrangements may be made for checking.

Checking of the setting out of any part of the work under this Contract may be carried out any time by the S.O., and the Contractor shall provide any assistance that may be required to carry out such checking.

Notwithstanding this provision, the Contractor shall not be relieved of his responsibility for the correctness of the setting out and levelling, and will remedy at his own cost any works wrongly performed as a result of incorrect setting out or levelling including the rebuilding of any section of work so constructed, whether such work was checked by the S.O., or not.

9. DIMENSIONS AND LEVELS

Before the Works or any part thereof are commenced, the Contractor shall verify the dimensions and levels shown on the Drawings, Computer Print-outs etc., and shall notify the S.O. of any discrepancy which may affect the dimensions or levels or any part of the Works. Such notification by the Contractor shall be given in sufficient time to allow the S.O. to prepare details showing his amended requirements.

The Contractor shall in particular verify the levels of the existing ground surface within areas where earthworks are to be performed and the locations and bed levels of watercourses. These may differ from the levels and locations shown on the Drawings depending on the extent of erosion and settlement, which have taken place during the interval between survey and construction.

Where payment is to be made on measured quantities, the levels and dimensions taken by the Contractor and agreed by the S.O. shall form the basis of such measurement of works for payment. Failing such taking of levels and dimensions and agreement, the dimensions and levels shown on the Drawings or as otherwise determined by the S.O. shall be final and binding on the Contractor.

Written or figured dimensions are to be preferred in every case to scaled dimensions. Scaled dimensions may only be used after confirmation by the S.O. or his accredited representative.

10. PROTECTION OF WORKS

From the commencement of the Works to the date the Works are taken over by the Employer, the Contractor shall take full responsibility for the care thereof together with all temporary works and in case any damage, loss or injury shall happen to the Works or to any part thereof or to any temporary works from any cause whatsoever, he shall at his own cost repair and make good the same so that at completion, the Works shall be in good order and condition and in conformity in every respect with the requirements of the Contract and the S.O.'s instructions. The Contractor shall also be liable for any damage to the Works occasioned by him in the course of any operations carried out during the Defects Liability Period.

11. DESIGN OF TEMPORARY WORKS BY THE CONTRACTOR

Unless otherwise stated or requested by the S.O., the Contractor shall submit for the S.O.’s record purpose, the drawings and calculations, which are certified by a Professional Engineer, of any temporary works he intends to construct at least 14 days before commencing construction. Notwithstanding the comment made by the S.O., the Contractor is solely responsible for the adequacy and safety of his work and for any necessary modification or addition whenever found necessary by the S.O.

The Contractor shall be liable for the design and construction of the temporary works.

The Contractor shall make safe and reinstate all areas affected by the temporary works to its original condition.

12. ADJOINING PROPERTY

The Contractor shall arrange and carry out the works so as to cause minimum interference or interruption to the adjoining properties including roads, footpaths, other access and any existing services thereto. He shall comply with all instructions or directions given by the S.O. in these matters.

13. GOODS, MATERIALS AND WORKMANSHIP

Material and workmanship throughout the Works shall be to the approval of the S.O.

Wherever, in this Specification any proprietary goods or materials are specified, goods or materials of alternative manufacturer may be considered for acceptance provided they comply in all respect as regards to appearance and quality and are approved by the S.O.

If, however, the Contractor has shown beyond reasonable doubt that the specified goods or materials cannot be obtained and the S.O. is satisfied with regard to the non-availability of the goods and materials and there is also the lack of time, the benefit of cost savings, if any, resulting from the Contractor's proposal or substitution of goods or materials approved by the S.O. shall be deducted from the Contract Sum.

14. METRICATION

Unless otherwise specified hereinafter or shown in the drawings, only materials of metric dimension shall be used for the Work. Materials of equivalent imperial dimension may only be used if the Contractor can satisfy the S.O. that the required materials are not available in metric dimension.

15. ORDERING

The Contractor shall place his orders for specified materials at the earliest possible date after notification of acceptance of tender or at such times as may be specifically stated elsewhere herein for any particular material.

16. SAMPLES

The Contractor shall submit samples of materials or execute samples of workmanship for S.O.'s approval, and for further samples as required until the samples submitted or executed are in accordance with these specifications.

Samples, after approval, shall indicate the standard of materials and workmanship to be maintained in the execution of the Works.

17. CONTRACTOR'S PLANT

All mechanical plant used by the Contractor shall be of such type, size and method of working suitable to the type and nature of the works and site conditions where the works are to be executed.

18. MAINTENANCE OF EXISTING ROADS AND PROTECTION OF TRAFFIC

The Contractor shall maintain and carry out repairs alterations or additions, as may be required, to existing roads, bridges, culverts and any other associated structures within the Resettlement sites in order to render them safe and suitable for traffic at all times and for the full duration of the Contract unless otherwise directed or permitted by the S.O. In the event that the Contractor fails to carry out such maintenance, repairs or alterations, or fails to achieve the required standard, the Employer may, after giving notice to the Contractor, carry out such maintenance, repairs or alterations so required, and recover such costs from the Contractor.

19. LOCATION, TEMPORARY PROTECTION AND TEMPORARY DIVERSION OF PUBLIC UTILITY INSTALLATIONS AND OTHER SERVICES

The Contractor shall be responsible for locating the positions of all public utility installations, including water mains, overhead and underground cables, pipes, sewers and drains and all service connections to buildings, and where necessary, shall adopt

such methods of excavation as may be required by the appropriate authorities or owners to ensure that no damage is caused to them.

The Contractor shall make good, at his own expense, any damage caused by him to the existing services to the approval of and in accordance with the instruction of the appropriate authority or owner concerned, and shall keep the Employer indemnified at all times from all claims, costs and expenses which may arise on account of any damage (whether permanent, temporary or recurring) to the said services.

Any information given on the drawings, or by the S.O., is given as a guide only and does not relieve the Contractor of the responsibility of making his own enquiries.

The location of the underground services shall be marked on the ground by the Contractor using approved markings, and the Contractor shall allow for, and carry out any pilot trench excavations required to determine their exact locations.

All such installations, which are encountered in the course of the Works, shall be adequately supported, slung-up, strutted or otherwise protected from injury to the satisfaction of the respective authority.

The temporary diversion or relocation of any service within or outside the Works to permit the construction of the Works shall be the responsibility of the Contractor.

The Contractor shall inform the service authority or owner, and the S.O., regarding the services that will be affected by the work to be carried out under the Contract and obtain their requirements with respect to:

(a) methods of excavation and/or backfill required to prevent damage

(b) relocations (i.e. moving the service to a new permanent location) or temporary diversions required

(c) any other special precautions or requirements

The Contractor shall programme for, and carry out, such required relocations or temporary diversions to satisfy any timing and other requirements by the service authority, the owner and the S.O., to the satisfaction of the service authority and the S.O., with minimum inconvenience to road users and adjacent residents. Where the service authority requires for the relocation work to be carried out by the service authority themselves, the Contractor shall be responsible to co-ordinate and arrange for such work to be carried out and allow all such effects arising therefrom.

Temporary diversion shall mean works involved in the diversion of services that will be reinstated to their original position and condition on completion of the works in the affected areas. In planning his work for the diversion or relocation of services, the Contractor shall make reasonable allowance for the time necessary to obtain the S.O.'s approval for the work and for the appropriate authorities or owners to authorise the work, obtain the necessary materials and carry out the work.

The Contractor shall not be entitled to any extension of time due to his failure to allow for a reasonable period of time necessary for obtaining approval and completing the work.

20. DRAINAGE OF SITE

The Contractor shall make proper provision for the drainage of surface water from the work site including rainwater from surrounding areas which drain on to the site.

The Contractor shall at his own cost, provide, form, fix and maintain such pumps, chutes, walls, drains, bunds, silt traps and other temporary works necessary for the proper drainage of the site so that no flooding or other damage or disturbance is caused to areas surrounding the Works or to the Works throughout the duration of the Contract.

21. SITE OFFICE AND ACCOMMODATION FOR S.O.'S SUPERVISING STAFF

The Contractor shall provide a well-lit and fully air-conditioned room in their site office for S.O.'s supervising staff, and shall furnish the following furniture and equipment:

(a) Two (2) office tables, five (5) chairs, and two (2) lockable steel file cabinets.

(b) Two (2) new mobile phone with connection to the Malaysia's private phone network system, complete with mobile data of minimum 3GB per month, battery charger, and accessories; including paying rental and call charges to a maximum of Ringgit Malaysia Two Hundred Only (RM200.00) per month for hand phone set.

(c) One (1) photocopying machine (up to A3 size, with reduction / enlargement features) complete with sufficient A3 and A4 papers and toners as and when requested by S.O.,

(d) One (1) set of new laptop computer system with following minimum requirements comprises:

(i) Computer set with Intel Core i5 2.3GHz dual-core Processor, 4GB LPDDR3 Memory, 128GB SSD storage, 13.3" full HD resolution screen, 16x DVD-RW drive, cordless mouse, mouse pad, automatic voltage regulator and uninterruptible power source. Latest version of licensed software for MICROSOFT WINDOWS, MICROSOFT OFFICE full version, and anti-virus software.

(ii) One (1) laser printer (colour) for A4 size paper, complete with scanning and facsimile facilities, including the supply of all consumable items.

(iii) Supply of compact diskettes and DVD diskettes as and when requested by S.O.

(e) Supply of stationeries as and when requested by S.O.

(f) Office accessories including 1 no. programmable calculators, 10 pairs safety rubber boots, 10 No. safety helmets, 10 pairs safety boots, 10 No. dust masks, and 10 No. raincoats.

The Contractor shall maintain the site offices and its facilities and equipment including paying rental of telephone lines with internet service and calls charges, electricity and water bills, cleaning and repairing until practical completion of the Works.

All furniture, equipment and fittings of the site office shall remain the property of the Contractor after the removal of the site office, and the Contractor shall reflect the repossession of the items in his pricing of site office.

The Contractor shall provide one (1) unit accommodation with two (2) bedrooms and a built-up area of minimum 70m^2 or equivalent at the Transmission Tower site for S.O.'s supervising staff. The rented quarter shall be in close proximity to the site, and acceptable to S.O.

The accommodation shall be provided with furniture, fittings, appliances and equipment as specified below:

Table A1 – Furniture, Fittings, Appliances and Equipment for S.O.'s Accommodation

Item	Description	No./set
(i)	*Living Room and Dining Area*	
	Sofa, upholstered for 3 persons (rubber cushion type of approved quality).	1
	Coffee table.	1
	Fire extinguisher (soda acid).	1
	Stand/Ceiling fan.	1
	Dining table with 6 No. chair, upholstered with backrest.	1
	Stand/Ceiling fan.	1
(ii)	*Kitchen*	
	2.4m long x 0.75m wide x 1m high bench with built-in cupboard complete with stainless steel sink, all Formica lined or approved type.	1
	Cooker with 2 gas rings, including one (1) gas cylinder.	1
	Refrigerator (min. 250 litres) with doors.	1
	Electric rice cooker (1.8 litres).	1
	Electric kettle (3 litres).	1
	Table fan.	1
(iii)	*Each Bedroom*	
	Queen size double bed with headboard, completed with 150mm good quality rubber mattress, pillows, bolster, 2 bed sheets, 4 pillow covers, 2 bedcovers, 2 blankets, 2 bedside table, and 2 bedside reading lamps.	1
	Writing table with 2 drawers, including 1 chair with backrest.	1
	1.5 HP air-conditioning unit.	1
(vi)	*Bath/Toilet Room*	
	Shower unit with pull back curtain.	1
	Plastic pails.	2
	Stainless steel clothing rail.	1

The accommodation shall be connected to the electricity and water supplies from the public utility authorities or private operators. Electricity and water bills of the buildings shall be paid by the Contractor.

The Contractor shall pay for all rental deposits, commissions, connection charges to all services and any cost associated with securing the accommodation for S.O.

At the end of the one-month period after the practical completion of the Works, the Contractor shall pay for any disconnecting charges of services, and any costs associated with removing all the furniture, fittings and appliances.

22. VEHICLES FOR THE S.O.'S SUPERVISING STAFF

The Contractor shall provide one (1) new unit of air-conditioned four wheel drive vehicle of minimum 2800 c.c., crew cab type, complete with competent driver for the S.O.'s supervising staff or any other persons permitted by the S.O. for the supervision of the Works and administration of the Contract (hereinafter referred as S.O.'s staff") within one (1) week after Date for Possession of Site.

The vehicle shall be maintained by the Contractor until one (1) months after the practical completion of the Works.

The Contractor shall ensure that the vehicle is accident free and are in a well maintained condition. The Contractor shall also provide comprehensive insurance to cover the driver and passengers, and ensure that all road tax is valid throughout the maintenance period.

All necessary fuel, oil and lubricants, general maintenance, comprehensive insurances and road tax shall be provided by the Contractor throughout the contract period. Replacement of vehicle shall be provided when normal vehicle is not available such as during periods of servicing, maintenance or repair.

The vehicle shall be in the custody of the Contractor at all times, and shall remain the property of the Contractor after the maintenance period.

23. RESTRICT WORKMEN TO THE SITE

The Contractor shall be responsible for restricting all persons under his control, including those employed by Sub-contractors, Merchants and Haulers to the site of the works and shall take all necessary precautions to prevent damage and nuisance of any kind and shall indemnify Employer against any claim arising here from.

24. FIRST AID KIT

The Contractor shall be required to provide a complete First Aid Kit which shall be kept and properly maintained in the Contractor's Site Office. The Kit shall be in the

charge of either the Contractor's site representative or some other responsible person who will be on the site during all working hours to ensure that the First Aid facilities are available without delay at all times when work is in progress. One responsible member of the Contractor's staff shall be trained in first aid duties.

25. SANITATION

The Contractor shall provide for his workmen adequate temporary latrine, accommodation, and bathing place, built on concrete floors and provided with all necessary water and drainage. These facilities shall, in every respect, conform, and be maintained to the satisfaction of the Health and/or other local authorities.

26. WATER AND POWER

The Contractor shall provide and maintain all water, lighting and electric power required for use in the Works and shall pay all costs, fees and charges in connection therewith and allow all Sub-contractors free use of same.

27. SECURITY WATCHING

The Contractor shall provide all necessary security watching and lighting at all times for the whole period of the Works.

28. HOARDING AND OTHER PRECAUTIONARY MEASURES

The Contractor shall supply, erect and maintain for as long as is considered necessary adequate fencing, hoarding, warning lamps and such other precautionary measures necessary to ensure the safety of the public and others who may be on or within the vicinity of the site. Wherever required, these precautionary measures shall be done in accordance with the relevant local bye-laws. The Contractor will be held solely responsible for all accidents arising from any negligence in this respect.

29. PROGRAMME

Within 14 days after the receipt of the Letter of Acceptance of Tender, the Contractor shall submit to the S.O. for his approval a programme using "Primavera" or approved equivalent software showing the order or procedure and method in

which the Contractor proposes to carry out the works and shall whenever required by the S.O., furnish for this information particulars in writing of the Contractor's arrangements for carrying out of the Works and of the constructional Plant and temporary works, if any, which the Contractor intends to supply, use or construct as the case may be. The programme shall also include planning of the workforces required to carry out the tasks/works. The submission to and approval by the S.O. of such programme or the furnishing of such particulars shall not relieve the Contractor of any of his duties or responsibilities under the Contract.

If at any time it should appear to the S.O. that the actual progress of the Works does not conform to the approved programme referred to hereinbefore, the Contractor shall produce, at the request or the S.O., a revised programme showing the modifications to the approved programme necessary to ensure completion of the whole Works within the time for completion as stated in the Contract.

30. PHOTOGRAPHIC RECORD OF WORKS

The Contractor shall provide one (1) No. new project digital camera of the following specification for the purpose of taking record photographs and videos of the Works as and when directed by the S.O.:

- minimum 12 mega-pixel;
- 4X optical zoom with built-in flashlight, time and date features;
- 2 No. 32GB memory card;
- capable of recording still and mobile images;
- waterproof casing;
- rechargeable battery, spare battery and battery charger;
- camera case; and
- accessories.

The Contractor shall bear the costs of providing the film, development of film, printing of photos in 4R size (minimum 50 prints per set) and documenting the photographs in suitable albums.

The digital files of the photographs shall be the property of the Employer and no prints from these digital files may be supplied to any person or persons except with the approval of the S.O. A suitably typed caption shall be affixed to the reverse side of each photograph describing the subject and the time at which it was taken. One copy of each photograph shall be signed by the Contractor and the S.O.

31. WORKING HOURS AND OVERTIME

Normal working hours of S.O.'s Site Supervisory Staff shall be within the period 8.00 am to 5.00 pm Monday to Friday, and within the period 8.00 am to 12.00 noon on Saturday. No work shall be carried out on Sunday or prescribed Public Holidays or outside normal working hours or any day without the permission of S.O. Except in extraordinary circumstances such permission will be granted only relation to plant maintenance or similar works not forming part of the permanent works and not required supervision by S.O. The Contractor shall give not less than two (2) days' notice to the S.O. of any work he proposes to carry out outside normal working hours and the S.O.'s decision as to whether work may be so proceed shall be binding and not subject to appeal.

In the event that the S.O.'s approval is obtained for works forming part of the permanent Works outside these normal working hours, which require supervision by their Site Supervisory Staff, the Contractor shall reimburse Sarawak Energy for the overtime expenses incurred for such supervision. The Contractor shall issue payment within twenty eight (28) days of receipt of overtime expenses billed by the Consultant. Failing to do so, Sarawak Energy may deduct from money due or become due to the Contractor under this Contract.

32. SAFETY PROVISION

The Contractor shall be responsible for the safety of all workmen and other authorized persons entering the Works and shall take all necessary measures to ensure their safety. Such measures shall include:

(a) Provide and display safety and emergency regulations
(b) Provide and display warning signs
(c) Provide a fully equipped first-aid box. At least one member of the Contractor's workforce should be available at all times, conversant with first-aid.
(d) Safe supporting of all excavation
(e) Provide Personnel Protective Equipment (PPE) where necessary for all personnel including authorized visitors to the Works and the ER's staff
(f) Provide safe reliable plant and equipment properly maintained and regularly checked.

The Contractor shall ensure that all national, local and trade safety regulations are complied with and shall submit for S.O.'s approval the regulations which he proposes to distribute and/or display to workmen.

The Contractor shall ensure that all his employees are fully conversant with the safety regulations, emergency and rescue procedures and shall dismiss any employee committing a breach of such regulations. A fully qualified full-time Construction Site Safety Supervisor (certified by CIDB) shall be employed for the project.

Failure to comply with safety regulations may result in a **Stop Work Order** being issued in accordance with the Safety Codes/Rules and Safety Acts.

33. COMPLIANCE WITH ENVIRONMENTAL LEGISLATION AND OTHER REQUIREMENTS

The Contractor shall be fully responsible for carrying out the whole works in an environmental friendly manner, and in particular shall strictly comply with the Environmental Quality Act 1974 and its subsidiary regulations as well as any by-laws as amended from time to time, guidelines and requirements made by any public, statutory and government agencies relevant to the environmental aspects of the site and other related issues thereto.

The Contractor shall keep the Sarawak Energy and/or his representatives indemnify from any breach of the Act, regulations, by-laws, guidelines and requirements throughout the execution of the Works.

The Contractor shall price for all costs and expenses to provide care of work, safety on site and all preventive measures to prevent injury, damages to work, provide and proper preservation of existing vegetation, protection of existing or new slopes from erosion or slippage and to construct adequate temporary water courses and drains to prevent erosion and water ponding.

34. PROJECT REGISTRATION WITH DOSH

Any building operation or works of engineering construction involving use of machinery and which the project duration exceeds six weeks old should be registered with DOSH via “Form E, Factories and Machinery Act 1967, Factories and Machinery (Notification, Certification of fitness and Inspection) 1970 – Regulation 4”.

35. MONTHLY REPORTS AND SITE MEETINGS

35.1 Monthly Reports

The Contractor shall prepare a written overall report at monthly intervals on the progress of the Works, covering progress of the month and overall, the then current Construction Programme. The Report shall be supported by photographs and include:

- Physical and Financial Progress for the Month, and overall, together with "S-Curves" for the overall Physical and Financial Progress.
- Anticipated cash-flow.
- The Construction Programme suitably marked up to show the current status.
- A summary progress schedule for each main activity and delivery dates of principal materials.
- Details of any activity changes in the period.
- A statement of the time gained or lost, during the month and overall.
- Reason for delays, and actions proposed to overcome such delays.
- A summary of the proposed activities and work areas for the coming month.
- A Schedule of Extensions of Time showing:
    - days or hours claimed for each notice of a claimed extension of time.
    - days or hours approved for each notice of a claimed extension of time.
    - cumulative total approved extension of time.
    - the then current contract completion date.
- A schedule of variations and other money claims submitted, and their status and details of the actual level of manpower and plant on the site on a weekly basis.

The Contractor shall, unless otherwise specified or instructed, provide four (4) copies of the Monthly Report to the S.O. within 7 days of the end of each calendar month.

35.2 Weekly Report

The Contract6or shall provide weekly report in digital form to the S.O. and the Consultants on every Monday. The Report shall include:

- progress of the week supported with photographs;
- manpower, plants and machineries on Site; and
- proposed activities for the coming week.

35.3 Site Meetings

Site Meetings shall be held to discuss progress on the Contract, and any matters in connection with the Contract, which the parties wish to raise.

The Contractor and/or his representative(s) shall attend site meetings, which will also be attended by the S.O. and the Consultant. The meeting shall be held at the time frequency and location to be advised by the S.O. (or his representative), who shall also chair the meeting and be responsible for the meeting's minutes.

36. SHOP DRAWINGS AND AS-BUILT DRAWINGS

36.1 Shop Drawings

Where Shop Drawing or Schedules (which terms are deemed to include the Contractor's design, fabrication and construction drawings, material schedules, survey records, and the like) are required to be submitted for any of the works or part of the Works, the Contractor shall be responsible to supply such required Shop Drawings or Schedules to the S.O.

Drawings shall be A1 size unless otherwise approved by the S.O., and shall be clear and legible and suitable for reduction in size to A3 size. Schedules and the like shall be A4 size unless otherwise approved by the S.O. Three (3) copies of such Drawings or Schedules shall be submitted unless a greater number is specified elsewhere in the Contract.

The S.O. will review such Shop Drawings and Schedules and advise the Contractor of any adjustment or resubmissions to be made. In the event of resubmissions being required, a minimum of three (3) copies shall be supplied. The Contractor shall not be entitled to any cost or time adjustments associated with such corrections and/or resubmissions.

Where the S.O. is reasonably of the opinion that the Shop Drawings or Schedules satisfy the requirements, he will affix an authorization and "Construction Issue" stamp to them, granting "permission to use" status to those documents, and return one (1) copy of such authorized documents to the Contractor.

Notwithstanding the granting of "permission to use" to any such documents, this does not relieve the Contractor from the full responsibility for the correctness and sufficiency of such documents.

36.2 **"As-Built" Documents**

During the construction the Contractor shall keep accurate records and maintain two (2) sets of documents both marked up in red to reflect approved changes and "as built" details (including alignment and levels). Such documentation shall proceed as each portion of the work is completed. During the construction period, one set of such marked-up drawings shall at all times be available to the S.O. for short periods as appropriate for him to study, utilize in this office, copy data or check as-built construction in the field.

Upon completion of the Works or sections of the Works, the Contractor shall provide one (1) set originals, and three (3) printed copies of all as-built drawings, complete with three (3) CD-ROM containing the soft copies of these drawings (both in PDF format and AutoCAD format) to the S.O. These drawings shall also include the as-built construction details of the shop drawings and shall be certified by the Contractor.

37. CLEARING UP OF SITE

The Contractor shall make every effort to keep the Site in reasonably clean and tidy condition for the duration of the Works, and shall, from time to time, remove site rubbish and surplus material arising from the execution of the work under the Contract (including any work performed during the Defects Liability Period), and make good disturbed areas all to the approval of the S.O. Particular attention must also be taken to prevent the spread of dengue in accordance with Employer Regulations issued from time to time.

Within fourteen (14) days after the Date of Practical Completion of the Works, the Contractor shall remove all buildings, workshops, Temporary Works, Construction Plant and equipment which he may have constructed or brought on the Site for carrying out the work under the Contract except such as are required by the Contractor for the purpose of performing the work during the Defects Liability Period for the Works specified in the Contract, and which the S.O. permits to remain on the site.

All areas outside the road prism which have been disturbed during construction, including spoil dumps and borrow pits must be properly landscaped and trimmed to the satisfaction of the S.O. All excess earth, stones, boulders, debris and other waste material must be removed or buried to approval.

Disused roads, including access tracks and haulage roads, shall be levelled with the existing ground scarified and broken up to a depth of 150mm to promote plant growth.

Top soil and protective vegetation for erosion control shall then be provided in accordance with Clause 2.2.8, to the approval of the S.O.

All buildings, workshops, Temporary Works, Construction Plan and equipment required by the Contractor the purpose of performing work during the Defects Liability Period for the Works or during any Operational Maintenance Period for the Works specified in the Contract shall be removed by the Contractor on completion of that work and he shall ensure that, within fourteen (14) days after the completion of that work, the site is left clean and tidy and free of rubbish and surplus material and with disturbed areas made good all to the satisfaction of the S.O.

If the Contractor fails to comply with any obligation imposed on him by this clause the Employer may, after giving 2-day notice in writing to the Contractor, have the work of cleaning and tidying up carried out by other persons and the cost incurred by the Employer in having the work so carried out shall be a debt due from the Contractor to the Employer which may be deducted or recovered by the Employer pursuant to the Form of Contract.

Before handing over the Works to the S.O. the Contractor shall scrub all floors, pavings, staircase, etc. and clean out all gutters, gulleys, manholes, sumps and drains. The Contractor shall also clean all glass panes and leave every part of the completed Works included in this Contract in clean, sound and tidy condition to the approval of the S.O.

38. OPPORTUNITIES FOR OTHER CONTRACTORS

The Contractor shall, when required by the S.O., afford all reasonable opportunity to any other Contractors employed by the Sarawak Energy and their workmen and to the workmen of the Sarawak Energy and of any other duly constituted authorities who may be employed in the execution on or near the Site of any work not included in the Contract.

RE-TENDER FOR RECTIFICATION WORKS AT 275KV TRANSMISSION LINE TOWER SO6 AT SAMALAJU, BINTULU DIVISION, SARAWAK

SARAWAK ENERGY REF. NO.: SLOPE-SO6-TL2018

PART I – TENDER PROCEDURES

SECTION 1 – INTRODUCTION

ANNEXURE B – TECHNICAL SPECIFICATIONS

ANNEXURE B – TECHNICAL SPECIFICATIONS

1. EXCAVATION

1.1 Relocation of Existing Utilities and Services

Before commencing on any excavation the Contractor or his representative shall accompany the S.O. on a site inspection to consider any circumstances, which may indicate the presence of underground cables, water or other service pipes at or in the vicinity of such excavations. Thereafter the Contractor shall carry out the excavation work in a manner and sequence as approved by the S.O.

If during excavation the Contractor's workmen uncover any cables or other service pipes, work shall be stopped immediately and shall not be again started until the matter has been reported to the S.O. who will notify the appropriate Local Authority and subsequently issue whatever directions he deems appropriate.

1.2 Excavation for Foundations Pits and Trenches

Foundation trenches, pier holes, etc. shall be excavated to the lengths and widths as shown on the drawings, with sides trimmed and bottoms levelled and stepped as required.

All excavations shall be carried down to hard ground. On no account shall foundations rest or made filled ground. Any variation to depth as shown on the Drawings, together with any variation caused thereby to concrete and brickwork, etc. shall be measured and valued as variations, as provided for in the Contract and the Contract Sum shall be adjusted accordingly. The Contractor shall at his own cost and expense, make good any over excavation below the required depth with suitable material or concrete as approved by the S.O.

1.3 Sides of Excavation

The Contractor shall ensure that at all times the sides of the excavation are maintained in a safe and stable condition and shall be responsible for adequate provision of all timbering and strutting required for this purpose and shall comply with any instructions issued by the S.O. in this respect.

1.4 Excavation to be Kept Dry

The Contractor shall be responsible for keeping dry all excavations whether in open cut or in trench so as not to interfere with the work in progress. He shall without extra cost to the Employer, provide, fix, maintain and work as and where directed by the S.O., such pumps, wells, drains, dams and other things necessary to effectively deal with all water which may collect or find its way into the excavation from any cause whatsoever. Nevertheless such directive shall not relieve the Contractor from his liability for any damage to the Works or adjoining land and property or water courses due to his operations.

1.5 Bottom of Excavation

Unless otherwise stated, the excavation, whether in open cut or in trench, shall be proceeded with in such portions at a time as the S.O. may approve and shall not in the first instance be carried down to a depth nearer than 150mm above the required excavation level; the last 150mm of depth to the said level shall be carried out by manual labour immediately in advance of placing concrete.

Any pockets of soft material or loose rock in the bottom of pits and trenches shall be removed and the resulting cavities and any large fissures filled with properly compacting blinding concrete. The Contractor shall take such steps as and when necessary to prevent damage to the bottom of excavation due to exposure to the weather. After the placing of any blinding concrete no trimming of the side faces shall be carried out for the next 24 hours.

1.6 Inspection

The Contractor shall report to the S.O. when the excavations are ready to receive concrete and no concrete shall be laid until the excavation have been inspected and approved by the S.O.

1.7 Backfilling

A portion of the excavated material shall be returned, filled around walls, columns and the like in 225mm layers and each layer thoroughly compacted using rammers or mechanical compactors as the S.O. may approved, until compaction is complete. However, only suitable and approved fill materials shall be returned for backfilling. The surplus excavated materials shall be deposited, spread and levelled on site or deposited elsewhere as approved.

Any planking sheets used for the sides of the excavation shall be withdrawn in stages as the compaction of backfilling proceeds.

1.8 Clearing of Existing Ditches, Drains, River, etc.

During the execution of the earthwork, the Contractor shall take all necessary precautions to prevent blockage or obstruction and to ensure free-flow of existing drains, ditches, streams and the like.

1.9 Protection and Maintenance of Earthworks

The Contractor shall provide all necessary protection and maintenance of earthworks particularly from the damaging effects of water entering the works from rainfall, runoff, springs, rivers or streams. Damage to finished or partly completed work arising from the lack of such protection and maintenance work shall be made good by the Contractor at his own cost and expense.

1.10 Hardcore

Where shown and required approved hardcore consisting of good, sound, broken bricks or stones shall be provided and laid to the thickness shown on the drawings, well rammed, compacted and blinded with sand.

All hardcore shall be well watered immediately prior to the depositing of concrete thereon.

1.11 Excavated Material

All excavated materials not needed for backfilling including materials arising from cutting and trimming but suitable for filling shall be deposited, spread and levelled on site or stock-piled at an approved location on site as directed by the S.O..

Unsuitable spoils, surplus material or material containing organic matter shall be carted off the site as directed by the S.O.

Cart away shall mean either carting off unsuitable or surplus material from the site and dumping at an approved place or carting suitable fill material to designated location on site, deposit, spread and level as directed by the S.O.

1.12 Compaction of Excavated Surfaces

All excavated surfaces about to receive concrete or hardcore shall be consolidated and compacted where necessary to the satisfaction of the S.O.

2. STEEL SHEET PILES

2.1 General

The Contractor shall construct the Sheet pile wall and other sheet piles to the extent, at the locations and to the details shown in the drawings and as specified unless otherwise instructed by the S.O.

All materials and workmanship shall be in accordance with this specification.

2.2 British Standards and other Codes of Practice

All materials and workmanship shall be in accordance with the appropriate British Standards, Japanese Standards, Codes of Practice and other specified standards current at the date of tender except where the requirements of these Standards and Codes of Practice are in conflict with this Specification in which case the requirements of this Specification shall take precedence.

The whole of the works and materials are to be in accordance with the following British Standards:

- BS 8002: 1994 – Code of Practice for Earth Retaining Structure;
- BS 4360 – Specification for Weldable Structural Steels for Grade 43A or 50A steel;
- BS EN 10025 – Hot Rolled Products of Structural Steels for Grade Fe 430A or Fe 510A; and
- JIS A 5523: 2012 – Weldable Hot Rolled Steel Sheet Piles for Grade SYW 295.

2.3 Ordering of Piles

The Contractor shall furnish manufacturer's certificates for sheet piles supplied as proof of the quality for acceptance by the S.O. before any materials are brought to site.

The Contractor shall ensure that the piles are available at the time for incorporation in the Works. All piles and production facilities shall be made available for inspection at any time. Only new piles shall be used for permanent works. Piles shall be carefully

examined at the time of delivery and damaged piles repaired or replaced. The records of testing of the steel used in the piles shall be submitted prior to commencing the works.

2.4 Materials

2.4.1 General

The type of sheet pile required for the works shall be as shown on the drawings, with interlocking connectors with one another to form a continuous wall.

Special sections shall be used for corners, junctions and at changes of directions. Special sections shall be fabricated as instructed or of an approved rolled section.

The S.O. may at his sole discretion, require tests to be made on samples taken from the sheet piles supplied to the site. The Contractor shall be deemed to have allowed in his rates and prices for all sampling and testing required by the S.O. to demonstrate compliance with the specifications.

In the event of any sheet pile found to be not in compliance with the specifications, the whole batch of sheet piles from which samples were taken shall be ejected and the Contractor shall remove the rejected batch from the site notwithstanding any previous acceptance based on the manufacturer's certificates.

The sources of supply of materials shall not be changed until the Contractor has demonstrated that the materials from the new source can meet all the requirements of the Specifications.

2.4.2 Standard Sheet Piles

Unless specified otherwise, all steel piles shall be manufactured to JIS A5523. The dimensional tolerances of the sheet piles shall comply with Table 2.1.

Table B1: Dimensional Tolerances of Steel Sheet Piles

Dimension to which tolerance applies	Tolerance	
	U Type	Hat Type
Width	± 1 %	+10mm -5mm
Height	± 4 %	± 4 %

Table B1: Dimensional Tolerances of Steel Sheet Piles		
Dimension to which tolerance applies	Tolerance	
	U Type	Hat Type
Thickness	t < 10mm, +1.0mm -0.3mm 10 ≤ t ≤ 16mm, + 1.2mm - 0.3mm t ≥ 16mm, + 1.5mm - 0.3mm	t < 10mm, ± 1.0mm 10 ≤ t ≤ 16mm, ±1.2mm t ≥ 16mm, ±1.5mm
Straightness	Deflection : < 0.1% of pile length (max. 20mm) Camber : < 0.2% of pile length (max. 20mm)	Deflection : < 0.12% for length ≤ 10m; < (L-10)x0.1% + 12mm for length > 10m Camber: 0.25% for length ≤ 10m; (L-10) x 0.2% +25mm for length > 10m.
Squareness of ends	< 4% of pile width	< 4% of pile width
Overall width difference	Within 1m of the end part in the length direction, the difference between the maximum and minimum of the overall width is 4mm or under.	-
End deflection	Within 1m of the end part in the length direction, the end deflection is 1.5mm or under.	-
Coupling mating joint angle	≥ 6.0°	≥ 4.0°

2.4.3 Fabricated Sheet Piles

All fabricated piles e.g. corners, junctions, box sections, high modulus sections, shall be fabricated and supplied to the sheet pile manufacturer's recommendations

2.4.4 Coatings Of Sheet Piles And Tie Rods Against Corrosion for Permanent Sheet Piles

2.4.4.1 General

Before commencement of painting on the coating to the surface of the sheet piles and tie rods, the Contractor shall submit to the S.O. certificates for each consignment of paint or paint material the Contractor intends to use for corrosion protection.

Such manufacturer's certificates shall certify that the paint or paint material complies with the requirements of the specifications. In addition the manufacturer's certificates shall provide:

- Description of the material;
- Vendor's reference number;
- Batch number;
- Date of manufacture;
- Shelf life of material

2.4.4.2 Definition

The term coating shall include the primer and the coats specified.

2.4.4.3 Specialist labour

The preparation of the surfaces and the preparation of the coatings shall be carried out by specialist labour having experience in the preparation of the surface and application of the coating specified

2.4.4.4 Protection during corrosion protection works

All works associated with surface preparation and the application of coats to form the coating shall be undertaken inside a waterproof structure

2.4.4.5 Surface preparation

Degreasing with detergent wash compatible with the coating shall be carried out where necessary.

All welding slags and spatter shall be removed and all surfaces requiring coating shall be blast cleaned with approved abrasive to Swedish Standard Sa 2 ½ i.e. near white blast cleaned surface finish.

The surface finish is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paints or other foreign matter have been completely removed from the surface.

The abrasive used shall be free from contamination and any material and shall be cleaned to the satisfaction of the S.O. before re-use. The use of silica sand or mineral grits containing silica as abrasives shall not be permitted.

2.4.4.6 Application and type of primer

Within 4 hours after surface preparation, before visible deterioration takes place, the surface shall be coated with an approved primer. Where deterioration has taken place, sweep – blast shall be carried out immediately prior to application of the primer. Primer shall not be applied to a metal surface which is not thoroughly dry.

The primer shall be compatible with the specified coating and shall be such that if subsequent welding or cutting is to be carried out it shall not emit noxious fumes or be detrimental to the welding.

2.4.4.7 Parts to be welded

The coating within 200 mm of a weld shall be applied after welding. The method of application shall comply with the manufacturer's recommendations.

2.4.4.8 Coatings

The coating system shall be as described herein below:

(i) One (1) coat of Dimetcote 9 inorganic Zinc Silicate or approved equivalent primer to a dry film thickness of 75 microns.

(ii) Intermediate coat of Amercoat 385P Inhibitive Epoxy Primer or approved equivalent to a dry film thickness of 50 microns.

(iii) One coat of Amercoat 78HB Amine Cured Coal Tar Epoxy or approved equivalent topcoat to a dry film thickness of 400 microns.

2.4.4.9 Coating thickness

The nominal thickness of the finished coating and of each coat shall be as specified. The average coat or finished coating thickness shall be equal to or greater than the specified nominal thickness. In no case shall any coat or finished coating be less than 75% of the nominal thickness. Each coat shall be applied after an interval that ensures the proper hardening or curing of the previous coat.

Where more than one coat is applied to a surface, each coat shall, if possible, be of a different colour from the previous coat. The colour sequence and final coating shall be notified

2.4.4.10 Inspection of coatings

The finished coating shall be generally smooth, of dense and uniform texture and free from sharp protuberances or pin holes. Excessive slag, dimpling or curtaining shall be retreated.

Any coat damaged by subsequent processes or which has deteriorated to an extent such that proper adhesion of the coating is in doubt shall be removed and the surface shall be cleaned to the original standard and recoated with the specified number of coats.

The completed coating shall be checked for thickness by a magnetic thickness gauge or elcometer or other instruments as may be agreed by the S.O. Areas where the thickness is less than that specified shall receive farther treatment.

The completed coatings shall be checked for adhesion by means of an adhesion test to BS 3900 Part E6 carried out on 10 % of the sheet piles. The adhesion of any completed coating shall not be worse than Classification 2. Adhesion tests shall not be carried out until 7 days after coating. On completion of testing, the test area shall be made good to the standard specified. Areas where the adhesion is defective shall be repaired and reinstated.

2.4.4.11 Supply and storage of coatings

All coatings shall be supplied from the same source. Coatings shall be stored in a secure store where temperatures are not extremes. All storage requirements recommended by the manufacturer shall be adhered to. The temperature of the store shall be in the range of 4 to 27 degrees Celsius.

Coatings not used after 12 months from manufacture or whose shelf life has expired shall not be used and shall be removed from the store and replaced.

Coatings from painter's kettles shall be returned to the store at the end of each working period and stored in sealed containers. Fresh paints or thinners shall not be added when reused.

2.4.4.12 Application of coatings

Prior to application of coating, the Contractor shall demonstrate by tests that his proposed procedure, equipment and painters can satisfy the requirements of the specifications and the manufacturer's recommendations. The Contractor shall

prepare test panels following his proposed procedure to demonstrate that such procedures and methods will result in full compliance with the specifications and manufacturer's recommendations.

All coatings shall be supplied already prepared to painters directly from the store. There shall be no adding of thinners or any materials thereafter.

Coatings shall not be applied when:

- The relative humidity rises above 90% or during fog or mist;
- Condensation has occurred or is likely to occur on the surface.

Unless otherwise agreed by the S.O., each coating shall be applied to produce a continuous film of uniform thickness. As soon as the first priming coat has dried, an extra stripe of paint shall be applied by brush to edges, corners and crevices, bolt heads, river heads and welds, using paint of a similar composition to the prime coat but of a contrasting shade. Successive coats shall be of different colours and each coat shall be thoroughly dry before application of the subsequent coat.

Wet film thickness gauges may be used for checking but shall not be permitted as a means for determining dry film thickness.

2.5 Wall Layout, Design and Construction

The Contractor is required to construct elements of the types of walls and dimensions specified and having the qualities of materials and workmanship specified.

2.6 Ground Conditions

No responsibility is accepted by the S.O. or Employer for any information, opinion or conclusions given in any factual or interpretive ground investigation reports. The Contractor shall report to the S.O. any circumstances which indicate that in the Contractor's opinion, the ground conditions differ from those reported in or which could have been inferred from the ground investigation reports or preliminary pile results.

2.7 Tolerances

2.7.1 Setting out

Setting out shall be carried out from reference lines and points shown in the Drawings. Immediately before installation of the pile, the pile position shall be

marked with suitable identifiable pins or markers

2.7.2 Tolerances, Position and verticality

Sheet piles shall be installed within the following tolerances:

- In plan +- 75 mm of the given sheet pile line at commencing surface;
- Vertical 1 in 75; and
- Level +- 50 mm of the required top level.

Pile dimensions shall be based on the nominal size of the piles.

2.8 Sheet Pile Construction Method

2.8.1 Required Sheet Pile Lengths and Depths

Sheet piles shall be installed to the length and depth shown on the drawings or to such lengths and depths as may be instructed by the S.O.

Trials shall first be carried out at the different locations of the site to establish the procedure for installing the pile to the required length and depth without injury to the sheet pile and damage to the coatings; such trials shall be completed before commencement of installation of the sheet piles. The procedure for installation of the working sheet piles shall be established from the trials.

The method for installation shall be to the agreement of the S.O.

The S.O. shall be notified 24 hours before the commencement of trials installation and also before installation of the working sheet piles.

2.8.2 Sheet Pile Handling

When assembling piles before pitching, the Contractor shall ensure that the interlocks are clean and free from distortions. All storage, handling, transporting and pitching of piles shall be carried out in such a way that no significant damage occurs to piles and their coatings.

2.8.3 Sheet Pile Installation

2.8.3.1 Installation of sheet pile wall

The sheet piles shall be guided and held in place by temporary gates with each pile properly interlocked with its neighbour. Piles shall not bypass one another in place of

interlocking. When sheet piles are driven in panels, the end piles to each panel shall be driven in advance of the general run of piles. After allowing for initial penetration, no pile in the panel shall be driven to an excessive lead in comparison with the toe level of the panel in general and where hard driving is encountered this lead should not exceed 1m.

At all stages during driving the free length of the sheet pile shall be adequately supported and restrained. The Contractor shall ensure that the sheet pile panels are driven without damage or declutching.

The selection of driving and other plant shall be made having due regard to the ground conditions and pile type and to enable installation of the sheet pile without damage to the sheet piles or to the coatings.

2.8.3.2 Installation of the anchor sheet pile

Anchor sheet pile shall be installed to the lengths and depths shown on the drawings.

The equipment to be adopted and the method of installation shall be such as to ensure that the sheet piles can be installed to the required depth without damage to the sheet pile, declutching or damage to the coatings.

The sheet piles shall be guided and held in place by temporary gates with each pile properly interlocked with its neighbour. Piles shall not bypass one another in place of interlocking. When sheet piles are driven in panels, the end piles to each panel shall be driven in advance of the general run of piles. After allowing for initial penetration, no pile in the panel shall be driven to an excessive lead in comparison with the toe level of the panel in general and where hard driving is encountered this lead should not exceed 1 m.

At all stages during driving the free length of the sheet pile shall be adequately supported and restrained. The Contractor shall ensure that the sheet pile panels are driven without damage or declutching.

2.9 Welding

2.9.1 Welder's Qualifications

Only welder's who are qualified to BS EN 287 and who have a proven record over the previous 6 months, or who have attained a similar standard, shall be employed on the Works. Proof of the welders' proficiency shall be made available to the S.O. on request.

2.9.2 Welding Standard

For manual metal arc and semi-automatic welding of carbon and carbon manganese steels, welding of piles and steel framework shall be carried out in accordance with BS 5135, the standard being Quality Category D in accordance with Appendix H, Tables 18 and 19. Defective welds shall be cut out and replaced. Where steel piles are to be spliced by butt welding the interlocks shall not be welded unless a sealing weld is required.

2.10 Nuisance and Damage

2.10.1 Noise and Disturbance

The Contractor shall carry out his works in such a manner and at such times as to minimize noise, vibration and other disturbance in order to comply with current statutory requirements and legislations. He shall comply with all the requirements of all the relevant authorities.

The Contractor shall also comply with the recommendations of noise and vibrations given in:

- BS 5228 for Noise control on construction and open sites. Part 4. May 1992. Code of Practice for noise and vibration control applicable to piling operations.

- BS 7385 for Evaluation and measurement for vibration in buildings. Part 1: 1990. Guide for measurement of vibration and evaluation of their effects on buildings.
  Part 2: 1993. Guide to damage levels from ground borne vibrations.

- BRE Digest - Damage to structures from ground-borne vibration. Digest 403. March 1995.

The Contractor shall carry out measurements of noise and vibrations during the installation of the sheet piles at such times as may be instructed by the S.O.

2.10.2 Damage to Adjacent Structures

If during the execution of the work damage is, or is likely to be, caused to mains, services or adjacent structures, the Contractor shall submit to the S.O. his proposals for repair and avoidance of such damage.

The Contractor's site procedures and method of working shall at all times be such as to limit to a practical minimum any settlement and lateral movement of the ground, structures and buildings around the site.

The Contractor shall be responsible for any damage or movement in adjacent properties including roads paved areas, drains, services, buildings, street furniture, underground structures of any type, etc.

Allowance shall be made for all ancillary treatment and all works necessary to ensure the stability of roadways, adjacent structures, services and underground constructions and for all remedial works needed to make good any damage to the satisfaction of the relevant Authority or owner of the property and the S.O.

2.10.3 Damage to completed wall elements

The Contractor shall ensure that during the course of the work, displacement or damage which could impair either performance or durability does not occur to completed wall elements. The Contractor shall submit to the S.O. his planned sequence and timing for installing wall elements, having regard to the avoidance of damage to adjacent wall elements.

2.11 Supervision and Control of the Works

The Contractor shall keep upon the Works a competent site supervisor to be in charge of the wall construction. The site supervisor must be experienced in construction of sheet pile walls. Curriculum vitae for the supervisor shall be submitted prior to commencement. The S.O. reserves the right to reject the proposed supervisor if in his opinion the experience of the supervisor is inadequate. The whole time of the supervisor shall be devoted to the sheet pile works. The site supervisor shall not be removed from the Works without the S.O. being notified in advance with at least one week's notice.

The Contractor shall submit to the S.O. one week prior to commencement works his Quality Plan for the works. Subsequent revisions, amendments or additions shall be submitted to the S.O. prior to their implementation. Quality Assurance and Quality Control documentation shall be made available to the S.O. on request.

2.12 Progress Report

The Contractor shall submit to the S.O. on the first day of each week a progress report showing the current rate of progress and progress during the previous period on all important items on each section of the Works.

2.13 Records

Comprehensive records shall be kept. This record shall include the following information:

(i) Contract, Section;

(ii) Reduced level on the pile position;

(iii) Pile reference number;

(iv) Pile type and grade of steel;

(v) Pile length;

(vi) Type of hammer;

(vii) Date of driving;

(viii) Commencement surface level;

(ix) Date driven;

(x) Length of offcuts;

(xi) Length of pile extensions;

(xii) Measurement of driving resistances at specified depths;

(xiii) All information regarding interruptions, unexpected changes in driving characteristics, obstructions and times in overcoming them.

3. CONCRETE WORK

3.1 General

3.1.1 Scope

This section covers the supply of materials for concrete, design of concrete mixes, quality control of concrete, mixing, transporting, placing and curing of concrete.

3.1.2 Reference Standards

The following are the principal standards referred to in this section:

BS 12	Ordinary Portland cement
BS 340	Precast concrete kerbs, channels, edgings and quadrants.
BS 368	Precast concrete flags
BS 812	Testing aggregates
BS 882	Aggregates from natural sources for concrete.
BS 1200	Building sands from natural sources
BS 1377	Methods of test for soils for civil engineering purposes.
BS 1881	Testing concrete
BS 3148	Tests for water for making concrete
BS 4027	Sulphate resisting Portland cement
BS 4251	Truck type concrete mixers
BS 4550 Part 2	Methods of testing cement: chemical tests
BS 5075 Part 1	Accelerating admixtures, retarding admixtures and water reducing admixtures.
BS 5328	Specifying concrete including ready mix concrete.
BS 6073	Precast concrete masonry units
BS 6213	Selection of constructional sealants
BS 8007	Code of Practice Design of structures for retaining aqueous liquids
BS 8110	Code of Practice for the structural use of concrete
ASTM C227	Potential Alkali Reactivity of Aggregate - Mortar Bar Method

ASTM C289	Potential Alkali Reactivity of Aggregate - Chemical Method
ASTM C295	Petrographic examination of aggregates for concrete
AWWA C652	Disinfection of water storage facilities

3.1.3 Test Certificates

Manufacturers' certificates for cement and admixtures confirming compliance with the relevant standard for each consignment are required and shall be kept as records for inspection.

The Contractor shall keep available for inspection:

- certificates of calibration for the weighing and dispensing equipment on the concrete batch mixing plant and the test equipment for testing hardened concrete; and
- certified test results for all tests carried out on aggregate, water, fresh concrete and hardened concrete, all as specified.

3.1.4 Aggregate Samples

Before work on trial mixes of concrete is commenced, the Contractor shall make available for inspection samples weighing 50kg of each aggregate, which he proposes to use. The source of each aggregate shall be clearly marked on the container of each sample. Certified test results demonstrating compliance with the relevant quality standard shall be made available at the same time. Samples shall remain preserved at site for reference.

Samples and certified test results shall be submitted for each new source of aggregate proposed by the Contractor in the course of the Contract.

3.1.5 Records of Concreting

An accurate and up-to-date record showing dates, times, weather and temperature conditions when various sections of the works were concreted shall be kept by the Contractor and shall be available for inspection. The Contractor shall also record the results of all tests of concrete and shall identify these results with the parts of the works of which the sampled material is representative.

The Contractor shall keep a daily record for each grade of concrete, of the number of batches mixed, the number of batches and total volume of concrete placed, the number of batches wasted or rejected and the weight of cement used.

The record shall also include specific details of each location in the works where concrete was placed, together with the grade of concrete, total volume of concrete placed and the number of batches used for each location. The record shall be kept available for inspection.

3.1.6 Concrete Mixes

At the commencement of the Works the Contractor shall design a mix for each grade of concrete, which will be required for use in the Works and shall make available for inspection full details of the mix designs. Each mix design shall comply with the requirements of the Specification.

3.1.7 Construction Joints and Lifts

A construction joint is defined as a joint in the concrete introduced for convenience in construction at which special measures are taken to achieve subsequent continuity without provision for further relative movement.

The Contractor shall submit to the S.O. for his approval not less than three weeks before the commencement of concreting, drawings showing his proposals for placing concrete on which the position of all construction joints (if different from those shown on the Drawings) and lifts shall be shown. No concreting shall be started until the S.O. has approved the method of placing, the positions and form of the construction joints and the lifts. The construction joints shall be so located as not to impair the strength of the structure. Rebates, keys or notches shall be formed and waterstops inserted as the joints and the size of formwork panels shall be so co-ordinated that where possible the line of any formwork joint and that in any case all construction joint lines and formwork joint lines appear as a regular and uniform series. For all exposed horizontal joints and purposely inclined joints, a uniform joint shall be formed with a batten of approved dimensions to give a straight and neat joint line.

Concrete placed to form the face of a construction joint shall have all laitance removed and the aggregate exposed prior to the placing of fresh concrete. The laitance shall wherever practicable be removed by spraying the concrete surface with water under pressure and brushing whilst the concrete is still green. Where the laitance cannot be removed whilst the concrete is still green the whole of the concrete surface forming part of the joint shall be hacked to expose the aggregate. Where aggregate is damaged during hacking it shall be removed from the concrete face by further hacking. All loose matter shall be removed and exposed surface

cleaned by wire brushing, air blasting or washing, and the surface to which fresh concrete is applied shall be clean and damp.

3.1.8 Movement Joints

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

The Contractor shall submit to the S.O. for his approval, as soon as practicable after the acceptance of his tender and not less than three weeks before the commencement of concreting, details of his proposals for the installation of waterstops. These shall show where joints are to be located and details of the intersections and changes of direction to a scale that shows the position of any joint or shape of any moulded section.

As far as possible jointing on Site shall be confined to the making of butt joints in straight runs of waterstops. Where it is agreed with the S.O. that it is necessary to make an intersection or change of direction or any joint, other than a butt joint in a straight run, on Site, a prefabricated joint intersection or change of direction piece shall be made and submitted to such tests as the S.O. may require.

Flexible waterstops shall be fully supported in the formwork, free of nails and clear of reinforcement and other fixtures. Damaged waterstops shall be replaced and during concreting care shall be taken to place the concrete so that waterstops do not bend or distort.

The surface of set concrete in a movement joint shall, where specified on the Drawings, be painted with two coats of bituminous paint and fresh concrete shall be placed against it only when the paint is dry. Expansion joints shall be formed by a separating strip of approved performed joint filler.

Caulking grooves shall be provided as shown on the drawings. At all joints where a caulking groove is formed, immediately prior to caulking, the groove shall be wire brushed and loose material remove and blown out by compressed air. After the groove has dried it shall be primed and caulked with approved jointing compound applied in accordance with the manufacturer's instructions. At all caulked joints, the face of the caulking strip and 25 mm width of concrete on either side shall be painted with two coats of paint having the same base as the caulking compound.

3.2 Materials

3.2.1 Cement

All cement shall be obtained from suppliers approved by SIRIM. The cement used for any particular mix shall comply with whichever of the following standards is relevant:

Ordinary Portland Cement	BS 12 and as suitable for use in a tropical climate
Sulphate-resisting Portland Cement	BS 4027 and as suitable for use in a tropical climate

In addition to obtaining the test certificates to be provided under BS 12 and BS 4027 the Contractor shall confirm that the factory which has produced the cement carries out chemical composition tests in accordance with BS 4550 Part 2 as a matter of course and that records show compliance with the requirements of Clause 6 of BS 12 and Clause 7 of BS 4027 in respect of them. If required, copies of such records shall be obtained and kept for inspection.

When required the Contractor shall provide performance figures for the current output from the manufacturer in respect of chlorides, sulphur as SO3 and alkali content as determined using the methods of testing described in BS 4550 Part 2, Clauses 17, 12 and 16.2 respectively.

Cement used in the Works shall be ordinary Portland cement unless otherwise specified.

No cement shall be used from any factory, which shows a current output acid-soluble alkali, content greater than 0.6% (calculated as Na20 + 0.658 K20).

Any cement which is lumpy or partially set shall be rejected and the Contractor shall remove such cement from the site. Cement, which has been stored on the site for more than forty days, and cement, which is of doubtful quality, shall not be used in the Works unless it has been retested and the test results show that it complies in all respects with the relevant standard.

3.2.2 Storage of Cement

Immediately upon arrival at the site, cement shall be stored in silos designed for the purpose or in dry weather-tight and properly ventilated structures with floors raised

above ground level with adequate provision to prevent absorption of moisture. All storage facilities shall be such as to permit easy access for inspection and identification. Each consignment of cement shall be kept separately and the Contractor shall use the consignments in the order in which they are received.

Cement of different types and from different sources shall be kept in clearly marked separate storage facilities. Cement delivered to the site in drums or bags provided by the Supplier or manufacturer shall be stored in the unopened drums or bags until use in the works. Any cement in drums or bags, which have been opened on the site, shall be used immediately or shall be disposed of.

3.2.3 Aggregates

Fine aggregate shall consist of natural sand, crushed materials or be a blend as described in BS 882 Section 2.3. The grading shall be in accordance with BS 882 Section 5.2. The maximum quantities of clay, silt and fine dust shall, in any event, not exceed 3% by weight when using the test given in Clause 7.2.4 of BS 812 Part 1.

Limestone or quartzite aggregates shall not be used without the written approval of the S.O.'s representatives.

Coarse aggregate shall comply with the requirements in Table 4 of BS 882 for graded aggregate to the nominal maximum size specified for the appropriate class of concrete and shall be made up from 20 mm single sized aggregates.

The shape of the aggregates shall be rounded or irregular or angular. The flakiness index, as determined in accordance with BS 812 Part 105, shall comply with the requirements of BS 882 Table 1 and the 10% fines value, as determined by BS 812 Part 3, shall comply with the requirements of BS 882 Table 3.

The aggregates shall be such that concrete when made and tested in accordance with Building Research Establishment Digest 35 (2nd series) shall not show a drying shrinkage greater than 0.065%.

Water absorption of aggregates when tested in accordance with the standard procedure set out in BS 812 Part 2 shall not exceed 3%.

Where aggregates are to be used for concrete of grade C25 and above and are to be supplied from a location which is not already established as a source of aggregates for high grade concrete the Contractor shall, if so instructed by the S.O., carry out a petrographic examination of the proposed material in accordance with ASTM C295 and shall forward the results for examination prior to approval of the source.

Unless otherwise instructed the Contractor shall provide an opinion from an approved independent testing laboratory as to whether samples of proposed aggregate exhibit potential reactivity when tested against ASTM Test C289 or by the 'gel-pat' method as described in Part IV of 'Reactions between Aggregates and Cement'. National Building Studies Research Paper Nr 14 by F.E. Jones and published by HMSO, 1952. If either of these tests indicates that the aggregate is potentially reactive such aggregate shall not be used until a mortar bar test complying with ASTM test C227 has established an expansion of less than 0.05% after 3 months.

Limestone or quartzite aggregates shall not be used for concrete destined for construction of water retaining structures unless the Contractor is able to demonstrate that they are of types unlikely to have an adverse effect if used in such structures.

The soluble chloride and sulphate contents of aggregate shall be such that the allowable percentages for chlorides and sulphates as given in Clause 3.3.3 are not exceeded.

Any rejected aggregate shall be promptly removed from the site.

3.2.4 Storage of Aggregates

The Contractor shall provide means of storing the aggregates at each point where concrete is made such that (i) each nominal size of coarse aggregate and the fine aggregate shall be kept separated at all times; (ii) contamination of the aggregates by the ground or other foreign matter shall be effectively prevented at all times; and (iii) each heap of aggregate shall be capable of draining freely.

The Contractor shall ensure that graded coarse aggregates are tipped, stored and removed from store in a manner that does not cause segregation.

Wet fine aggregate shall not be used until it has drained to constant and uniform moisture content, unless the moisture content of the fine aggregate is monitored continuously and the amount of fine aggregate and added water is adjusted for each batch to allow for the water contained in the fine aggregate.

If necessary to meet the requirements of this clause, the Contractor shall protect the heaps of fine aggregate against inclement weather.

4.2.5 Water

Water for washing aggregates and for mixing concrete and curing shall be clean and free from harmful matter and satisfy the recommendations in the Appendix to BS 3148. The Contractor shall take periodic samples of the water being used or which it is proposed to use for mixing concrete and test them for quality, including determining the concentrations of sulphates and chlorides, which shall be such that the concrete mix as a whole complies with the specified limit for salt content. If river water is the only source available, the Contractor shall, additionally, arrange for the water to be settled for 24 hours in order that the silt content of the water can be reduced to within an acceptable limit.

4.2.6 Admixtures

Admixtures shall mean material added to the concrete materials during mixing for the purpose of altering the properties of the concrete mix. Admixtures shall be included in the mix if the S.O. considers that their use will be particularly advantageous to the construction of the works. Admixtures containing calcium chloride shall not be used.

A record shall be kept of the following:

i) the name of the product used
ii) the chemical name(s) of the main active ingredient(s) of the admixture
iii) the batches to which admixtures have been added
iv) the dosage

Admixtures shall comply with BS 5075. Admixtures shall be used in accordance with the manufacturers' instructions. When more than one admixture is used in a concrete mix the compatibility of the various admixtures shall be ascertained by standard tests and certified by the manufacturers.

4.2.7 Test Equipment

The Contractor shall furnish all equipment and materials necessary for collecting samples and carrying out field and laboratory tests on materials for concrete and on fresh and hardened concrete or shall make arrangements for testing to be undertaken by a commercial laboratory approved by the S.O. On site laboratory equipment shall be housed in a suitable laboratory building, which shall also incorporate space for storage of field test equipment and for curing of concrete test cubes in an orderly manner so that they are readily accessible for testing on the due date. The Contractor shall also furnish all weights, containers and other equipment

necessary for testing the weigh-batching equipment for concrete materials and the dispensers for admixtures.

The equipment to be used by the Contractor shall include, but shall not be limited to, the following:

i) standard slump cone and accessories;
ii) machine, moulds and other accessories for compression tests of 150 mm cubes of hardened concrete;
iii) equipment for measuring the surface moisture content of aggregate; and
iv) equipment for gradation of aggregates.

3.3 Workmanship

3.3.1 Grades of Concrete

Grades of concrete containing ordinary or sulphate-resisting Portland cement for use in the Works shall be as shown in the table below:

Table B2 – Concrete Grade with Cement Content and Free Water / Cement Ratio

Concrete Grade	Characteristic Strength at 28 days (N/mm2)	Minimum Cement Content (kg/m3)	Maximum Cement Content (kg/m3)	Maximum Free Water /Cement Ratio
C35	35	325	400	0.55
C30	30	325	400	0.55
C25	25	325	400	0.55
C20	20	280	-	0.65
C15	15	200	-	-

Concrete grade is that number, which represents its 28-day characteristic strength, expressed in N/mm2.

Characteristic strength is that value of cube crushing strength below which not more than 5% of all test results fall. This condition shall be deemed to be satisfied when test results comply with the specified test requirements.

3.3.2 Free Water/Cement Ratio

In designing and establishing satisfactory mixes of concrete for any part of the works the Contractor shall keep strictly within the limitations on free water/cement ratios

which may be shown on the drawings or expressly stated elsewhere as applying to concrete for particular parts of the works.

3.3.3 Salt and Alkali Content

(1) The selection and proportioning of ingredients shall be undertaken with the aim that no concrete or satisfactory mix shall contain more than the following total quantities of substances expressed as percentages by weight of cement.

(a) For mixes containing ordinary Portland cement to BS 12

Total water soluble chlorides: 0.4% (as ratio by mass of total chloride ions to cement content)

(b) For mixes containing cement complying with BS 4027

Total chlorides: 0.2% (as ratio by mass of total chloride ions to cement content)

(c) For all mixes

Total acid soluble sulphates: 4.0% (as ratio by mass of total sulphate ions to cement content)

Tests shall be carried out in accordance with the following standards:

- chloride in aggregates BS 812 Part 4
- sulphate in aggregates BS 1377 Test 9
- chloride in mixing water BS 812 Part 4
- sulphate in mixing water BS 1377 Test 10

The amounts of chloride and sulphate in the cement shall be taken from the performance figures for current output as described in Clause 2.1.

(2) The Contractor may use cement with alkali content greater than 0.6% if the concrete to be made from such cement contains less than 3.0 kg/m3 alkali from all sources including alkali equivalent of any chlorides in the mix.

3.3.4 Workability

The workability of each grade of concrete shall be such that satisfactory compaction can be obtained when the concrete is placed and vibrated in the work and that there

is no tendency to segregate when it is handled, transported and compacted by the methods which the Contractor proposes to use in the Works.

Workability shall be measured by slump as described in BS 1881. The tolerance on the specified slump shall be +25mm or one third of the specified value whichever is the greater.

3.3.5 Design of Concrete Mixes

Each mix shall be designed to comply with requirements specified in Clause 3.1 and be such that:

i) The aggregate shall comprise both fine aggregate and coarse aggregate. The maximum size of coarse aggregate shall be 20mm unless shown otherwise on the Drawings.

ii) The cement content shall not be below the minimum specified for the grade of concrete nor shall it exceed the maximum where this is specified.

iii) The maximum free water/cement ratio shall be the maximum water/cement ratio measured when the aggregate is saturated but surface dry.

iv) The mixes shall be designed to produce mean concrete cube strength at 28 days after manufacture such that the conditions in both (a) and (b) below are met:

(a) the average strength determined from any group of four consecutive test results exceeds the specified characteristic strength by:
- 12 N/mm2 for concrete of grades C20 and above.
- 7.5 N/mm2 for concrete of grade C15.

(b) the strength determined from any test result is not less than the specified characteristic strength minus
- 12 N/mm2 for concrete of grades C20 and above.
- 7.5 N/mm2 for concrete of grade C15.

For any concrete containing admixture, the strengths shall not be less than those specified but the mixes for the grade of concrete will be separately designed to take account of the effects of the admixtures, and shall have separate trial mixes made and tested.

3.3.6 Trial Mixes

As soon as suitable mixes have been designed, one batch from a trial mix for each grade shall be produced in laboratory using cement and surface dry aggregates known to be typical of the proposed source of supply. The proposed mix proportions for each grade shall be considered satisfactory only if the batch for each grade has the correct cement content and a free water to cement ratio at or below the maximum value for the proposed degree of workability. The proposed workability shall be appropriate to the eventual placing conditions. Where this cannot be pre-determined, the trial mixes shall be designed to have a slump of 100 mm.

When mix proportions have been found satisfactory, a further batch of concrete for each grade shall be made at site under scale production conditions using the same mixing time and handled by means of the same plant which the Contractor proposes to use in the works.

The proportion of cement, aggregates and water shall be carefully determined by weight in accordance with the satisfactory mix design, and sieve analysis shall be made, by the method described in BS 812, of the fine aggregate and each nominal size of coarse aggregate used.

The slump and temperature of each batch of each trial mix shall be determined immediately after mixing by the method described in BS 1881 and shall not be outside the limits specified under workability in Clause 3.4 and temperature in Clause 3.12.

Sets of three 150 mm compression test cubes from each batch shall be made by the Contractor from each site trial mix. The cubes shall be made, cured, stored and tested at 28 days after manufacture in accordance with the method described in BS 1881. If the average value of the compressive strength of the three cubes taken from any trial mix is less than the minimum target mean strength determined by the S.O. and used in the mix design or if any individual cube test result falls below 85% of the target mean strength, the Contractor shall redesign that mix and make a further trial mix and set of test cubes.

If at any time during the construction of the works a change is made in the source of cement or aggregate or if the grading of the aggregate alters to such an extent that the fraction of aggregate retained on any sieve cannot be maintained within 2% of the total quantity of fine and coarse aggregate when adjusted as specified for sampling and testing of aggregates, and these conditions result in a general lowering of cube strengths, then further trial mixes of concrete shall be made and shall be tested until suitable for use.

3.3.7 Material Batching

All cement used in the manufacture of concrete shall be measured by weight either with an approved weighing machine or by making the size of each batch of concrete such as to require an integral number of complete bags or drums of cement.

For concrete of grade C25 and above the fine aggregate and the several nominal sizes of coarse aggregate shall be measured singly or cumulatively by weight using weigh-batching machines unless otherwise approved by the S.O.

For concrete of grades C15 and C20, the fine and coarse aggregate will be measured separately either by weight using weigh-batching machines or by volume in gauge boxes.

Weigh-batching machines shall provide facilities for the accurate control and measurement of the aggregates either singly or cumulatively and shall be capable of immediate adjustment by semi-skilled operators in order to permit variations to be made to the mix. All weight dials shall be easily visible from the place at which filling and emptying of the hoppers is controlled.

Each concrete mixing machine shall be of a recognised proprietary make and shall comply as closely as possible with the following specification in respect of the addition of water to the mix:

i) A device is fitted to measure added water by weight and so constructed that the water inlet and outlet valves are interlocked so that either one of them cannot be opened unless the other is fully closed.

ii) The measuring device is provided with an overflow with a cross-sectional area at least four times that of the inlet pipe and with its discharge point clear of the mixing plant.

iii) The measuring device is fitted with a drain pipe, which allows the full quantity of water being measured to be drained off for checking the measurement.

iv) The outlet arrangement of the measuring device is such that between five and ten percent of the water enters the mixer before the other materials and a further five to ten percent of the water enters the mixer after the other materials.

v) The remainder of the water is added at a uniform rate with the other materials.

vi) The water measuring device is readily adjustable so that the quantity of water added to the mixer can, if necessary, be varied for each batch.

Where volume batching is permitted by the specification, gauge boxes shall be soundly constructed of timber or steel to contain exactly the volume of the various aggregates required for one batch of each mix. They shall have closed bottoms and shall be clearly marked with the mix and aggregate for which they are intended. When calculating the size of the gauge box for fine aggregate, an allowance shall be made for the bulking of the fine aggregate due to the average amount of moisture contained in the stockpiles on the site.

Any admixtures, which may be used, shall be measured separately in calibrated dispensers.

All mixing and batching plants shall be maintained free of set concrete or cement and will be clean before commencing mixing. The accuracy of calibration of the weighing plant, water measuring plant and admixture dispenser shall be checked before carrying out trial mixes, before mixing concrete for inclusion in the works, after each service or adjustment to the mixing plant, and in any case at least once per month.

3.3.8 Mixing Concrete

Concrete shall be mixed in batches in plant capable of combining the aggregates, cement and water (including admixtures, if any) into a mixture uniform in colour and consistency, and of discharging the mixture without segregation.

On commencing work with a clean mixer, the first batch shall contain only half the normal quantity of coarse aggregate to compensate for the adhesion of other materials to the drum.

The moisture contents of the aggregates shall be determined before the commencement of each day's concreting and at such intervals during each day as may be necessary. The Contractor shall make due allowance for the water contained in the aggregate when determining the quantity of water to be added to each mix, and shall adjust the amount of water added to each mix to maintain constant the design free water/cement ratio of the mixed concrete.

3.3.9 Preparing For Concreting

Before placing concrete the Contractor shall remove from the surface of the foundations or previously placed concrete, all oil, loose fragments of rock, earth, mud, timber and other debris, and standing water.

Where specified and elsewhere as deemed necessary the excavated surfaces shall be prepared as specified under concrete protection.

3.3.10 Transporting Concrete

Concrete shall be conveyed from the mixer to its place in the Works as rapidly as possible by methods, which will prevent segregation or drying out and ensure that the concrete is of the required workability at the time of placing. The length and drop of conveyors or trunking proposed for delivery of concrete into its position in the works shall limit the free fall of concrete to 1.5m and shall be subject to approval by the S.O. If segregation has nevertheless occurred in any instance, the materials shall be remixed or rejected.

Unless otherwise agreed by the S.O., truck mixer units and their mixing and discharge performance shall comply with the requirements of BS 4251. Mixing shall continue for the numbers and rate of revolutions recommended in accordance with Item 9 in Appendix "B" of BS 4251 or, in the absence of the manufacturer's instructions, revolutions at a rate of not less than seven revolutions per minute.

3.3.11 Placing Concrete

Concrete shall be placed and compacted before the initial set has occurred and in any event not later than 30 minutes from the time of mixing.

When pneumatic placers are used, if the end of the placer pipe is not equipped with an energy absorbing device, it shall be kept as close to the work as practicable. Mortar or water used at the beginning or end of a run shall be discharged outside the formwork.

The placing of concrete shall be suspended during heavy rain.

No fresh concrete shall be placed against concrete that has attained its initial set without the formation of a construction joint.

Ready mixed concrete may be used only with the agreement of the S.O. and shall comply with all clauses of this specification with regard to concrete.

The concrete shall be carried in purposely made agitators; operating continuously, or truck mixers. The concrete shall be compacted in its final positions within two hours of the introduction of cement to the aggregate. The time of such introduction shall be recorded on the delivery note, together with the weight of the constituents of each mix.

When truck mixed concrete is used, water shall be added under supervision, either at the site or at the central batching plant, as agreed by the S.O., but in no circumstances shall water be added in transit.

3.3.12 Concreting In Hot Weather

In hot weather, the Contractor shall take steps to limit the temperature of the concrete as placed and ensure that the maximum temperature of the concrete when leaving the mixer shall not exceed 32 degrees C and that the maximum internal temperature attained during setting does not exceed 70 degrees C.

To achieve this, the Contractor shall provide sun shades over stockpiles of aggregate, cement silos, mixing water tanks and pipelines, and in addition shall carry out the following procedures:

i) Shade or wet the outside of the formwork

ii) Apply a fine moisture (fog) spray of clean cool water to shaded areas immediately prior to placing concrete.

If the maximum setting temperature is exceeded, the S.O. will reject any concrete showing signs of cracking.

3.3.13 Concrete Placed In Water

Concrete shall only be placed in water where it is not practicable to place the concrete in the dry; the quantity of cement in any concrete placed in water shall if necessary be increased so that the free water/cement ratio of the mix is not more than 0.47.

Concrete shall not be placed in running water nor shall concrete be allowed to fall through water.

Concrete shall only be placed in water with a bottom opening watertight box or a tremie. Bottom-opening boxes shall not be opened until they are resting on the

work, and the lower ends of tremies shall always be kept below the surface of freshly placed concrete.

3.3.14 Compaction

All concrete placed in situ shall be compacted with power driven vibrators supplemented by hand spading and tamping. The vibrators shall at all times be adequate in number, amplitude and power to compact the concrete properly and quickly throughout the whole of the volume being compacted. Spare vibrators shall be readily on hand in case of breakdown.

Vibrators shall be inserted into the uncompacted concrete vertically and at regular intervals. Where the uncompacted concrete is in a layer above freshly compacted concrete the vibrator shall be allowed to penetrate vertically for about 100 mm into the previous layer. In no circumstances hall vibrators are allowed to come into contact with the reinforcement or formwork nor shall they be withdrawn quickly from the mass of concrete but shall be drawn back slowly so as to leave no voids. Internal type vibrators shall not be placed in the concrete in a random or haphazard manner nor shall concrete be moved from one part of the work to another by means of the vibrators.

External vibrators may only be used where expressly approved as being more suitable for use under the prevailing conditions.

The duration of vibration shall be limited to that required to produce satisfactory compaction without causing segregation.

Vibration shall on no account be continued after water or excess grout has appeared on the surface.

After the concrete has been thoroughly compacted, the surface shall be worked to a dense true finish with a wooden or steel float to the tolerance given in Clause 3.21.

3.3.15 Attendance Of Steel Fixer And Carpenter

During the concreting of all reinforced concrete, a competent steel fixer and carpenter shall be in attendance on each concreting gang, and shall ensure that the reinforcement, formwork and embedded fittings are kept in position as work proceeds.

3.3.16 Curing Of Concrete

Concrete shall be cured by protecting the surface from the effects of sunshine, drying winds, rain, running water or mechanical damage for a minimum continuous period of seven days when the cement used in the concrete is ordinary Portland cement. The protection shall be applied as soon as practicable after completion of placing by one or more of the following methods:

(a) in water sprays in continuous operation.

(b) in covering with hessian or similar absorbent material, or sand kept constantly wet.

(c) after thorough wetting, by covering with a layer of waterproof fabric kept in contact with the concrete surface.

(d) by the application of an approved non-staining liquid curing membrane, this is either self-removing or easily removed following the curing period, which has a 75% moisture retention standard. The liquid shall be applied to formed surfaces immediately after stripping of the formwork.

3.3.17 Grout

Grout shall be a cement paste mixture consisting of cement and water or cement, fine sand and water. Cement shall be ordinary or sulphate-resisting Portland cement. The volume of water shall be the minimum necessary to produce a homogeneous mixture suitable for its intended use.

3.3.18 Porous Concrete

Porous concrete for use in drainage layers shall be a paste mixture comprising cement, fine and coarse aggregates and water. Cement shall be ordinary or sulphate-resisting Portland cement. The ratio of fine to coarse aggregate shall be 0.15. The volume of water shall be the minimum necessary to produce a homogeneous mixture suitable for its intended use.

The mix shall comply with the following requirements:

Table B3 – Porous Concrete Grade with Cement Content and Aggregate Size				
Ground Conditions	Cement Type	Minimum Cement Content (kg/m3)	Maximum Aggregate Size (mm)	Characteristic Strength at 28 days (N/mm2)
Non-aggressive	Ordinary	230	40	10
Aggressive	Sulphate-resisting	290	40	10

Porous no-fines concrete shall be composed of ordinary Portland cement and 40 mm single size aggregate complying with BS 882. The ratio of aggregate to cement shall be 8:1 by volume or 10:1 by mass. The concrete shall be mixed by machine or by hand to a uniform colour and consistency before placing. The quantity of water used shall not exceed that required to coat all of the aggregate particles without forming excess grout. The concrete shall be compacted by hand only.

3.3.19 Construction Joints

A construction joint is defined as a joint in the concrete introduced for convenience in construction at which special measures are taken to achieve subsequent continuity without provision for further relative movement.

Concrete placed to form the face of a construction joint shall have all laitance removed and the large aggregate exposed prior to the placing of fresh concrete. The laitance shall wherever practicable be removed when the concrete has set but not hardened by spraying the concrete surface with water under pressure or brushing with a wire brush sufficient to remove the outer mortar skin and expose the large aggregate without disturbing the large aggregate. Where the laitance cannot be removed to hardening of the concrete, the whole of the concrete surface forming the joint shall be treated by a high pressure water jet, sand blasting, use of needle gun or a scaling hammer to remove the surface laitance. Before concreting is resumed, all loose matter on the existing concrete surface shall be removed and the surface shall be slightly wetted. A layer of grout shall be placed over the existing concrete surface.

3.3.20 Surface Finishes

Finishes shall generally be provided as described below or as specified on the Drawings.

Formed surfaces

Class F1 - Surfaces against which further concrete is to be placed and surfaces to be permanently concealed by rendering, plastering, etc.

Class F2 - All surfaces permanently or periodically in contact with stored, retained or flowing liquids. Surfaces against which a membrane tanking is to be applied.

Class F3 - 'ribbed' and 'exposed aggregate' finishes. Surfaces prominently exposed to public view where good appearance is of special importance. Class F3 is also known as 'fair-faced' finish.

Unformed surfaces

Finishes to unformed surfaces of concrete shall be classified as U1, U2, U3, 'spaded' or 'bonded concrete' or such other special finish as may be particularly specified. Where the class of finish is not specified the concrete shall be finished to Class U1.

Class U1 finish is the first stage for Class U2 and U3 finishes and for a bonded concrete surface. Class U1 finish shall be a levelled and screeded, uniform plain or ridged finish, which (unless it is being converted to Class U2, U3 or bonded concrete) shall not be disturbed in any way after the initial set and during the period of curing, surplus concrete being struck off immediately after compaction.

Where a bonded concrete surface is specified, the laitance shall be removed from the Class U1 finish surface and the aggregate exposed while the concrete is still green.

A spaded finish shall be a surface free from voids and brought to a reasonably uniform appearance by the use of shovels as it is placed in the works.

Class U2 finish shall be produced by manual or mechanical floating of the concrete surface after the initial set has taken place and the surface has hardened sufficiently. The concrete shall be worked no more than is necessary to produce a uniform 'sandpaper' finish free from screed marks.

Class U1 - Surfaces of foundation slabs and other structural members to be subsequently covered by further stages of concrete construction, bonded concrete toppings or cement/sand screeds.

Class U2 - All surfaces permanently exposed to view, except where Class U3 finish is required. Surfaces either permanently or periodically in contact with stored, retained

or flowing liquids. Surfaces including those of blinding concrete, against which a membrane tanking is to be applied.

Class U3 - For hard smooth surfaces to slabs, walls, parapets and other structural members, where exposed to weathering.

3.3.21 Dimensions and Surfaces of Finished Concrete

Workmanship in formwork and concreting shall be such that concrete will normally require no making good, surfaces being perfectly compacted, smooth and with no irregularities. Concrete surfaces for the various classes of unformed and formed finishes shall in any event never exceed the maximum permitted tolerances which will be as shown in the table below except where expressly stated otherwise in the specification or drawings.

In the table 'line and level' and 'dimensions' will mean the lines, levels and cross sectional dimensions shown on the drawings.

Surface irregularities will be classified as 'abrupt' or 'gradual'. Abrupt irregularities include, but will not be limited to, offsets and fins caused by displaced or misplaced formwork, loose knots and other defects in formwork materials, and will be tested by direct measurement. Gradual irregularities will be identified by means of a straight template for plane surfaces or its suitable equivalent for curved surfaces, the template being 3.0m long for unformed surfaces and 1.5m long for formed surfaces.

Table B4 – Maximum Tolerance (mm)

Class of Finish	Line and Level	Abrupt Irregularity	Gradual Irregularity	Dimension
F1	±30	10	±20	±20 -10
F2	±10	5	±10	±10 -5
F3	±5	3	±3	±5
U1	±30	10	±20	-
U2	±10	5	±10	-
U3	±5	3	±5	-

3.3.22 Building In Pipes

When pipes are to be installed through walls or floors of concrete structures under this contract, the Contractor shall cast the concrete around the pipes, which shall be installed, properly aligned and secured in the formwork so that the pipes do not move while the concrete is being placed.

When pipes are to be installed through walls or floors of concrete structures by the Plant Contractor, circular or square openings shall be 'boxed out'. Such 'boxing out' may incorporate a suitable rubber waterstop. After the Plant Contractor has installed the pipework the surfaces of the opening shall be thoroughly wire brushed and the space unoccupied by the pipe filled with concrete of the same class as the adjacent wall in the manner detailed in the drawings.

3.3.23 Dip Groove

A half round 12mm drip groove shall be cast into the underside of all concrete overhangs, 40mm from the external edge.

3.3.24 Precast Concrete Products

Unless otherwise specified or shown on the Drawings, all precast concrete units shall be manufactured in accordance with relevant British Standards, e.g. BS 340 for concrete kerbs, BS 368 for concrete flagstones and BS 6073 for concrete blockwork, whether such units are manufactured on site or obtained from manufacturers approved by the S.O..

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 replace at his own expense any precast units which are damaged due to his own negligence or which are rejected by the S.O..

All units shall be laid, bedded, jointed and fixed in accordance with the lines, levels and other details as shown on the drawings. Mortar for bedding and jointing precast units shall consist of one part by volume of ordinary Portland cement to two parts by volume of natural sand or crushed stone to grading of BS 1200 Table 2.

3.3.25 Sampling and Testing Of Aggregates

The Contractor shall sample and carry out a mechanical analysis of the fine aggregate and each nominal size of coarse aggregate in use employing the methods described in BS 812 at least once in each week when concreting is in progress and more often where deemed necessary. The grading of all aggregates shall be within specified limits and should the fraction of aggregate retained on any sieve differ from the corresponding fraction of aggregate in the approved mix by more than 2% of the total quantity of fine and coarse aggregate, the Contractor shall consider the effect of this difference and, if desirable, shall make an appropriate adjustment to the relative proportions of the aggregates in the mix.

3.4 Inspection and Testing

3.4.1 Sampling and Testing Of Concrete

The Contractor shall provide slump cones and associated equipment and shall measure the workability of concrete in accordance with BS 1881 from time to time during the day at the point where the concrete is being placed.

For each grade of concrete, works test cubes shall be made not less frequently than as follows unless otherwise particularly specified:

For concrete of Grade C25	One set of cubes per 10 m3 or part thereof, concreted per day
For concrete of Grade C20	One set of cubes per 10 m3 or part thereof, concreted per day

Each set of cubes (two cubes per set) shall be made from a single sample taken from a randomly selected batch of concrete and cured for 28 days. On completion of the curing, the specimens shall be tested and the average of the two results shall be taken as the test result.

The procedure for making curing and testing the samples shall be as described in BS 1881 Part 108, Part III and Part 116 respectively.

3.4.2 Compliance with Specified Requirements

The concrete shall be deemed satisfactory provided that:

i) The average 28 days strength determined from any group of four consecutive results exceeds the specified characteristic strength by not less than 3 N/mm2 for grades C25 and above and C20 concrete and 2.0 N/mm2 for grade C10.

ii) Each individual test result is not less than the specified characteristic strength minus 3 N/mm2 for grade C25 and above and C20 concrete and 2.0 N/mm2 for grade C10.

iii) The slump shall be appropriate to the placing conditions and shall not vary from the specified value by more than ±25 mm or one third of the specified value, whichever is the greater.

If only one result in a group of four consecutive results fails to meet the second requirement, that result may be considered to represent only the particular batch of concrete from which the sample was taken, provided that the average strength of the group satisfies the first requirement.

If more than one result in a group of four consecutive results fails to meet the second requirement or if the average strength of any group of four consecutive test results fails to meet the first requirement then all the concrete in all the batches represented by all such results shall be deemed not to comply with the strength requirements.

3.4.3 Non-Compliance with Specified Requirements

When the average strength of a group of four consecutive test results fails to meet the first requirement, no further concrete from that mix shall be placed in the work and the Contractor shall establish the cause of the failure and apply such remedies as are necessary.

The Contractor shall within 24 hours of the date of the test notify the S.O. of the proposed action to be taken in respect of any concrete represented by test results, which fails to meet any of the requirements. These proposals may include, but shall not be limited to, cutting and testing cores.

Concrete, this is ultimately found not to comply with any of the requirements of the Specification, shall be rejected and shall be broken out and replaced.

3.4.4 Cutting and Testing of Core Samples

Where cutting and testing of cores has been proposed cylindrical core specimens of 100 mm nominal diameter shall be cut normal to the face of the hardened concrete

for the purpose of examination and testing. The procedure for drilling, examination, measurement and testing for compressive strength shall be in accordance with BS 1881 Part 120. If the crushing strength of the specimen determined in accordance with paragraph 7 of BS 1881 Part 120 is less than the characteristic strength at 28 days for the grade of concrete or if the concrete fails to meet the specified requirements in other respects, the concrete in that part of the works of which it is a sample shall be considered not to comply with the specified requirements.

3.4.5 Inspection Procedures

Before any concrete is placed, the Contractor shall carry out an inspection to ensure that all preparations are complete, including the provision of the necessary equipment and personnel, and shall ensure that sufficient materials are available to complete the work proposed.

3.5 Formwork

3.5.1 Scope

This section covers the supply, erection and removal of formwork, the finishes to be attained and the remedial action to be taken to the finished concrete after removal of formwork.

3.5.2 Submissions

The Contractor shall retain as records his calculations and designs for formwork including layout of panels and may be required to submit copies of his calculations to the S.O..

3.5.3 Materials

Formwork shall be constructed of timber, sheet metal or other suitable material, which shall inter alia prevent loss of grout when the concrete is placed and vibrated. The Contractor shall also furnish all struts, braces and ties to withstand the placing and vibrating of concrete and the effects of weather.

Form ties shall be the rod and cone or other proprietary type. They shall be designed so that no part remaining embedded in the concrete after formwork has been removed shall be nearer than 50mm from the surface in the case of reinforced concrete and 150mm in the case of unreinforced concrete.

Form ties for use in water retaining structures shall incorporate a diaphragm of not less than 50mm diameter welded to the midpoint of the tie, designed to prevent water passing along the tie.

3.5.4 Design and Detailing

The Contractor shall be responsible for the adequacy and safety of formwork.

On formwork to external faces, which shall be permanently exposed, all horizontal and vertical formwork joints shall be so arranged that joint lines will form a uniform pattern on the face of the concrete. The finished appearance of the entire elevation of the structure and adjoining structures shall be considered when planning the pattern of joint lines caused by formwork and by construction joints to ensure continuity of horizontal and vertical lines.

3.5.5 Form Surfaces - Class of Finish

Finishes to formed surfaces of concrete shall be classified as F1, F2 or F3 as specified in Clause 3.20. Where the class of finish is not specified the concrete shall be finished to Class F1.

Formwork for Class F3 finish shall be lined with panels of non-staining material with a smooth unblemished surface such as sanded plywood or hard compressed fibreboard. The panels shall be as large as possible and shall be arranged in a uniform pattern and fixed to back formwork by oval nails. Unfaced wrought boarding or standard steel panels shall not be used.

Formwork for Class F2 finish shall be faced with wrought tongued and grooved boards or plywood or metal panels arranged in a uniform pattern free from defects likely to detract from the appearance of the surface.

Formwork for Class F1 finish shall be constructed of timber, sheet metal or any suitable materials. Surfaces subsequently to be rendered, plastered or tiled shall be adequately scabbled or roughened as soon as the formwork is removed to reduce the irregularities to not more than half the thickness of such rendering, plastering or bedding for tiles and to provide a satisfactory key.

3.5.6 Erection of Formwork

All formwork shall be soundly constructed, firmly supported, adequately strutted, braced and tied to withstand the placing and vibrating of concrete and the effects of weather. Formwork shall not be tied to or supported by reinforcement.

Faces of formwork in contact with concrete shall be free from adhering foreign matter, projecting nails and the like, splits or other defects, and all formwork shall be clean and free from standing water. Joints shall be sufficiently watertight to prevent the escape of mortar or the formation of fins or other blemishes on the face of the concrete.

All exposed exterior angles on the finished concrete of 90 degrees or less shall be given 20mm by 20mm chamfers.

Formwork shall be provided for the top surfaces of sloping work where the slope exceeds 15 degrees from the horizontal (except where such top surface is specified as spaded finish) and shall be anchored to enable the concrete to be properly compacted and to prevent air being trapped.

Formwork in contact with the concrete shall be treated with suitable non-staining mould oil prior to reinforcement and concrete placement to prevent adherence of the concrete except where the surface is subsequently to be rendered. Care shall be taken to prevent the oil from coming in contact with reinforcement or with concrete at construction joints. Surface retarding agents shall not be used unless specified

Where ties are built into the concrete for the purpose of supporting formwork, the whole or part of any such supports shall be capable of removal so that no part remaining embedded in the concrete shall be nearer than 50mm from the surface in the case of reinforced concrete and 150mm in the case of unreinforced concrete. Holes left after removal of such supports shall be neatly filled with well rammed dry-pack mortar.

Openings for inspection of the inside of the formwork, for the removal of water used for washing down and for placing concrete shall be provided and so formed as to be easily closed before or during placing concrete. Before placing concrete all bolts, pipes or conduits or any other fixtures which are to be built in shall be fixed in their correct positions, and cores and other devices for forming holes shall be held fast by fixing to the formwork or otherwise.

3.5.7 Removal of Formwork

Formwork shall be so designed as to permit easy removal without resorting to hammering or levering against the surface of the concrete.

The periods of time elapsing between the placing of the concrete and the striking of the formwork shall be as deemed necessary after consideration of the loads likely to

be imposed on the concrete and shall in any case be not less than the periods shown in the table following, or as determined in accordance with the `cubes cured alongside' procedure as described in CIRIA Report No. 73 (October 1977). Where soffit formwork is constructed in a manner that allows the removal of the majority of the formwork and the retention during and after such removal of a sufficient number of adequate supporting props in an undisturbed condition, the Contractor may remove the formwork at earlier times than are listed below provided that the props are left in position and are not disturbed during removal of the majority of the formwork.

Table B5 – Times for Striking using Ordinary Portland Cement	
Position	Times for Striking using Ordinary Portland Cement (days)
Beam sides, walls and columns	3
Slabs (props left under)	4
Props to slabs	10
Beam soffits (props left under)	8
Props to beams	21

Notwithstanding the foregoing, the Contractor shall be responsible for any damage arising from removal of formwork before the structure is capable of carrying its own weight and any incidental loading.

3.5.8 Building in Plant

The Contractor shall erect all formwork, struts and other temporary work to enable plant to be built-in, and such formwork shall be designed to allow placing of the concrete, mortar or grout so as to fill the voids completely, and to enable air to escape from any cavities during filling. The formwork shall be sealed against pipework and other items of plant to prevent leakage of grout. Formwork shall be supported independently of all plant and pipework.

3.5.9 Dry-pack Mortar

Dry-pack mortar for filling holes and repairing surface blemishes shall be made from one part by weight of cement and three parts by weight of fine aggregate passing a 1mm sieve. The colour of the mortar shall match that of the surrounding concrete.

The mortar shall be mixed with only sufficient water to make the materials stick together when being moulded in the hands.

The dry-pack materials shall then be placed and packed in layers each having a thickness not greater than 15mm. The compaction shall be carried out by use of hardwood stick and hammer and shall extend over the full area of the layer, particular care being taken to compact the dry-pack against the sides of the hole. After compaction the surface of each layer shall be scratched before further loose material is added. Holes shall not be over filled and the surface shall be finished by laying a hardwood block against the dry-pack fill and striking the block several times.

3.5.10 Defects in Formed Surfaces

Workmanship in formwork and concreting shall be such that concrete shall normally require no making good, surfaces being perfectly compacted and smooth.

No making good of any of any sort shall be carried out before the approval of the S.O. is obtained. Any unauthorised making good work done without the S.O.'s approval shall be undone at the Contractor's expense.

Any minor surface blemishes shall be repaired immediately after inspection by the S.O. and obtaining his approval to do so. Remedial measures may include, but shall not be limited to, the following:

- holes left by formwork supports shall be thoroughly cleaned out to remove all loose material and the sides shall be roughened, if necessary, to ensure a satisfactory bond; they shall then be filled with dry-pack mortar;

- fins, pinhole bubbles, surface discolouration and minor defects may be rubbed down with sacking and cement.

- abrupt and gradual irregularities may be rubbed down with carborundum and water after the concrete has been fully cured;

- small defects and minor honeycombing shall be chipped out normal to the face of the concrete to a depth of at least 25mm and filled with dry-pack mortar.

- Dry pack mortar shall be used only where reinforcement has not been exposed in blemishes or areas of honeycombing. If reinforcement has been exposed, the affected area will be broken out such that concrete aggregate can pass behind the reinforcement and the hole then shall be re-concreted. For this

purpose a mix using 10 mm aggregate, of the same nominal strength as the concrete broken out may be used, subject to the S.O.'s approval.

Where deeper or more extensive defects occur, the methods of repair may include, but shall not be limited to cutting out to a depth of 25mm with a diamond saw to give a regular edge to the repair and further chipping to form a hole with dovetail shape to sound concrete or to a total depth of 75mm whichever is the greater. If reinforcing steel is exposed, the concrete shall be removed to a depth of 25mm beyond the back side of the reinforcement. Steel mesh reinforcement shall then be sprung into the dovetail. The void shall be refilled with concrete or suitable epoxy resin mortar.

The Contractor shall thoroughly clean any hole or defective area that is to be filled and where the surface has been damaged the Contractor shall break out any loose, broken or cracked concrete or aggregate.

Where the remedial work is to be carried out using dry-pack mortar or concrete, the concrete surrounding the hole shall be thoroughly soaked after which the surface shall be dried so as to leave a small amount of free water on the surface. The surface shall then be dusted lightly with cement by means of a small dry brush until the whole surface that will come into contact with the dry-pack mortar has been covered and darkened by absorption of the free water by the cement. Any dry cement in the hole shall be removed.

Dry-pack mortar shall be mixed and placed as specified.

Where concrete is to be used, the concrete mix shall be placed and compacted into the hole, using formwork as necessary.

Where the remedial work is to be carried out using epoxy resin mortar or other specialist material, the surface of the cleaned hole shall be prepared and primed and the repair material placed, compacted and finished in accordance with the manufacturer's instructions.

Where a defect is too extensive to permit satisfactory repair, either from the point of view of structural integrity or appearance, the concrete containing the defect shall be broken out and replaced.

3.5.11 Inspection

No concrete shall be placed against any formwork until its position and alignment has been checked and approved by the S.O..

3.6 Reinforcement for Concrete

3.6.1 Scope

This specification covers detailing, fabricating, supplying and placing of reinforcing steel and accessories for all cast in place and precast concrete.

The Contractor shall be entirely responsible for the correctness of bar schedules before arranging for the supply, cutting and bending of steel reinforcement.

3.6.2 Reference Standards

The following standards are referred to in this section:

BS 4449 Hot rolled steel bars for the reinforcement of concrete.

BS 4461 Cold worked steel bars for the reinforcement of concrete.

BS 4466 Bending dimensions and scheduling of reinforcement for concrete.

BS 4483 Steel fabric for the reinforcement of concrete.

BS 4871 Approval testing of welders working to approved welding procedures.

BS 5135 Process of arc welding of carbon and carbon manganese steels.

BS 8110 Code of Practice for the Structural use of concrete.

3.6.3 Submissions

The following records shall be retained for inspection:

i) Test certificates
- Manufacturer's test certificate for each delivery of reinforcing steel. Each certificate shall show the country of origin and test.
- Welder qualification tests.

ii) Data
- Manufacturers' data on accessories.
- Welding procedures.

iii) Drawings

- Reinforcement bending schedules.

3.6.4 Steel Reinforcement

Steel for reinforcement shall be of the following kinds as may be specified or detailed on the Drawings:

Type R hot-rolled plain round mild steel bars conforming to BS 4449;

Type Y either hot-rolled deformed high yield steel bars conforming to BS 4449 (with geometrical classification Type 2), or cold-worked deformed high yield steel bars conforming to BS 4461 (with geometrical classification Type 2);

Fabric welded hard drawn steel wire and other cold-worked high bond bar fabric conforming to BS 4483.

3.6.5 Accessories

The Contractor shall supply all accessories such as reinforcing steel supports, hold-downs, spreaders, hangers, tie wire and all other incidentals necessary to complete an acceptable installation of all concrete reinforcement. All accessories shall be of steel with the exception of spacers to maintain concrete cover to reinforcement against formed or blinded surfaces, which shall be of concrete of the same texture, colour and composition as cast-in-place concrete. Concrete spacers shall be in the form of a truncated cone or pyramid and shall be used with the larger face towards the reinforcing steel. The smaller face of a truncated cone or pyramid shall have a minimum dimension of 50mm.

3.6.6 Detailing

Steel reinforcement shall be as shown on the Drawings. When any information relating to reinforcement is missing or apparently incorrect, the Contractor shall immediately request the required information.

3.6.7 Cutting and Bending of Reinforcement

Bars shall be cut and bent in accordance with the provisions of BS 4466. All bending shall be done with the use of an approved bending machine. Bars shall not be re-bent. Cut and bent bars shall be bundled and labelled for positive identification with the Drawings and bending schedules, until they are incorporated into the work.

3.6.8 Storage of Reinforcing Bars and Fabric

The Contractor shall stack separately and label different types of reinforcement for positive identification.

Steel reinforcing bars shall be kept clean and shall be free from pitting, loose rust, mill scale, oil, grease, earth, paint, or any other material, which may impair the bond between the concrete and the reinforcement.

Reinforcement shall be wire brushed before fixing to remove loose rust, mill scale, etc. No reinforcement shall be used if corrosion has reduced the area of cross-section below 98% of its original value.

Reinforcing steel shall be stored and fabricated under cover on wooden or concrete supports such that the steel is elevated from the ground surface by a minimum of 150mm.

3.6.9 Fixing Of Reinforcement

All reinforcement shall be securely and accurately fixed in positions shown on the Drawings using approved spacer blocks or chairs. Intersections of bars shall be secured with Nr 16 gauge (1.60mm) soft iron wire, the ends being turned into the body of the concrete. The Contractor shall ensure that all reinforcement is maintained in position at all times, particular care being taken during placing of concrete.

Concrete cover to reinforcement shall be as specified or detailed on the Drawings, and shall be maintained in accordance with the tolerances specified in BS 8110. Correct concrete cover to reinforcement shall be maintained with the aid of approved spacer pieces. Top reinforcement in slabs shall be maintained in position by means of chairs, the diameter and quantity being sufficient to ensure security of the reinforcement in shape and position.

No part of the reinforcement shall be used to support formwork, access ways, working platforms, or the placing of equipment or for the conducting of an electric current.

3.6.10 Welding

Reinforcement, which is to be welded, shall be welded in accordance with the requirements of BS 5135 and the recommendations of the manufacturer. The strength of the parent metal shall not be reduced and the weld shall possess a

strength not less than that specified for the parent metal. The welding procedure established by successful trial welds shall be maintained and no departure from this procedure shall be made.

Following the establishment of a satisfactory welding procedure, each welder to be employed on the Works shall carry out welder performance qualification tests on reinforcing bars of the same metal and size as those on the Works. The requirements of BS 4871 shall be observed.

Details of welding procedure and welder qualification tests shall be retained as records.

3.6.11 Inspection

No concrete shall be placed around any reinforcement until its position has been checked and approved by the S.O..

4. STEEL AND METAL WORKS

4.1 General

All materials shall conform to the relevant British Standards. Equivalent standard may be accepted with the approval of the S.O.. The manufacturer's test certificate shall be produced to the S.O. before any steel can be accepted.

4.2 Structural Steel

The quality and characteristics of structural steel sections and plates shall conform to the following specifications unless otherwise stated:

(i) Structural steel shall comply with BS EN 10113 and BS EN 10025 Grade 43/S275; and

(ii) Dimensions, weights and permissible variations of hot rolled steel section shall comply with BS 4, BS EN 10056, and BS EN 10210.

4.3 Bolts

Bolts shall be of the following types:

(a) Black bolts and nuts shall comply with BS 3692 and BS 4190.

(b) High strength friction grip (H.S.F.G.) bolts and nuts shall comply with BS 4394. Washers for H.S.F.G. bolts shall be load-indicating washers appropriate to the type and the quality of the bolt used.

(c) Countersunk bolts and nuts shall comply with BS 4933.

(d) Plain and taper washers shall comply with BS 4320 or BS 3410 as appropriate.

4.4 Welding Electrodes

Welding consumables used in metal arc welding of grades of steel complying with BS 4360 shall comply with BS 5135.

Welding consumables and the procedures used shall be such that the mechanical properties of the deposited weld metal shall not be less than the respective minimum values of the parent metal being welded.

4.5 Steel

4.5.1 Submissions

4.5.1.1 Particulars of Steel

The Contractor shall furnish, in triplicate, certified mill test reports, testing laboratory or fabricator's test certificates in accordance with the governing specifications.

4.5.1.2 Alternative Sections

The Contractor may propose alternative equivalent sections for structural members, provided always that the properties of the section and quality of the steel are equal to or better than those specified and that there shall be no extra cost to the Employer.

If this option is exercised then the proposals shall be made well in advance of the date on which materials are to be ordered and no orders are to be placed until the S.O.'s approval to the proposed alternative has been given.

4.5.1.3 Shop Drawings

The Contractor shall prepare and supply fully detailed shop drawings for fabrication and erection of all steel structures. The shop drawings must be endorsed by a

professional engineer. These drawings shall be prepared on the basis of the general data shown on the Drawings and shall be submitted to the S.O. for approval, at least 6 weeks before the scheduled date of fabrication. The Contractor shall supply all written information required by the S.O. regarding calculations, fabrication and erection of all the parts comprising the structures.

The Contractor shall design all the structural connections, which may be welded or bolted, or a combination of welded and bolted.

The fabrication of the structures shall not proceed until the shop drawings have been approved by the S.O.

The approval of shop drawings will not relieve the Contractor either from his responsibilities for the accuracy of fabrication and assembly details nor from the responsibilities related to the completion of the work in accordance with the work programme.

All parts shown on the Drawings as identical items shall be made interchangeable.

4.5.1.4 Welding Operators

The approval and testing of welders shall be in accordance with BS 4871 or BS 4872 as appropriate. The Contractor shall satisfy the S.O. that the welding operators are certified for the type of work upon which they will be employed. For this purpose details of qualifications obtained by the operators under any appropriate standard laying down qualification tests shall be submitted as evidence of their efficiency and suitability.

The names of operators qualified in accordance with the foregoing requirements, together with the particulars of tests passed by each of them, are to be recorded and made available to the S.O. a minimum of 4 weeks before fabrication of the steelwork starts. Evidence of competence of all welding operatives and supervisors shall be provided.

4.5.1.5 Welding Programme and Procedures

The Contractors programme and procedures for shop and field welds shall be submitted to the S.O. at the same time as the details of the welding operators and shall include the following:

(i) details and particulars of methods to be used in the preparation of the fusion faces;

(ii) methods to be used in making the welds;

(iii) welding positions;

(iv) pre-heating arrangements where required;

(v) types of electrodes to be used;

(vi) welding sequences to be followed;

(vii) position of temporary attachments if any and proposals for removal;

(viii) post-weld heat treatment if any.

4.5.1.6 Method Statements

Contractor shall submit the following method statements:

(a) fabrication

(b) erection and installation.

The method statement for fabrication shall including the following:

(a) method for cutting steel elements, plates, beams, channels, etc.

(b) method for "guides", if any, when fabricating to ensure quality of fabrications.

(c) method for weld preparation.

(d) method of identification of members relating member shown in the shop drawings and members fabricated.

The method statement for erection and installation shall include:

(a) trial erection, if any.

(b) on site connection, site welding or bolting.

(c) safety precaution, taken during erection process.

4.5.2 Handling and Storage of Materials

4.5.2.1 Handling of Steelwork

Steelwork shall not be subject to rough handling, shock loading or dropping from a height.

During handling and transport of coated steelwork, the steelwork shall be separated from wires and lashings by rubber padding in such a manner that the coatings are not damaged or discoloured. Free ends shall be stiffened, measures shall be taken to prevent permanent distortion and machined surfaces and faying surfaces shall be protected.

Steelwork shall not be lifted from the painting bed until the last applied coating is sufficiently dry or cured for handling.

Rivets, bolts, nuts, washers, screws and small plates and articles shall be packed in containers marked to identify the contents.

4.5.2.2 Storage of Steelwork

Steelwork shall be stored off the ground on level supports in well drained areas in a manner, which will not result in damage or deformation to the steelwork or coatings, or in contamination of the steelwork or coatings. Packings shall be placed between steelwork, which is stacked.

Covered places in which steelwork is stacked shall be ventilated.

Different types and sizes of steelwork shall be stored separately.

Steelwork shall not be stored on or adjacent to concrete surfaces, which form part of the Permanent Works.

Steelwork shall be protected from exposure to conditions, which may affect the steelwork or coatings.

Wet paint films, steelwork surfaces that are to be primed or over coated and joint surfaces, which are to be assembled, shall be protected from exposure to conditions, which may affect the film or surface.

4.5.2.3 Storage of Welding Electrodes

Electrodes shall be stored and kept under dry conditions and any electrode, which has become damaged by moisture, shall not be used unless it is stated by the manufacturer that when the electrode is properly dried there remains no detriment. Any electrode which has part of its flux coating broken away or is otherwise damaged shall be discarded.

4.5.3 Workmanship

4.5.3.1 Fabrication of Steelwork

Fabrication of steelwork shall comply with BS 5950 except as otherwise specified herein.

All plates, bars and shapes shall be carefully trued, straightened and taken out of winding by pressure before they are drilled. Heating of rolled sections and plates for purposes of straightening will not be permitted.

No burning-in welding, filling or plugging-up of defective work will be permitted, except with the express approval of the S.O. in writing.
Templates throughout the works shall be of steel.

Jigs shall be used for all drilling and machining.

All steelwork shall be given the protective coating specified in the sub-section on painting and coating and, with the exception of site welds and bolted connections as shown on the shop drawings, all steelwork shall be fully fabricated prior to the application of the protective coating.

4.5.3.2 Bolted Connections

Holes shall be drilled accurately to template. Burrs and arises shall be removed from the edges of holes before the parts are assembled and holes shall not be punched without the prior approval of the S.O.

The diameters of holes for bolts shall not exceed the size of each bolt under its head by more than 1.5mm unless otherwise approved.

All bolts shall be provided with washers under the nuts, and washers shall be tapered in the insides of flanges of structural steel sections. In all cases bolts shall project not

less than one full thread through the nut after tightening up. After erection the ends of the bolts shall be burred to prevent removal of the nuts.

4.5.3.3 Use of High Strength Friction Grip Bolts

High Strength Friction Grip (HSFG) bolts shall comply with BS 4395 and shall be used in accordance with BS 4604 Part 1.

The faying surfaces at HSFG bolted connections shall be shot blasted as specified in sub-section on painting and coating. They shall then be protected from oil, paint or other contamination by means of an approved coverage of self-adhesive waterproof membrane. Such protection shall only be removed immediately prior to assembly of the connection. In the event of plate areas at connections becoming contaminated or painted such areas shall be blast-cleaned to bare steel.

When assembled, plates shall be in contact over their entire area before the friction grip bolts are tightened except that for connections transmitting loads in shear only a step between adjacent surfaces across the joint not exceeding 1mm may be permitted. For bolts transmitting loads in tension, contact over the entire area of the faying surfaces shall be demonstrated before bolting up is commenced. Faying surfaces distorted during fabrication or inaccuracies in erection shall be corrected so that the above conditions are satisfied.

HSFG bolts shall be provided with load indicating washers of approved manufacture, which shall normally be fitted against the bolt head, and the nut shall be tightened against a hardened steel washer. Where access is impossible to the bolt head to check tightness, the load indicating washer shall be fitted against the outer ply and a hardened steel washer inserted between it and the nut. Preliminary tightening shall be carried out until the proof load indicated in BS 4604 is correctly indicated by a feeler gauge.

The HSFG bolts may be used as service bolts but when used for that purpose they shall not be fully tightened until they are finally tightened in proper sequence to complete the joint. Bolts, which have been tightened and then slackened, shall not be used in the Permanent Works. All such bolts shall be forthwith removed from the fabrication workshops or from the Site as appropriate.

4.5.3.4 Welding

Welding and welded work shall comply with BS 5135 as appropriate unless otherwise specified herein.

The types, dimensions and lengths of all welds shall be as shown on the approved shop drawings. No departure shall be made from the agreed welding programme or from the details shown on the shop drawings without the prior approval of the S.O. Where procedure trials have been carried out to establish particular welding or flame cutting procedures, these procedures shall be strictly followed.

Welding shall only be carried out under the direction of an experienced and competent supervisor. Each welder and welding machine operator shall have assigned to him an identification number letter or symbol. This identification mark shall be made adjacent to all joints that he welds and shall be ringed with paint for easy identification. Where two welders are employed on the same piece of work both their marks shall be made.

Proper and efficient staging shall be provided for welders when working elsewhere than on the ground. Due precautions shall be taken to ensure the safety of welders at all times and particularly when working over water.

No welding of joints will be permitted until the S.O. has approved the alignment of the members.

The use of mechanically guided flame cutting will be permitted for the preparation of steelwork for welding but steelwork shall be machined or ground where the flame cut edges are inferior in appearance to a sawn edge or are considered by the S.O. to be insufficiently clean or straight.

The gaps for welded joints shall be accurately set by means of suitable jigs and the steelwork shall be held firmly in position until the welded joint is sufficiently rigid to be freed without causing strain or distortion.

Presetting, pre-bending, skip welding, back-step techniques and other measures shall be taken as necessary to counteract shrinkage or distortion due to welding, gouging, thermal cutting or heat treatment.

Butt welds shall be complete penetration butt welds made between fusion faces.

But welds in each component part shall be completed before the final assembly of built-up assemblies.

At all fixed joints the surfaces of steel in permanent contact, which cannot afterwards be painted, shall be sealed by welding.

In order to ensure soundness groove welds shall be terminated wherever possible by the use of extension bars or run-off plates. Where ordered, run-off plates or bars shall be removed by flame cutting. The cut shall not be closer than 5 mm to the sides of the parent metal and the remaining metal shall be removed by grinding.

No welding shall be carried out when the quality of the complete weld may be impaired by weather conditions including winds, blowing sand or dust or airborne moisture. Wind shields shall be used when welding out of doors.

No painting of welds will be permitted until after inspection and approval by the S.O.

4.5.3.5 Erection

Steelwork shall be secured in position by temporary supports and fastenings until sufficient permanent connections are complete to withstand the loadings liable to be encountered during erection. The temporary supports and fastenings shall be capable of withstanding loadings, which may be encountered during erection and shall not damage the steelwork or the protective coatings.

Drift pins will be allowed only for bringing together the several parts of the structures, and shall not be used in such a way as to distort the work or enlarge the bolt holes.

Steelwork shall be erected in such a manner that the alignment and levels of the steelwork comply with the tolerances stated herein; allowance shall be made for the effects of temperature on the steelwork.

Complete sections of the various steel structures as may be directed by the S.O. shall be erected in the fabricator's works, to check the accuracy and interchangeability of the work. This temporary erection shall be carried out prior to the application of the protective coating.

Measures shall be taken to ensure that the steelwork will remain stable before temporary supports and fastenings are slackened or removed for lining, levelling, plumbing or other purposes. The temporary supports and fastenings shall be re-tightened or replaced as soon as the adjustments are complete and at the end of each continuous period of working.

Permanent connections shall be made as soon as a sufficient portion of the steelwork has been lined, levelled and plumbed. Temporary supports and fastenings shall be replaced by permanent connections progressively and in such a manner that the parts connected are securely restrained in the aligned position at all times.

Permanent connections for each portion of steelwork shall be completed not more than 14 days after the portion has been erected.

Foundation bolts for steelwork shall be held firmly in the set position during fixing. Measures shall be taken to ensure that the full movement tolerances are achieved and the bolts are not displaced during concreting. Bolts and nuts, including the threads, shall be protected against damage, corrosion and contamination.

Bolt pockets shall be kept dry and clean. Tubes, which are cast in concrete for grouting bolt pockets, shall be securely fixed and sealed to prevent ingress of grout during concreting.

Bolts in bolt pockets shall be installed in such a manner that the bolt can be moved inside the pocket as designed without hindrance.

The material, size, position and cover of packs, shims and other supporting devices for steelwork which are to be embedded shall be as approved by the S.O.

4.5.4 Tolerance

4.5.4.1 Fabrication of Steelwork

The main dimensions of each structure shall be contained within a tolerance of 2mm for members 10m or less in length and within 3mm for members over 10m in length.

The lengths of members that have ground ends and that are to be joined to other parts of the structure shall have dimensions within a tolerance of 0.2mm in 1m with respect to those indicated on the approved shop drawings.

Compression members shall not deviate from straightness by more than 1/1000 of the axial length between points, which are to be laterally supported.

4.5.4.2 Foundation Bolts

The position of cast-in foundation bolts at the top of base plates shall be within 3mm of the specified position. The position of foundation bolts in bolt pockets at the top of base plates shall be within 5 mm of the specified position. The line of bolts shall not be tilted from the specified line by more than 1 in 40.

4.5.4.3 Erection

Steelwork shall be erected to within the tolerances stated herein after lining, levelling, plumbing and making the permanent connections.

The position in plan of vertical components at the base shall be within 5mm of the specified position.

The level of the top of base plates and the level of the lower end of vertical or raking components in a pocket base shall be within 5mm of the specified level.

The thickness of bedding shall be within one-third of the nominal thickness or 10mm, whichever is less, of the specified nominal thickness.

The line of vertical or raking components other than in portal frames shall be within 1 in 600 and within 10 mm of the specified line in every direction.

The line of vertical or raking components in portal frames shall be within 1 in 600 and within 10mm of the specified line normal to the plane of the frame.

The position and level of components connected with other components shall be within 5mm of the specified position and level relative to the other components at the point of connection.

The position of components supported on a bearing shall be within 5 mm of the specified position relative to the bearing along both principal axes of the bearing.

The difference in level between adjacent sloping and horizontal components connected by a deck slab shall be within 10 mm of the specified difference in level.

4.5.5 Testing

4.5.5.1 Testing of Steel and Steel Products

If required by the S.O. the steel and steel products shall be tested by the Contractor on the manufacturer's premises in the presence of the S.O. and the manufacturer shall provide the required facilities.

A test from each steel cast will be accepted for all plates, bars, joists, sections and similar products rolled from that cast. All steel or steel products not complying with the required tests will be rejected by the S.O.

Tests shall be carried out in accordance with the appropriate standards referred to in this specification.

4.5.5.2 Testing of Welds

Examination and testing of welds shall be carried out after post-weld heat treatment and before the application of corrosion protective coatings. De-burring, dressing, grinding, machining and preening shall be carried out after the visual inspection for cracks, surface pores and joint fit-up and before other inspections and tests are carried out.

Welds for structural steel and steel castings shall be visually inspected in accordance with BS 5289. A weld subject to visual inspection shall be acceptable if:

(i) the weld is free from cracks;

(ii) the weld exhibits full fusion between parent plate and weld metal;

(iii) all craters are filled;

(iv) the weld exhibits the required size profile;

(v) the weld is free from excessive undercut and/or overlap (undercut should not exceed 1 mm or 5% of the material thickness whichever is the less);

(vi) the frequency of piping porosity in filler welds does not exceed one in each 100 mm of length and the maximum pore diameter does not exceed 2.5 mm.

Non-destructive testing shall be carried out on a proportion of welds after visual inspection. The compliance criteria and the proportion of welds to be tested are denoted by quality categories as stated in BS 5135, Table 18 for butt welds and Table 19 for fillet welds. The quality categories of welds shall generally be category C except welds for which 100% non-destructive testing is required by the S.O., which shall be category A.

Non-destructive testing of butt welds shall be carried out by ultrasonic examination in accordance with BS 3923 : Part 1 or BS 3923 : Part 2 or by radiographic examination in accordance with BS 2600 : Part 1, BS 2600 : Part 2 or BS 2910. Non-destructive testing of fillet welds shall be carried out by either the liquid penetrant method in accordance with BS 6443 or the magnetic particle flaw detection method in accordance with BS 6072. The particular standard or part of standard to be used shall be appropriate for the joint geometry, material and production requirements

and shall be as agreed by the S.O.. Welds shall be dressed to facilitate ultrasonic examinations. The frequency of testing shall be at the rate of 10% for butt welds and 5% for all fillet welds.

If the parent metal adjacent to a length of weld subject to non-destructive testing has been tested for laminations in accordance with BS 5996, the same areas on the parent metal shall be tested by ultrasonic examination in accordance with BS 3923 : Part 1 or BS 3923 : Part 2 as appropriate when non-destructive testing is carried out on that length of weld.

Welds for steelwork, which has been fabricated and tested by non-destructive testing at the fabricator's works, shall be visually inspected for cracks when the steelwork is delivered to the Site. 5% of the welds shall be examined for cracks by the magnetic particle flaw detection method in accordance with BS 6072.

4.5.6 Contractor's Design

Unless connections and other details are provided or where the Contractor is required to design any structural member/ truss or temporary support system, the Contractor shall engage an approved structural steelwork fabricator to design such details and prepare shop drawings.

Prior to fabrication, the Contractor shall submit the following documents and details for the S.Os' approval:

a. The design plan defining the principal design activities in a logical sequence, type of design output, target dates to meet the programmed requirements and allocation of design responsibilities.

b. Design documentation, production and checking procedures (verification).

c. Fabricator's certification that the software used has been validated.

d. Method Statement for handling and transportation requirements for unusually shaped or large components to ensure stability during movement.

e. A report of the design review before the issuance of detailed Drawings.

4.5.7 Fabrication Off-site

4.5.7.1 General

Work off site shall conform to the appropriate clauses of BS 449.

4.5.7.2 Drilling holes

Where high strength friction grip bolts are used the holes shall be drilled full size to a diameter not more than 1.59mm greater than shank diameter of the bolt and all burrs shall be removed.

4.5.7.3 Treatment to surfaces in contact

All surfaces in contact and all surfaces inaccessible after assembly shall first be treated as described under Painting of Structural Steel.

4.5.7.4 Bolting

Where H.S.F.G. bolts are used, the method and procedure for tightening shall be in accordance with the Clause 7.2 hereinafter.

4.5.7.5 Machining of Butts, Caps and Bases

Where indicated in the Drawings, ends of stanchion and other members shall be machined to a uniformly flat surface at right angles to the axis or such other angle as indicated. The machining shall be carried out with the angle cleats and gussets on the end of the shaft fixed in their permanent position. Where a load is transmitted by a direct bearing, column base plates and splice division plates shall be machined to a uniform flat surface. Except where otherwise indicated on the Drawings the outstanding legs of web stiffeners shall be machined to bear against the top and bottom flange of the member.

4.5.7.6 Slab Bases and Caps

Ends of stanchion may be sawn and shall be provided with the simple base plates connected by a continuous fillet weld or bolted base plates designed to transmit the whole load in the stanchions.

4.5.8 Works on Site

4.5.8.1 General

No structural steel works on site shall commence without the prior approval of the S.O.

4.5.8.2 Storing and Handling

The greatest care shall be taken in loading, unloading, transporting, stacking, and erecting steelwork to avoid making or damage to painted or metal-coated steelwork. Painted or metal coated fabricated steelwork which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure no pools of water or dirt can accumulate on the surfaces. Suitable packing shall be laid between the layers of stacked materials. Where cover is provided it shall be ventilated.

4.5.8.3 Setting Out

The position of all foundations or points of support for structural steelwork shall be set out so that the distances between any two points joined by a shop-fabricated component of structural steel are within 3mm of the required dimension. The foundation of any stanchion shall be set out with a tolerance of 1 in 1200 but no point shall be more than 25mm away from the position shown on the drawings. Levels of floors or foundations shall be within 6mm of those shown on the drawings, but levels along the length of beams of members of adjacent beams, and of members connected to the same stanchion, shall not differ by more than 3mm. The axes of vertical stanchions shall not be out of plumb by more than 3mm.

The Contractor shall inform the S.O. of the stage by stage completion of lining and levelling of the work for inspection.

4.5.8.4 Stability during Erection

The Contractor shall notify the S.O. at least four weeks in advance of his commencing work on site of the method by which he proposes to erect the steelwork, and the type of cranage he intends to utilise. Shop details of all temporary guys and bracing the Contractor proposes to use during erection shall be where required.

4.5.9 Site Connections

(a) General

Unless otherwise stated on the Contract drawings, no welding or burning equipment shall be used on the site without the written approval of the S.O. If the Contractor intends to make individual site connections in more than one stage by developing initially only a proportion of the joint strength shown on his shop drawings, and finally, the full joint strength, more than 24 hours later, he shall firstly inform the S.O. in writing of such intention.

(b) Bolting

The site bolting of permanent connections shall conform to Clause 62 of BS 449. Where high strength friction grip bolts are specified they shall be of the load indicating type such that the achievement of the proof tensile load can be directly related to feeler gauge measurement of gap closures on the bolt head or on the washer. The Contractor shall submit to the S.O. for his approval the type of load indicating system he wishes to use and also the name of the load indicating bolt or load indicating washer manufacturer.

Washers shall be of hardened steel conforming to BS 3139 and shall be provided under all nuts. Where load indicating washers are used they shall be placed under the head of the bolt.

During the tightening operation the bolt head shall be prevented from rotating. No painting of the bolts or washers shall be carried out without the prior approval of the S.O. In all other respects of bolts and bolting the relevant clauses of BS 3294 Part I shall be adhered to.

4.5.10 Welding

Welding shall be carried out in accordance with BS 1856. Surface preparations and welding conditions shall be in accordance with BS 1856, Part 5, Section 3. The information shown on the Contractor's working drawings shall comply with BS 1856, Clause 18. Where the working drawings and welding procedure are required, the Contractor shall submit them to the S.O. for approval at least four weeks before welding commences. Tack welds shall conform to BS 1856, Clause 34 except that in no case shall the minimum length of weld be less than 50mm. The Contractor shall not place any welds not shown on drawings on any steelwork, even for temporary attachment or to repair faulty plates by welding, unless the Contractor has submitted his proposals to and obtained the approval of the S.O.

Contractor shall show evidence to the S.O., that the welders employed by him have satisfactorily completed the appropriate tests in accordance with BS 2645, Part 1 and 2. Welders shall complete weld test pieces to the approval of the S.O. on materials of the maximum thickness and welds of the type to be incorporated in the Works. Changes in the welding procedure requiring qualification of the welders and the extent of qualifications of welders should be as specified in BS 449, Part 6. Where heat treatment of welds is specified, this shall be done in accordance with the standard for the particular application, where this exists, or shall be fully detailed where there is no such standard.

Welds shall be tested as specified in BS 709 if the appropriate tests exist, or in the absence of such tests, as specified by the S.O. If so required by the S.O. the Contractor shall carry out procedural trials on the welded joints in accordance with BS 2642, Clause 17 and/or non-destructive tests on the welds. For butt welds the latter shall include:

(a) Radiographic examination to comply with BS 2600 or BS 2910, as appropriate, and/or

(b) Ultrasonic examination to comply with BS 3923, Part 1 or 2, as appropriate.

For Fillet welds these will include:

(c) Visual inspection, or

(d) Dye penetrate of magnetic particle tests, to the approval of the S.O.

Where a weld is found to be faulty, it shall be cut out in such a way as not to impair the subsequent strength of the structure and replaced with sound weld to the requirements of the drawings and the specification.

4.5.11 Painting of Structural Steel

(a) General

All structural steel surfaces shall be finished with "SISSONS Tungolac" or equal and approved gloss enamel paint.

The painting shall be carried out by skilled painters under strict supervision.

No painting shall be carried out during rain or mist, or when condensation has occurred or is likely to occur on the steel.

(b) Surface Preparation

All steel surfaces shall be mechanically cleaned by means of power driven tools such as carborundum grinding discs, clipping hammers and needle guns followed by steel-wire brushing and dusting to remove or loosened material. Excessive burnishing of the metal through prolonged application of rotary wire brushes shall be avoided. Surfaces that have been exposed to sea spray or salt-laden winds after cleaning shall be hosed or washed down with clean fresh water and allowed to dry before being painted. Surfaces contaminated with oil or grease shall be cleaned with clean white spirit or naphtha. The surfaces shall then be primed with the first coat or red lead primer within 4 hours of having been cleaned.

(c) Application of Paint

All paints shall be supplied to the painters ready for application and the addition of thinners or of any other material shall be prohibited. Any instruction given by the paint manufacturer shall be strictly adhered to.

Unless otherwise specified, each coat of paint shall be applied by brush to produce a continuous film of paint of uniform and even thickness. As soon as the first priming coat has dried an extra coat of paint shall be applied by brush to the edges, corners, crevices, bolt heads, rivet heads and welds. Each coat shall be thoroughly dry before applications of a further coat.

RE-TENDER FOR RECTIFICATION WORKS AT 275KV TRANSMISSION LINE TOWER SO6 AT SAMALAJU, BINTULU DIVISION, SARAWAK

SARAWAK ENERGY REF. NO.: SLOPE-SO6-TL2018

PART I – TENDER PROCEDURES

SECTION 1 – INTRODUCTION

ANNEXURE C – BOREHOLE LOGS

The following pages were extracted from "Soil Investigation Works for Rectification Works for EK98 and SO6 Tower Sites for EHV Transmission Line" as prepared by Geospec Sdn. Bhd. (Report No. GSI/2017/2671 issued in May 2017):

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SARAWAK ENERGY REF. NO.: SLOPE-SO6-TL2018

PART I – TENDER PROCEDURES

SECTION 1 – INTRODUCTION

ANNEXURE D – HEALTH, SAFETY & ENVIRONMENT (HSE) REQUIREMENTS FOR CONTRACTOR

RE-TENDER FOR RECTIFICATION WORKS AT 275KV TRANSMISSION LINE TOWER SO6 AT SAMALAJU, BINTULU DIVISION, SARAWAK

SARAWAK ENERGY REF. NO.: SLOPE-SO6-TL2018

PART I – TENDER PROCEDURES

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ANNEXURE E – LIST OF TENDER DRAWINGS

ANNECURE E – LIST OF TENDER DRAWINGS

Refer Drawing No.: 7542/G/001 List of Drawings in Tender Drawings.

RE-TENDER FOR RECTIFICATION WORKS AT 275KV TRANSMISSION LINE TOWER SO6 AT SAMALAJU, BINTULU DIVISION, SARAWAK

SARAWAK ENERGY REF. NO.: SLOPE-SO6-TL2018

PART I – TENDER PROCEDURES

SECTION 2 – TENDER PARTICULARS

These Tender Particulars specify matters particular to this tender process and should be read in conjunction with the Instructions to Tenderers set out in Part I, Section 3 of the Tender Documents.

Tender Particulars Tender for **RE-TENDER FOR RECTIFICATION WORKS AT 275KV TRANSMISSION LINE TOWER SO6 AT SAMALAJU, BINTULU DIVISION, SARAWAK** **SARAWAK ENERGY REF. NO.: SLOPE-SO6-TL2018**			
No.	**Clause Reference**	**Description**	**Details**
1.	Clause 1.1(c)	Closing Date and Time	3:00 p.m. on **Friday, 20th July 2018**.
2.	Clause 1.1(h)	Eligibility Requirements	*a)* The Tenderer must be registered with: i) UPKJ Class BX or above under Head I Sub-Head 1, and ii) CIDB Grade 5 or above, Category CE. *b)* The Tenderer must have experiences in slope remedial works including mechanical stabilised slope or soil nailing works or steel sheet piling works. *c)* The Tenderer shall be a Malaysian-registered entity, in which case, for any Consortium Tenderer, all members of the Consortium Tenderer shall be Malaysian-registered entity.
3.	Clause 1.1(t) and Clause 9	S.O.	Name and designation: Robert Cheu Senior Manager Transmission Line Division Transmission Department Contact details: Tel. No.: +6082 388 388 Extension No.: 8523 Fax. No.: +6082 340 598 Email: robertcheu@sarawakenergy.com.my
4.	Clause 1.1(bb)	Tender Validity Period	The period commencing from the Closing Date and Time and expiring on the date falling one hundred and eighty (180) days from the Closing Date and Time.

Tender Particulars Tender for **RE-TENDER FOR RECTIFICATION WORKS AT 275KV TRANSMISSION LINE TOWER SO6 AT SAMALAJU, BINTULU DIVISION, SARAWAK** **SARAWAK ENERGY REF. NO.: SLOPE-SO6-TL2018**			
5.	Clause 5.1	Tender Briefing	A tender briefing (**attendance is compulsory**) will be conducted as follows: The date and time for the tender briefing is **9:30 a.m. on Wednesday, 18th July 2018**. The location for the tender briefing is in Auditorium, Level 2, Menara Sarawak Energy, No. 1, The Isthmus, 93050 Kuching, Sarawak, Malaysia.
6.	Clause 6.1	Site Visit	A site visit (**attendance is compulsory**) will be conducted as follows: The meeting point for the purposes of the Site visit is as below: (a) **Tower SO6**: The date and time for the Site visit is **Thursday, 19th July 2018 @ 10:30 a.m.** Meeting Point: Petronas Station, Samalaju Industrial Park.
7.	Clause 25.1	Pricing Method	Lump sum with Provisional Quantities Contract.
8.	Clause 29.1	Value of Tender Security	For Local Tenders with estimated Tender Sum of above RM2,000,000.00, the amount of Bid Bond shall be 2% of the Tender Sum, subject to a maximum of RM100,000.00. Except for Sarawakian Tenderers.

Tender Particulars Tender for **RE-TENDER FOR RECTIFICATION WORKS AT 275KV TRANSMISSION LINE TOWER SO6 AT SAMALAJU, BINTULU DIVISION, SARAWAK** **SARAWAK ENERGY REF. NO.: SLOPE-SO6-TL2018**			
9.	Clause 32.1	Copies of Tender Offer	The Tenderer shall prepare and submit: (a) one (1) original version; and (b) one (1) set soft copy versions (in separate CD-ROMS, or such other electronic format as may be acceptable to Sarawak Energy), of its Tender Offer
10.	Clause 33.1(b) and Clause 34.1	Address for submission of Tender Offers	Delivery by hand or by courier to: **The Chief Executive Officer** Sarawak Energy Berhad Tender for Rectification Works at 275kV Transmission Line Tower SO6 at Samalaju, Bintulu Division, Sarawak. c/o Tender Box The Officer-in-Charge Tender Box Level 1 (Ground Floor), North Wing Menara Sarawak Energy No. 1, The Isthmus 93050 Kuching Sarawak Malaysia.
11.	Clause 35.1	Alternative Tender Offers	Tenderers **may** not submit Alternative Tender Offers.