

<u>Drawing No.</u>	<u>Title.</u>
P-1	Layout.
P-2	Transit Sehd and First Aid and Fire Station.
P-3	First Aid Station - Details.
P-4	Vehicle Shed.
P-5	Labourers Canteen - Fire Hose Cabinet.
P-6	" " - Toilet, Bunk Room and Grease Trap.
P-7	Security Office and Timekeepers Office.
P-8	Toilet Water Pipe to Quay Face.
P-9	Toilet and Washroom.
P-10	Septic Tank for 25, persons.
P-11	" " 100, 150 persons.

The letters prefixed to Drawing Numbers stand for:

- C - Civil Engineering Works,
- A - Building Works,
- S - Building Structures, and
- P - Plumbing and Sanitary Works.

5. Datum for the Works

The zero point of the datum to be used through the Works shall be 11.20 ft. below the Land Survey Datum. The zero mark on the stick-type water gauge installed at the Pending Jetty by the Japanese Survey Team is 3.896 ft. below the Datum for the Works. The Bench Mark TBM 301 installed by the Land and Survey Department is 20.150 ft. above the Datum for the Works.

CHAPTER 2 GENERAL AND PRELIMINARY

Conditions of Contract, Contract Drawings, Specification and Bills of quantities.

S201. The Conditions of Contract, Contract Drawings and the Bills of Quantities shall be read in conjunction with this Specification. Matters referred to, described in one are not necessarily repeated in the others.

Notwithstanding the sub-division of the Specification under different sections and headings, every part of it is to be deemed supplementary to every other part and is to be read with it so far as it may be practicable to do so, or where the context so admits.

Material and workmanship to be best quality.

S202. The Contractor shall complete the Works as specified in the Contract Documents and Drawings using the best materials and description of their respective kinds and exercising the highest quality of workmanship and capability.

Where any work is not up to the required standard in any respect it will be condemned or rejected and the Contractor shall re-execute the work at his own expense within the original specified period for completion of the Contract Works.

Execution of the Works.

S203. The Contractor shall take all the actions necessary to make good progress in the Works in compliance with the detailed programme which was previously submitted and approved. The Contractor shall submit detailed programmes of the various sections of the Works as and when required by the Engineer.

The Contractor shall take all precautions and cover all contingencies to secure that adequate spare vessels, machinery, materials and equipment are available at all times to secure completion of the Works in accordance with the approved programme.

Safety of Works and protection of existing facilities.

S204. The Contractor shall take all reasonable and proper measures for the safety of his workmen or other persons on land, water and air and for the protection of all places on or about the Works which may be endangered by the execution of the Works.

The Contractor shall also provide and maintain all requisite and necessary temporary marks to define the boundary and protect his works.

The Contractor shall execute the Works in such a manner that it will not cause damage to or interference with existing services located in the proximity to the Site. The Contractor shall take full responsibility for and repair, at his own cost, any damages which may be caused to these services

due to execution of the Works.

All structures in close proximity to the Works that they may be damaged by the Contractor's operations shall be inspected in the presence of the Engineer, before work is commenced, after which the Contractor shall submit a detailed report to the Engineer if so required.

Arrangement for materials, equipment and labour.

S205. In the execution of the Contract Works or Works as directed by the Engineer, the Contractor shall make all the necessary arrangements, when approved by the Engineer, for the adequate supply of materials, equipment and labour in accordance with the construction programme. The Contractor shall take upon himself the full and entire responsibility for such arrangement and will be held responsible for any delay in delivery to Site of all materials from whatever cause arising.

Materials on and under the Site of Works.

S206. All soil, turf, gravel, stone, timber or other materials obtained in the excavation, clearing and stripping of the Site of the Works shall belong to the Employer and must not be disposed of without the consent of the Engineer. The Contractor, however, may use for the construction of the Works any of the materials excavated, if so approved by the Engineer.

Temporary fences.

S207. If and where required, the Contractor shall erect and maintain at his own expense suitable and approved temporary fencing to enclose such areas of the Works to be carried out and all other areas of land occupied by the Contractor within the Site as may be necessary for the execution of the Works to the satisfaction of the Engineer.

Plant yard, storage and working areas.

The Contractor must make his own arrangements for storage and working areas for materials, plant, the mixing of concrete materials and casting yards, etc. Such areas shall be sited to the satisfaction of the Engineer.

Water, electricity, telephone, etc. for the Works.

S208. The Contractor shall make his own arrangements for the supply of fresh water, electricity, telephone and other services to the Permanent Works, Temporary Works and concrete plant, and shall maintain them at his own expense.

Photographs for the Works.

S209. The Contractor shall make necessary arrangements for taking photographs showing the progress and

completed portions of the Works, places where inspection at later date is either difficult or impossible, occasions at which unforeseen conditions were encountered and such other occasions as and when specifically directed by the Engineer. In taking the photographs, consideration shall be given to simultaneously take a certain object in the picture by which the comparison of the size and dimensions is possible. Each photograph shall have printed on the face the date taken and the position in the Works of the subject matter for identification purpose. Prints of the photographs in sizes and numbers as directed by the Engineer shall be promptly submitted, suitably inscribed in English and affixed in albums. The negatives of the photographs shall be the property of the Employer and no prints from these negatives may be supplied to any third party unless under the authority of the Employer.

Tidal and boring data.

S210. The tidal and boring data given in these Contract Documents are believed to be correct but the Employer accepts no responsibilities for any inaccuracies in the information given and no claim will be admitted in respect of any loss, damage or additional work or delay arising therefrom.

Bench Mark and survey pegs.

S211. The Bench Mark (B.M.) and survey pegs to be used in the Works shall be as shown on the Drawings.

The Contractor shall give a proper protection to the Bench Mark and survey pegs to insure that they will not be disturbed. Should it become necessary to move them with the progress of the Works the Contractor shall obtain prior instructions from the Engineer.

Meteorological information.

S212. The Contractor shall in accordance with the instructions of the Engineer provide, maintain and operate throughout the duration of Contract Works such meteorological equipment as necessary for the daily observation of the followings:

- a) Rainfall,
- b) Water-level of the river (The water gauge installed by the Japanese Survey Team may be used), and
- c) Direction and velocity of the wind.

The Contractor shall maintain the observation records in such a manner that they are readily available for the inspection by the Engineer at any reasonable time, and submit in triplicate the monthly record to the Engineer in the following month.

Extra cautions
against abnormal
weather
conditions.

S213. The Contractor shall at all times take extra cautions against the weather conditions, such as heavy rain, gale, flood, etc. in order to minimize any possible loss in or damage to the Works.

Recovery of
sunken materials,
equipment and
vessels.

S214. All materials, plant and equipment and vessels accidentally dropped or sunken into the river during the progress of the Works must be recovered by the Contractor at his own expense.

Removal of
rubbish from
time to time.

S215. The Contractor shall keep the Site and adjacent areas clear of rubbish and debris resulting from the Works throughout the construction period.

Engineer's
office.

S216. The Contractor shall within two months of the Commencement of the Works construct, fit, furnish, equip and make available a field office for the Engineer at a location designated by him to his satisfaction, and shall remove the same upon the expiration of the Contract. The property of the field office shall revert in the Contractor upon its removal from the Site. Details of the Engineer's Office are set out in Appendix "A".

The Contractor shall construct and maintain access roads to the office and a car park sufficient for ten cars.

Engineer's
launch.

S217. The Contractor shall provide a launch, approximately 20 feet long, equipped with life jackets and self-recording echo-sounder during the whole period of the Contract.

The Contractor shall during the contract period provide experienced helmsmen for the launch, be responsible for all the maintenance and repairs and for the supply of fuel, oils, grease, and other consumable stores, replacement of the launch by newer units if necessary and for taxes and insurances.

The insurance policy provided by the Contractor shall cover all claims by third parties against the Engineer and his staff as helmsmen or passengers. The insurance shall also cover driving of the launch by any member of the Engineer's staff and by helmsmen supplied by the Contractor and approved by the Engineer.

The said launch shall be made available to the Engineer at all times and in the event of it not being available due to breakdown and repair, the Contractor shall provide an equivalent replacement acceptable to the Engineer at an earliest possible time. On the completion of the Contract, the launch shall be deemed to revert in and become the property of the Contractor.

Assistance to Engineer.

S218. The Contractor shall provide all assistance to the Engineer for the purpose of checking, setting out and making tests, etc.; and shall supply chainmen, trade men, labourers, all surveying instruments, diving and other apparatus as and when required by the Engineer.

The Contractor shall also clean and maintain the Engineer's office to the satisfaction of the Engineer.

Drinking water and sanitary conveniences.

S219. The Contractor shall provide on the Site, for the use of his staff and workpeople, an adequate supply of drinking water and sanitary conveniences, with all necessary drainage, and shall make all the necessary arrangements therefor with the competent authorities. The number, capacity and location of the installations shall be to the satisfaction of the Engineer. All the costs relating to the provision, maintenance and removal, upon completion, of all the installations shall be borne by the Contractor.

First aid service.

S220. The Contractor shall provide adequate first aid service on the Site.

The Contractor shall also make necessary arrangements with a local hospital and with local doctors so that his sick or injured persons can receive the best available medical treatment with the minimum of delay at any hour of the day or night.

Signboards, and warning and instruction notices.

S221. Unless otherwise specified, all the signboards for buildings, structures and dangerous objects, and all warning and instruction notices required to be fixed on machines and any other things shall be in Bahasa Malaysia, Chinese and English.

Approval by the Engineer, etc.

S222. Except where otherwise specified all the drawings, documents, samples, etc. requesting the approval of the Engineer shall be submitted in triplicate, a copy of which shall when approved be returned to the Contractor and the remainder retained by the Engineer. The size and form of the drawings and documents or the quantity of samples shall comply with the instructions of the Engineer.

Nominated Sub-Contractor.

S223. The Contractor shall give the Nominated Sub-Contractor as much facilities as he can in respect of the use of temporary works provided by him at site. However, the Contractor shall not be required to provide any special facilities in excess of those provided by him, for the works to be done by the Nominated Sub-Contractor.

The Contractor shall provide or form all holes and chases where required in the buildings, or pinning and other general building works for the Nominated Sub-Contractors. The Contractor shall provide at least one 230 volt 15 ampere power outlet at each building for use by the Nominated Sub-Contractors.

The Contractor shall in all possible way co-ordinate his work with that of the Sub-Contractors, and provide them with, and obtain from them, all information necessary to enable their respective works to be set out and executed correctly. Any later demolition, etc., due to his failure in this respect shall be made good at the Contractor's expense.

Structural steel work for the transit shed.

S224. Allow for the sum of M\$750,000.- entered in the Bill of Quantities on structural steel for the transit shed (including the expense required for the erection supervisor) to be delivered at Kuching Port by the firm nominated by the Engineer.

Profits (if necessary) and overhead charges shall be included in the Tender Sum and the percentage shall be specified in the Bill of Quantities. Such profits and overhead charges will be payable to the Contractor in accordance with the percentage entered times the actual cost of the materials supplied.

Electrical work.

S225. Allow for the sum of M\$ entered in the Bill of Quantities on electric installation (including contribution to be paid to the Sarawak Electricity Supply Corporation) to be perfectly carried out by the firm nominated by the Engineer. Costs required for attendance, provision of facilities and building works in connection with the electric installation shall be included by the Contractor in his Tender Price.

Profits (if necessary) and overhead charges shall be included in the Tender Price and the percentage shall be specified in the Bill of Quantities. Such profits and overhead charges will be payable to the Contractor in accordance with the percentage entered times the actual cost of the Electrical Works executed by a Nominated Sub-Contractor.

CIVIL ENGINEERING WORKS

CHAPTER 3 MATERIALS

Standard Specifications and Codes of Practice.

S301. (a) Except where otherwise specified or authorised by the Engineer in writing all materials shall conform to the latest edition of the relevant British Standard Specification (hereinafter abbreviated to B.S.) published by the British Standards Institution, or any other authoritative Standard which ensures an equal or higher quality. Any materials not fully specified herein and for which there is no British Standard shall be the best of their kind and shall be specifically approved by the Engineer.

(b) Standards of workmanship and methods of construction shall, except where otherwise specified or authorised by the Engineer in writing, be in accordance with the relevant British Standard Codes of Practice (hereinafter abbreviated to C.P.).

Alternative Materials and Equipment.

S302. In cases where the name of a particular type or make of materials, equipment or other thing is referred to on the Drawings or elsewhere in this Specification this is intended to indicate the standard acceptable.

The Contractor may offer alternative materials or equipment of equal or higher quality to that specified. In all cases, the Contractor shall submit, prior to such materials or equipment being used, a statement detailing such alternative including full technical descriptions, drawings and manufacturer's specification, for the approval of the Engineer. If and when required by the Engineer, the Contractor shall, at his own cost, produce specimen of such materials or conduct tests on such equipment to the satisfaction of the Engineer.

Inspection and testing.

S303. (a) All materials and articles which the Contractor proposes to incorporate in the Permanent Works shall be subjected from time to time to such inspections and tests with analyses, if and when directed by the Engineer. Should the Engineer so require the Contractor shall at his own expense produce Test Certificates supplied by the manufacturers.

The Contractor shall provide and prepare at his own expense such test pieces and samples of the various materials as may from time to time be directed or specified. All costs of inspection and testings shall be borne by the Contractor.

Any tests of materials or completed works shall be carried out in the presence of the Engineer and shall be performed in such manner as he may consider desirable.

Materials used.

(b) All materials used in the Works are subject to further approval of the Engineer immediately before they are put in use, notwithstanding that the materials may have been passed as satisfactory at the time of delivery to the Site. Any loss or damage which may be caused to the Contractor from the disapproval by the Engineer shall be borne by the Contractor.

The Engineer will be at liberty to reject any or all materials and workmanship in the Works that are not equal in quality and character to approved samples, and the Contractor shall immediately remove such materials or demolish such works at his own cost.

Steel sheet pile. S304. The steel sheet piles to be used for the quay wall and revetment shall be the products of Nippon Steel Corporation or Hüttenwerke Ilse de Peine Aktiengesellschaft of West Germany or approved equal. Chemical composition and mechanical property shall conform to the following or higher:

Chemical composition.

P. 0.040% max.
S 0.040% max.
Cu 0.25% min.

Mechanical properties.

Tensile strength:
71,000 lbs per sq.in. and over.
Yield point:
42,000 lbs per sq.in. and over.
Elongation:
18% and over.

Permissible tolerance.

Item	U-type	Z-type	H-type
Width	+25/64in. -13/64in.	+5/16in. -5/32in.	5/32in.
Height	±4%	±13/64in.	±1.0%
Thickness			
Under 25/64in.	±1/32in.		
Over 25/64in. Under 5/8in.	±3/64in.		
Over 5/8in.	±1/16in.		
Length	+ no limit, -0		

The types of the steel sheet piles shall be as follows:

Type	Single Length in. ft.	Section modulus cu. in. per. ft.
YSP B-66	60 & 55	123
YSP Z-32	50	59.3
YSP U-15	23 & 45	28.3
YSP U-9	19	16.4

Transport and storage of steel sheet piles.

S305. In transporting steel sheet piles adequate measures shall be taken to protect them from being dented or developing permanent set and to protect their grips from being injured or deformed.

In loading and unloading, all steel sheet piles shall be handled in a way so that no excessive deflection will develop. As a rule, the sheet pile shall be hoisted with wire ropes fastened at two points so spaced that the deflection to be caused by its dead weight shall be minimised.

The piles shall be stored at a place which will permit good drainage and ventilation and upon a level and hard ground so that no subsidence may be caused by the weight of piles.

The piles shall not be stacked higher than 7 feet. The number of stacked piles per course shall normally be five or less, and the sleepers are to be placed in between the courses at intervals of less than 13 feet. The standard size of the sleeper shall be 8 inches square. If piles shall be stacked with the flange face resting horizontally on sleepers and sleepers shall be used in between every layer of piles in a direction perpendicular to the pile.

Where there is fear of the piles being deformed, the piles shall be re-stacked immediately.

Tie rod.

S306. The tie rod to be used for the quay wall and revetment shall be semi-high tensile steel and shall have the mechanical properties and tolerance on the dimensions as given below:

Mechanical properties.

Item	Quality	Yield point lbs/sq.in.	Tensile strength lbs/sq.in.	Elongation %
Tie rod proper, * Ring joint pin KST-III		64,000 and over	99,000 and over	20 and over
Turnbuckle, Ring joint nut, Fixing nut	B.S.1449	44,000 and over	74,000 and over	23 and over
Ring joint plate	B.S.968	45,000 and over	71,000 and over	21 and over
Ring joint washer	B.S.4360	33,000 and over	58,000 and over	24 and over

*Kobe Steel tie rod - III.

Tolerance on dimension.

Item		Tolerance on dimensions
Tie rod	Rod section	Length: $\pm 1-3/16$ in, -0. Dia. $\pm 1.5\%$
	Upset section, thickness	$\pm 5/32$ in, -0.
	Screw section	Comply with B.S. 3643, Part 2.
Anchor nut		Comply with B.S. 916.
Turnbuckle		$\pm 5/64$ in.
Ring joint section		$\pm 5/64$ in.
Anchor washer		$\pm 5/64$ in.

Transport and
Storage of tie
rod.

S307. Care shall be taken to ensure that the surface and threaded section of the tie rod are not subject to any damage during the transport. The threaded section of tie rods shall be covered with a coating of grease and wrapped tight with hessian or cloth. Accessories such as turnbuckles, ring joints, etc. shall be packed in timber boxes or bags during the transport. The tie rod and accessories shall be stored in well-ventilated sheds, separately according to their use, diameter, length, etc.

Steel pipe pile.	S308. The steel pipe piles to be used for dolphins, bitt, etc. shall comply with B.S. 4, Part 2, (1965) "Structural steel sections" or of higher quality with the shape and dimensions as specified and approved by the Engineer.
Transport and Storage of steel pipe piles.	S309. Steel pipe piles shall be transported and stored in the similar manner as described in Clause S305 for the transport and storage of steel sheet piles.
Steel reinforcement.	S310. Steel reinforcing bars for concrete work and for other purposes shall comply with the following British Standards: B.S. 785 (1967) "Hot rolled bars and hard drawn wire for the reinforcement of concrete". B.S. 1144 (1967) "Cold worked steel bars for the reinforcement of concrete".
Storage of steel reinforcement.	S311. In storing, the steel reinforcement shall not be placed directly on the ground. They shall be placed upon suitable sleepers or racks and under cover to protect them from rains. The steel reinforcement shall be stored separately according to their diameter and length.
Channel and angle.	S312. Steel channel and angle shall comply with B.S. 4 (1965) "Structural steel sections".
Steel sheet.	S313. Steel sheet or plate shall comply with B.S. 4360 (1968) "Weldable structural steels".
Bolts and Nuts.	S314. Black bolts and nuts shall comply with B.S. 916 (1953) "Black bolts, screws and nuts". Those bolts and nuts which are specified in the Specification and on the Drawings shall be galvanized.
Electrodes.	S315. Electrodes used for welding mild steel shall comply with the requirements of B.S. 639 (1964) "Covered electrodes for the manual metal-arc welding of mild steel and medium tensile steel".

A manufacturer's test certificate giving the results of the initial tests carried out on such representative electrodes supplied shall be furnished by the Contractor. Any electrode with the flux on its surface being stripped off or damaged shall be rejected.

Cement.

S316. Portland Cement to be used shall comply with all the requirements of B.S. 12 (1958). If the Contractor so desires, Rapid-Hardening Portland cement or other special cements may be used in place of Ordinary Portland cement with prior approval of the Engineer.

Each parcel of cement supplied shall be given a separate consignment number and shall not exceed 200 tons in quantity and no one series of tests or analyses shall be applicable to a greater quantity of cement than this. Samples shall be taken from each parcel in the presence of the Engineer, or alternatively two copies of test certificate accompanied with test results shall be submitted to the Engineer, if acceptable. A sample taken for the tests from each parcel shall be 15 lbs. and be placed in an airtight container marked with a clear identification, before sending to a laboratory designated by the Engineer. The cement from which the samples have been extracted shall not be used in any works before the completion of the testing and analyses and until it has been passed as satisfactory by the Engineer.

In addition to the above tests and analyses, the Engineer may further test any parcel of the cement after it has been stored at the Site prior to use, in order to make certain if the cement has deteriorated during transit or storage. No cement will be allowed to be used until it has been passed as satisfactory by the Engineer.

If it should appear from the results of these tests that any of the cement does not comply with the requirements of B.S. 12, (1958) parcel of cement from which the samples have been obtained shall be rejected and immediately removed from the Site at the Contractor's sole cost.

The Contractor shall provide, at his expense such suitable labour and cement, sand and other materials for tests by the Engineer at Site. Measurements and various tests of cement shall be carried out in accordance with the instructions of the Engineer.

Transport and storage of cement.

S317. Cement shall be delivered to the Site in original bags with the description of item, quantity, quality, and name of manufacturer clearly printed on the bag. Damaged bags shall forthwith be removed from the Site. Bagged cement shall be adequately protected from weathering by tarpaulins or other coverings while being loaded or unloaded and during transit from the manufacturer's premises to the Site or from the shed to concrete mixer, whether conveyed in vehicles or by mechanical means. Samples of the bags shall be submitted to and approved by the Engineer before use.

The use of bulk cement will not be prohibited, however, the details proposed for its transport, storage and use shall be submitted to the Engineer for his approval.

If the cement is delivered in bags to the Site, the Contractor shall construct at his own cost adequate weatherproof and well ventilated sheds having a floor of

wood or concrete raised at least 18 inches above the ground. The sheds shall be large enough to store sufficient cement to ensure continuity of work and each parcel must be kept separately to permit easy access for identification, inspection, testing and issue. Bagged cement shall not be stacked higher than 12 bags. Upon delivery at the Site the cement shall at once be placed in these sheds and used in the order of delivery.

The Contractor shall submit a weekly return to the Engineer of the various consignments of cement then in store, showing what quantity has been received and issued during the week, from whom obtained, and in what portions of the Work the cement has been used.

Any cement which has been stored more than 3 months or which is suspected of being exposed to air shall be tested by the Contractor and approved by the Engineer before being used, notwithstanding that the cement may have been passed as satisfactory earlier.

**Concrete
aggregates.**

S318. All concrete aggregates shall be obtained from sources approved by the Engineer. The Engineer shall have the right to reject any aggregate delivered at the Site which in his opinion is unsuitable for use, notwithstanding that the aggregates may have been obtained from the approved sources.

Aggregates for concrete and mortar shall be tested and comply with the requirements of B.S. 882 (1965) "Aggregates from natural sources for concrete".

A sufficient quantity of acceptable aggregates shall always be in stock on the Site to ensure that the concreting work may continue for one month without halt.

Coarse aggregate. S319. The term coarse aggregate means an aggregate retained on a 3/16 inch B.S. test sieve. The grading of the coarse aggregate shall be within the limits given in Table 1, B.S. 882 (1965). When the results of the grading analyses revealed shortage of a specific size to the extent that may affect the density of the concrete, the Engineer may direct the Contractor to add required amount of such deficient aggregate. The grading of the coarse aggregate shall be such that it shall produce a workable concrete of maximum density and strength. Such densities for the various classes of concrete shall be fixed by the Engineer after tests have been carried out on the Site. The Contractor shall take any step that may be necessary to prevent the segregation of coarse aggregate into separate sizes after it has been graded and stored.

The coarse aggregate shall have an Aggregate Crushing Value not exceeding 30% for concrete wearing surfaces nor 45% for other concrete work. The Aggregate Crushing Value shall be determined as described in B.S. 812 (1967) "Methods for sampling and testing of mineral aggregates, sands and fillers".

The crushed stone shall be hard, durable and clean, and shall not contain any clay, flaky or elongated particles or weathered rock. Stone shall be crushed to the specified sizes by an approved type of crusher. Powder or fines passing the 3/16 inch test sieve shall be kept apart and thoroughly washed by the approved method, if so directed by the Engineer.

Fine aggregate. S320. The sand for concrete shall be perfectly clean, sharp and free from clayey and organic matter and shall be capable of passing through a 3/16 inch B.S. test sieve and the portion passing through B.S. test sieve No. 100 shall be less than 10%. And, it shall be graded so that when mixed with the coarse aggregate, cement and water it shall produce a workable concrete of maximum density. The sand shall comply with the requirements of B.S. 882 (1965) "Aggregates from natural sources for concrete".

Crushed stone sand may be added to natural sand in order to achieve the required grading. Crushed stone fines may only be used with the approval of the Engineer.

Storage of aggregates. S321. All sand and aggregates for concrete work shall be stored in bins or on stages which are so designed as to prevent the segregation of sizes, or inter-mixing or aggregates of different sizes and to avoid the inclusion of dirt, organic matter and other deleterious materials. Each size of aggregate shall be stored separately unless otherwise approved by the Engineer.

Stone. S322. The stone to be used in the Works shall be of the best quality suitable for respective purposes, and shall be hard, durable, tough, resistant to abrasion and weathering and free from earthy or friable matter, and other defects. Crushed stones shall not be flaky or elongated and the sources of supply shall be approved by the Engineer.

The Contractor shall make his own arrangements to secure a sufficient supply of specified stone for the Works.

Admixtures. S323. Admixture in concrete shall be used only after trial tests have been carried out in accordance with Clause S404 and approved by the Engineer.

Water. S324. The Contractor shall make his own arrangements to provide sufficient supply of approved water for the

production and curing of concrete. The Contractor may draw water supply at his own cost from Pending Heights Estate, about 1½ miles from the Site.

The water shall comply with the requirements of B.S. 3148 (1959), and shall not contain deleterious substances such as oil, acid, salts and other chemicals or organic impurities in a quantity that may affect adversely the quality of concrete.

Timber.

S325. Timber used in the Permanent Works as specified respectively shall be first grade Belian or Bakau produced in Malaysia and shall be properly seasoned and matured, sound, straight, free from warp, sapwood, rot, shakes, large and loose knots, worm holes, wanes, cracks and other defects and shall comply with the requirements of "The Malayan Grading Rules for Sawn Hardwood Timber Special Market Specifications for Strips and Scantlings".

Except for those piles used in anti-erosion work, all piles to be used for the foundation shall be straight barked fresh timber free from warp, cracks, decay, etc. The point of the round piles shall be cut into a cone or shape of pyramid. The standard length of the points shall be 1.5 times the diameter of piles.

Timber for temporary works such as for supporting the sides of trenches and excavations shall be of good sound quality and dimensions sufficient for the work in which it is to be used.

Sawn timber to be used shall be cut die square and true on all four sides to the scantlings and shapes shown on the Drawings, and all joints to be accurately cut and close fitting, well housed and spiked together.

Timber specified to be treated for preservation shall be vacuum/pressure impregnated and tanalised with wood preservative to an average dry salt retention of 0.35 lb/cu.ft. for all interior timbers and 0.50 lb/cu.ft. for all exterior timbers.

All timber to be treated must be machined to final dimensions before treatment. All timber must be thoroughly seasoned to comply with B.S.C.P. 112 (1967) and to a moisture content of not more than 25% before treatment. Treatment certificates shall be obtained from the treatment plant and submitted to the Engineer.

The whole of the timber stored on the site must be protected from the weather and properly stickered and stacked to enable free circulation of air around all faces.

The dimensions indicated on the Drawings shall, in the case of sawn timber, be as the finished size, and in the case of round timber, the mid-length size except otherwise specified.

Fascine

S326. The fascine may be made from any kind of tree except coniferous trees, but the selection must be guided by the general principle of obtaining solid and tenacious ones as much as possible.

A dozen-odd sticks with length over 8 feet shall be firmly tied into a bundle with pliable bark or wisteria vine or Rotan rope at three places. The girth of the bundle thus prepared shall be not less than 2 feet 1 inch and 1 foot 10 inches at the points of 1 foot 6 inches and 6 feet 6 inches from the cut end, respectively. When sticks shorter than 8 feet are approved for making fascine, the mixing ratio shall be as follows:

8 feet and over	30%
Under 8 feet	
6 feet and over	40%
Under 6 feet	
3 feet and over	30%

The fascine shall be green; if any fascine has been kept in open storage for too long a period, it shall be inspected again before use. In storing fascines at the site, the Contractor shall see to that all the fascines are stacked and placed in such a way that air would pass through the fascine freely and water would drain readily. Should the fascine be found to be dead or rot on re-inspection, the Engineer shall have the right to reject such materials, notwithstanding that the fascine may have been inspected to be satisfactory at the site.

On inspection, the Engineer shall take out a bundle at random from every 100 bundles and measure its girth at places of 1 foot 6 inches and 6 feet 6 inches from the cut end respectively, tightly squeezing the girth with both hands using a rope to ascertain if the girth is adequate as specified. Any loose bundles found shall be replenished by additional number of fascines to make up the required volume at the direction of the Engineer.

Bamboo cribbing.

S327. The bamboo to be used shall be 3" to 4" diameter, cut in 1/3 and each piece in length of not less than 11 feet. All bamboo shall be green and straight and acceptable to the Engineer.

Bakau Peg.

S328. The Bakau pegs to be used for the fascine mattress shall be durable and straight, about 1/4 feet in length and up to 1 1/2 to 1-2/3 inches in diameter at the cut end. The top end shall be pointed square. Ten of such pegs shall be tied into a bundle.

In storing at the site, four to five bundles shall be stacked alternately crosswise until 100 or 200 bundles are piled up in one heap.

Pegs in each heap shall be inspected as to their length and diameter, and the Contractor shall replace those rejected by the Engineer.

Fenders.

S329. The fenders to be used for the quay wall and the breasting dolphin shall be Super-arch Dock R 2 Fenders as manufactured by Bridgestone Tire Co., Ltd., or Seibu Rubber Chemical Co., Ltd., or approved equal, and shall be to the dimensions shown on the Drawings.

The fenders shall satisfy the following standards at a time when the deflection reaches 40%:

	<u>Reaction Force</u>	<u>Absorption Energy</u>
Quay Wall	110 tons	16 tons-m.
Breasting Dolphin	89 tons	15 tons-m.

Fixture for fenders.

S330. The fixture for fenders shall be Super Bolt, A type as manufactured by Bridgestone Tire Co., Ltd., or approved equal, and shall be to the dimensions shown on the Drawings.

The boxes and bolts of the fixture shall be made of stainless steel.

Bollards and bitt.

S331. The bollard and bitt shall withstand the line pull of 35 tons and 100 tons respectively, and be of the shape and dimensions as detailed on the Drawings. All material shall comply with the requirements of B.S. 3100 (1967), "Carbon steel castings for general purposes". The fixing bolts and nuts shall be of the shape and dimensions as shown on the Drawings, and of quality complying with B.S. 916 (1953).

Cast iron manhole covers, etc.

S332. Cast iron manhole covers and frames shall be of heavy grade and shall comply with B.S. 497 (1967), "Cast manhole covers, road gully gratings and frames, for drainage purposes", and shall be to the sizes and pattern numbers shown on the Drawings.

R.C. pipe.

S333. Reinforced concrete pipes to be used for drainage culverts shall comply with B.S. 556 (1966), "Concrete cylindrical pipes and fittings including manholes, inspection chambers and street gullies".

Paint.

S334. Paint to be used for bollards, bumpers and others shall comply with the requirements of B.S. 278 (1936) "Ready mixed paints (oil gloss) zinc oxide base".

Bitumen. S335. Bitumen to be used for the pavement of roadways, open storage area and for the joints of concrete pavement shall comply with the requirements of B.S. 3690 (1963), "Bitumens for road purposes".

Toe protection bags. S336. The material to be used for making sacks for toe protection works shall be of polypropylene Sheet No. PPF 700 manufactured by Mitsubishi Petrochemical Co., Ltd. of approved equal.

Grating. S337. Gratings to be used for open drains, Type A, B, and C, shall be made by processing, fabricating, welding and galvanizing steel plate complying with B.S. 4360 (1968) The gratings shall be the products of Kobe Steel Works, Ltd. or approved equal.

Gratings, types D and E, shall be made as shown on the Drawing by cutting, processing and welding channels and round bars. After fabrication, the gratings shall be thoroughly cleaned with wire brush to be free from loose mill scale and rust, and they shall be applied with three coats of protective paint approved by the Engineer.

Aluminium coated steel wire. S338. The aluminium coated steel wire shall have smooth surface and be free from defects such as bubbles, flays, cracks, rust or coating damaged due to bending or any other causes, and shall comply with the following standards:

<u>Diameter</u> <u>mm</u>	<u>Tolerance</u> <u>mm</u>	<u>Tensile</u> <u>strength</u> <u>kg/mm</u>	<u>Torsion</u>	<u>Coating</u> <u>g/sq.m.</u>	<u>Winding</u> <u>test</u>	<u>Uniformity</u> <u>test</u> <u>Times/min</u>
5.0-5.5	± 0.12	35-55	25	100	5	3
4.5-5.0	± 0.10	"	"	"	"	"
4.0-4.5	"	"	30	80	4	2½
3.5-4.0	"	"	"	"	"	"
3.2-3.5	"	"	"	"	"	"
2.9-3.2	± 0.08	"	"	"	"	"
2.6-2.9	"	"	"	"	"	"
2.3-2.6	"	"	40	60	3	2
2.0-2.3	"	"	"	"	"	"

Galvanized steel wire. S339. Galvanized steel wire shall be made of mild steel wire complying with B.S. 1052 (1942) and galvanized in accordance with B.S. 443 (1961) "Galvanized coatings on wire".

Stellar sheet.

S340. The Stellar sheet shall be made from a mixture of palm fibre and synthetic fibre in the ratio of 60% and 40%, respectively; with rubber latex for bond and dyed with coloring agent, then vulcanized and dried for finishing.

The Stellar sheet shall have a tensile strength of 1.3 kg/sq.cm, elongation of 32%, density of 135 and specific gravity of 0.067. The tolerance on thickness shall be within $\pm 5\%$.

Alternative materials may be used if the samples and test data submitted by the Contractor show a quality equivalent to that specified or higher and approved by the Engineer.

CHAPTER 4 GENERAL CIVIL WORKS

4-1 Concrete

Mixing
proportion
and strength.

S401. Concrete shall consist of cement, aggregate and water thoroughly mixed and compacted to provide strengths as shown below:

Quality of Concrete	Maximum size of coarse aggregate in.	Minimum quantity of cement per cubic yard of concrete in situ. lb.	Standard design strength lb/sq.in.	
			7 days	28 days
AA	1	560	3,000	4,700
A	1-5/8	510	2,850	4,000
B	1	460	2,500	3,500
C	1-5/8	460	2,500	3,500

The quantity of cement given in the above table is intended to serve only as a guide to secure the required strength of concrete at the Site. Tests shall be carried out prior to the actual placing of concrete of various classes in accordance with B.S. 1881 (1952) and Clause S402 to determine the proportions of cement, aggregates and water to be put into the mixer. The results of the preliminary tests shall show the desired workability with strength of 25% over that of prescribed test cubes, or strength higher than the margin the Engineer considers allowable to cover the possible breakage as the results of testings performed in consideration of the Contractor's plant, equipment, organisation and degree of quality control. The mixes finally decided upon by the preliminary tests shall be adhered to during the progress of the work except otherwise modified by the Engineer which may be required in consideration of any change in materials or test results.

Preliminary test to determine concrete mixes.

S402. Before commencing any concreting in the Works, the Contractor shall make trial mixes of various classes of concrete using samples of aggregates and cements typical of those to be used in order to determine the required workability, durability and strength, and submit the results to the Engineer for his approval. The Contractor shall make six test cubes according to the prescribed mix proportions and carry out the preliminary tests.

Based upon the results of these tests, the proportion of cement, coarse aggregate, fine aggregate, water and, if approved by the Engineer, admixtures for various classes of concrete shall be determined. The Contractor shall allow sufficient time to enable the Engineer to study the trial mixes and the results of 7-day and 28-day strength tests. The test cube shall be a 6 inch cube and the method of testing shall conform to B.S. 1881 (1952).

Laboratory.

S403. The Contractor shall within two months after the Date of Commencement of the Works provide a laboratory for carrying out tests required for the quality control of concrete and asphalt pavement works as well as other tests as specified in the Contract. The provision of the laboratory shall be deemed to include the building, fitting, furnishing, equipment, supply of water, fuels, electricity and materials required in the tests, and removal upon the completion of the Works.

The Contractor shall provide at his own cost, the services of one trained and competent Laboratory Assistant and two laboratory workers for the maintenance and efficient functioning of the laboratory. The number of the above required personnel shall be taken as an average for the entire period of the Works, but for the actual requirement at any one stage of the Works the Contractor shall supply them in accordance with the instructions of the Engineer. Such personnel shall be placed under the direct supervision of the Engineer.

The laboratory equipment shall include those listed in Appendix 'A' to the Bills of Quantities. Non statement of certain equipment, instruments, apparatus, etc. in the said Appendix shall not relieve the Contractor of his responsibility to carry out tests required by the Engineer for the execution of the Works.

Test of concrete. S404. All test cubes shall be tested in accordance with B.S. 1881 (1952). The method of compacting cubes by vibration shall be approved by the Engineer.

Six test cubes shall be taken as and when directed by the Engineer during the concreting. Each cube shall be indelibly marked with date, series number and other markings required by the Engineer 24 hours after the cubes were cast.

These test cubes shall be tested to destruction by compression under the supervision of the Engineer. Three of each series of six cubes shall be measured for weight and compressive strength after 7 days in the presence of the Engineer, and the remaining three after 28 or other number of days required by the Engineer.

The full details of the results of all compressive strength tests, accompanied by information on the type and quantity of the cement used, and the results of sieve analyses of aggregates, together with mix proportions of concrete of various classes shall be submitted to the Engineer within three days after the completion of the tests.

Any concrete which test results shows a strength lower than the design strength shall be rejected. The Contractor shall prepare histogram clearly showing the test results for the approval of the Engineer.

In addition to the compressive strength tests, the Contractor shall carry out air content and slump tests on concrete from time to time in accordance with the instructions of the Engineer.

Test failure.

S405. If any test cube fails to meet the specified strength, the cause of the failure shall be investigated forthwith and the results of investigations shall be submitted in writing to the Engineer. After having studied the report, the Engineer shall take one of the following measures which he considers most appropriate.

The representative of the Engineer shall, pursuant to Clause 39 of the Conditions of the Contract, order the Contractor to cut out the concrete in that part of the Works of which it is a sample and replace it by new concrete.

When the failure relates to concrete in structural members which lend themselves to load test such as beams, columns or slabs, the Engineer may order such member to be so tested in accordance with his instruction. If cracking or any other signs of failure appears in the test, such concrete member shall be cut out or demolished to the extent ordered by the Engineer and replaced with sound concrete.

When the failure, in the opinion of the Engineer, is slight and occurs in a construction joint or other continuous concreting operation for a large mass of concrete, the completed work may be retained until the next test result has been obtained and, if the failure still persists, the Engineer may then order that concreting shall cease forthwith until further trial tests show that the mix has been corrected.

When the failure is serious and relates to a mass concrete, the Engineer may order one or more cylindrical cores to be drilled out and tested in accordance with B.S. 1881 (1952). According to the results obtained the Engineer may order the defective concrete work to be cut out or demolished and replaced by new concrete.

The cost of all these remedial works including tests, the provision and installation of jacks, kentledge, deflectometers, and other equipment shall be borne by the Contractor.

Batching.

S406. All batching of cement and coarse and fine aggregates shall be done by approved adjustable weigh batching machine.

The water shall be fed into the mixer from a tank provided with means of adjusting the correct amount of water supply. The moisture content of the aggregates shall be duly taken into account so that the amount of water to be fed into the mixer may be determined accurately. The moisture content of any aggregates shall normally be measured twice a day, once in the morning and once in the afternoon, or at such other time as considered necessary by the Engineer.

The tolerance for the batching shall be within 3% for cement and aggregates and 1% for water.

Equipment for concreting.

S407. All machines, tools and equipment used for mixing, transporting or placing concrete shall be kept clean at all times. The batching machine shall be provided with simple and convenient weighing mechanism, and they shall be checked and adjusted from time to time in the presence of the Engineer. All mixing machines shall be thoroughly cleaned with water before mixing concrete. The same mixer shall not be used continuously for mixing different mixes, without being washed and cleaned.

Mixing concrete.

S408. Concrete shall be mixed in a batching machine of approved type, continuously and thoroughly to a uniform density, colour and consistency. The mixing time shall be more than 1½ minutes at a speed not exceeding 18 revolutions per minute and when the specified time has been prolonged to more than three times, the operation of the mixer shall forthwith be suspended.

No new materials shall be fed into the mixer until the concrete in the drum has been wholly discharged and cleaned.

Should the Contractor find it expedient to use small-type mixers for special or outlying portions of the Works rather than from the main batching plant or plants, he may, subject to the approval of the Engineer, do so, provided such smaller concrete mixer has also been equipped with a weighing mechanism.

Normally, hand mixing of concrete will not be allowed, but where the total quantity of concrete is small or where the works are of minor importance, the mixing may be done by hand, subject to the Engineer's approval, and his entire discretion. Where permitted, hand mixing of concrete shall be done on a hard, even and impervious surface of adequate size. The materials shall be turned over not less than three times in a dry state. A measured quantity of water shall then be added gradually while the materials are further being turned over not less than three times in a wet state and worked together until a mixture of uniform consistency and colour is obtained.

Where the volume batching is specifically approved by the Engineer, suitable gauge boxes may be used.

Formwork and
centering.

S409. The Contractor shall design and construct the formworks and centering so as to ensure that the finished concrete works are true to the required lines and dimensions shown on the Drawings and that the concrete can be thoroughly compacted without distortion.

The formwork and centering shall be so designed as to fully withstand their dead weight, the weight and impact of concrete, workpeople and concreting equipment as well as side pressure exerted from concrete on the formwork and centering during the concreting operation.

Prior to the construction of formworks and centering, the Contractor shall submit for the approval of the Engineer the details of their structure and materials he proposes to use. But such approval shall in no way relieve the Contractor of his responsibility for the sufficiency and efficiency of the formworks and centering.

The formwork shall be so designed that it may be easily constructed and removed and the joints of shutters or panels shall be securely upright and as perpendicular or parallel to the axis of concrete members as possible and be perfectly closed and tight to prevent the leakage of mortar. Unless otherwise shown on the Drawings or directed by the Engineer, $\frac{3}{4}$ in. by $\frac{3}{4}$ in. chamfers or fillets shall be provided at all angles and arrisses.

The material and position of any ties passing through concrete members shall be to the Engineer's approval. Any metal ties and securing devices used to hold the formwork must be of such a type that the metal parts left permanently embedded in the concrete are not nearer than one inch from any finished surface. The holes left by the removal of ties must be completely filled with mortar of approved composition and to the satisfaction of the Engineer.

The inside faces of formworks shall be coated with mould oil or other approved preparation, in either case of a type that will not affect the strength or mar the appearance of the finished concrete, and care shall be taken to prevent the oil or other approved preparation from coming into contact with steel reinforcement.

Where formwork is re-used, it shall be thoroughly cleaned and repaired to the satisfaction of the Engineer.

The centering shall be so constructed that the load borne thereby may be securely transmitted to the foundation. The foundation for centering shall be sufficiently solid and stable so that no uneven subsidence may occur.

The completed formwork and centering shall be inspected and approved by the Engineer before any concreting is commenced.

The formwork and centering shall be removed at the time and in the order approved by the Engineer. Such removal shall be done as gently and securely as possible so that no damage is caused to the structures.

The formwork for exposed external faces of concrete shall be wrought formwork and for un-exposed faces the rough formwork.

Moulded concrete. S410. All link blocks, kerbs and other similar things specified or shown on the Drawings or other moulded concrete shall be cast in strongly built moulds fitted with all requisites for the formation of chamfers, radii, V-grooves, recesses, lewis holes, etc. to produce units perfect in shape, true to dimensions with smooth faces and having clearly defined chamfers and radii and sharp arrisses on all exposed edges.

The mould shall be placed level on the well compacted hard ground or on a concrete floor for casting. The concrete shall be deposited slowly, well worked in and thoroughly packed and vibrated so as to dispel all air bubbles and to fill the mould in all corners perfectly.

Adequate preventive measures shall be taken to prevent the mould from swelling, deflection or widening in any way when the concrete has been deposited in the mould. Also, suitable measures shall be taken in the removal of the mould without causing any damage to the cast unit.

All moulded concrete shall be cured as specified in Clause S415.

The Contractor shall cause the date of manufacture of all concrete blocks to be readily known and no cast blocks may be brought into the Site unless the test cubes results on the blocks shall have attained a strength greater than the minimum work cube strength specified for 28 days for the class of concrete used in the casting.

During the manufacture of link concrete blocks, the Contractor shall make three test cubes from any one batch of every 500 blocks or less and carry out a series of strength tests on these cubes at his own cost according to the instructions of the Engineer.

Steel reinforcement.

S411. Steel rod reinforcement shall be bent and cut to the exact shape and length as shown on the Drawings and in a manner which will not damage the material. Where it is necessary for the reinforcing bars to be worked hot, the full details of the whole work shall be approved by the Engineer.

Before steel reinforcement is being fixed in the Works, any loose mill scale, loose rust, oil, grease, dirt or other matters impairing the bond between the concrete and steel reinforcement shall be removed by wire brush or other method acceptable to the Engineer.

The Contractor shall submit to the Engineer bending schedules detailing the reinforcement required for the Permanent Works, and all working drawings and lists of reinforcement based on the above schedules in accordance with "3. Form of bar schedule" of B.S.1478 (1967), "Bending dimensions and scheduling of bars for the reinforcement of concrete" at his own cost.

The Contractor shall provide all necessary distance pieces and spacer bars made of mortar at his own cost to maintain the reinforcement in the correct position as shown on the Drawings. The use of wooden blocks will in no circumstance be allowed.

Upon the completion of the bending, cutting and placing in the formwork, the steel reinforcement shall be inspected by the Engineer for his approval. When a long time has elapsed between the placement of reinforcement and the concreting after such approval, it shall be inspected again by the Engineer for his approval before concreting.

Where splices or overlapping in reinforcement are required, the round bars, whether in same size or not, unless otherwise shown on the Drawings, have an overlap of not less than thirty diameters where a U-hook is employed on each end of the overlapping bars. Twenty-four diameters shall be used in the case of deformed bars. The fabric reinforcement sheet shall have two meshes overlapped. Bars shall be securely wired together with a pair of best black annealed wire No. 16 S.W.G. at three or more places, wound twice and twisted tight with proper binding tools.

The number, size, form and position of all steel reinforcing bars, ties, stirrups and other parts of the reinforcement shall be placed in exact accordance with the Drawings and kept in the correct position in the form-works in a manner approved by the Engineer so that they will not be displaced during concreting or compaction of the deposited concrete.

All the intersection of reinforcing bars shall be bound tight with the previously mentioned black annealed soft-iron wires in the same manner as in the splicing of bars or by using clips.

Conveyance of concrete.

S412. All freshly mixed concrete and mortar shall be conveyed as quickly as possible from the mixer to ensure that no bleeding or segregation of the aggregate constituents may occur and the slump value shall not decrease in any way.

When wheelbarrows or trolleys are used for the conveyance, a level passage shall be provided to ensure that the concrete does not segregate while being transported.

The belt conveyor and distributing chutes shall only be used with the approval of the Engineer.

Depositing concrete.

S413. In no circumstances shall the time elapse more than half an hour between the time when water is added to the mix and the time when the concrete is finally placed in the Works.

Before placing the concrete in position, the surfaces to receive the concrete shall be blown and cleaned of all debris, dust, rubbish, dirt or any other harmful matter and then covered with a blinding layer of mortar of about the same quality with the mortar in the concrete.

The concreting in any one section shall be carried out continuously in the order approved by the Engineer. The concrete shall be deposited in such a manner that it shall not be segregated or moved after being placed in the formwork.

Concrete shall be so deposited that its surface is nearly level within a section. In no case shall concrete be dropped from a height more than 4 feet.

Before new concrete is added to concrete which has already set, the laitance film and porous layers shall be removed, the surface keyed, wire brushed and well watered, and a 1/2 inch thick coat of cement mortar of about the same quality with the mortar in the concrete shall be applied. The new concrete shall be well rammed to the old.

Except where arrangements have been made for placing concrete under water with the approval of the Engineer, the area on which any concrete is to be placed shall be made free from standing water during concreting. Running water entering such areas shall be kept under control during concreting and for 24 hours after the concreting.

In the event of rain storms or other severe weather conditions arising, concreting shall be stopped. All concreting materials and plant are to be adequately protected against the rains and strong winds. To meet such circumstances the Contractor shall always have in readiness on Site approved framed sheeting, tarpaulins, etc. for the protection of newly placed concrete. Should any concrete be damaged due to rain storms or other weather conditions, the Engineer may order the cutting out and replacement of the damaged concrete, all at the expense of the Contractor.

Compaction of concrete.

S414. Concrete shall be consolidated into place during and immediately after depositing by means of approved internal vibrators.

The vibrators shall have a frequency of not less than 7,000 impulses per minute and the vibration shall be applied to concrete, on the average, for 30 seconds at a time. Care shall be exercised, however, not to cause segregation of aggregate constituents by excessive vibration.

The vibrator shall be vertically inserted for about 4 inches into the layer immediately below the layer to be compacted at grid intervals less than 2 feet.

Vibration shall be continued until the concrete being placed shall no longer show any decrease in volume, and a glistening and even surface shall appear. The vibrator shall be withdrawn from concrete slowly so that no air pockets will be formed inside.

Where it is difficult to employ the internal vibrator because of thin walls or the construction of the formwork, compaction may be done by means of the form vibrators or by hand ramming using reinforcing bars or rods with the approval of the Engineer. In no case may the vibrator be applied to the reinforcing bar to consolidate the concrete by vibration of such reinforcing bar.

Curing of concrete.

S415. Freshly deposited concrete shall be protected from the sun, wind and rain until it has achieved initial set, and shall also be prevented from too rapid drying by being kept covered with damp sacks, screens, sand, etc., or by means of sprinklers or of other approved means, for at least 7 days after placing.

Where there is fear of the formwork becoming dry, it shall always be kept damp by sprinkling water.

The concrete shall be protected from vibration, shock or load from outside during its setting period.

All concrete liable to be affected by wave action shall be adequately protected from damage during the setting period and all protective works shall be to the satisfaction of the Engineer.

Finish to concrete surfaces.

S416. All concrete surfaces shall be finished free from excessive air holes, burrs and projections.

Any defective concrete work shall, at the discretion of the Engineer, be demolished completely and rebuilt or cut out and made good with new concrete of the same mix, to the satisfaction of the Engineer.

Construction joints.

S417. Joints shown on the Drawings shall be formed true to the specified locations. No joints shall be formed unless they are shown on the drawings or otherwise approved by the Engineer before work is commenced.

4-2 Earthworks

Borrow pits.

S418. The Contractor shall make his own arrangements for any borrow pits and, investigate and ascertain that adequate supplies of the specified materials may be obtained for the Works.

Quality of fill.

S419. Any materials to be used for the fill shall be a mixture of properly graded sand and gravel and containing an appropriate amount of good clay for bonding. The fill shall conform to at least A-2-7 or higher in accordance with the U.S. Public Roads Classification. Any material containing a deleterious amount of organic substances, pumice or mica shall not be used. Fine sand of uniform grain, silt, bentonite, serpentine rock or humus soil shall be rejected. The fill material must in all circumstances not contain any stones, gravel or other solid substance larger than 4 inches.

Earthwork equipment.

S420. Prior to the earthwork, the Contractor shall select and determine the best combination of the suitable earthwork equipment for the excavation, hauling, levelling and compaction. A list of all these equipment showing their types, capacities, numbers, and other information shall be submitted to the Engineer for his approval.

Filling.

S421. The material from the borrow pits in accordance with the work schedule approved by the Engineer shall be spread and levelled in layers not exceeding 12 inches and consolidated by means of compacting machines. The degree of compaction shall be not less than 95% of the value specified in B.S. 1377 (1967), Test No. 9 or at least 5% in C.B.R. in-situ. In addition, the Contractor shall carry out in the presence of the Engineer the proof rolling to check the compaction of the fill.

Protection against rain.

S422. The Contractor shall take adequate measures to prevent the filled surface from turning soft due to rain during the earthwork. Care shall be taken not to leave fill materials or excavations in foundation work piled up in heaps, or to leave material brought in the area without compaction. The compacted surface shall have a slope of about 4% to the horizontal and the whole of the top surface of the reclaimed area shall be provided with temporary surface drainage and covered with tarpaulins, where necessary.

The Contractor shall protect the side slope around the edge of the reclaimed areas to minimise the possible damage of the slope by rain, and provide temporary perimeter drains where directed by the Engineer.

Excavation.

S423. All excavation for drains, manholes, etc. shall be carried out to the levels, cross sections and slopes shown on the Drawing. Firm foundations shall be made by tamping.

The completed excavation shall be inspected and approved by the Engineer prior to any subsequent works.

Spoil from excavations not required for any purpose shall be spread evenly in areas adjacent to the Site or disposed of to a dumping ground designated by the Engineer.

Drainage of ground water.

S424. Suitable drainage shall be provided to ensure that any ground water welling out from the excavation shall be channelled into collection pits and removed by pumping, bailing or other approved methods.

Turfing.

S425. Generally, all turfs shall be cut 8 inches wide and one foot long and laid at 24 inches center in each direction. They shall consist of healthy dense indigenous turf firmly rooted at least 1 inch in the top soil. The turf shall be free from Minosa, Lallang and any other undesirable plants, and be laid on the same day as they are cut. Turf which has not been laid within three days after cutting may, at the discretion of the Engineer, be classified as topsoil.

Turf shall be laid on approved topsoil which shall be spread evenly in a depth of 4 inches and lightly compacted before turfing.

Turf on sloping surfaces or elsewhere considered necessary by the Engineer shall be pegged down with wood or bamboo sticks so that it will not slip out due to rain or other causes.

The Contractor shall regularly water the newly laid turf during dry weather. Any turf which dies through lack of watering shall be replaced at the Contractor's expense.

Where close turfing is required on slopes or other area indicated by the Engineer, the turfs shall be planted to cover the whole area without any visible space left between them and shall be well trodden down and rammed smooth by hand.

4-3 Piling

Scope. S426. The piling work described and covered in this section relates to timber piles and steel shell piles, excepting steel sheet piles which will be described under Chapter 5-1.

Quality, shape and dimensions of piles. S427. Piles shall be of the quality, shape and dimensions as described in the Specification and shown on the Drawings. Unless otherwise specified, the diameter shown on the Drawings is to be taken as that at mid-length but the toe end of Bakau piles shall not be less than $3\frac{1}{2}$ inches in diameter.

The permissible tolerance on the size and length of piles shall be as follows:

Timber piles. Diameter: Not smaller than that shown on Drawings.

Length: Not shorter than that shown on Drawings.

Warp: Less than 1 in. in 18 ft.

Steel shell piles. Outside diameter: $\pm 1\%$.

Length: Exact.

Thickness: $\pm 1/64$ in.

Warp: Less than 1/1,000 of length.

Cut end: $\pm 5/64$ in. on plane perpendicular to pile axis.

Storage and handling of piles. S428. Care shall be taken to store the piles on places as level as possible. Adequate battens shall be used between the piles when they are stacked.

In storing and handling, the piles shall be protected from damages such as permanent set caused by their dead weight or shocks. The details of methods which the Contractor proposes to employ for the storage and handling of steel piles shall be submitted to the Engineer for his approval. Any pile which has developed warp, dent or other defects greater than the tolerance shown in the preceding clause shall be replaced, if so ordered by the Engineer.

Protection of piles. S429. The toe end of the wood pile shall be cut into a conical shape symmetrical to the pile axis. To protect the heads of piles being damaged during driving, steel rings or helmet shall be used; unless, in the opinion of the Engineer, there is no fear of the pile head being damaged by driving.

Steel bands as shown on the Drawings shall be welded onto the tips and heads of steel piles, and shall be of the same quality as that of the steel pile. The welding of the steel band should preferably be done at the workshop of the manufacturer of the steel piles.

Test of parent metal of piles.

S430. The test of the parent metal of steel piles shall be carried out in accordance with B.S. 4360 (1968). The Contractor shall submit the mill sheet to the Engineer for his approval.

The suitability of wood piles shall be decided by the Engineer.

Pitching of piles.

S431. The position at which piles are to be driven shall be set out by accurate survey. The methods the Contractor proposes for the survey and setting-out shall be approved in advance by the Engineer. Special care shall be exercised in deciding the positions of piles to be driven in the water for the breasting dolphin and the mooring dolphin. The position of such piles shall be set out accurately by using sight rails on the land and/or scaffolds erected in the water.

All piles shall be pitched truly vertical in position before driving.

Pile driving equipment.

S432. Pile driving equipment shall include a hammer, driving frame, winch, pile helmet and dolly complete with moving carrier. When driving piles in water, floating pile rig shall be used, or a temporary staging shall be constructed. All the details of pile driving equipment shall be approved by the Engineer.

In selecting pile driving equipment, the Contractor shall take into account various factors such as the type of piles used, required embedment, soil conditions and other conditions relative to the driving of piles.

The hammer for driving timber piles shall be a plain drop hammer. Any other type of hammer will not be permitted. For driving steel piles, any type of hammers including the drop, steam-air, diesel and vibro may be used, if such hammer fulfills all the requirements of the pile driving to the satisfaction of the Engineer.

The pile helmet shall be of a shape suitable for the piles and be of a material sufficiently strong to withstand the impact of the hammer. The helmet cushion shall be made of oak or other hardwood or synthetic or rubber pads. A sufficient number of spare cushions shall be provided.

Driving of piles. S433. The initial blows of the hammer shall be as light as possible. Then, the pile shall be driven with the full striking force of the hammer after ascertaining that the pile is being driven in true vertical. The helmet and cushion shall always be placed centrally between the hammer and the driven pile.

Throughout the process of driving, special attention shall be paid constantly to detecting any tendency of deflection, rotation or inclination of any piles, and any such tendencies shall be corrected immediately to ensure that the piles are driven accurately in the correct positions. When the pile head has been damaged or when either insufficient or excessive penetration has occurred during the driving, the Contractor shall forthwith suspend the driving operation, and notify the Engineer for his instructions.

All piles shall be driven continuously with the practicable minimum of interruption until the required set has been achieved.

If the Engineer is of the opinion that a pile has been damaged during driving, the pile shall be withdrawn and repaired or replaced by a new pile and re-driven at the Contractor's own expense.

Any piles driven shall not be more than 3 inches out of position, unless otherwise sanctioned by the Engineer. Nor any piles may be inclined by more than 3 degrees.

Cutting and splicing of piles.

S434. The pile length given on the Drawings is the design length. The Engineer may from time to time order the piles to be cut or spliced according to the results of the test driving and the actual driving in situ. In principle, the splicing of timber piles shall not be permitted.

Steel piles shall be cut by the oxy-acetylene method and the splicing shall be done by the arc welding method.

The Contractor shall submit the full details of the cutting and splicing of the piles to the Engineer for his approval.

The driven piles shall be cut to the top level shown on the Drawing within the maximum permissible variation of ± 2 inches.

Driving records.

S435. Calibrations shall be marked with paint on all the piles at intervals of two feet except the section near the anticipated point of final set which shall be calibrated at four inches, and full records shall be taken as set out below, which shall be compiled in a form directed by the

Engineer and submitted to him. The records shall be taken of all the driven steel piles, but for wood piles, with such frequency as directed by the Engineer:

1. Pile number.
2. Outside diameter.
3. Unit length.
4. Date and time the pile is driven.
5. Name of recorder.
6. Particulars of pile driving equipment.
7. Particulars of cushions.
8. Total depth of penetration.
9. Total number of blows for every foot of penetration from beginning to end.
10. Average penetration per blow.
11. Height of drop.
12. Amount of rebound.
13. Inclination of pile, if any.
14. Abnormality encountered in driving.

Plans showing the positions of driven piles shall be submitted to the Engineer upon the completion of the driving operation.

**Test driving
of piles.**

S436. The Contractor shall carry out test driving of piles, when and where directed by the Engineer, at no extra cost whatsoever.

The test piles may be taken as permanent piles, if acceptable to the Engineer. The Contractor shall provide all the required materials and equipment for such test driving, and submit to the Engineer for his approval full details of test methods he proposes to employ.

4-4 Welding and Galvanizing

Method of welding.

S437. All welding shall be carried out by the electrical arc welding and shall comply with the requirements of B.S. 1856 (1964), "General Requirements for the Metal-Arc Welding of Mild Steel".

Welder and welding equipment.

S438. All welding shall be carried out by experienced welders only, who shall have at least 6 months experience including two consecutive months immediately before the Works.

The Contractor shall submit a roster of all the welders employed in the welding work showing their names, job experience and other details to the Engineer for his approval.

DC or AC electric arc welding equipment shall be used. The electric cables shall be well insulated. The electrodes to be used shall comply with the requirements given in Chapter 3, Clause S.315 and shall be of the low hydrogen type or illuminite type. All the equipment and materials shall be approved by the Engineer.

Cutting and Welding.

S439. Cutting of steel materials shall be carried out accurately by the oxy-acetylene process. Extra care shall be exercised in the cutting of long or deformed materials to ensure that no deformation will develop. These materials shall not be cut continuously from one side.

The procedure of welding shall be approved by the Engineer before the execution of the work.

Generally, the welding shall be done in such a posture that the welder will face downward on the work. Other postures shall be subject to the approval of the Engineer.

Before welding, all the surfaces to be welded and the adjacent area shall be thoroughly cleaned of rust, paints, slag and dirt, and wiped dry.

During welding, the materials to be welded shall be rigidly held together in correct position by means of jig or tack welding. The tack welding shall be limited to the minimum possible extent.

The weld in the butt welding shall be cut carefully and accurately and the gap between the roots of the shells shall be maintained precisely, as shown on the Drawing.

During welding, the welding current and speed shall be such that V-welds will be completely gorged with deposited sealing bead of weld metal. Care must be taken to prevent insufficient deposition of weld metal, inclusion of slag into weld, irregularity of the craters and cracks.

The Contractor shall be responsible for making good all unsatisfactory welds including air bubbles, overlaps, undercuts, excess or shortage of the throat thickness or size.

No welding work shall be done in the rain or storm. Welding may be carried out with the approval of the Engineer where adequate protective measures are taken against the effects of such weather conditions.

The Engineer may order any welded seams to be examined and tested by approved radiographic method when he considers such tests are necessary. If so ordered, the Contractor shall provide or make arrangements for the supply and operation of all the necessary equipment.

**Zinc for
galvanizing.**

S440. Zinc to be used for galvanizing shall comply with the requirements of B.S. 3436 (1961), "Ingot zinc" and the Contractor shall produce evidence to the satisfaction of the Engineer that this is so. The net content of pure zinc shall be 98.5% or more.

Galvanizing.

S441. The steel materials to be galvanized shall be in the finished form with all necessary processings completed. Immediately before galvanizing, each article shall be shot-blasted or pickled so that it is free from scale, paint, varnish, oil, grease, welding slag, dust and other surface impurities.

All galvanizing shall be done in accordance with B.S. 729 (1961), "Zinc coatings on iron and steel articles. Part 1: Hot-dip galvanized coating". The coating shall be uniform, clean and smooth and shall weigh not less than 1.5 oz per square foot of area covered.

After coating, all traces of flux shall be washed away with ample water. All articles shall be stored for seven days after galvanizing in such a manner that they will be thoroughly dried. At the end of this period the articles will be examined by the Engineer and those found to be defective shall be rejected.

4-5 Cathodic Protection.

Object of
cathodic
protection.

S442. For the protection of steel structures from corrosion, the cathodic protection shall be applied, employing the galvanic anode method, to the surface of the steel sheet piles of the quay wall and revetment and also of the steel pipe piles of the breasting dolphin, which are in direct contact with the river water, together with the surface of portions driven in the ground and facing to the river.

Galvanic anode.

S443. The galvanic anodes to be used in this work shall be "ALAP" H-120, aluminium alloy anode, as manufactured by Nakagawa Boshoku (Corrosion Protection) Kogyo Kabushiki Kaisha or Nihon Boshoku Kogyo K.K. or approved similar.

The chemical composition of the aluminium alloy anode shall suffice the following requirements:

Anode potential: Not more than - 1,050mV
(Saturated calomel electrode).

Effective current output: Not less than
2,300A.hr./kg.

The Contractor shall submit to the Engineer assay certificates of the aluminium alloy anode prepared by the manufacturer or alternatively extract samples and forward them to a laboratory designated by the Engineer for test and analyses. All the test results shall be subject to the approval of the Engineer.

The standard shape and size of the anodes shall be as shown on the Drawing, and the anodes shall be provided with the necessary fixture.

Fixing of
galvanic anodes.

S444. The anodes shall be fixed on to steel structures at the intervals and to the heights shown on the Drawing. The anode fixture shall be welded to the steel sheet piles and steel pipe piles as shown on the Drawing before these piles are to be driven. After the piles have been driven in position the anodes shall be firmly bolted to the fixture by an experienced diver.

The fixture to be welded to the piles shall be so processed as to have the shape and size shown on the Drawing and female threads shall be cut and welded at specified positions. The welding shall be performed in accordance with Chapter 4, Section 4-4.

The heights of the fixture on these vertical piles shall be adjusted properly, taking into account the anticipated fluctuations in the depth of the final set of each pile driven. The permissible tolerance on the height of the fixture as measured on piles driven to refusal shall be within ± 1 foot.

The anodes must be securely bolted to the piles by well experienced divers.

Electric potential measuring device.

S445. Measuring devices with mechanism shown on the Drawing shall be installed at nine specified locations for the quay wall, three locations for the revetment and at one location for the breasting dolphin. These devices are to be installed before the concrete is placed. The terminal box for measurement shall be made of cast iron and of the shape and size as shown on the Drawing. The terminals shall be of stainless steel and steel bars. The steel bars shall be welded to steel sheet piles and pipe piles.

Inspection and acceptance.

S446. The work shall be inspected and comply with the following standards:

1. The electrical potential measured at a time when the specific resistance of the river water is less than 80Ωcm shall be not more than -770mV by the saturated calomel electrode.

2. From ten days after the installation of galvanic anodes, the potential shall be measured at different verticals once a day for a total of ten times, and 70% of values obtained from such measurement shall be not more than -770mV by the saturated calomel electrode.

Sub-contractor.

S447. All the galvanic anodes for cathodic protection shall be manufactured and engineered by a sub-contractor specialising in this field. The sub-contractor whom the Contractor proposes to employ shall be approved by the Engineer.

CHAPTER 5 WHARF

5-1 Quay Wall.

Structure and extent of quay wall.

S501. The quay wall consists of steel sheet pile wall, wale, anchor, tie rod, concrete cap wall, back-fill, apron and ancillary works such as fender and bollard. In order to prevent the corrosion of steel sheet piles, the cathodic protection shall be applied in accordance with Chapter 4, Section 4-5.

The extent of the quay wall shall be from the approach revetment abutting on the anti-erosion work, on the side of Sungai Kuap to the junction with the revetment behind the breasting dolphin.

Quality of piles, transport and storage.

S502. The quality, shape and size of steel sheet piles as well as the transport and storage shall comply with provisions in Chapter 3, where applicable.

Establishing normal line for driving.

S503. The normal line along which the piles are to be driven shall be established by conducting an accurate survey. For this purpose, observation stands shall be provided in the water on both ends of the normal line.

The Contractor shall prepare drawings showing the construction of such stands and submit to the Engineer for his approval. The stands shall be constructed rigid and be free from the effect of the wind, wave, current, etc., throughout the entire period of pile driving operation.

The sight points marked on the observation stands shall always be kept at correct positions, and any deviation found on subsequent surveys shall be adjusted accordingly.

The marking and inspection of the sight points must be made in the presence of the Engineer and to his satisfaction.

Lead pile and guide member.

S504. The lead pile and guide member shall be installed before driving steel sheet piles. The guide frame shall be assembled in such a way that it may be dismantled upon completion of driving in a section and re-used.

The lead pile and guide member shall be strong enough to prevent any distortion or rotation of piles during the pitching and driving, and be approved by the Engineer.

The lead pile shall be of steel and driven vertically. The guide members shall be positioned in truly parallel to the normal line for driving and rigidly bolted to the driven lead piles.

Driving equipment.

S505. The pile driving equipment must be approved by the Engineer.

Driving method.

S506. The method of pile driving shall be determined by the type, shape and size of piles, required embedment, soil conditions and the working environment.

In principle, the steel sheet pile YSP B-66 shall be driven one at a time and other sheet piles in a pair as far as possible, according to the methods approved by the Engineer. Z-shaped sheet piles, in particular, shall be paired before the pitching.

Pitching.

S507. Steel sheet piles shall be pitched vertically at the correct position. In pitching piles, care shall be exercised to ensure that no torsion is caused to the piles nor damage to the grip of the piles. Where a gap exists between the pile and guide members, the piles shall be prevented from being swayed using wedges or other suitable means.

The initial pile shall be accurately pitched with great care, observing its position and inclination in the presence of the Engineer.

Driving.

S508. When steel sheet piles are driven under water, the false pile or other suitable device shall be used. All such devices, materials and driving method shall be subject to the approval of the Engineer. When the grips of piles are found to be out of place during the driving or thereafter, the piles shall be extracted and redriven, or proper steps shall be taken according to the instructions of the Engineer.

When the piles are found to be excessively inclined out of the normal line during driving, the inclination shall be corrected by pulling them with wire or by means of taper sheet piles in accordance with the instructions of the Engineer. The full length of the taper sheet pile shall be driven in one operation. The taper sheet pile shall not be used in succession, nor in the ends and corner of the quay wall, or junctions with different type of piles or in their vicinity.

The use of water jetting will not be permitted unless specially approved by the Engineer.

Driving records. S509. The pile driving records shall be taken in accordance with Clause S435. The detailed records required in Clause S435 shall be taken at the frequency of one in every ten piles, but the total depth of penetration and the total number of blows must be taken of all piles. If the driving conditions suddenly change or if so directed by the Engineer, the Contractor shall take detailed records of every and all piles.

Irregular sheet piles. S510. All the irregular steel sheet piles shall, in principle, be wrought and manufactured at the factories of the manufacturer.

When circumstances necessitate the manufacture of irregular piles such as the tapered or for the corner of the quay, in the vicinity of the Site, facilities and equipment to be used for the manufacture as well as the method proposed therefor shall be approved by the Engineer.

When the standard steel sheet piles are to be cut out to form any irregular piles, the cutting shall be done by a method which will not cause undue strain on the material. The steel sheet piles shall be spliced by welding or riveting. All the welding shall be done in accordance with provisions of Chapter 4, Section 4-4 and the rivets shall comply with the requirements of B.S. 641, (1951) "Dimensions of small rivets for general purposes".

Skilled workmen. S511. The Contractor shall employ well experienced skilled workmen for the pitching and driving of the steel sheet piles, and submit to the Engineer for his approval a list showing the names and experience of such workmen.

Inspection of driven piles. S512. The permissible tolerance on the driven piles shall be as follows:

Deviation from normal line:	+1ft. after the driving. +0.5ft. after tie rods are fixed.
Inclination on normal line, at the front and behind:	Not more than 2/100 after the driving. Not more than 1/100 after tie rods are fixed.
Accumulated inclination in direction to normal line:	Not more than 16 inches in any one section of piles completed. A taper pile cut to fit shall then be used if the inclination is exceeded.
Crown height:	+0.3ft. of the design crown height.
Overall sheet wall length:	+, not more than the width of one pile. -, zero.

**Processing of
waling.**

S513. The waling shall be aligned and adjusted according to the normal line and actual line of piles driven where the walings are to be fixed. In cases where a gap exists between the driven piles and the walings due to the inclination and/or distortion of piles, the steel plate filler shall be inserted in the gap, or the positions of bolt holes connecting the piles and the walings shall be changed accordingly.

The bolt holes on the walings shall be made by using proper machines and on the driven piles by the machine tool or the oxy-acetylene method. These holes shall be bored as shown in the Drawing and no holes shall be formed larger than actually required nor in irregular shape. All the bolt holes made erroneously on the sheet piles and walings shall be filled up with the same material by welding.

**Fixing of
waling.**

S514. The waling shall be bolted horizontally at the position shown on the Drawing and tightened securely. Any loose bolts found shall be firmly re-tightened. Any bolts and nuts to be completely embedded in concrete need not be galvanized.

All the walings and sheet piles are to be closely fitted as far as possible. If the gap exceeds a quarter of an inch, the filler shall be inserted. The walings shall be rigidly connected each other by joints in a manner as shown on the Drawing. The steel plate connecting a pair of walings placed horizontally shall be fixed by welding as shown on the Drawing. The welding shall be done in accordance with Chapter 4, Section 4-4. The permissible tolerance on the fixing height of walings to the sheet wall shall be ± 1 inch.

**Installation
of anchor wall.**

S515. The anchor wall shall consist of steel sheet piles as shown on the Drawing. The pitching and driving of the sheet piles shall be executed according to the provisions of Clause S503 to 511. The time, procedure and method of anchoring shall be decided by the Engineer, taking into account the execution of the front sheet wall.

The anchor wall shall be constructed accurately along the position indicated on the Drawing and in all respects shall comply with Clause S512. The tolerance on the distance with the front sheet pile wall shall be not more than one foot. If the distance is exceeded, the Engineer shall be entitled to order re-driving of the piles. The processing and fixing of the walings shall be done in accordance with Clauses S513 and 514.

**Centering for
tie rods.**

S516. For the installation of tie rods, the Bakau timbers shall be provided as shown on the Drawing. The Bakau piles shall be driven in accordance with the provisions of Chapter 4, Section 4-3. Horizontal timbers shall be tightly bolted to the driven piles after the fixing level has been determined by accurate survey.

Fixing tie rods generally.

S517. Tie rods shall, where possible, be fixed immediately after the completion of driving the sheet piles and anchor piles. The quality of tie rods shall be as described in Chapter 3, and the shape and size as shown on the Drawing. The protective covering on the threaded parts of tie rods shall not be removed until the rods are ready for fixing at the Site. Care shall be taken in handling the rods to ensure that the surface is not damaged.

Fixing tie rods.

S518. Tie rods shall be fixed to level or to falls as specified. Where the rods are fixed above the water, centering shall be provided as stipulated in Clause S516. When the rods are fixed on shore, they shall be done after the ground is excavated, filled and thoroughly compacted to the required level. The fixing height of the rod shall in this case be properly adjusted using wood sleepers.

Tie rods shall be fixed at right angles to the line of sheet pile walls. If the holes for fixing tie rods or the fixed height of walings are found to be out of the specified positions, necessary correction shall be made to re-fix the rods in correct position. No rod shall be fixed without making all the necessary correction.

When the rods are fixed to a specified inclination, either taper washers or wedges or both shall be inserted at both ends of rods before the fixing of nuts to ensure that the tension on tie rods may be exerted in the axial direction.

If the rods are found to be excessively long or the thread damaged, they shall not be cut off or re-threaded at the Site. When the rods are found to be too short, they shall not be lengthened by splicing or by connecting makeshift material for the same purpose.

In any case, if the rods are found to be either too long or too short or have damaged thread, they shall all be rejected and replaced by new rods to specified length at the expense of the Contractor. However, if the excess or shortage in length is of such an extent that they are adjustable within the range of threaded parts, the Engineer in his discretion may permit the use of multiple washers or metal boxes.

The ring joints and turnbuckles which are not completely embedded in concrete after the rods are fixed in position shall be well protected by applying a coat of ample grease and covering with cloth or tape.

Fixing of ring joints.

S519. The ring joints shall be assembled and fixed to ensure that they may function properly and turn up and down freely.

Tightening of tie rods.

S520. After the rods are fixed in position, tie rods shall be tightened by the nuts on their both ends and by turnbuckles until uniform tension may be exerted on them.

Extra care must be taken in tightening the rods so as not to sustain excessive tension. Correction on the irregularity of the normal line of sheet pile walls shall never be tried by adjusting the tightening nuts.

The final tightening-up shall be made by adjusting the turnbuckles or the fixing nuts on the side of the anchor wall.

The length of tie rods to be screwed into turnbuckles shall be not less than the thickness of fixing nuts. The fixing nuts shall be screwed down the rods until at least three pitches of screw are shown protruded.

Filling.

S521. The filling in and behind the sheet pile wall shall not be done until the sheet piling, anchoring and the fixing of tie rods have been completed. The filling shall be done in sections and in even layers. Any swelling of the sheet walls caused by the filling operation shall not be corrected by adjusting the tie rods. To prevent excessive swelling, the deflexion of sheet walls shall be observed throughout the filling operation. On all matters regarding the execution of the filling operation, the Contractor shall obtain the approval of the Engineer.

Quality of fill.

S522. The fill materials shall be sand of good quality, not less than 60% of which being large particles retained on Sieve No. 200. The Contractor shall submit to the Engineer for his approval the samples, together with specific gravity, bulk density, results of sieve analyses, etc.

Filling above sand fill.

S523. The complete filling behind the sheet pile quay wall and over shall be carried out after the filling with sand has been finished. Materials used for the fill shall be equal to that specified in Chapter 4, Section 4-2, or higher and subject to the approval of the Engineer. The fill shall not be placed, even temporarily, higher than the crown height of the quay wall shown on the Drawing. The Contractor shall make a continuous observation of the deflexion of the sheet pile walls during the filling operation, and if and when excessive deflexion or the sliding-out or circular sliding of the banking load is found or perceptible anywhere, the Contractor shall at once suspend the filling operation and take appropriate measures. When the fill is fed out from the shore, it shall be carried out by a method which will not have any adverse effect on the tie rods. When bulldozers or the likes are used for spreading the fill, the thickness of earth covering over tie rods shall be not less than 4 feet.

Excavation in front of quay wall.

S524. The excavation in front of the quay wall shall be executed after the completion of all the filling operations. The depth of excavation shall be to 28 feet below the datum as indicated on the Drawing except the area for the foot protection work which shall be to 29 feet. The permissible tolerance limits for the excavation shall be such that no area is shallower than the specified level and any over-excavation shall be up to one foot only. Any area excavated deeper than the allowable overdepth shall be back-filled.

The excavation shall be done gradually and in uniform depth over the whole area along the wharf; any attempt to cut right down to the specified level in a section in one operation is prohibited.

In excavation, care shall be taken to ensure that no damage is caused to the driven piles. Dredging equipment, if used for excavating the area within 20 feet from the sheet pile wall, shall be specially approved by the Engineer. The spoil shall be disposed of in accordance with Clause S806.

Execution of toe protection work.

S525. The toe protection work shall be carried out immediately in sections where excavation has been completed and approved by the Engineer without waiting the completion of the whole excavation. Protection shall be made with synthetic fabric sacks, 1 ft. in diam. x 20 ft. in length, filled with approved sand and stone as stated in Chapter 3. The processing and manufacture of these cylindrical sacks shall be done on the shore, and the both ends shall be tightly bound to prevent the leakage of sand and stone. Filled sacks shall be tightly bound with Manila ropes at four places of 5 feet interval.

Filled sacks shall be lifted horizontally by means of a crane or otherwise, and placed in position at right angles to the quay wall in such a manner that each sack comes into close contact with the other.

Sacks shall be placed accurately in position determined by using a theodolite and markings on the concrete cap wall.

If the sacks are found to be misplaced, they shall be redone. Any sacks damaged during the work shall be rejected.

Execution of concrete cap wall.

S526. The execution of the concrete cap wall shall not be started until it has been confirmed that there is no tendency of any deflexion along the sheet walls after the completion of the excavation in front of the quay wall and of all the filling operations behind. For this reason, the Contractor shall at all times make close observation of any deflexion, compile and edit the results in a form of graphs and submit them to the Engineer for his approval.

Any deviation from the normal line of the sheet piles which may have been caused by driving of sheet piles, tightening of tie rods, filling, excavation in front of the sheet wall or by any other reason must be adjusted on the alignment of the concrete cap wall.

The concrete cap wall shall be reinforced as shown on the Drawing. The concrete, formwork, cutting and bending of reinforcing bars, welding and other related works shall comply fully with provisions of Chapter 4, Section 4-1.

Construction joints shall be provided on the concrete cap wall at positions indicated on the Drawing. The joint filler shall be used to prevent the leakage of materials from behind, and be approved by the Engineer.

The formwork shall be provided with all the fixture, holes, etc. necessary for the installation and fixing of the bumpers, fenders, bollards, and accessories for the cathodic protection, and other facilities.

Upon completion of the concrete cap wall, the deviation from the normal line should be checked and should not be more than $\pm \frac{1}{4}$ inch. The deviation in the crown height shall be within $\pm \frac{1}{4}$ inch. If any deviation is found to be greater than the specified limits, the Contractor shall at his own cost cut out a part or whole of the concrete and re-lay with new concrete.

Coping of
anchor wall.

S527. The coping of the anchor wall shall be of reinforced concrete as shown on the Drawing, and shall comply with the preceding specification, Clause S526.

Bollards.

S528. The bollards shall have the quality as stipulated in Chapter 3, with its shape and size as shown on the Drawing, and shall be fixed to the bolts embedded in the concrete cap wall. Before fixing, surfaces of the recess to receive the bollards and its vicinity shall be cleaned and rendered with screed of cement-sand mortar (1:2) to a thickness of 1 inch. The nuts shall be securely tightened. After the fixing of nuts, the recess shall be filled with concrete of the same mix as that of the concrete cap wall, and its surface shall be smoothly finished and flush with the level of the concrete cap wall.

Bollards shall be filled with concrete of the same mix as that of the concrete cap wall to the top opening, and the top surface shall be smoothly finished in the same curvature as bollard head.

The whole bollard shall be cleaned of deposits such as rust, oil, dirt, mortar, etc. and be painted with three coats of paint specified in Chapter 3. Colour of the paint shall be subject to the approval of the Engineer. The time for the final coat shall be directed by the Engineer.

Fenders.

S529. The rubber fenders and metal fittings thereof shall possess the quality as specified in Clauses S330 and S331. The fenders shall be firmly bolted to metal fittings which should have been embedded during the concreting of the concrete cap wall. If the bottom of a fender can not be placed intact to the surface of the concrete cap wall due to its irregularity, proper filler shall be inserted in accordance with the direction of the Engineer.

At both ends of the quay wall, wood fenders of Belian timber shall be installed, and shall be processed to the shape indicated on the Drawing and fixed with fender fixtures. Besides, the fender shall be securely tightened with steel band at three points on the vertical. All the steel plate and nails to be used herein shall be galvanized.

Bumpers.

S530. The bumper consists of steel plates, angles, bolts, nuts, reinforcing bars, etc. as shown on the Drawing. These components shall be manufactured at factories. Steel materials shall comply with the requirements of B.S. 4360 (1968), and B.S.4 (1962), and be accurately processed and fabricated. Welding shall be done in accordance with the provisions of Chapter 4, Section 4-4. The bumper shall be fitted simultaneously as concrete for the concrete cap wall is placed and firmly tightened with nuts upon the removal of the formworks. The nosing for the protection of the corner of concrete cap wall shall be fixed to the whole length of the concrete.

Concrete of the same mix as that of concrete cap wall shall be used in the bumpers, and the top surface of concrete shall be smooth finished.

When completed, bumpers shall be cleaned of all deposits such as rust, oil, dirt, mortar, etc. and be painted with three coats of paint, the primer coat being anti-rust paint and two coats in stripes of specified colours.

Cat ladders.

S531. Cat ladders shall have a dimension as shown on the Drawing and shall be fixed to the quay wall at four specified positions. Cat ladders shall be correctly manufactured at factories, and shall be galvanized in accordance with Chapter 4, Section 4-4.

Metal fixtures for the cat ladders shall be the products of Bridgestone Tire Co., Ltd. or approved equal, and embedded in concrete whilst placing concrete for the concrete cap wall.

Belian timbers wrought as shown on the Drawing shall be fixed at both sides of cat ladders with metal fittings. The bottom ends of Belian timbers shall be protected in such a manner as shown on the Drawing. Bolts and nuts used for fixing shall all be galvanized.

Paving of apron.

S532. The apron behind the quay wall shall be paved with concrete as shown on the Drawing. The 12 inch thick base course shall be laid upon the subgrade formed by the fillings, then 1 inch thick sand layer, and then an 8½ inch concrete pavement on the top. The concrete pavement shall be laid with joints, and reinforced with steel bars as shown on the Drawings.

Apron subgrade.

S533. The construction of subgrade shall be carried out in accordance with provisions in Chapter 4, Section 4-2 relating to filling, and the materials to be used shall be sand and sandy soil of good quality. The term subgrade referred herein shall mean the top surface of about 4 feet thick of the reclaimed land behind the quay wall. The subgrade shall be thoroughly compacted until the CBR value of 5% or higher is obtained. Any section which does not show the specified CBR value shall be excavated and replaced with new fill and rolled until the specified compaction is obtained. The irregularity of the finished surface of subgrade shall be not more than ¾ inch from the specified level. One CBR test shall be conducted in every 250 sq.yd., and if the results are still unsatisfactory, two more tests shall be conducted in the vicinity of the original site. If both tests satisfy the specification, the section represented by the tests may be accepted.

Equipment used for compaction shall be subject to the approval of the Engineer. Care shall be taken in the execution of compaction work so as not to damage the tie rods or anchor wall.

Apron base.

S534. The base shall be compacted true to the specified level and profile to receive the concrete surface. The cross fall shall be 1:60 as shown on the Drawing, and the permissible tolerance shall be within ¼ inch. The width of base shall be one foot wider than that of concrete surface.

The 12" base shall be block stones and shall be laid in two courses. Bottom course shall be block stones not larger than 4" and laid by hand. Upper course shall be graded stones not larger than 2" and shall comply with the following grading:

B.S. Sieve Size/Nos.	Percentages by weight passing
2 in.	100
¾ in.	50 - 100

3/8 in.	40 - 80
No. 4	30 - 65
No. 10	20 - 50
No. 40	10 - 30
No. 200	0 - 10

Only well graded stones giving maximum density shall be used in the pavement.

The Contractor shall carry out sieve analyses of stone materials to be used for the base, and submit the results to the Engineer for his approval.

The apron base shall be compacted to not less than 30% in CBR value, and the bearing capacity shall not be less than 215 lbs/sq.in./in. by Plate Bearing Test using 30 cm. diam. plate. These tests shall be performed at the rate of more than once per 250 sq.yd.

Bottom course shall be rolled until all voids fully filled in with smaller stones. The upper course shall then be evenly spread and compacted to finish level and profile and to provide a smooth and even surface free from loose material.

Sand layer.

S535. A layer of sand with thickness of 1 inch shall be evenly spread over the surface of the base. Before placing concrete, the layer shall be well saturated by sprinkling water.

If approved by the Engineer, the base paper may be used in place of the sand layer.

Kerb.

S536. All concrete kerbs on the apron shall be constructed as shown on the Drawing.

Concrete surface.

S537. Provisions of Chapter 4, Section 4-1, shall apply to the concrete surface. The concrete surface shall be finished within the limit of 1/4 inch on a 10 feet straight edge laid in either direction.

In principle, both spreaders and finishers shall be used for placing and compacting concrete. The type of equipment and the method of work proposed by the Contractor shall be subject to the approval of the Engineer.

Plain round bars of 1/4 inch in diameter shall be laid in grid form in all sections of concrete at 2-3/4 inches from its surface. The iron grid shall be made smaller by about 4 inches than that of the concrete section at the edges, and the overlap of the grid shall be about 8 inches. The bars shall be connected by welding or tightly bound by annealed wires.

Construction joints.

S538. Construction joints shall be provided for the concrete surface at location shown on the Drawing. There are three types of joints, i.e., transverse expansion joint, contraction joint and longitudinal joint, all as shown on the Drawing.

Sliding bars and tie bars shall be correctly placed at specified position and be supported by suitable chairs. The equipment and methods used in forming joints shall be approved by the Engineer.

The faces of concrete cap wall and services duct or drains against which the paved apron is to be placed shall first be painted with one coat of bitumen before the concrete of the latter is laid, so as to ensure free movement of either structure in the event of any unequal settlement of the ground.

Services duct.

S539. Services duct for laying water pipes and telephone cable for supply to or use by vessels moored alongside shall be provided on the apron. The duct shall be made of reinforced concrete complying with provisions of Chapter 4, Section 4-1. The foundation bed together with stones laid on the surface shall be well rammed down and covered with a layer of sand. The quality of stones and execution of compaction shall comply with the specification for the base of the apron pavement.

After the works for the water pipe and wirings have been completed and approved by the Engineer, the duct shall be covered with precast R.C. slabs. All the joints shall then be hermetically sealed with bitumen to ensure watertightness. A set of stand pipes for the supply of water shall be installed at four places, and covered with cast steel lids. Drain holes with diameter of 4 inches shall be provided on the bottom of the services duct at about 20 feet apart.

5-2 Breasting Dolphin

Boring.

S540. Before the construction of the breasting dolphin, the Contractor shall carry out boring tests at the specified positions to ascertain the depth of the shale underlying.

Steel pipe pile.

S541. The breasting dolphin shall be constructed at positions indicated on the Drawing, which shall be determined by accurate survey. The work shall be executed after the completion of the dredging and the formation of slope in front of the revetment.

Piles to be used in the work shall be steel pipe piles as shown on the Drawing and specified in Chapter 3. Both ends of the piles shall be reinforced with steel rings as shown on the Drawing, and the fabrication shall be done at the factory of the manufacturer. The permissible tolerance on the shape and size shall comply with provisions of Chapter 4, Section 4-3. Should the quality, shape and/or size of any piles fail to meet the requirements, the Engineer shall have the power to reject the piles delivered at the Site.

Pitching and driving of piles.

S542. The pitching, driving and all other works relative to pile driving shall comply with provisions of Chapter 4, Section 4-3. Piles shall be driven into position in one single length without splicing. If it is not possible to drive the piles with the available piling equipment, piles may be lengthened by splicing in situ with the approval of the Engineer. In such case, the welding position, method of welding and equipment to be used shall all be approved by the Engineer.

Encasing of piles.

S543. Each pile driven shall be covered on top with reinforced concrete pipe for the length shown on the Drawing. The space between the piles and R.C. pipes shall be filled with cement-sand mortar (1:2) to form a monolithic unit.

Concrete Cap.

S544. The concrete cap shall be made of reinforced concrete, which shall comply with the provisions of Chapter 4, Section 4-1 where applicable. Reinforcing bars shall be welded to the steel pipe piles, and all metal fixtures for bitt, ladder, etc. shall be incorporated in the formwork before placing concrete. The surface of the concrete cap shall be finished smoothly to a slope of 1:500 from its centre in four directions as shown on the Drawing.

Bitt.

S545. The bitt shall be of the quality as specified in Chapter 3 and have the shape and size as shown on the Drawing. The bitt shall be constructed in

accordance with Clause S528.

Cat ladder.

S546. The cat ladder shall be fixed at the position shown on the Drawing, and the fabrication and fixing shall be done according to Clause S531.

The lower part of the ladder shall be supported by steel plate band fixed to the R.C. pipe. All the steel materials used shall be galvanized.

At the specified positions on top of the concrete cap, the cast iron hand grip hold and drain holes with diameter of 2 inches shall be provided.

Catwalk.

S547. The catwalk shall be made of Belian timber which shall be worked upon and finished smoothly in accordance with the Drawing, and fabricated rigidly using bolts, nuts, nails, clamps, etc., all to be galvanized.

The catwalk shall be of Belian joists supported on a steel pipe pile. After the pile is driven, the steel cover plate and angle shall be welded to the head of the pile as shown on the Drawing.

Fender.

S548. Rubber fender to be used shall be of a good quality and have the shape and size as shown on the Drawing. The fender shall be fixed to the mounting base on the front face of the dolphin using the manufacturer's metal fixtures. For general specification, refer to Clauses S329 and S529.

5-3 Mooring Dolphin

Boring.	S549. Clause S540 shall apply.
Steel pipe pile.	S550. The mooring dolphin shall be constructed at the position indicated on the Drawing, which shall be accurately determined. The work shall be executed after the completion of the excavation and formation of the slope in front of the anti-erosion work. The quality, shape and size of the steel pipe piles shall be the same as those specified in Chapters 3 and 4 and Clause S541.
Pitching and driving of piles.	S551. Clause S542 shall apply.
Encasing of pile.	S552. Clause S543 shall apply.
Concrete cap.	S553. Clause S544 shall apply.
Bitt.	S554. Clause S545 shall apply.
Cat ladder.	S555. Clause S546 shall apply.
Catwalk.	S556. Clause S547 shall apply. A Belian pile shall be driven on the shore in accordance with provisions of Chapter 4, Section 4-3.

5-4 Mooring Bitt

Position and
Steel pipe pile.

S557. The mooring bitt shall be constructed at the position shown on the Drawing. The driving of the piles shall be done after the excavation to the specified level. The piles shall be of the quality specified in Chapter 3, and have the shape and size as shown on the Drawing.

All pitching and driving shall be done in accordance with the provisions of Chapter 4, Section 4-3. The four piles driven shall be rigidly braced together by welding channels to them, in accordance with Chapter 4, Section 4-4. Both ends of the piles shall be reinforced by steel plate rings.

Concrete cap.

S558. Stones shall be placed evenly on the bottom of the excavation and be well rammed down. Provisions of Chapter 4, Section 4-1, shall apply to the concrete and reinforcing bars. The top surface of the concrete shall be finished flush and to the same slope as the concrete apron. A Bench Mark TBM 301 shall be fixed accurately on top of one of the piles as shown on the Drawing and directed by the Engineer.

Bitt.

S559. S545 shall apply.

CHAPTER 6 REVETMENT

Type and extent. S601. As in the quay wall, the revetment shall be of the steel sheet pile type, and consist of sheet pile wall, waling, anchor wall, tie rods and accessories.

The revetment shall be constructed on the immediate downstream end of the quay wall as shown on the Drawings.

Bore test. S602. Before commencing the revetment work, the Contractor shall at the specified position carry out bore testing using a rotary boring machine.

Number of bore holes: 3 (45ft./hole).

Undisturbed samples: About 15 (At every 7 ft. deep).

The Contractor shall perform the following tests on the undisturbed samples obtained, and submit the results to the Engineer:

1. Bulk density.
2. Moisture content.
3. Grading analysis.
4. Liquid limit.
5. Plastic limit.
6. Unconfined compression test.

The testing method shall comply with B.S. 1377 (1967), "Methods of testing soils for civil engineering purposes".

The test results together with a plan and boring logs for each bore hole clearly showing the depth and the bored materials shall be submitted to the Engineer for his study and approval.

Execution of revetment work. S603. The pitching and driving of steel sheet piles, fabrication and fixing of waling, fixing of tie rods, and placing of concrete for the concrete cap wall and the anchor wall's coping shall be done as indicated on the Drawing and in accordance with the provisions for the quay wall of Chapter 5, Section 5-1.

Replacing with sand. S604. All the clay in the section shown on the Drawing shall be excavated and dumped to an area beyond the reclamation area and spread evenly. The hole made in

the excavation shall be filled to the specified level with sand of which more than 60% shall be retained on sieve No.200.

Samples and the results of sieve analyses of the sand shall be submitted to the Engineer for his approval.

- Bollards.** S605. Bollards of the same design as used for the quay wall shall be installed at positions shown on the Drawing and in accordance with Clause S528.
- Cat ladder.** S606. The cat ladder shall be installed at the position shown on the Drawing, complying with the provisions of Clause S531.
- Bumpers.** S607. The bumpers shall be manufactured, fixed and painted in accordance with Clause S530.
- Concrete apron.** S608. The general specifications given in Clauses S532 to 538 inclusive shall apply.
- Kerb.** S609. Clause S536 shall apply.
- Fenders.** S610. Fenders shall be made of Belian timber. The horizontal members shall first be fixed to the concrete cap wall by metal fixtures, then Belian piles be driven in front of the members and jointed to the members using steel plate, bolts and nuts. The pitching and driving of the piles shall be done in accordance with Chapter 4, Section 4-3, but care must be exercised to ensure that the piles are driven closely in contact with the horizontal members. The head of all the driven piles shall be at the specified level. All the bolts, nuts, steel plate, etc. used for bracing the horizontal members and piles shall be galvanized.
- Toe protection work.** S611. The toe protection work shall be executed in the area shown on the Drawing and in accordance with Clause S525.
- Junction with anti-erosion work on Sungai Sarawak side.** S612. The riverbank shall be cut or filled to the level and falls as indicated on the Drawings and in accordance with Clause S701. In sections where the work is difficult to be executed from the shore, the cutting or filling shall be done by means of dredging equipment, or at the direction of the Engineer.

Belian piles shall be driven at the junction indicated on the Drawing and according to the provisions of Clause S703. In sections where the piles cannot be driven from the shore, the work shall be done by a floating pile-driver, or by erecting temporary staging, or other method approved by the Engineer.

The Stellar sheet shall be laid in accordance with Clause S705 except that the thickness shall be 30mm.

On top of the Stellar sheet, sack gabions whose section at one end is elliptic and the other end round, shall be laid in accordance with Clause S707.

The gabions which may be laid on the shore shall be securely held down to the ground by using 2 wood piles per gabion. Gabions which are to be laid in water shall be placed in position by means of a crane or other equipment after they are completely assembled on the shore and filled with stones.

At the front of piles, sacks filled with sand shall be placed to the extent indicated on the Drawing and in accordance with the provisions of Clause S525.

CHAPTER 7 ANTI-EROSION WORK

Earthwork.

S701. The existing riverbank shall be cut and filled in such a manner as to ensure that the section of the finished slopes at right angles to the normal line for the work approved by the Engineer will match with the typical section shown on the Drawing; then the prepared surface shall be levelled and compacted to the satisfaction of the Engineer.

Any surplus earth resulting from the cutting and filling to form the sections required by the Drawing shall be tipped into an area designated by the Engineer, and any imported material to make up the shortage shall be approved by the Engineer.

The Contractor shall plant level stakes for the cutting and filling operations and for placing of pre-cast link concrete blocks and rectangular gabions at the positions shown on the Drawing and at such other positions as and when directed by the Engineer. The Contractor shall not be relieved of his responsibility to make good all the works, if any structures constructed fail to conform to the finished shape and stakes shown on the Drawings, regardless of whether or not the stakes have been previously inspected by the Engineer. No stakes may be removed without the permission of the Engineer, even after the completion of the works.

Piles and piling.

S702. Piles shall be driven plumb vertical to the levels and at the positions as shown on the Drawing, and any piles not so driven shall, if required by the Engineer, be replaced at the expense of the Contractor. The piling shall be done using the method and equipment approved by the Engineer. Steel caps or ring shall be used for the protection of pile heads, which shall be first trimmed around in bevel edges.

If, during the driving, the piles are damaged, warped, twisted or driven out of position or excessively inclined, they shall be rectified according to the instruction of the Engineer.

All piles shall be driven with the minimum possible gaps between them to the satisfaction of the Engineer. Care shall be taken in driving the piles to prevent them from being deflected or distorted by use of supporting beams or the like, where necessary.

Belian Sheet pile.

S703. Belian sheet piles shall be driven plumb vertical to the levels and at the positions as shown on the Drawings with care being taken to prevent them from being deflected or distorted by use of supporting beams or the like. Piles shall, in principle, be driven in panels vertically to the line.

Joints of sheet piles shall be tongue-and-groove as shown on the Drawing. The piles driven shall be in close contact with one another so as to leave no gap in between joints, and the pile head shall be cut off truly flat with bevel edge around.

Stellar sheet. S704. The Stellar sheets shall be joined together in the direction parallel to the length of the slope. Nylon cord or equivalent approved shall be used to sew them up securely in a manner satisfactory to the Engineer.

Precast link Concrete block. S705. Link concrete block shall be cast to concrete class "B" using steel form as shown on the Drawings. The Contractor shall submit a sample of such steel form for the approval of the Engineer, before they are used.

Before casting the blocks, the Contractor shall submit to the Engineer a programme together with a list of equipment to be used for his approval. All the work shall be carried out in strict accordance with Clause S410-Moulded Concrete, and to the satisfaction of the Engineer.

Great care shall be exercised in the transporting and placing in position of the precast link concrete blocks to ensure that the edges of the blocks are not damaged or chipped. All blocks brought into the site shall be inspected by the Engineer before they are placed in position, and blocks having rough surface, broken edges or any other defects shall be rejected. Any block found to have rough surface or broken edges after placing in position shall be replaced with a perfect one to the satisfaction of the Engineer.

Concrete link blocks brought into the site for storage shall be laid on flat ground in upright position in rows, and they shall never be piled up.

When the ground surface has been prepared as specified and the Stellar sheet laid, the blocks shall be placed from the lower end up the ground slope leaving a minimum possible gap in between, and the 3/8" diameter steel bars shall then be pushed through the tying holes and drawn right up to the top end of the area where the blocks are to be placed. The rest of the blocks shall be slipped down in position with the steel bar in the hole. The finished surface of the block placed shall be truly to the slope and free from any undulation in both directions. The edges of blocks both lengthwise and breadthwise shall be aligned on straight lines all to the satisfaction of the Engineer.

Rectangular
gabion.

S706. The block stones for filling the rectangular gabions shall have a weight of 10 to 45 lbs. each piece, and be approved by the Engineer.

On filling the gabion through the stone filling hole, large stones weighing 35 lbs and over shall first be placed on the bottom and sides and ends closely with each other leaving minimum voids between them. Smaller stones weighing 10 lbs and over shall be packed in the centre and finally large stones weighing 35 lbs and over shall be placed on the top and sides and ends in such a way as to stop any stones from slipping out of the holes.

The completed gabion shall be such that no stone may be pulled out by hand through the mesh. The stone filling holes shall be closed with binding wire only after the gabions are completely filled and inspected to the satisfaction of the Engineer.

When a single or group of gabions are placed together against the gabions already laid, the top and side corners shall be first securely wired together with connecting wire of same gauge and quality as the mesh, to ensure that the stincline is a fixed mass as possible.

When group of empty gabions have been placed in position ready for filling, the filling shall be carried out by stages and uniformly throughout.

Front toe
pile and
anchor pile.

S707. The excavation for the anchor piles shall be carried out with care and only to the level specified for the anchor piles. No anchor piles shall be driven into places where the ground has been excavated beyond the specified level and then back-filled. If and where excavation has been done beyond the specified level of the anchor piles, the Contractor shall fill in to the correct level with approved material and well compacted, or change the driving position of the piles, or otherwise as directed by the Engineer.

The toe piles and anchor piles shall then be connected as shown on the Drawing by using No. 8 metric galvanized steel wire firmly wound round the bolt so that it will not come off and to the satisfaction of the Engineer.

The tie wire connecting the toe piles and anchor piles shall be strung tightly without any sagging.

Fascine matt-
ress.

S708. Each unit of the fascine mattress consists of top and bottom lattices, 3 layers of fascine, cribbing for stones, etc. shall be made in strict accordance with the Drawing. On laying a whole unit of the mattress shall be laid and completed in the same day.

On completion of the laying any surplus dredged material from the area where mattress is laid shall be disposed of in accordance with the instruction of the Engineer.

When sinking the mattress down to the riverbed, the stones shall first be thrown onto the outer row of the cribs in a quantity so as to prevent the mattress from tilting to either side. The rest of stones shall be thrown in uniformly over the surface after the mattress has sunk in place.

The outward end of the fascine mat shall be projected two to three feet beyond the edge of the mattress, and the pegs on this side shall protrude two more inches above the rest of the pegs to prevent the cribbing from coming off the pegs.

During sinking the fascine mattress care should be taken to prevent the movement of mattress due to the current in the river. On completion of all preparations the mattress and the sinking position shall be first inspected by the Engineer, and the sinking shall then be done in his presence. After sinking the mattress, the Contractor shall ascertain whether the mattress has been sunk at the specified position or not by a method directed by the Engineer.

Where the mattress is to be laid in two rows breadthwise, any gaps left open in between mattresses shall be filled with stones, as well as the gaps in between the toe piles or Bellian sheet pile. Sand or other approved materials shall be placed on top of the gaps to the satisfaction of the Engineer.

The mattress laid in lengthwise shall be neatly placed close to each other so that no gap is left between them. Where there is a gap excessively large in between the mattresses, the Contractor shall rectify such defect in accordance with the instruction of the Engineer.

The fascine rope shall be made from the brushwood, long straight sticks with many twigs selected and arranged in such a way that all top ends placed to the same direction and staggered at the joints, which shall then be carefully formed into a rope with a girth uniform in size throughout. The rope shall be tightly bound with approved split Rotan at 6" centres as shown on the Drawing. The Rotan shall be wound round twice and tied in a wartknot, which shall be on a straight line throughout the rope. The ropes shall be long enough to leave extra 6 inches at both ends, lengthwise or breadthwise, when they are formed in a lattice.

The ropes made up into a lattice shall be laid with the knots facing upward without distortion and the branches facing downstream or toward the river to reduce resistance due to current flow.

The sequence of laying fascine mats shall be as shown on the Drawing and directed by the Engineer.

**Fabricating
bamboo
cribbing.**

S709. A pair of bamboo cut in eight equal parts shall be used in making bamboo cribbings.

The cribbing shall be spaced to form cribbings as shown on the Drawing, and shall be woven staggered accurately and securely to the satisfaction of the Engineer. On completion of weaving, the top rim shall be hammered down gently with a maul to ensure tightness. Before the work is started, the Contractor shall make a sample of the cribbing for the approval of the Engineer. He shall always follow the method as directed by the Engineer and only the same skilled men shall be employed throughout the work.

CHAPTER 8 DREDGING

Dredging area.

S801. The area to be dredged shall be as indicated on the Drawing, including the excavation and formation of the slopes for the anti-erosion work and that in front of the revetment.

The Contractor shall dredge all the materials in the above area to the specified depth and slopes, and transport and dispose of the dredged materials to an area beyond the reclamation area, or otherwise designated by the Engineer.

Nature of materials to be dredged.

S802. Materials to be dredged vary from soft clayey soil to sand and gravel in some areas, and they are underlain by soft to hard shale, which is believed to become harder as the depth increases.

The Contractor shall be deemed to have a full knowledge in these materials, and the Engineer shall take no responsibility whatsoever with regard to the materials or the informations given on such materials.

Survey and sounding.

S803. The Contractor shall, before dredging and at any time directed by the Engineer, carry out levelling and sounding over the dredging area and its adjacent areas, and submit to the Engineer the results of such surveys in a form of drawings.

All the surveys shall be conducted under the direction of the Engineer.

The sounding shall, in principle, be done by means of an approved echo-sounder.

Dredging equipment.

S804. The Contractor shall provide, transport and operate the dredging equipment which should be fully capable of dredging materials of whatever nature in the area to the depth as specified. The equipment shall further be capable of completing the work within the approved scheduled period. All particulars of the dredging equipment shall be subject to the approval of the Engineer.

In the event of breakdown of or any accident to the dredging equipment, the Contractor shall make immediate arrangements for the supply of an alternative equipment to ensure no delay in the work.

Dredging.

S805. The whole area covering the immediate front of the quay wall, anchorage and swinging areas shall be dredged to -28.0 feet, and no spots anywhere in the area may be shallower than this level. In principle, the slopes at the edges of the dredging area shall be formed to the falls of 1:5 for clay and sand and 1:1 for shale.

The slopes in front of the anti-erosion work and the revetment shall be formed as shown on the Drawings. Any deviations more than one foot shall be corrected by further dredging or filling up. The area within 20 feet from structures shall be dredged in accordance with Clause S524.

Whenever the Contractor is ready to dredge shale materials, he shall give notice to the Engineer and provide suitable survey equipment and carry out the survey to locate the boundary and depth of the shale.

Spoil tip.

S806. All trees, stumps, roots, Nipa-palms, Mangroves, Blakars, Lallang and all other vegetation whatsoever, and any obstructions within the triangular area located northward immediately above the reclamation area shall be felled, cleared, grubbed up and removed and disposed of to the area designated by the Engineer, and then burnt away.

All the dredged materials shall, unless otherwise directed by the Engineer, be disposed of over the area indicated in the preceding paragraph hereof.

The Contractor shall, if necessary, enclose such area with timber fence or the likes to prevent tipped materials from flowing out of the area. In the event of the tipped materials flowing out of the designated area, the Contractor shall recover them at his own responsibility and cost.

Dredged materials do not belong to the Contractor. They shall not be removed or disposed of without the consent of the Engineer.

Use of dredged materials.

S807. When the Contractor desires to use dredged materials for filling and other purposes, he shall submit to the Engineer for his approval an application giving the methods he proposes for obtaining and transporting the desired materials, places where the materials are to be used, characteristics of materials, etc.

Maintaining dredged level.

S808. If any clay and sand or other materials accumulate in the dredged area due to flood, land slide or any other causes during the course of dredging, the Contractor shall from time to time re-dredge the area to the specified level, notwithstanding such area may have previously been dredged to the specified level.

Inspection and acceptance.

S809. The preliminary inspection of the dredging work in front of the anti-erosion work and the revetment will be carried out as soon as practical after the completion of dredging.

The preliminary inspection of the dredging work over the anchorage and swinging areas will be carried out in sections.

The final inspection and acceptance of the whole dredging area will be conducted three months before the completion of all the Works in this Contract. The inspection shall be done by sounding as described in Clause S803. Any section not to the satisfaction of the Engineer shall be re-dredged by the Contractor.

All equipment, materials and personnel required for the inspection shall be provided by the Contractor for use by the Engineer.