EXTENSION OF QUAY NO.3 – CONSTRUCTION OF QUAY WALL, CRANE TRACK AND OTHER ALLIED WORKS

CONSTRUCTION SEQUENCE

1. Initial banking for driving sheet piles

   All initial banking has to be formed at contractor's own cost for taking the machinery to drive the sheet piles. The area shall be filled with pit sand for leveling the ground.

2. Driving of steel sheet piles

   Interlocking sheet piles to be driven are Z section with minimum Section modulus of 2510cm^3/m and about 24 meter long. Necessary provision is made at the end of the existing quay wall for interlocking the new and old sheet piles. Driving of sheet piles shall commence from this location.

   The steel sheet piles are to be protected using sacrificial anodes on the waterside. For fixing the anodes stainless steel nuts suitable for 20mm dia bolts are to be welded on to the sheet piles before they are driven in to the earth.

   Piles shall be driven, true to plumb and alignment. Hammer for sheet pile driving shall be drop hammer, steam hammer, air hammer, diesel hammer or vibratory hammer. Sheet pile driving shall commence initially with minimum impact of hammer, which can be increased later after ensuring that the piles are being driven vertically through the interlocking grooves along with designed alignment. The sheet piles are to be driven with batten welded at suitable intervals. The SSP may be lifted at single point.

   CSL has observed during construction done earlier that the sheet piles sink in to the earth by about 1m to 1.50 m by its own weight as well as the weight of the hammer.

3. Installation of well point system

   Suitable well point system for the construction of anchor wall shall be prepared by the contractor and got it approved by the Engineer - in - charge in advance, installed properly and commissioned before taking up earth work excavation and maintained for functioning during the course of work. The present average general ground level at site is +2.50. Water table is generally between +1.40m to +0.30m except during rainy season when it is almost flush with the GL. Water table shall be depressed generally to a level of (–)3.10m and kept at that level till the completion of concreting of foundations.

4. Earth work excavation

   The average ground level at site now is +2.50. Earth work excavation has to be done up to a maximum level of –3.10. The type of soil generally clay except for a depth of about 1.00 metre from the top which is mainly dredged material consisting of silt and fine sand. Excavated earth shall be transported and dumped at areas designated for the purpose inside / outside shipyard. The lead will be within CSL premises however the contractors have to quote their rate for dumping earth outside shipyard within 3 km and rates for every additional lead of 1 km.

5. Anchor wall and cobble stone filling

The anchor wall is of RCC. To increase the passive resistance, granite broken stones, 150mm to 200mm size is to be packed in front of the anchor wall and blinded with river sand/M sand. The surface of the stone packing shall be gunited with CM 1:3 for a thickness of 50mm with chicken wiremesh. Extreme care shall be taken to fill the entire voids of the rubble stone packing. The space above the tie rod and upto the level shall be banking with river sand / M sand.

6. Installation of Tie rods

The sheet piles are tied to the RCC anchor wall using Tie rods of specified diametres and about 26m long. Each Tie rod is in 4 pieces connected by ring joints and turn buckle. The rods have thread outside (projecting beyond the rod dia.) and handling shall be done very carefully to avoid damage to the thread. The tightening is to be done twice, first at the time of laying finally after initial dredging. The rods shall be supported to avoid sagging while fixing Tie rods and refilling around these Tie rods.

7. RCC piling

RCC piles are provided for supporting the crane tracks and for bitt foundations. The piles are 650mm/500mm dia. and depth up to 45m (approx.) long. Approximate number of piles required to be installed is 170 Nos. for 650mm dia. and 100 Nos for 500mm dia.. The piles can be bored cast-in-situ. Piles shall be reinforced for its full length and the concrete to be used is M30. Total working load (end bearing alone) on 650mm dia pile is 140 tonnes excluding friction. Factor of safety is 1.5 for permanent load.

Since some piles are to be driven in area where tie rods are laid already, the tie rods are to be exposed before pile driving. Where piles are to be installed in the area where portion of the quay wall had already been constructed and exists now, the cobble stones in front of it's the anchor wall will have to be dismantled for driving the piles. RC piles in general should be driven in such way that the same do not cause any damage to the tie rods or other structures. Refilling over tie rods is needed to take pile driving equipment.

8. Coping Beam

The quay wall consists of sheet piles with RCC coping beam on top. The bottom level of coping beam is below the lowest low water level. The casting of concrete is to be done in two stages. First level concreting is done after the sheet pile wall is tied on to the anchor wall. The second stage concreting is done after the completion of first stage dredging in front of quay wall and final tightening of the tie rods. Any correction required in the alignment of the coping beam due to deflection of sheet pile subsequent to dredging shall be carried out during second stage concreting. A number of structural items are to be embedded in the concrete to the correct line and level for fixing rubber fenders, ladders, safety chain etc.

9. Service Trenches

There are two service trenches. One for gas and water pipes and other for electric power cables running along the length of quay. Bottom slab and side walls are of RCC. Fabricated covers with chequered plate are to be provided. Embedments of structural steel are to be provided on the side walls for fixing cable/pipe supports. The existing 100T bitt foundation shall be chipped/cut by mechanical device for forming the service duct & cable pit ducts in line and level without damaging the bitt.

10. Crane beam

Crane beams are constructed over the piles. The rails are placed over the RCC beams to lines and levels within tolerance limits stated elsewhere.

11. Trolley duct

Electrical power cables running inside along the length of duct. Bottom slab and side walls are of RCC, fabricated covers with chequered plate are to be provided. Embedments of structural steel are to be provided on the side walls & bottom slab for fixing cable supports.

12. Pavement work

The area between the crane tracks and in between the quay wall and crane rail foundation are to be paved using precast concrete blocks. The blocks shall be laid only after proper compaction and levelling of sub grade. Required camber also is to be provided while laying the blocks. The gaps between the blocks are to be sealed with hot bitumen sand mix and finished smooth.
The area between existing road to SSD area and crane track and beyond the end of crane track towards southern side for a length of 40m shall be consolidated to line and level with two layers of water bound macadam and roads are surfacing with 50mm thick semigrouting and sand flushing seal coat.

13. Fixing of Bitts, Fenders and Anodes

There are about 3Nos.100T Bitt, 11 Nos. 50T bitts and 10Nos. 10T bitts to be installed in position on foundations at specified locations along the quay wall.

About 50Nos. rubber fenders are to be installed on the quay wall. For fixing the same the fixtures are to be embedded in the quay wall in advance.

Aluminium alloy anodes (approximately 160 Nos) are to be fixed on steel sheet pile after initial dredging. Anodes are to be fixed under water. Stainless steel nuts are to be welded on to the SSP before driving down the sheet piles. Each anode will weigh 50kgs approximately.

Detailed specification of the above items of work are given separately.

No: CIV/112/2009/AGM (CE)

EXTENSION OF QUAY NO.III – CONSTRUCTION OF QUAY WALL, CRANE TRACK AND OTHER ALLIED WORKS

SPECIFICATION

1. GENERAL

DATUM LEVEL

All the levelling and sounding surveys in CSL has been performed with reference to the bench mark set at the abutment of the railway-highway bridge on the side of Willingdon Island. The bench mark named B.M. 16 is 7.089 m (23.26 ft) above datum level. Top of the existing Coping wall is + 3.00m which may be taken as Datum Levels required during the course of execution of the project.

The Contractor shall be deemed to have familiarized himself of all possible tidal levels that may affect his progress of work during the Contract by carefully examining all the local tidal records in the past. Details of certain tide levels of Cochin backwaters are given below for guidance.

a)	Highest water level recorded in Dec. 20/1960	+ 1.40M
b)	High water level	+ 1.07M
c)	Low water level	+ 0.30M
d)	Lowest water level recorded in Nov. 21/1964	± 0.00M

Back-waters of Cochin are connected to Vembanad Lake in to which many rivers discharge. During rainy season water level in the channel adjoining Cochin Shipyard will undergo changes.

STANDARD SPECIFICATIONS

The Indian Standard Specifications & Indian Standard Code of Practices as referred to in this Contract shall be observed by parties concerned. Latest publications or amendments made to the above specifications and Codes shall supersede the previous ones.

In case of any variations or differences between the Indian Standard Specifications and the other specifications referred to in the Contract, the Engineer-in-charges' decision shall be final and binding.

EQUIPMENT, BUILDING, MATERIALS, ETC. FOR CONSTRUCTION

The Contractor shall pay special attention to the requirements in the specifications as governing the entire works generally. Various requirements and description, although not necessarily be repeated for each separate division of work, shall be deemed to be applicable to any and all of the corresponding works.

In addition, the general requirements as listed from (a) through (m) below shall be applicable also to every part of the works:

a) All the labours, constructional plant, machinery, tools, instruments, tackle and devices, temporary office, workmen's sanitary and welfare facilities and other buildings, temporary structures, works, services and operations, materials, stores and things of whatever description necessary to construct, complete and maintain the entire works, temporary or permanent, or to fulfill the requirements specified in the Contract, shall be provided, performed and used by the Contractor. The constructional plant, equipment, materials, temporary building, works, services etc. shall be as provided in the Contract and be of type, capacity, power or quantity, strength, design and construction most effective for the proper and safe performance of the works under the Contract. The above mentioned equipment and facilities shall be located at sites conforming to the above conditions, constructed and used at the time and in the manner that may best suit the above mentioned purpose.

b) The Contractor shall be solely responsible for provision, sufficiency, stability, safety, protection, construction, demolition, transport, maintenance and insurance against all risks, of all the aforesaid constructional plants, tools, equipment, temporary building, structures, works, services and operations, materials, stores and other items, etc. and shall, except where otherwise stated in the contract, replace or reconstruct them or re-execute them in the event of their being lost or damaged or inaccurate. On completion of the contract the Contractor shall remove from the site all the constructional plant, temporary offices and structures and unused materials and stores and debris and shall leave the site in tidy conditions all to the approval of the Engineer-in-charge. Regarding sanction, Ground rent etc. Special condition of contract may be referred.

c) Except where otherwise indicated, Contractor shall make all own arrangements and shall at his own cost provide and distribute at all points where they are required, such supplies of water, fuel lighting and power as may be required for all the operations under the Contract, and shall provide and use all the necessary appliances, works, service and other things necessary to distribute the supplies to

various parts of works. He shall also provide a satisfactory supply of water to the offices, latrines and other temporary buildings requiring the service. He shall also provide a sufficient supply of drinking water of good quality for his employees. An electric power and water out-let will be provided by CSL as per terms in Special conditions of contract.

d) The Contractor will be deemed to have familiarized himself with the means of access to the project site, and plant to and from, and over the site the relative position, lines and levels of existing railway, roads, sewers, drains, wires, cables and buildings and all others that may arise during the Contract period, and shall, where necessary, furnish, install and maintain the requisite temporary gangways, ladders, stagings, railway, roads and foot-paths to and from as well as around the site of works, as may be necessary for the construction or for transportation of labours, plant and materials.

e) All the items to be constructed and utilized for the works shall be made available for reasonable use to the employer, Engineer and other contractors alike without charge, and the contractor shall observe all the instructions in this regard by the Engineer-in-charge,

f) The Contractor shall, except where otherwise stated in the Contract, be responsible for all risks due to water, whatever the source of cause may be, and shall properly deal with and dispose of water by use of sufficient temporary works, structures, services, operation, plant, equipment and appliances, etc., as to ensure the entire items of the works being executed in a satisfactorily dry and safe manner, all to the approval of the Engineer-in-charge.

g) The Contractor shall set out and measure up all the works in accordance with the Contract and for this purpose he shall appoint and employ all the necessary qualified staff and assistants.

h) The datum for which all levels are marked or measured is the datum level as referred to under “DATUM LEVEL” and the Contractor shall perform all the works to the exact depth, height and levels delineated in relation to the datum, or to such other levels and lines as the Engineer-in-charge may from time to time direct.

i) The Contractor shall, when required by the Engineer-in-charge furnish all the information as to quality and weight of the works, and to dimensions, levels, strength and descriptions of the materials and works, and give the Engineer-in-charge such other particulars as may be required.

j) All testing, provision of scales, appliances, materials, labour and everything necessary for the testing of concrete, asphaltic concrete, fine and coarse aggregates, any other materials found necessary by the Engineer – in- charge, shall be at the Contractor's own expenses as shall also be the cost of retesting any materials or works to replace those which have failed to pass the specified test requirements.

k) The Contractor shall keep the Engineer-in-charge notified in writing of the following points:

   i) Workshops and their location;

   ii) Sources from which materials and products are supplied;

   iii) Place and time for inspecting materials

   Testing shall be performed so as not to cause any delay in delivering materials to the site.

l) Should the Contractor fail to conform to these requirements, the Engineer-in-charge may at his discretion make special arrangements for inspection, the extra cost of which shall be borne by the Contractor and no claim for delay arising from such failures will be considered.

m) The rates or sums entered by the Contractor in the Bill of Quantities shall be deemed to cover and the applicable costs of complying with any and all of the foregoing requirements, (a) to (l) unless stated otherwise in the contract.

PLAN OF OPERATION

Before commencing the Contract work, the Contractor shall submit to the Engineer-in-charge for his approval the drawings showing general arrangements of temporary office buildings, access roads, plants, machinery and equipment, etc. together with general information regarding constructional plants, haulage, conveyor systems, arrangements and methods for excavation, method for backfilling, driving of steel sheet piles, construction of cast-in-place R.C. piles, concrete work, temporary staging. The order in which the Contractor proposes to carry out the temporary and permanent works shall be indicated in proper drawings and descriptions, and shall be subject to the approval of the Engineer-in-charge.

The Contractor shall prepare his proposed schemes for dewatering, seepage disposal and removal of existing revetments and submit the same to the Engineer-in-charge for his approval.

The Contractor shall prepare his detailed schedules necessary for the steel sheet pile driving, indicating excavation, steel sheet pile driving, installation of tie-rods anchor

wall and cast-in-place R.C.piles, and submit the same to the Engineer-in-charge for his approval.

The Contractor shall prepare detailed plan to show locations of the proposed concrete batch and mixing plant storage yards of fine and coarse aggregates, cement and reinforcement bars, and schemes for performing concrete works and submit the same to the Engineer-in-charge for his approval. The Contractor shall further give full description of his proposed plans of washing and grading control of aggregates, mixing concrete of proper class and conveying the mix from plant to its place of deposition so hat the Engineer-in-charge may be able to consider for approval the entire scope of project including both temporary and permanent works.

2. CONCRETE

CEMENT

All cement required for the concrete works shall be ordinary Portland/ pozzolana cement and shall conform to the standards laid down in current IS 8112/12269 and other relevant IS for ordinary Portland / pozzolana cement. Cement admixture shall not be used as a routine, except when specifically provided for in the schedule. Contractor's quoted rate for those items shall be inclusive of cost of such admixture.

The Contractor shall at his own cost, transport the cement to a suitable place at the work site and store it in well ventilated and watertight sheds of sufficient capacity. The floor of the shed shall be at least 450mm above the ground. No stack of cement shall be more than fifteen bags high. Cement, when conveyed to the site by Lorries or other vehicles, shall be properly covered with tarpaulins or other effective water-tight covers to keep the materials free from moisture. The cement shall be used as soon as possible after delivery at the site.

SAND

The sand to be used for mortar and concrete shall be taken from fresh water river-bed, and shall be coarse, sharp, clean and free of all impurities, conforming to the requirements of current IS 383 for coarse and fine aggregates from natural sources. It shall be washed, screened and graded as required by the Engineer-in-charge. The sand shall be a suitably graded mixture of coarse and fine grains from 4.75mm downwards. Fine sand of uniform size will not be acceptable. Samples of not less than 50Kg in weight shall be submitted to the Engineer-in-charge from time to time as required, and if approved by him all sand to be used in the work shall be of quality at least equal thereto.

The samples submitted shall be subjected to sieve analysis, and the material from the subsequently approved sources shall comply with the grading as revealed by the sieve analysis

of the sample from 4.75mm down to 150 micron as specified in the applicable provisions in IS 383.

If necessary, any deficiency in the quantity of larger particles in the sand between 4.75mm and 1.13 may be made good with approved quality crusher grit of the appropriate sizes.

Crusher-run dust will not be acceptable.

Any sand which does not comply with the requirements of this Specification shall be immediately removed from the site.

The sand shall be stored at the site in bins or in stock yards so as to avoid contamination with or risk of shoveling up earth or clay when being used. In place of river sand M sand satisfying the above specification shall be also be used for the construction with respect to the relevant I S. Confirmatory test at suitable intervals as decided by the engineer in charge has to be carried out at the expense of the contractor.

MORTAR

Composition of cement mortars

The mortar used for all works unless otherwise specified shall be composed of cement and sand as specified and shall be mixed in proportions by volume.

The qualities of mortar to be used for various items of work shall be as specified in each item of work.

The materials shall be accurately and separately measured in suitable boxes, which shall be made to the satisfaction of the Engineer-in-charge.

The ingredients shall be first thoroughly mixed in a dry state, after which the water shall be added and the whole mixed to the proper consistency for respective use. No more water shall be added after the mortar mixing has been completed.

Mortar shall be mixed only in small quantities as required and those once beginning to set shall not be re-mixed.

For filling holes where temporary shuttering bolts are removed after completion of concreting and elsewhere as directed , a special stiff mortar shall be used. This shall consist of one part of cement, one part of sand and one part of coarse aggregates ranging from 4.75mm to 9.5mm by volume. The mixture shall be made only sufficiently damp to ensure hydration and gaps and holes shall be well plugged with the mix as instructed by the Engineer-in-charge, care being taken not to damage adjacent concrete.

COARSE AGGREGATE FOR CONCRETE

Coarse aggregate for concrete shall consist of crushed, hard, close-grained blue stone of an igneous rock to the approval of the Engineer-in-charge. If aggregate is made by crushing, it should give an approximately cubical shape when broken, and any material which tends to break in long flakes will not be accepted. All coarse aggregate shall be perfectly clean and entirely free

from dust, clay, earth and other impurities, and any exposed and weathered rock shall not be used for aggregate. It shall be thoroughly washed and screened to the required categories, and all fine material 5mm and smaller shall be removed. A sample from each course to be approved before use by the Engineer – in- charge.

The Engineer-in-charge shall have power to reject any material supplied which does not conform to these requirements. The variation in grading between the approved samples and the subsequent consignments shall not exceed plus or minus 7.5 percent by weight.

The coarse aggregate shall include all specified size (say 40mm) and downgraded upto 5mm mesh.

The Contractor will be required to weight each grade of coarse aggregates separately so that the combined coarse aggregate shall when mixed with the appropriate quantity of sand and cement, give a concrete of the maximum density and workability, with the minimum water-cement ratio as per the mix design.

The gradings of the coarse aggregates shall conform to the current IS 383, but the amounts of each grading shall be decided from time to time as may be necessary depending upon the nature and source of the coarse aggregates and sand used by the Contractor.

No claim will be admitted for variation in grading of the coarse aggregates, and the Contractor shall prepare his prices for concrete with such modifications in view.

PROPORTIONS OF CONCRETE

The grades of concrete required to be used in various situations of the work unless otherwise specified shall be M30 and M25 as specified in individual items of the Bill o f Quantities.

Each grade of concrete will have either 40mm or 20mm maximum size of aggregate, thus concrete grade M25 with 20mm maximum size of coarse aggregate will be designated grade M25/20mm.

Similarly if with 40mm maximum size of aggregate, it will be designated grade M25/40mm.

The determination of the proportions of cement, aggregates and water to attain the required strength for each of the above grades of concrete shall be made from the evaluation of compressive strength on cubes. The concrete mix shall be designed to have an average strength, corresponding to the values specified for each grade of concrete.

The proportions of concrete shall be such that the concrete is of adequate workability for the conditions prevailing on the work in question and can be properly compacted with the

available means. It should also be proportional in such a way the resulting mix will have maximum density.

The grading of aggregates shall be controlled by using the coarse aggregate in different sizes and blending them in the right proportions as required, with the different sizes being stocked in separate stack. The grading of coarse and fine aggregates shall be checked as frequently as possible, the frequency of which will be determined by the Engineer-in-charge to ensure that the material supplied is of the same grading as that of the approved samples.

In proportioning concrete, the quantities of both cement and aggregate should be determined by weight/ volume as directed by Engineer- in charge. Where the weight of cement is determined by accepting the Maker's weight per bag, a reasonable number of bags should be weighed separately to check the net weight.

Water shall be measured either by volume in calibrated containers or weighed. All measuring equipment should be maintained in a good clean condition and their accuracy shall be periodically checked.

It is most important to maintain the water-cement ratio constant at its prescribed values established in the preliminary tests. To this end, in addition to exercising strict control on the amount of water added determination of the moisture content in both fine and coarse aggregates shall be made as frequently as possible, the frequency being determined by the Engineer-in-charge depending upon the weather conditions.The quantity of water to be added will be corrected, if any variations are observed in the moisture content.

No substitution of materials used in the work or alternations in the established proportions shall be allowed without additional tests to show that the quality and strength of concrete are satisfactory, and subject to the approval of the Engineer-in-charge in writing.

Workability of concrete shall be checked at frequent intervals. The slump and or other tests may be adopted for this purpose.

Workability of concrete shall be controlled by direct measurement of water content making allowance for any surface water of aggregates. In the absence of exact data, the following values may be taken as a general guide.

Very wet sand	120 litres/M^3
Wet sand	80 litres/M^3
Moist sand	40 litres/M^3
Moist crushed rock	20 litres to 40 litres/M^3

WATER FOR CONCRETE

Only clean fresh water shall be used for mixing concrete, mortar, grout, etc. Neither sea water nor fresh water which is not potable shall be used for concrete. Water

for this purpose shall be reasonably free from silt, oil, alkali, salt and other impurities conforming to current IS 456.

CONSISTENCY OF CONCRETE:

Consistency of all concrete shall be determined by means of slump test in accordance with current IS 456 and 1199 and or other tests. The Contractor shall provide at his own cost necessary number of slump cones and rods as required by the Engineer-in-charge. The slump cones shall be designed to be slid up to form a truly vertical plane and this shall be controlled by guides set on a steel base. The guides are also used to determine the exact amount of slump.

Consistency test shall be done at least three times a day when concrete placing is in continuous progress unless ordered at closer intervals of time by the Engineer-in-charge. The first consistency test shall be made immediately when concrete work commences on any section. For the purpose of any test, two slump tests shall be taken at a time and the average shall be adopted.

The water-cement ratio shall be strictly controlled so that the concrete shall have the slump figure specified or as the Engineer-in-charge may from time to time order for the various sections of the work. The water-cement ratio shall be kept at all times as low as possible. The quantity of water in any concrete shall not be in excess such as to run off the surface in the process of consolidation by vibration or hand tamping as the case may be and no undue superfluous moisture shall appear on the surface of the concrete.

The slumps shall be varied to suit the mixture being used and the purpose for which the concrete is required and whether being consolidated by hand or by mechanical vibration.

No concrete shall be used with a slump exceeding 10cm without the approval of the Engineer-in-charge. The amount of water to be used shall be adjusted by taking into account the moisture contents of the sand and coarse aggregate.

MIXING PLANT OF CONCRETE:

Unless, it is approved as a special case by the Engineer-in-charge all gauging of concrete shall be by weight for design mix only. Arrangements for gauging concrete materials either by weight or volume as well as for gauging and adding cement and water shall be to the approval of the Engineer-in-charge and shall be such that the whole operations can be monitored from a single point and thus be fully inspected and checked by one Supervisor. The concrete mixing plant shall be installed at suitable positions on the site to the approval of the Engineer-in-charge, and shall comply with the standards given in current IS 4925.

MIXING OF CONCRETE:

The concrete shall be mixed as near as possible to the place of deposition in batch-type mixer with capacity to the approval of the Engineer-in-charge. The mix thus made shall be placed as soon as possible after mixing.

Mixing shall be continued at the approved speed for the particular machine in accordance with the following standards after all the materials including water are put into the drum and before any portion of the batch is discharged. The method of mixing shall be such as to produce a dense, homogenous concrete without excess water, and the order in which the concrete materials such as water, cement, fine and coarse aggregates are fed into mixer, shall be subject to the approval of the Engineer-in-charge. The mixers shall be equipped with a device to the approval of the Engineer-in-charge for necessary control of water quantity in each batch to make the water-cement ratio or the slump as required by the Engineer-in-charge. This device shall be capable of setting to give a quantity of water down to one (1) percent of the required volume, while keeping uniform water supply as well as rapid adjustments to regulate water per batch by taking into account the variation of free moisture in the fine and coarse aggregates. The Engineer-in-charge shall carry out such tests as he may consider necessary to determine the free moisture contents in the fine and coarse aggregates and by making use of these data, the appropriate amount of water per batch shall be obtained. Mixing time shall comply with the standards of IS 4925.

Capacity of Mixer (cubic metre)	Time of Mixing (minute)
up to 2	1.5
up to 3	2
up to 4	2 .5

During windy weather, efficient precaution shall be provided to prevent cement from being blown away during the process of proportioning and mixing in both machine and hand-mixed concrete.

Precaution shall also be taken to protect the cement and concrete during wet weather. Concrete which has commenced to set shall not be used in the work.

TESTING CONCRETE:

The concrete shall bear the stresses specified under “proportion of concrete” as a minimum.

Preliminary crushing tests shall be made on 15cm cubes of concrete specimen in conformity with IS 456 and 516, and no concreting will be permitted till the results of the tests are satisfactory with regard to the increased strength expected from laboratory

specimens as compared with concrete made and deposited on the site. The concrete shall be made from the materials to the exact proportions specified for the works. Where directed by the Engineer-in-charge concrete shall also be taken direct from the mixing platform or the mixing machine or from the place of laying and test.

Six specimens shall be made for each separate test. The frequency of the tests shall be at such intervals as directed by the Engineer-in-charge.

The compressive stresses shall be tested in accordance with current IS 456 and 516.

The Contractor shall provide twelve metal moulds in good condition for casting the concrete specimens. No extra payment will be allowed in respect of the labour and materials used in making, curing, handling despatching of concrete test specimens and testing, and the Contractor should allow for these costs in his rates for concrete in the Bill of Quantities.

PLACING CONCRETE:

All concrete work shall as far as practicable be carried out continuously. The concrete immediately after being mixed and before the initial set has taken place shall be carefully placed within the shuttering so as not to displace the shuttering or reinforcement. It shall be conveyed from the mixing plant to the place of deposit by means approved by the Engineer-in-charge and shall then be carefully turned over, placed into position in layers approved by the Engineer-in-charge so that the concrete will fill up all spaces within the shuttering and around the reinforcements, and be well compacted by means of approved tools or by mechanical vibration.

Receptacles for transport and chute for placing shall be kept clean and washed out after each operation.

In placing concrete, the full depth as approved by the Engineer-in-charge shall be laid in one layer at one stretch of operation. Where this is impracticable because of the excessive depths required, the required depth as indicated by the Engineer-in-charge shall be constructed by placing concrete in regular layer, well rammed and consolidated in place by hand tools or vibrators as required. Concrete placing shall be continuous as far as practicable, until the section being dealt with is completed up to the height shown or required. Concrete placing in small sections shall not be allowed except with the approval of the Engineer-in-charge and only where in the opinion of the Engineer-in-charge it is unavoidable.

All concrete work shall be completed before initial set commences, and care shall be taken not to disturb the concrete before it has set hard. No concrete that has begun to harden shall be used in the work.

Where placement of concrete requires to be suspended, suitable precaution shall be taken to ensure satisfactory joints between old and new concrete placed.

In case concreting is done through chute or pipes, these shall be set over the gentlest possible slope that allows free flow of concrete in an unbroken stream without causing segregation of materials. Concrete so placed if required, shall be thoroughly remixed before being finally placed in the positions.

Where wheel barrows are used for transport of concrete, they should be of metal to avoid loss of fine materials, and rubber tyred unless otherwise approved.

CONSOLIDATION OF CONCRETE:

Immediately after placing, each layer of concrete shall be consolidated as dense as possible so as to work up the mix well against faces and into corners of existing shuttering.

Immersion type of vibrators driven by diesel/petrol electric motor or air compressor shall be used for consolidating concrete. In case immersion type vibrators are not applicable, concrete shall be consolidated by form vibrators or by hand tools with the approval of the Engineer-in-charge.

Sufficient care shall be taken to avoid excessive use of vibrators, which will cause segregation of aggregates and coming up of water. Care shall also be taken not to cause the heads of vibrators striking against shutterings or reinforcement.

The contractor shall provide sufficient number of mechanical vibrators to ensure efficient consolidation of concrete in place. Number and type of vibrators to be used shall be to the approval of the Engineer-in-charge.

Special care shall be taken to ensure that all shutterings adopted are sufficiently strong to permit vibrator operation without disturbing the shuttering, or without causing it to bulge or move out of alignment.

Special care shall also be taken to prevent leakage of mortar through joints in the shuttering during vibration.

All the costs and charges, necessary to cover the cost of mechanical vibration of the concrete , shall be included in the rates or prices for the respective items of concrete.

JOINTS IN CONCRETE:

All joints, either permanent or temporary, shall be formed either on horizontal or vertical planes.

Construction joints, as a rule, shall be provided at positions where shearing stress or tensile stress is the least and where appearance and functions of finished face of structure is least influenced.

The following important requirements shall be complied with while providing construction joints in concrete work.

Timber strips shall be installed truly horizontal to the inside surface of shuttering, and all concrete shall be placed up to the level of these strips so as to provide a smooth, horizontal surface upto the edge lines. This shall apply to all vertical and horizontal joints, wherever shown on drawings or wherever any stoppage joints have to be made by suspending concrete work.

PVC water stop 250mm wide shall be used in the expansion joints requiring watertight treatment.

20-gauge GI sheet 200mm wide shall be placed in the construction joints as directed by the Engineer-in-charge. Rate for concrete shall be inclusive of this also.

All faces and joints in concrete which have become fully set shall be picked all over, washed thoroughly clean with water and scrubbed so that the old surface will be sufficiently roughened to insure satisfactory bonding with fresh concrete. The indentions thus made shall be atleast 12mm deep and shall be washed clean of all laitance and foreign matters by water and wire brush. In order to avoid the concrete edges from being broken or damaged, the above picking and scrubbing shall not be done until concrete has fully set.

For bonding larger beds of concrete work, a small water jetting device assisted by compressed air shall be applied against the partly set surface of the concrete so as to wash off all laitance and surplus paste without dislodging any of the exposed aggregates. Surplus water and waste shall be blown off by means of air jet. Commencing time for chipping job after placement of concrete shall be to the approval of the Engineer-in-charge.

Where any joints have been covered or soaked by sea water within a period of three days after placement, the beds and joints shall be chipped to a depth of not less than 25mm or to such greater depth as may be required by the Engineer-in-charge in order to reach sound material before the next lift of concrete is applied.

No extra payment will be allowed for hacking, cleaning and preparing the existing concrete beds and joints and supply of mortar at joints, etc. The cost of this work shall be included by the Contractor in his rates in the Bill of Quantities for the respective class of concrete.

The face, either vertical or horizontal, after being chipped, shall then be rendered with a 13mm thick mortar well placed into the existing concrete face immediately prior to

placement of new concrete. This thin coating of mortar shall be laid just ahead of the fresh concrete being placed, and the fresh concrete shall be thoroughly distributed to form a monolithic concrete with the existing one by vibrator or by other method.

Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristled brush without dislocating aggregates. The surface shall be thoroughly wetted and all free water removed, and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150mm in thickness and shall be well placed against the old surface, paying particular attention to fill up all corners and close spots.

In all cases, the preparation of beds and faces of set concrete as described above are to be approved by the Engineer-in-charge before any mortar or new concrete is placed.

No concrete shall be placed on or through water without approval of the Engineer-in-charge in writing.

The contractor shall so deal with all water, tidal and otherwise, encountered during concreting operations as to prevent it from damaging the surface or exerting pressure against the concrete until at least 48 hours have elapsed after concrete placement.

CURING OF CONCRETE:

The Contractor shall pay special attention to see that all concrete shall be protected from rainfall and prevented from rapid drying, and during the first seven days of hardening, the shuttering and the exposed face of the concrete shall be kept constantly wet, by spraying with water or other means.

After the shuttering has been removed, the exposed concrete surface shall be covered by wet sacks or other approved hessian material, frequently watered, and this shall continue at least one week after removal of the shuttering and preferably for 10 days if the conditions permit.

CONCRETE FACE WORK:

The exposed faces of all concrete shall be made true to line, fair and smooth. Should any part of the face work present a rough, uneven, honey-combed or imperfect appearance when the shuttering is removed, it shall be picked out to such a depth and refilled and properly refaced with each class of concrete at the Contractor's expense to the direction of the Engineer-in-charge. As for the accuracy for surface finish the Contractor shall perform the work in strict accordance with the requirements for each item of work.

Particular care shall be taken on all exposed work, to see that no irregularity or roughness occurs between successive sections of shuttering, and the finished faces shall be perfectly smooth and to such shapes as shown on the drawings, free of board or shutter marks. Horizontal and vertical construction joint shall be true and regular and the

Contractor shall use timber strips as specified elsewhere or adopt such other means as may be necessary to obtain these results.

Where cutting and making good is necessary in concrete work, joint work shall be done as specified herein, and all the surface shall be finished uniform conforming to correct line and level.

SHUTTERING FOR CONCRETE:

All shuttering or moulds shall be of suitable quality, and of such substantial strength with ample scantlings as will ensure that the shuttering or moulds remain rigid without any springing or distortion throughout placing, ramming, consolidating, setting and hardening of concrete.

All shuttering or moulds shall be of such a design as to ensure that there is no leakage of mortar through joints during placing or consolidation of concrete.

Where concrete corners will be exposed permanently, all shuttering shall be provided with angle fillets so as to form chamfers on internal and external angles. The width of the angle fillets shall be 3cm unless specifically noted on the drawing.

The design of the shuttering shall be such as to permit its easy removal or reuse without injury to the concrete.

The Contractor shall submit the drawing of shuttering and details of shuttering supports to the Engineer-in-charge for his approval before starting erection of shutterings. All shuttering should be steel/ timber shuttering with sufficient scantling as approved by Engineer- in charge.

The faces of shutterings that will come into contact with placed concrete shall be thoroughly cleaned prior to erection. Oil to be coated on the internal surface of shuttering shall be mineral oil or other materials approved by the Engineer-in-charge. It shall be applied in a thin coat over the surface and care shall be taken not to leave any stains on the concrete surface. The surface of shutterings shall be oiled as a rule prior to their erection, but if approved by the Engineer-in-charge the oil coating may be made after the erection. Oil on reinforcements shall be completely cleaned by effective means.

REMOVAL OF SHUTTERING

Removal of shuttering after hardening of concrete shall be carefully done so as not to give any shock, disturbance or injury to the concrete in place. Shuttering shall not be removed until concrete is set hard enough to safely withstand the stress induced due to removal of shuttering and due to other causes.

Unless specifically approved by the Engineer-in-charge the minimum period required till the removal is as give/.n in the table below for each part of structure made of ordinary Portland cement or pozzolana cement. Notwithstanding the data given in this

table, the Contractor shall delay the removal date until the concrete is found sufficiently hardened, and if any injury caused in the concrete by premature removal of shuttering, the Contractor shall be held responsible thereof and make necessary repair at his own costs. With a view to confirming to see if the concrete is sufficiently set and hardened, only a small section of shuttering shall be removed before starting removal of entire shuttering.

a)	Walls and vertical sides of beams	24 to 48 hours as directed by the Engineer-in-charge
b)	Floor slab and beam soffits (props left under)	7 days
c)	Removal of props under beam	14 to 21 days as instructed by the Engineer-in-charge

The above time requirements may be increased in accordance with the temperature conditions.

Note:

Whenever pozzolana cement is used, removal of shuttering will be delayed by 30% more than that is admissible for ordinary Portland cement.

No loading shall be done on floor or beam earlier than 14 days after concreting.

Rates for the concrete items shall include the steel or timber shuttering for concrete work. The Contractor shall include in these items the costs of all timber, steel plates and sections, bolts and nuts, sheet metal or other linings, supports, stagings, nails, straps, clamps and all other fixers, all cutting and wastage and the cost of all labour and materials in making, erecting, painting and removing shutterings other supports and fastenings and the costs for all preliminary and other work, required to construct the concrete to the forms and dimensions shown on drawings or as directed by the Engineer-in-charge.

All concrete shall, unless otherwise specified, be measured and paid for in accordance with current IS 1200 (Part II).

The rates for concrete shall include all the costs for construction of all temporary joints and preparation of temporarily exposed faces, as well as for providing, vibrating and compacting the concrete, embedding all objects, curing and all other costs and expenses or labour required to complete the work in accordance with the Contract.

REINFORCEMENT FOR CONCRETE:

Steel reinforcements for concrete in Permanent works shall be torsteel conforming to IS 1786. All reinforcements shall be cut to the exact length and made truly straight or bent to the exact shape and size indicated on the drawings before it is fixed on the work.

All bending of the deformed reinforcements shall be cold bent. Rods of small denominations may be supplied in coils. The contractor shall prepare plans at his cost showing clearly the bar bending schedule and erection bar schedule and got it approved well in advance by the Engineer -in -charge.

All reinforcements, immediately before being placed in the work, shall be well cleaned and made perfectly free from dirt, scale, rust, paint, oil, cement wash or any other coating.

All the steel reinforcements shall be fabricated to the forms and dimensions and fixed exactly in the position shown on the drawings or in accordance with current IS 2502. Special care shall be taken so as to see that the overall length of reinforcements is accurate and that after fixing in position the reinforcements remain in place without any warp or twist.

Reinforcements shall be firmly bound together with 22 gauge binding wire at intersection of reinforcements/welded to ensure that the arrangements will retain its designed form, and the bar network shall be so temporarily supported as to retain its correct position in the moulds during placing and consolidating the concrete. The ends of all such tying wire shall be turned into the concrete body and not allowed to project towards the surface of the concrete. During concreting, a competent bar bender shall attend on the work to adjust and correct position of the reinforcements immediately prior to placing of concrete. In the case of reinforcement used inside concrete piles every joint be tack welded. Main reinforcement shall be welded to a flat provided at intervals along the main bars of reinforcement for inside piles.

CAST –IN-PLACE CONCRETE BORED PILE:

Diameter of cast-in-place R.C. pile shall be 650mm/500mm, appx. 45m long driven to a stratum which will give a bearing capacity equivalent to N value not less than 50 around the pile tip.

The Contractor shall prepare particulars of complete construction methods for the above and submit the same to the Engineer-in-charge for his approval.

Trunk section of pile to be cast shall have longitudinal bars in place bound up tightly and tack welded with spiral members so as to form reinforcement assembly. For the purpose of securing reinforcements in position, tie-hoops shall be inserted at several levels along the entire length of piles and welded to the main reinforcements.

Materials for the pile:

a) Concrete: Concrete to be used for the foundation piles shall contain not less than 430 Kg of cement in cubic meter concrete. The concrete shall be of M30 and its slump is 10 to 15cm with sufficient workability.

b) Reinforcement bars: Reinforcements to be used for principal and spiral members shall be deformed round and have diameters as shown in relevant drawings and shall be of a quality as specified in IS 1786. The reinforcements shall have both ends cut off, and no hooking is allowed for bonding.

c) Test of materials: Concrete and reinforcements to be used for the piles shall be tested as specified in relevant IS, and the results shall be reported to the Engineer-in-charge in writing as soon as practicable.

PILE INSTALLATION

Cleaning of Pile bore

Pile bore shall be cleaned by flushing through tremie pipe after placing reinforcement and just before start of concreting. Flushing is to be continued till pile bore bottom is thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.

Concreting

Concreting shall not be done until the Engineer is satisfied that the bearing strata (soil/rock) met with at the termination level of pile. SPT shall be conducted as directed by the Engineer-in-charge wherever required.

The time interval between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time interval exceeds 6 hrs the pilebore shall be abandoned. However, the Engineer may allow concreting provided the Contractor extends the pile bore by 0.5 m beyond the proposed depth, and clean the pilebore. The entire cost of all operation and materials for this extra length shall be borne by the Contractor.

Cut off level (COL)

Cut off level of piles shall be as indicated in drawings released for construction or as indicated by the Engineer.

The top of concrete in pile shall be brought above the COL to atleast 1.0 metre to remove all laitance and weak concrete and to ensure good concrete at COL for proper embedment in to pile cap.

When the pile cut off level is less than 1.0 metre below the working level, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection. In case COL of pile is more than 1.0 metre below working level then concrete shall be cast to a minimum of 1.0 metre above COL.

Breaking off of Piles

If any pile already cast, requires breaking due to lowering in cut off level or for any other reason, then the same shall be carried out, not before seven days of casting without affecting the quality of existing pile such as loosening, cracking etc. and to the satisfaction of the Engineer.

Preparation of Pile head

The exposed part of concrete above the COL shall be removed/chipped off and made to a uniform level at COL with a mechanical cutter neatly, but not before seven days of casting of pile and as directed by the Engineer in charge. The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored into the pile cap.

Contractor shall observe and comply with the following while installing cast-in-situ piles using bentonite suspension.

Bentonite suspension used for piling work shall satisfy the following requirements:

a) The liquid limit of; bentonite when tested in accordance with IS: 2720 (Part V) – 1965 shall be more than 300% and less than 450 percent.

b) The sand content of the bentonite powder shall not be greater than 7%.

c) Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the bentonite solution should be about 1.12.

d) The Marsh viscosity when tested by a Marsh cone should be about 37 seconds.

e) The swelling index as measured by the swelled volume after 12 hours in abundant quantity of water shall be at least two times its dry volume.

f) The PH value of the bentonite suspension shall be less than 11.5.

Bentonite suspension shall be prepared using fresh water and sodium bentonite and shall be mixed properly. Mix shall be prepared 24 hours before use. The specific gravity of bentonite suspension shall be checked by taking samples from the bottom using specially designed sampler. Consistency of the drilling mud suspension shall be controlled throughout the boring as well as concreting operations in order to keep the hole stabilized.

Before a pile is concreted the bottom of the bore hole shall be cleared of all loose materials. The bore hole shall be flushed with fresh drilling mud before concreting. The depth of the hole shall be measured with respect to a suitable datum.

Concreting of bore holes shall start as soon as possible after its completion. The bottom of bore hole shall be cleaned thoroughly before reinforcement cage is lowered into the bore hole. Before commencement of concreting the cross section of the bore hole be checked by lowering a hollow pipe of appropriate diameter to check the bore hole is clear of the minimal dimension noted in the drawing. Tremie pipes diameter not less than 200mm shall be used for concreting. Total concreting time should be minimum and the concreting operation shall be carried out as fast as possible so as to ensure good continuous concrete in the pile shaft. Concreting once commenced shall continue without any interruption.

Concrete mix shall have a slump not less than 150mm and the aggregate size shall not exceed 20mm. Concreting shall be done at such speed that the reinforcement cage is not lifted up by the upward flow of concrete within the hole. The concrete shall be filled at least 0.5M above the cut off level so that good concrete is available below the cut off. The cage of reinforcement shall be kept suspended till completion of concreting of bore hole.

In case the cut off level is the same as the top of the casing, then the concrete may be allowed to overflow till good concrete would be visibly start flowing out of bore hole. It should always be ensured that the tip of the tremie pipe is at least 2 to 3M within concrete to avoid mixing of fresh concrete with bentonite.

Contractor shall transport and dispose off used as well as surplus bentonite slurry outside CSL within 2 days of completion of piling job. Even when the piling work is in progress, used bentonite slurry shall be transported from the site and disposed off as mentioned above. Unused bentonite powder shall also be removed from the site immediately after completion of the piling work.

<u>Tolerance in pile driving:</u>

Allowable tolerance in pile driving is as follows:

a) Deviation of pile center line from the true vertical line shall be within 1 deg

b) Tolerance in pile spacing shall be within 5% of the center to center of pile or 100mm, whichever is lower. If any pile shows deviation exceeding the above limits, additional pile or piles shall be driven at the discretion of the Engineer-in-charge at no extra cost.

Loading test of pile

Loading test shall be performed, as per relevant Appendix B after elapse of 45 days of the pile driving. Load for the pile loading test shall be not less than 210 tons for dia 650mm piles. These loads are to be achieved at the foot of the piles excluding friction. Loads at top of pile will be load at the tip of pile plus friction. Contractor shall assess the frictional load and design the testing system accordingly. Available soil data will be furnished to the contractor. Contractors if so desire can collect additional soil data at their cost. The work shall be done as directed by the Engineer-in-charge. Payments to Contractors for the loading tests shall be made on the basis of the number of tests performed, and shall be deemed to include the costs of all the ;material, labour and equipment for reaction piles, jacks, loading beams, instruments, preparing, maintaining and reporting test results, and others necessary to complete the work.

Payments for the cast-in-place concrete pile:

Payment for the cast-in-place concrete piles shall be made on the basis of the length of pile in place as measured to the top of finished level of the pile (cutoff level) as indicated on the drawings before concreting the superstructure.

3. STEEL SHEET PILE WORK

Transportation:

The Contractor shall set up, in accordance with the construction schedule make all the necessary arrangements for hauling of all materials for the steel sheet pile driving so that all the materials will be available for immediate use whenever required:

a) All the steel sheet piles shall be delivered intact at the site without causing any permanent distortion in the member or injury or deformation at joints.

b) Care shall be taken in handling such materials as tie-rods to avoid damage to the thread and shop coat painting.

c) Handling of such long members as waling shall be carried out in the same way as for the steel sheet piles.

Storage:

a) Storage space for steel sheet piles shall be reasonably leveled and compacted. The site so selected should be got approved by the Engineer-in-charge.

b) Steel sheet piles shall be stacked in such a way as to avoid strain or distortion in the materials.

c) Steel sheet piles shall be stacked up in such tiers as each consisting of not more than 3 piles, and between each tiers wooden sleepers shall be inserted at intervals not exceeding 4M. Total height of stack shall not exceed 2M.

d) Tie-rods and accessories shall be sorted, stacked in accordance with their diameters and shall be stored under cover and not be directly exposed to weather.

e) The Contractor shall be responsible for safe handling, mobilization & demobilization and storage of piles and other materials. The rate for sheet pile driving shall include the cost for handling and storage of piles and other accessories, forming driving pit, formation and removal of earthen bund if required, all other requisites for successfull driving of sheet pile..

Sheet pile driving

a) The alignment of sheet pile wall shall be correctly set up for the approval of the Engineer-in-charge before commencing the sheet pile driving.

b) Guide frames and stakes shall be installed correctly and secured properly to ensure driving piles on the centre line.

c) Steel sheet pile driving shall be performed by one of the following methods:

   i) In driving single pile one by one, special care shall be exercised to keep each pile penetrating in strictly vertical direction.

   ii) In driving a group of piles (about 20 pieces simultaneously) a guide frame shall be used to keep them in a straight alignment, and in the initial stage all the piles shall be driven to a depth just enough to enable them to stand in positions. Then one or two pieces on both ends shall be driven down first, followed by the intermediate piles which shall be driven alternately in several stages to final level.

d) Hammer for steel sheet piling shall be drop hammer, steam hammer, air-hammer, diesel hammer, electric vibratory hammer and vibro-hammer. Before employing a driving hammer, Contractor shall obtain approval of the Engineer-in-charge for its use in the job.

e) Prior to starting pile driving, the Contractor shall submit the driving method and time schedule for approval of the Engineer-in-charge and in accordance with the sequence approved by the Engineer-in-charge the piles shall be driven vertically in the specified positions.

f) Pile driving:

   i) Sheet pile driving shall commence initially with minimum impact of hammer and increased later after ensuring that the piles are being driven vertically in designed alignment.

ii) Pile shall be driven with cap and cushion on top of the pile for protection against the impact of drop hammer.

iii) Lengthening of pile, if required, shall be done by welding additional piece on to the top of pile already driven. The joints shall be as strong as the normal section of the pile.

iv) In case interlocks of piles with adjacent ones are found loosened or dislocated during or after driving, such piles shall be pulled out and replaced with new ones or redone otherwise in accordance with instructions of the Engineer-in-charge.

v) The Contractor shall take every step to ensure safety and to prevent accident while handling and driving piles. If any deviation from specified lines, fractured top, deficient or excessive penetration is observed during pile driving, the driving shall be suspended to take corrective measures as directed by the Engineer-in-charge.

vi) Necessary data and logs such as of the number of blows, length of penetration etc. during sheet pile driving shall be made and submitted in duplicate to the Engineer-in-charge at no extra cost. Format of driving log shall be got approved by Engineer-in-charge prior to commencement of driving sheet piles

Reformed steel sheet piles:

a) Reformed steel sheet piles shall be of three types, namely corner sheet pile, junction sheet pile and wedge sheet pile.

(i) Corner sheet piles are used where centre line for driving turns to form an angle, and joined by welding to the sheet pile walll that has changed its direction, 90 degrees in this case.

(ii) Junction sheet piles are those to be used where two walls of sheet piles meet at right angle forming a T junction, and where the sizes of sheet pile change along the same line.

(iii) Wedge sheet piles are used to make up for the deviation of piles from the plumb line caused during driving. This type of pile is characterized by its wedge like shape, tapering downward to the tip.

b) Reformed steel sheet piles as mentioned above shall as a rule be manufactured in a factory. If it becomes inevitable to fabricate them in the field at site, the Contractor shall provide equipment and manufacturing means equivalent to those of the regular factory production and have close supervision and control over the process. If the Contractor finds it necessary to use the reformed steel sheet piles,

he shall obtain approval of the Engineer-in-charge for the use, and fabricate the same at his own cost in accordance with the instructions of the Engineer-in-charge.

1. Cutting:
   - i) Cutting of steel sheet piles shall be done by means of a gas cutting device.
   - ii) Steel sheet piles to be cut shall be free from curve and warp, and securely clamped on a level work table for cutting.
   - iii) Use of a special jig is desirable to minimize deformation due to cutting
   - ii) Whatever method is used in cutting, a certain degree of deformation is bound to occur. If the deformation is less than 40mm, it can be set right by hammering or by heat treatment to the deformed segment. If the deformation exceeds the above range, mechanical correction by means of jacks and press shall be made.
2. Welding:
   - i) Arc welding shall be adopted for steel sheet pile work
   - ii) Only skilled welders approved by the Engineer-in-charge shall be engaged for the work
   - iii) Welding equipment shall be AC rectifiers / arc-welding unit. Welding rods shall be those conforming to the relevant IS or equivalent and subject to prior approval of Engineer – in charge
   - iv) If any welding is rejected by the Engineer-in-charge, the Contractor shall perform the welding again by cutting off at the weld at his cost. All the costs therefore shall borne by the Contractor.

Extraction of piles:

If the pile driving work has not been done to the specification, the Contractor shall extract the rejected pile. The extraction shall be such as to avoid damages to the adjoining piles, other structures and installations. Cost of extraction and replacement shall be borne by the Contractor.

Payment for steel sheet piling:

The Contractor shall be paid for the net sectional weights of all the steel sheet piles actually used in the work in accordance with the Contract drawings or as may be directed by the Engineer-in-charge. The unit rate for steel sheet pile driving shall include the costs for manufacturing and replacement of the reformed steel sheet piles and no other claim will be admitted.

Specification for sheet pile

Steel sheet pile should be used shall conform to the following requirements and specification according to ASTM A690 / IS 2314 or equivalent

(1) Section Modulus (min) – 2510 cm^3 / m

(2) Tensile strength (min) - 485 N/ mm^2

(3) Yield point stress(min) - 294 N / mm^2

(4) Elongation (min) – 18 %

(5) Copper content (min) - 0.25%

Test certificate for sheet pile

Material Test certificate should be furnished along with the Supply.

ANCHOR WALL

Anchor walls shall be constructed by cast-in-place reinforced concrete, and the Contractor shall carry out the work as shown on the drawings.

Base course with good quality cut gravel for anchor walls shall be compacted sufficiently as instructed by the Engineer-in-charge to preclude further subsidence. The Contractor shall lay over the compacted base course a layer of levelling concrete, on which shutterings shall be erected for concreting.

Proportion of anchor wall concrete shall be M25. Reinforcements and shutterings shall be assembled and erected as shown on the applicable drawings.

The diameter of hole for inserting tie-rods to the anchor-wall shall be 15mm larger than that of tie-rods. The hole shall be formed by burying PVC pipe of approved quality.

The anchor wall shall be back filled with sound cobble stones so as to cause sufficient passive earth pressure against the tensile forces of the tie-rods. Care shall be exercised not to damage tie-rods while backfilling with cobble stones. Cobble stones to be used shall be approved by the Engineer-in-charge.

The cobble stone shall be densily packed in layers not more than 600mm thick and the void filled with river sand / M sand using water jet. The surface of the stone packing shall be gunited with cement mortar 1:3, for a thickness of 50mm with chicken wire mesh.

WALING

Fabrication and erection of waling members shall be done in accordance with the positions of tie-rods and the steel sheet piles in place.

Drilling holes in waling members shall be done by means of pneumatic drill or electric drill. These holes shall not be larger than required diameter nor reformed.

Waling members, splice plates, steel plates and bolts to be used shall be as shown on drawings and be securely fixed in place at correct position.

The rate for waling shall be inclusive of cost of equipment, installation, welding of steel plates and cost of wrought and put up, painting the surface with one coat of epoxy primer after cleaning by mechanical wire brushing.

Steel members to be used for waling job shall be as specified in current IS 800.

Payment for waling work shall be made on the basis of the weight of the said materials.

Test certificate

Material Test certificate should be furnished along with the Supply.

TIE RODS

Installation of tie rods shall be done immediately after completion of steel sheet pile driving, anchor wall construction and installation of waling member.

The contractor shall carryout the work to the specific requirements of the use, and install the tie rod with utmost care not to damage the threaded portion and exterior surface. After removing rust from the surface by mechanical wire brushing, the contractor shall apply tar epoxy resin coating on the cleaned surface as per specification

Tie rods shall be installed at right angle to the center line of the steel sheet piles.

If tie rods are found to be too long or too short, or defective, these shall not be used on this work.

Ring joints shall be assembled so as to permit their free rotation and be installed in such a way as to insure their normal function.

When installation of the tie-rod is completed, its entire length shall be adjusted by the turn-buckle located midway on the tie-rods as well as by the nuts on the side of sheet piles and the other on the side of the anchor wall so that tensile force will be uniformly distributed.

Final adjustment to tighten up the tie-rod shall be done by means of the turn-buckle or by the nut on the side of the anchor wall.

Length of threaded sections of each end of turn-buckle shall be sufficient to take up all the threaded lengths of the two fastening nuts when screwed tight and to leave at least 3 full threads beyond the nut.

Ground where the tie-rods are to be installed shall either be excavated or filled up, levelled and well compacted to the elevation required for the installation. If so directed by the Engineer-in-charge, the Contractor shall place temporary wooden piles and provide racks for supporting tie-rods to prevent their sagging.

Specification for Tie rod

Tie rod main body shall be prepared in accordance with the following:

(i) YIELD POINT, not less than 45 kg/mm^2

(ii) TENSILE STRENGTH, not less than 61 kg/mm^2

(iii) ELONGATION, not less than 18 %

Test certificate for Tie Rod

Material Test certificate should be furnished along with the Supply.

4. STEEL AND IRON WORK

STRUCTURAL STEEL WORK

Structural steel plates, rolled section, rivets and bolts for general engineering work shall comply with the requirements of current I.S.800. Steel work shall be fabricated, assembled and erected in strict accordance with the parts, dimensions and shapes as shown on the Contract drawings.

The sheared ends and edges of all the rolled sections and plates shall be finished with file, and all the shearing and cripping shall be done neatly and accurately within the allowable error of 1.5mm. All the butt ends and edges of compression members shall be accurately machined true and straight so as to insure full bearing at each ends. All structural steel after assembly shall be finished smooth, and all end connections shall be made flush each other and correct as to length and position.

All steel works shall be erected accurately and securely in correct position, line and level, all with first class workmanship. Proper templates shall be used to insure correct positioning of the members to be erected. Steel holding down bolts shall be supplied in time for building into concrete foundation as shown.

Unless otherwise specified, all the surface of steel plates and sections shall be applied with one coat of primer before fabrication and after erection at site two coats of anticorrosive paint over a coat of primer, conforming to relevant I.S and subject to the approval of Engineer – in charge. In case welding and drilling holes have been done after painting, the areas where painting has been removed or burnt shall be cleaned and repainted with paint of same quality as applied at shop.

All the steel works shall be dip galvanized whenever so indicated on the drawings or so required by the Engineer-in-charge. Any iron and steel works specified to be galvanized shall be pickled clean in dilute muriatic acid, and then dipped in a bath of pure zinc solution. All materials shall be passed rapidly through the bath, washed and brushed. All the metal items shall be galvanized only after drilling, trimming and finishing are all

completed. All galvanized surfaces shall present a bright texture with crystalline structure, clean and free from drops of smelter or rough edges, and surfaces.

Welding of the structural steel plates and rolled sections for general construction shall be done conforming to relevant I.S. by well qualified welders approved by the Engineer-in-charge and in strict accordance with the weld length and throat depth as indicated on the drawings. Welded portions shall be inspected by the Engineer-in-charge and any welded portion, if rejected by the Engineer-in-charge shall all be cut off and welded again.

Welding shall be done under weather-proof and sufficiently moist-proof conditions

STEEL FASTENENINGS:

All types of bolts, nuts and washers shall be of forged mild steel taken from steel ingot and fabricated true to required shapes, diameter and dimensions. Bolts, nuts and washers shall be durable, clean and flawless, with ISO standard thread neatly cut to uniform pitch. All nuts shall thoroughly fit on the thread cut on the bolts, and shall be manually tightened. The bolts shall be of such length as to have not less than one thread but not more than four thread left beyond the end of nut when tightened against the bolt. The shoulders of the heads shall be truly concentric with the axis of the bolts.

Test certificate

Material Test certificate should be furnished along with the Supply.

5. PIPE HANDRAIL WORK

PIPE HANDRAILS:

Pipe handrails shall be installed exactly at positions as shown on drawings or as directed by the Engineer-in-charge. Where so directed, the Contractor shall fabricate the pipes exactly to the required shapes and install them after plugging the ends to prevent air from entering the pipes.

Handrail pipe connection with the concrete shall be welded to the steel plates previously embedded in the concrete.

Pipe for handrails shall be SS 316 grade as per drawing and shall conform to relevant IS.

Payment to Contractors for the pipe handrails shall be made based on linear length of pipe works installed for each diameter.

Test certificate

Material Test certificate should be furnished along with the Supply.

6. FENDERS AND BITTS

FENDERS

Fenders shall be installed at positions as shown on the drawing.

The contractors shall submit samples of the above items in advance to the Engineer for his approval, and only when the data from various test on their performances and properties are satisfactory to and approval by the Engineer, the contractor may use the materials.

Rubber covering for the rubber fender surface shall be of synthetic rubber of neoprene type, 2 to 3mm thick, vulcanized and pressurized for strong bond with the main rubber body. Top surface (Rubbing face) shall be coated either with Urethane of thickness not less than 6mm or Rulon or Nylon for a thickness not less than 4mm.

Main Rubber body of fender shall of a quality natural or synthetic rubber fortified with carbon black, having sufficient resistance against ageing, brine, oil and abrasion, and shall be uniform in quality, free from air bubbles, cracks and other defects.

Rubber fender of grade R2 to be used for the work shall be as specified below.

(i) Super arch type 600mm H x 2500mm L

(a) Deflection – 45 %

(b) Reaction Force - 112 T

(c) Energy Absorption – 23 tm

(d) Weight – 1250 kg or nearest

(j) Super arch type 600mm H x 2000mm L

(a) Deflection – 45 %

(b) Reaction Force - 90 T

(c) Energy Absorption – 18 tm

(d) Weight – 949 kg or nearest

Quality of rubber fenders to be used for this work shall satisfy the following performance tests:

(a) Compression Tests: compression tests shall be performed on sample products made of the same quality material or model product.

(i) The results of the compression tests shall be reducted to 'Load strain' and Energy strain curves.

(ii) Compression Recovery Ratio: The test specimen is compressed down to one half of the normal height, and one minute after the removal of compressive force, the recovery rate of specimen must be more than 95 % in the direction of compressive force applied,

and no change in the recovery rate must be observed in the subsequent repeated application of the same compressive force.

(b) Quality Tests:

(i) Ageing Property: Ageing property test are conducted in accordance with JIS K 6301 or equivalent

Ageing conditions : 70^{o} C x 96 hours

Hardening : within +- 5 %

Before Ageing :

Tensile strength: Not less than 160 kg/ cm^2

Elongation Ratio: Not less than 350 %

After Ageing

Tensile strength: Not less than 80% when compared with value before ageing:

Elongation Ratio: Not less than 80 % when compared with value before ageing:

(ii) Tear resistance property :

The testing method is in accordance with JIS K 6301 (A) or equivalent. The tear resistance must not be less than 70 kg/cm^2 with respect to the core rubber block & not less than 60 kg/cm^2 with respect to the rubber coating

(iii) Residual compressive strains

The testing method is in accordance with JIS K 6301 (A) or equivalent with respect to the core rubber block only

Testing Conditions: 70^{o} C x 22 hours

Residual compressive strains: 30 % or less

(iv) Oil – Resistance Property

(a) Tested with respect to the rubber covering

(b) Testing Conditions : Specimen pieces (2mm x 20mm x 20mm) are immersed in heavy oil and industrial gasoline for 24 hours at 25^{o} C

(c) Volume change ratio: Not more than 20% when immersed in heavy oil; not more than 60 % when immersed in industrial gasoline.

Rubber that has satisfied all the above – listed tests shall be used for fenders subject to the approval by the Engineer.

Payment to Contractor for the supply and installation of fenders shall be made on the basis of the number of fenders used for various sizes and dimensions, and shall be

deemed to include all the costs for such installation including embedding the bolts in concrete and for conducting various tests as listed above. Test certificate

Material Test certificate should be furnished along with the Supply.

BITTS:

Contractor shall supply and install bitts exactly at positions as shown on the drawings.

Main body of Bitt shall be of fabricated steel which shall be made in accordance with the requirement of IS 2062 GRADE B and coated with anti corrosive paint.

The bitts shall be filled inside with cement concrete M25 grade, 15 days after the same has been fixed in position.

Payment to the contractor shall be made on the basis of the sizes and numbers and the rate shall include all costs for supply, installing and painting.

Test certificate

Material Test certificate should be furnished along with the Supply

7. EXCAVATION AND DEWATERING

EXCAVATION

Definition:

Materials to be excavated are all kinds of soil except hard rock and old concrete may include debris of old structures and vegetation, steel scraps, wooden logs etc.

Excavation in general:

a) Excavation for individual works shall be performed in accordance with width, length and depth as shown on drawings or as directed by the Engineer-in-charge in writing.

b) Contractor shall carry out excavation by means of the equipment and method he deems most proper and as approved by the Engineer-in-charge.

c) In carrying out excavation at the site, Contractor shall arrange his work in such a manner as to avoid formation of depressions or subsidence which may collect water. Contractor shall always take necessary measures to keep the leakage or rain water drained from the excavated area to the nearest pumping pits,.

d) The Contractor shall never deposit or leave the excavated materials for back filling on any ground other than specifically allocated for the purpose.

e) If the surplus earth laid on area proposed for filling is found to be higher than the specified finished level, the Contractor shall make the surplus earth surface even with the specified level.

Excavation of foundation:

When the excavation is carried down to the lines as shown or as indicated on the drawings, the Contractor shall notify the Engineer-in-charge thereof and request for his inspection and approval.

Surface settlement in fill area:

The Contractor shall be responsible to make good all settlements caused in the fill surface due to subsidence, damage by storm, erosions and various other reasons during the contract period.

Backfill of quay walls:

a) Backfilling behind quay walls shall be performed uniformly along the entire length, and shall all be well compacted by means of rammers. Fill shall conform to 75% of Proctors optimum dry relative density.

b) Backfilling shall be done with suitable river sand / M sand approved by the Engineer-in-charge.

(iii) While back filling, the Contractor shall take every care not to cause excess displacements of steel sheet piles, and whenever any excessive displacement is found in the steel sheet pile walls, the Contractor shall report the fact to the Engineer-in-charge without delay and shall follow instructions of the Engineer-in-charge

Measurement and payment for earth work

a) Measurement and payment for excavation:

Payment to Contractor for excavation shall be made on the basis of the measurement of the net sectional area as shown by the prescribed lines. Over-excavation beyond the prescribed lines shall be backfilled by the Contractor at his own cost.

Unit prices for the excavation in the Bill of Quantities shall include all the costs for labours, materials, equipment for excavation, cost for design and installation of WellPoint system, maintaining and removal after completion for the relevant item, cost of pumping for dewatering, and all transportation costs of the excavated materials to temporary deposit sites or to surplus disposal yard, dumping and grading, and removal and disposal of all obstruction.

b) Measurement and payment for filling the excavated area and other as directed by the Engineer-in-charge shall be made on the basis of the calculated quantities on the net sectional area. The unit prices for the fill and backfill works in the Bill

of Quantities shall include all the costs for materials labours and equipment, transportation from the temporary deposits, transportation, levelling and rolling if necessary. For the purpose of computing quantities initial level and final levels will be jointly taken size of grid will be decided by the Engineer-in-charge on the requirement of site conditions.

DEWATERING:

General:

During the period of construction, Contractor shall perform all pumping necessary for dewatering the excavated area. Lowering ground water level shall be by well point system and subject to the approval by the Engineer-in-charge.

Disposal of rain water:

Contractor shall take proper steps to prevent rain water from running into the works under construction and adjoining areas. The Contractor shall also take necessary steps to prevent rain water from running into the open-cut and trenches, to avoid slips and collapse of soil. Rain water disposal method shall also be subject to the approval of the Engineer-in-charge.

Dewatering during construction:

a) Contractor shall provide embankment, water channels and outfalls necessary for the dewatering scheme during the construction period, and shall also perform site grading and maintenance of the completed works in connection with the dewatering.

b) Provide well point system for dewatering during the time of anchor wall construction.

c) Costs for all the preparation and maintenance as specified herein shall be borne by the Contractor.

Works requiring dewatering

a) The Contractor shall perform all pumping works necessary for dewatering the excavation down to the bottom level to facilitate excavation.

b) The Contractor shall perform pumping continuously for 24 hours including Sundays and holidays so that the work may be maintained dry.

c) The Contractor shall provide sufficient electric power and operate and maintain pump units with full allowance for possible machinery breakdowns and other contingencies to the satisfaction of the Engineer-in-charge.

d) The Contractor shall provide at his own cost necessary stand by generators of minimum requirement to meet such emergency cases during power failure or shut

down or other troubles. Such standby generator units require approval by the Engineer-in-charge before installation.

Position of sump pits:

a) The positions of sump pits to be provided by Contractor for the pumping operation shall be subject to the approval of the Engineer-in-charge.

b) Any of the sumps that falls in the alignment of the proposed permanent works shall be relocated by the Contractor at his own costs.

Temporary drainage

All the trenches, channels, ditches and piping necessary for drainage of accumulating water in the excavation shall be provided by the Contractor at his own costs as component parts of his temporary works.

Discharge of pump water:

All pumped water shall be discharged direct into the sea, and the Contractor shall provide all pipes, channels, chutes,. And other means for conveying water from the pumps.

8. STEEL SHEET PILE QUAYWALL CONSTRUCTION

CONSTRUCTION SEQUENCE OF STEEL SHEET PILE QUAYWALL

Construction of the quay wall shall be performed in the following order. Contractor shall prepare and submit his proposed construction time schedule for the works in the order as listed below and obtain approval of Engineer-in-charge in writing prior to starting the work.

Reclamation for steel sheet piling.

Driving in of sheet piles, construction of anchor walls, installation of tie-rods and backfilling for anchor walls.

Placement of coping concrete over sheet pile tops.

Installation of bitts and fenders.

STEEL SHEET PILE WORK:

Steel sheet pile works shall be performed in accordance with the chapter steel sheet pile and as instructed by the Engineer-in-charge.

COPING FOR QUAY WALL

Reinforced concrete coping for the quay wall shall be constructed first by placing concrete for the portion below D.L. + 1.50m, followed by backfilling up to the bottom level of crane foundation. Then, after completion of dredging the seaward zone alongside quay wall, the steel sheet piles in place shall be realigned by adjusting the tie-rods. After

completion of the realignment, concrete for the portion above D.L. +1.50m shall be placed. Proportioning of concrete for this job shall be M 25/20mm.

Entire length of the quay coping shall be provided with a festoon iron chain with steel rings for about every 5 metre span, and with an escape ladder for approximately every 50 metre span, all as shown on the applicable drawings and as directed by the Engineer-in-charge.

9. TWENTY TON JIB CRANE FOUNDATION WORK.

CONSTRUCTION SEQUENCE OF 15 TON JIB CRANE FOUNDATION

Construction sequence of 15 Ton J.C. foundation shall be as follows. The Contractor shall prepare a detailed construction time schedule to be followed in performing the foundation works and submit the same to the Engineer-in-charge for his approval in writing before starting the work.

1. After completion of backfilling over the tie-rods, cast-in-place R.C piles shall be constructed.
2. Placing of gravel foundation and levelling concrete
3. R.C.C for water side crane beam
4. RCC for beam with trolley duct land side.
5. Embedment of trolley-duct hardwares and installation of cover-plate, clamping devices, jacking base etc.
6. Drainage for trolley duct.
7. Fixing of Rail and end stopper.

   The accessories for fixing rail should be listed as below.

   (i) Rail clips of JIS G 5702 & MATERIAL OF black heart malleable cast iron of grade FCMB 32 or equivalent

   (ii) Clip cushion of Synthetic Rubber

   (iii) Water tight spacer of Synthetic Rubber

   (iv) Stud Bolt & Nut of JIS G 3101& MATERIAL OF SS 41 or equivalent

   (v) Nylon insert & steel coil

   (a) Nylon case – Nylon 6

   (b) Chemical composition of spiral spring

   Carbon content - 0.21%

   Manganese content - 0.48%

   Silicon content - 0.47%

   The spring should have chromium plating on the surface.

   (vi) Plain washer of JIS G 3101& MATERIAL OF SS 41 or equivalent

(vii) Sole plate of JIS G 3101& MATERIAL OF SS 41 or equivalent

(viii) Insert Supporter of Synthetic Rubber

(ix) Gauge Adjuster of JIS G 3101& MATERIAL OF SS 41 or equivalent

(x) Belt shaped pad of Synthetic Rubber

Belt shape pad consists of top and bottom layer 4mm thick neoplas rubber & middle layer 4mm thick neoprene rubber.

Test certificate for rail & accessories

Material Test certificate should be furnished along with the Supply**.**

CONSTRUCTION OF CAST-IN-PLACE R.C. PILES

Backfilling work shall be made with sandy soil so that the tie-rods will not be damaged during piling. Cast-in-place R.C. pile construction shall be done in accordance with the chapter "cast in place concrete piles" and as instructed by the Engineer –in-charge.

In driving the cast-in-place R.C. pile, care shall be exercised not to cause any damage to tie-rod by clearly marking the position of the tie-rods.

LEVELLING CONCRETE WORK

Preparation of levelling concrete shall be 1:3:6/20mm as shown in the drawing. Levelling concrete shall be laid in an even surface and pile top shall be above the concrete surface.

FOUNDATION REINFORCED CONCRETE WORK AND
INSTALLATION OF TRACK RAILS

Reinforced concrete work shall be performed in accordance with as marked in our specification, and as directed by the Engineer-in-charge.

1. Proportioning of concrete shall be M25/20mm class.
2. The Contractor shall install with utmost care the track rails with elastic rail fastening devices in accordance with the drawings, limiting to the deviation stipulated below. Prior to the installation, the Contractor shall submit the detailed scheme of construction with time schedule to the Engineer-in-charge for his approval. The rails are to be straightened before installation. Ends of rails shall be cut square by mechanical sawing. The edges are ground by filling.
3. Acceptable local deviation of track rail shall be as follows:

Rail gauge	not more than 3mm
Differential in rail elevation	not more than 3mm
Horizontal deviation of rail	not more than 3mm
Vertical deviation of rail	not more than 3mm

4. Track joints:

H-shape steel (sole plate) for track joints shall be embedded in the foundation concrete as shown on drawings

CONSTRUCTION OF TROLLEY DUCTS

1. Proportioning of concrete for the trolley ducts shall be of M25/20mm class, and the concrete for the trolley ducts shall be placed simultaneously with that for the crane foundations.
2. Expansion joints for the trolley duct shall be provided by inserting P.V.C. water seal and concrete placing shall be done carefully. Samples of PVC water seal be got approved by the Engineer-in-charge well in advance of placement of order on the suppliers.
3. Acceptable local deviation of trolley duct from the center line of rail adjoining the trolley duct shall be not more than 2mm.
4. Embedded hardwares for the trolley duct shall be installed at positions shown on drawings. Trolley duct tie cover plate will be provided by separate agency. Embedded hardwares for providing cover plates for trolley duct are provided by civil contractor.

TROLLEY DUCT DRAINAGE:

Trolley ducts shall be provided with down- slope toward sea so as to facilitate draining water by cast-iron pipes.

CONSTRUCTION OF PIPING DUCT AND CABLE DUCT:

The size of piping duct and cable duct, location and size of embedded fastening devices and ducts may undergo minor changes .Ammendment drawings will be given by CSL in advance.

Proportioning of concrete for the piping duct and cable duct shall be M25/20mm class.

Expansion joint for the piping duct and cable duct shall be provided by inserting PVC water seal in the groove and concrete placing shall be done carefully.

Embedded hardware and cover plates for the piping and cable ducts shall be installed at positions shown on drawings.

INSTALLATION OF END STOPPER, CLAMPING DEVICE, JACKING BASE HARDWARES

Drawings of anchor hardwares for stoppers, clamping and jacking devices shall be furnished by Cochin Shipyard and their supply and installation shall be done by the Contractor in accordance with the drawings and as instructed by the Engineer-in-charge.

PAYMENT OF FOUNDATION EMBEDDED HARDWARE:

Payment for the concrete, levelling concrete and gravel shall be made in accordance with relevant Clauses of this Contract

Cost for the embedded hardware shall be all inclusive of supplying, fabricating, welding, assembling, handling, transporting, positioning, installing and all others required in connection with the above mentioned work.

10. PAVEMENT WORK

Pavement work

Pavement works consists of making concrete blocks and laying them on an area filled with sand and compacted to the specification of which details given elsewhere in the tender and the work shall be to the approval of the Engineer-in-charge. The concrete blocks shall be laid in such a way as to obtain a proper camber for drainage of surface water.

Making concrete blocks

Concrete blocks of size 300mm square at top and 325mm square at bottom having a depth of 200mm shall be made in concrete 1:2:4 using 20mm and 40mm metal in; the ratio 1:1 in suitable moulds. Smaller size blocks if required to close the edges of pavement shall also be made according to the instruction of the Engineer-in-charge. The pre-cast blocks shall be cured properly and stacked suitably.

Laying concrete blocks

The pre-cast blocks shall be laid in correct alignment each block touching the adjoining ones at bottom. The vertical gaps in between the blocks shall be filled with sand up to a level of 50mm from top. The 50mm will be filled with bitumen sand mix using 112 Kg of bitumen per M3 of sand.

11. CATHODIC PROTECTION

Cathodic protection shall be provided to the steel sheet piles in place for the entire length of Quay wall by fixing sacrificial anodes as shown on drawings.

After welding stainless steel nuts to steel sheet piles as shown on drawings, the sheet piles shall be driven in place. .

Payment to Contractor for the cathodic protection in place shall be made on the basis of the numbers of the aluminium alloy anodes used for the cathodic protection, and shall be deemed to include the cost of materials like stainless steel bolt and nuts and labour all installation cost such as underwater works etc.

The specification of sacrificial anodes is shown below

Characteristics of anode :

a. Material : Aluminium alloy

b. Type : Aluminium anode, Type H – 110

c. Dimensions : (110+130) x 125 x 1250 mm

d. Net weight : 49.6 Kg

e. Output currency : 2.5 A / anode

Test Certificate

The supply shall be made along with the test certificate with regards to the Electro chemical characteristics from M/s CECRI, Karaikudy or from M/s NML Jamshedpur or from any approved laboratory.

A P P E N D I C E S

A. PROCEDURE REGARDING TESTING OF FINE AGGREGATE COARSE AGGREGATE AND CONCRETE (IS)

B. PILE LOADING TEST METHOD

C. LIST OF DRAWINGS

APPENDIX "A"

PROCEDURE REGARDING TESTSING OF FINE AGGREAGATE COARSE AGGREGATE AND CONCRETE (IS)

A. FOR FINE AND COARSE AGGREGATE

1) Sieve Analysis:

The tests will be conducted as per I.S. 2386 Part (I) –1963. Clauses 2.1; 2.2; 2.3; 2.4.2; 2.4.3; 2.4.3.2; and 2.6

2) Determination of Clay, Sine silt and Fine Dust:

The tests will be conducted as per I.S. 2386 (Part II) 1963. Clauses 2; 3.3; 3.4; 3.5.1; 3.5.1.1; 3.5.2; 3.5.3; and 3.6

3) Estimation of Organic Impurities

The tests will be conducted as per I.S. 2386 Part (II) 1963. Clause 6.2 complete

4) Determination of Specific Gravity and water absorption

The tests will be conducted as per I.S.2386 Part (III)-1963. Clauses 2.3.1; 2.3.2; 2.3.3; 2.3.4; 2.4.1; 2.4.2.1; 2.4.2.2 and 2.4.3.

5) Determination of Necessary Adjustment for bulking of Fine Aggregates:

The tests will be conducted as per I.S 2386 Part (III)-1963 clauses 4.3.1; 4.3.2; 4.3.2.1; 4.3.2.2; and 4.3.3.

6) Determination of Surface Moisture

The tests will be conducted as per I.S 2386 Part (III) – 1963.

Clauses 5.1; 5.2; 5.3; 5.4.1; 5.4.2; 5.4.3; 5.5.1; and 5.5.6

7) Determination of Aggregate Crushing Value

The tests will be conducted as per I.S 2386 Part (IV)-1963 clauses

2.2; 2.3; 2.3.1; 2.3.2; 2.3.3; 2.3.4; 2.4; 2.5; 2.6; 3.2; 3.3; 3.4 and 3.5

APPENDIX B. PILE LOADING TEST METHOD

GENERAL

Vertical loading tests of cast-in-place R.C. piles shall be done under the same conditions or under conditions as near as possible to the actual ones as the piling is to be performed. The loading tests are intended to obtain all necessary data such as the load vs. Settlement relations of a single pile that will give criteria for determining bearing capacity of a single pile.

Planning for pile loading tests:

In planning the pile loading tests, the testing methods, maximum design load, items for measurements and measurement accuracies shall be determined by considering how the piles will be used and how the piles are subjected to loadings.

Method for loading tests

:Loading tests of piles shall be done as stated below:

Settlement of pile top shall be measured by applying the loads vertically on top of a vertically positioned single pile. The test shall be performed by one of the systems as hereinafter described.

Selection of test piles:

Typical piles shall be selected for the loading test to avoid mistakes in determining the bearing capacity of all piles.

Period to be allowed before Performing Tests

Time to be allowed before starting the load tests for R.C. cast-in-place piles shall be not less than 45 days after he concrete placing sufficient time required for concrete hardening.

LOADING TEST EQUIPMENT

Components of the equipment

The loading device shall consist of power devices such as jacks, loading beam and reaction devices such as piles and test loads.

Design of loading device shall satisfy the following requirements:

a) The device shall have adequate allowance for the maximum planned loads and be of such structure as to ensure safety in field erection and dismantling of the device and in loading operations:

b) The device shall be of such types as to ensure safe handling of loads and at the same time shall be capable of creating a nearly no-load condition during the test cycle

c) The instrumentation shall be such as not to be influenced and disturbed due to climatic and weather conditions.

d) The device shall be of such structure as o cause neither eccentric loading nor lateral forces to the piles under test.

Selection of loading device

Type of loading device shall be selected from such systems as loading by reaction piles, actual load or combination of the two so as to best meet individual cases by considering the purpose of testing, dimensions, maximum planned load and the site for testing

Loading device

a) Loading device for the test shall satisfy the following requirements:

   i) The device shall have a capacity of not less than 125% of the maximum planned loads and be capable of maintaining the planned load during a prescribed time;

   ii) The device shall be capable of adjusting the load to meet the specific requirement of each planned loading stages as well as of adjusting the load at a required place

   iii) The device shall be such as to cause least variation in load during the test and be capable of adjusting the loads as required.

b) Loading device shall be of such a design that its capacity will not be changed because of settlement of test piles or of deformation of the device

c) The loading device shall be equipped with such as spherical seat that helps to minimize possible eccentricity and component of force.

Loading beams

The loading beams shall be of such constructions as to be safe for each stress intensity and for deflection due to bending, shearing and bearing pressure and shall be free of local plastic deformation or breaking or overturning.

Reaction device by piles

Reaction device by piles to be used shall satisfy the following requirements

a) Center to center spacing between the reaction pile and the test pile shall be not less than 3 times the diameter of the test pile, and be placed at symmetrical positions.

b) Reaction piles shall have sufficient pull-out resistance against the maximum planned loads, with the minimum uplifting effects.

c) Reaction piles shall be designed sufficiently safe for each section area, joint, top, connection to anchor and anchor and anchor material when possible eccentricity, secondary stress and others are taken into account.

Reaction device by actual loading

Reaction device by actual loading shall satisfy the following requirements:

a) The pile shall be capable of holding not less than 125% of the maximum planned load

b) The reaction pile shall be safe even when entire loads are imposed on the test piles.

d) Support rigs shall be provided around the loading deck to prevent overturning of the load and the device.

Treatment of tops of test piles

Tops of test piles shall be treated in the following way so as not to interfere with the test performance:

a) Top of the piles shall be kept at a lowest possible level in so far as the erection and measurement of the device will not be interfered thereby.

b) Top of test pile shall be closely examined for local deformation or damage that may influence the test results, and if such defects are found, they shall be properly treated as instructed by the Engineer-in-charge.

MEASURING DEVICES:

Measuring devices in general

a) Measurement in loading test shall be made of the loading magnitude, settlement at pile top and time required for testing.

b) Measuring device that will insure accuracies to meet the purpose of test shall be selected.

c) Measuring devices shall be so arranged as to facilitate operation, adjustment, and measurement, and to help expedite progress of testing in general. At the same time, special care shall be exercised to insure that the testing operation will not be interfered by deformation of piles and loading device as the work progresses or by vibrations to the device as the work progresses or by vibrations to the device due to light contact by workers, or due to operation and general traffic.

Measuring device of surcharge

a) Methods for measurement of load on piles shall be selected by considering the maximum planned loads, loading methods, required accuracies and other conditions and as approved by the Engineer-in-charge.

Major methods currently in use are as listed below:

i) Methods by instruments, hydraulic gauge

ii) Weight calculation of loads

b) Gauge: Weight and unit weight of each load shall be confirmed by examination in advance as to the accuracy and degree of reliability.

Measuring device of pile settlement

Measuring device of settlement of pile generally consists of reference point, reference pile and settlement gauge

Reference pile

Reference piles, being intended as origin for measuring settlement, shall be free of such effects as by settlement of test and reaction piles, weather, heating and lighting conditions.

Reference point and reference beam

These shall be checked with regard to their settlement, accuracy and reliability before and during the tests.

Settlement gauge shall also be checked to confirm its normal function, accuracy and reliability in advance.

a) Reference points

Reference points shall be generally one of the following pile positions:

i) Foundation pile for reference point, shall be located a point at least about 2.5 times the pile diameter away (center to center) from the test piles and reaction piles.

iii) Temporary pile located at a point at least 5 times the test pile diameter apart c.t.c. from the test pile; or temporary pile at least 2.5 times the reaction pile diameter apart c.t.c. from the reaction pile.

b) Reference beam

Reference beams shall be sufficiently rigid to meet the spacing of the reference points and shall be securely fixed at the reference point.

c) Settlement measurement

i) Settlement shall be measured by means of dial gauges with 1/100 mm calibration and stroke of not less than 30mm and also by scale readings read by means of precision level that can read to 1/100 mm accuracy.

ii) Four settlement gauges shall be installed at a uniform height, at a uniform distance respectively from the pile center and at a uniform distance between each gauge for measuring vertical settlement. In addition horizontal displacement of piles is to be measured by means of 3 dial gauges.

iii) Settlement gauge shall be installed to face a proper direction so that settlement at the pile top can be correctly measured;

iv) The surface coming into contact with the tip of settlement gauge shall have a smooth and proper area and the gauge shall be horizontally secured.

v) Three scales are to be fixed on to the sides of test pile for taking readings by means of precision level.

Clock & stop watch

Cock & stop watch shall be able to indicate standard time as well as to measure the elapsed time

Method of testing: - By cyclic load test

Number of loading stages - Twelve

Rate of loading per stage - about Thirty tonnes

Method of loading - Loading is to be done in stages each stages loading is to be maintained for 2 hours and settlement reading taken. After keeping the load for 2hours the load is to be released and brought to zero loading in stages and again settlement readings taken for another 2 hours.

Settlement Readings

Readings have to be taken from zero loading and afterwards at 2 mts., 5mts. 10 mts., 15mts. and thereafter at 15 mts. Intervals upto 2 hours from the starting time of each loading stages. During the loading processes of each stage, settlement readings are to be taken at each loading of the previous stages. In addition, the penultimate loading in each stage is to be kept for 15mts. and settlement readings taken at zero mts. 2mts. 5 mts., 10 mts.,and 15 mts. Reading are to be taken during unloading also at every stages. Horizontal displacement of pile top is also to be measured at the above intervals.

Vertical displacement as well as horizontal displacement of reaction/loading devices are to be measured at every half an hour during entire period of pile test.

The test is to be carried out continuously till completion without any break in between.

Summary of Test Results

Graphic indication of test results

Load vs. settlement curve, time vs. load curve, and time vs. settlement curve respectively measured at pile top shall be graphically indicated. As for the multi-cycle loading tests, load vs. elastic deformation curve and load vs. residual settlement curve shall also be prepared.

Determination of ultimate load:

(ii) Ultimate load shall be determined as stated below by considering Oil – Resistance Property

The specification of sacrificial anodes is shown below the graphical indications as well as the settlement characteristics.

Ultimate load shall be determined by; log. P-log. S method, S-log. t method and their combination with others.

Ultimate load shall be the lowest value obtained from the following:

1. Time Vs load curve
2. Time Vs settlement
3. Load Vs settlement
4. Log P Vs settlement (S)
5. Log P Vs log settlement (Log-S)
6. Settlement Vs log time (Log-t)
7. Log Vs Elastic compression
8. Load Vs residual settlement

Contractor shall provide Engineer-in-charge following information relating to test piles reaction piles temporary and reference piles installed for testing piles

1. Static cone penetrator test (Dutch cone penetrometer)
2. Bore log details taken near the site of work if done by the contractor.
3. Pile driving log relating to test pile, reaction piles, temporary and reference piles.

--------x------x------x------x --------