

# Specifications

## Repair of R.C Wharf and Platform, Port of Cawit, Boac, Marinduque

### 1 DEMOLITION AND REMOVAL WORKS

#### 1.1 DESCRIPTION

The work includes the furnishing of all labor, materials and equipment required to carry out the demolition and removal of obstructions, portions of existing piers including extraction/cutting of r.c. piles at required depth and demolition of miscellaneous buildings, pavements, fences, utilities, navigation aids and wrecks etc., as required for the execution of the Contract.

The Contractor shall submit the proposed methodology or procedure of demolition work with detailed drawings and calculations if necessary, to the Engineer for approval, before the execution of the Works.

The Contractor shall keep all pavements and landing areas to and from the site of the disposal area clean and free of mud, dirt and debris during and after the execution of disposal. Disposal of debris and materials shall be as directed by the Engineer

For off-shore obstructions to pile driving and dredging, survey shall be executed by the Contractor with the Engineer before any demolition and removal of wrecks commence and shall be as directed by the Engineer.

#### 1.2 GENERAL PROVISIONS

1. The Contractor shall be deemed to have satisfied himself of the site conditions, and to have included in his unit prices provision for all risks that may arise during or in connection with the work.
2. The demolition work shall be carried out by approved methods and equipment such as concrete breakers, gas-cutters, hydraulic jacks, compressed air disintegrators, etc., however, no blasting shall be used unless approved in writing by the Engineer and after obtaining the written permission of the concerned Authorities.
3. The Contractor shall provide suitable equipment, skilled labor and appropriate temporary works such as scaffoldings to ensure safety in his demolition works as well as in the adjacent area.
4. The Contractor shall demolish all the structural members above the level on which the subsequent and permanent works under this Contract will begin. To this end, the temporary construction works such as excavation shall be conducted by the Contractor.
5. Materials coming from the demolition works, except general earth, shall remain the property of the Procuring Entity, the designated part of which shall be stored by the Contractor at places specified by the Engineer's authorized Representative.

### 1.3 INTERFERENCE WITH PORT OPERATIONS

1. During the execution of the work, the Contractor shall not interfere with the shipping, navigation and other traffic in the port.
2. The Contractor shall make arrangements with the operations people on the schedule of demolition and related works to keep port operation activities undisturbed at all times.
3. Prior to commencement of the demolition works, the Contractor shall inform/announce to port users the schedule of disconnection of utilities.

### 1.4 STORAGE AND DUMPING

Prior to the commencement of the demolition work, the Engineer shall submit to the Contractor a list in which all the materials to be salvaged and overhauled, as property of PPA and the location of their storage shall be described. Materials embedded in concrete units shall not be salvaged.

The Contractor shall separate materials to be salvaged from debris. Salvaged materials shall be loaded, transported and unloaded by the Contractor at the specified locations.

Debris, if it does not contain any pollutant in the opinion of the Contractor may be dumped at the offshore area.

The Contractor may dump debris on land areas but out of the site, which areas shall be procured and prepared at his own expense. In this case, safety measures shall be undertaken in the transporting, unloading, covering and others as requested by the Engineer.

### 1.5 EXECUTION

1. Prior to the commencement of demolition works, the alignments of the new construction works to existing pier shall be checked.
2. The width and alignment of portion of existing structure to be demolished shall be marked by paint.
3. With these lines as guides, concrete shall be broken and reinforcing bars cut, such that panels or portions of the structure can be lifted out for disposal elsewhere outside of the operational work area.
4. Extract concrete piles with care in order not to damage existing or adjacent structures, equipment or materials.
5. Piles (timber/concrete) for demolition/extraction shall be done with care and/or to the required level indicated in the plan as shown in the drawings.
6. Rocks removed from existing slope protection shall be stored for reuse in new construction.

7. Demolish buildings, pavements, curbs, fences, utilities, services, navigation aids and the like as determined in the field for each project and as shown on the drawings or as directed by the Engineer.
8. Materials coming from the demolish works shall be properly disposed by the Contractor.

## 1.6 SAFETY

At the end of each day's work, the site shall be left in safe condition, so that no part is in danger of toppling, or falling or creating hazards to personnel or equipment.

## 1.7 MEASUREMENT AND PAYMENT

Demolition and removal, unless otherwise noted, shall be measured by number or unit quantities or lump sums as appropriate for each class of work for each category. Cost of disposal of debris shall be incidental to the work and shall not be paid for separately.

Demolition and removal of existing pavement shall be measured and paid for under this section unless such pavement falls within or above the new subgrade, in which case, measurement and payment shall be under "Roads and Pavements."

The price listed above shall be full compensation for all labor, materials, tools and equipment and all incidental works necessary for the successful completion of work.

## 2. REINFORCED CONCRETE

### 2.1 GENERAL

All works falling under this category shall include reinforced concrete for all kinds and parts of any reinforced concrete structure.

### 2.2 MATERIALS

#### a.) Cement

Cement used shall be Type I Portland conforming to the requirements of the latest revision of ASTM C 150 "Standard Specifications for Portland Cement".

#### b.) Coarse Aggregates

Coarse Aggregates shall be washed, well graded, hard pieces of gravel, crushed gravel or rock conforming to the requirements of ASTM C 33 "Standard Specification for Concrete Aggregates".

#### c.) Fine Aggregates

Fine Aggregates shall be washed sand, stone screenings or other inert materials of same characteristics, or any combination thereof composed

clean, hard, strong, uncoated grains and free from injurious amount of dust, lumps of clay, shale, alkali, and organic matter. It shall conform to the requirements of ASTM C33 "Standard Specifications for Concrete Aggregates". Beach sand shall not be used unless approved by the Engineer.

d.) Admixtures

Unless otherwise required by field conditions admixtures may be used subject to the expressed approval of the Engineer. The cost thereof shall be considered as already included in the unit cost bid of the Contractor for the concrete.

## 2.3 STORAGE OF MATERIALS

- a.) Cement shall be stockpiled as closely as possible in weatherproof storage sheds, stacks suitably elevated above ground to prevent cement absorption of moisture.
- b.) Aggregates shall be placed in stockpile in a manner preventing segregation thereof and contamination with foreign materials.
- c.) Reinforcing steel bars shall be stored properly, covered and protected from humidity to prevent rusting and contamination with oil, dirt or other objectionable matters.

## 2.4 DESIGNED STRENGTH OF CONCRETE

Concrete for structural parts or members such as bearing piles or columns shall develop a minimum 28-day compressive cylinder strength of 4,500 psi., and for deck or floor slabs, beams and girders of the structure shall develop a minimum 28-day compressive cylinder strength of 3,500 psi., unless otherwise indicated in the drawings.

Concrete for non-structural parts or members such as partition walls and slab on fill shall develop a minimum 28-day cylinder strength of 3,000 psi., unless otherwise indicated in the drawings.

## 2.5 TRIAL BATCH FOR CONCRETE

Thirty (30) calendar days before the start of concreting works, the Contractor shall submit design mixes and the corresponding test result made on sample thereof. Sampling and testing shall be in accordance with the ASTM Standard procedures for sampling and testing, for the particular design strengths) required.

The particulars of the mix such as the slump and the proportionate weights of cement, saturated surface dry aggregates and water used shall be stated. Test results shall show 28-day strengths) fifteen (15) percent higher than the ultimate strength( s) required.

The design mix for concrete to be used shall be submitted together with at least three (3) standard cylinder samples for approval at least one (1) month prior to the start of each concreting schedule. Such samples shall be prepared in the presence of the Engineer.

Standard laboratory strength test for the 7, 14 and 28 days periods shall be taken to all concrete samples in addition to routine field tests, at cost to the Contractor. Only design mixes represented by test proving the required strength for 7, 14 and 28 days tests shall be allowed.

The cost of sampling, handling and transporting samples from jobsite to the laboratory and the cost of subsequent tests made until the desired mix is attained shall be for the account of the Contractor.

## 2.6 CONCRETE PROPORTION AND CONSISTENCY

Concrete proportion should produce mix consistencies that will work readily into angles and corners of the forms and around reinforcements irrespective of the method of placing employed, without permitting the materials to segregate or excess water to collect on the surface of the concrete and with separated individual particles of aggregates showing coating of mortar with proportionate amount of sand. The total aggregate in the proportion used shall be such that when sieved, the weight passing the No.4 standard sieve shall be thirty percent (30) of the total.

The methods used for measuring materials going into the concrete mix shall permit easy checking and control of proportions at any time during the work.

## 2.7 MIXING OF CONCRETE

All concrete used shall be machine-mixed at the site. Each batch shall be mixed at the mixer's design speed, for at least 1-112 minutes after all concrete materials are simultaneously placed in the mixer. The ideal rotation speed of the mixer shall be between 14 and 20 rpm.

All mix contents of the mixer shall be thoroughly removed before any succeeding batch is placed.

The materials for the first batch shall contain sufficiently excess cement, sand and water to coat the inside walls of the mixer without reducing the required mortar content of the mix.

The mixer shall be provided with devices for accurately measuring and controlling the amount of water used in each batch and for automatically recording the number of revolutions of the mixer.

Hand mixing of concrete will only be allowed in case of mixer breakdown, in which case it shall be stopped as soon as pouring for the particular section is completed, or at a construction joint as directed by the Engineer.

Re-tempering or remixing of partially hardened concrete with the addition of water will not be permitted.

## 2.8 PLACING OF CONCRETE

- a.) Concrete shall be placed in the presence of the Engineer only after the forms, reinforcing bars and other spaces to receive the concrete have been inspected and approved by him.

- b.) Concrete shall be placed only when wind and weather conditions will allow proper placement and curing of the concrete. Notice of any concreting operations shall be served to the Engineer at least three (3) days ahead of each schedule.
- c.) Mixed concrete shall be deposited in its final position within a practicable time. Each succeeding fresh deposit for particular structural member shall be placed at a practicable rate to prevent cold joints. Each successive fresh deposit of concrete shall be vibrated vertically at uniformly spaced points and levels, of such duration and intensity to compact the concrete thoroughly but shall be discontinued the moment segregation of materials is noticed.
- d.) Where concreting operations involve a fall more than 1.50 meters (4.92 feet), the fresh concrete shall be poured through approved sheet metal conduit or pipes. The pipes shall be kept full of concrete and its lower end kept below the surface of concrete throughout the pouring operations.
- e.) Deposition of concrete shall be in such a way as to prevent segregation of the materials and the displacement of the reinforcement. Placing shall be done preferably with the use of buggies, buckets or wheel-borrows. Troughs, conveyors and pipes and the manner of use of each one shall be with the expressed permission of the Engineer.
- f.) Each layer of concrete shall be placed approximately normal as possible in uniform layers not exceeding 0.30 meter, unless otherwise ordered. The rate of placing concrete in the forms shall preferably be 0.025 meter (0.082 feet) vertical rise per minute.

## 2.9 CONSTRUCTION JOINT

During stoppage of concrete pouring operations, and when jointing of old concrete becomes necessary, the following point should be observe:

- a.) Construction joint not indicated in the drawings shall be located as to least affect the strength of the structure. Such locations will be as pointed out by the Engineer.

## 2.10 FORMS AND FALSEWORK

All forms and falsework to be used in the work must be designed, and constructed by the Contractor, for rigidity and adequacy for carrying the loads of the fresh concrete and/or additional superimposed construction loads. The Authority may from time to time verify the adequacy and safety of such temporary works and may require the Contractor to submit detailed designed drawings of forms and falseworks proposed to be used. Approval of such drawings or design of forms, however, shall not relieve the Contractor of his liability on resulting imperfections or damages to the finished concrete, or other damages which may directly result therefrom.

Forms may be re-used but shall be scrapped by a wire brush of all clinging mortar. Bulges should be planed and realigned prior to its use.

Prior to placing concrete form surfaces should be oiled for easy form removal. However, the oil coating should not be so thick as to stain and soften the concrete surface. Oil coatings should be applied before rebars are placed.

## 2.11 CURING AND WATERPROOFING

All concrete shall be cured for at least 14 days after the date of placing in accordance with the approved and accepted methods.

## 2.12 FINISHING OF CONCRETE SURFACES

Concrete surfaces shall conform accurately to the form, alignment, grades and sections shown in the drawings or as prescribed by the Engineer. It shall be free from bulges, ridges, honeycombing or roughness of any kind, and shall be of a reasonably smooth wood float finish.

## 2.13 TREATMENT OF SURFACE DEFECTS

All irregular concrete surfaces, voids, holes, honeycombs exposed after removal shall be repaired by the Contractor in such a way that the repaired surface will be acceptable under paragraph 21.12 above.

## 2.14 ARCHITECTURAL FINISH

All exposed concrete exterior surfaces shall be given an architectural finish as directed by the Engineer.

## 2.15 PLACING OF REINFORCEMENT

Metal reinforcement shall be placed as accurately detailed on drawings and properly secured by approved means.

All bars shall be cold bent unless approved otherwise by the Engineer. Minimum distance between parallel bars shall be one and one half (1 1/2) times the diameter for round bars and twice the side dimension for square bars. The clear distance between bars shall not be less than 2.54 cm. (1 in.) nor is less than one and one third (1 1/3) times the maximum size of the coarse aggregate, whichever bigger.

All reinforcing steel shall be cleaned of all rust or scale and deleterious materials which tend to destroy the bond between the concrete and the steel.

## 2.16 REINFORCING BAR SPLICES

Generally, splice/s of reinforcement at points of maximum stress specially in slabs, beams and girders shall be avoided. Such splice/s may however be approved by the Engineer in writing provided the lap is bonded or butt welded is sufficient to transfer tensile stress between bars by at least 125 of the specified yield strength of the reinforcing bar. For adjacent bars splices shall be staggered.

## 2.17 READY-MIXED CONCRETE

Where ready-mixed concrete is used, the requirements specified for batching, mixing and transporting shall be in accordance with the requirements set forth in ASTM C94 Specifications for Ready-Mixed Concrete unless otherwise specified.

- a.) The Contractor shall notify the Engineer seven (7) days in advance before any continuous phase of concreting operations is started. Upon notification, the Engineer shall have the right to inspect the ready-mixed concrete supplier's plant/equipment and all materials and/or sources thereof. The Contractor must coordinate with the supplier and must provide safe and adequate guidance for the Engineer or his representative in conducting such examinations.
- b.) For all ready-mixed concrete delivered to site of work, discharge shall be completed within one hour after the addition of cement to the aggregates or before, the drum is revolved 25 times, whichever comes first. Under conditions contributing to the stiffening of concrete especially during hot weather, the time required between the introduction of cement to the aggregates and discharge of the mix may still be reduced by the Engineer.
- c.) Truck mixers shall be equipped with counters indicating the number of revolutions of the drums which shall be automatically actuated at the time of starting mixers at mixing speed.
- d.) Each batch or truck delivery of concrete shall be mixed inside the drum for not less than 70 revolutions of the drum at the rate of rotation designated by the equipment manufacturer. Additional mixing if ordered by the Engineer shall be at the speed designated as agitating speed by the manufacturer of the equipment.
- e.) Concrete for individual batches or deliveries should be of uniform consistency, mix and grading. If slump tests of a minimum 2 samples taken within 15 minutes of each other at approximately 15 and 85 discharge load give values differing more than 2.54 cm. (1 in.) when the specified slump is 76 mm. (3 in.) , use of the particular mixer in the work shall be stopped until corrections are made to prevent such conditions, which shall be confirmed by further slump tests.
- f.) Every batch of ready-mixed concrete delivered at the job site shall be accompanied by a ticket furnished in accordance with Section 15 of ASTM 94. The time when the materials were batched shall also be indicated.
- g.) Non-agitating equipment or combination truck and trailer equipment for transporting concrete will not be permitted.
- h.) The Authority reserves the right to verify from time to time the quality and quantity of materials used in every cement batch from the batching plant. The Contractor shall be aware of this provision and make the proper arrangement with the concrete supplier.

## 2.18 TEST ON CONCRETE

Test on concrete shall be in accordance with the following:

- a.) Concrete samples for tests shall be secured and molded in accordance with ASTM C 172 - "Method of sampling Concrete", and ASTM C31 - "Method of making Curing, Concrete Compression and Flexure Test specimens in the field".
- b.) Strength tests on samples shall be made in accordance with ASTM C39 - "Standard Method of Test for Compressive Strength of Molded Concrete Cylinder".

Not less than four (4) cylindrical specimens shall be made for each test of which at least two (2) shall be reserved for 28-day test. Not less than one (1) test shall be made for every fifty (50) cubic meters of concrete but in no case less than one (1) test for each day's concreting.

Samples shall be taken by the Contractor under close supervision of the Engineer; and shall be delivered as soon as practicable for testing, at his expense, to the designated laboratories.

The average strength of test samples representing any definite class of concrete used as well as the average of any five (5) consecutive strength tests representing the class of concrete shall be equal to or greater than the specified strength and not more than one (1) strength test in ten (10) shall have an average value less than 90 of the specified strength.

If the test results indicate strength values less than the required, the Project Manager shall have the right to order a change in the concrete proportion used for the remaining work, or in the procedure of curing the concrete.

## 2.19 LIQUIDATED DAMAGES

For failure to meet the specified strength required for concrete, designed, prepared and laid by him, the Contractor shall pay the AUTHORITY a liquidated damages, not as penalty or forfeiture the following, to be applied only to the quantity of concrete which the particular sample/s represent.

- a.) Payment of 30 percent contract unit cost per cubic meter of concrete affected, for test resulting to strength between 90 to 100 percent of specified strength;
- b.) Payment of 50 percent contract unit cost per cubic meter of concrete affected, for test resulting to strength between 80 to 90 percent of that specified strength;
- c.) Non-payment and removal and replacement at cost to the Contractor of all concrete affected for resulting to strengths below 80 percent of that specified, all in accordance with ACI - 318, and at cost to the Contractor.

## 2.20 FIELD TESTS

Field tests as may be deemed necessary to check on the quantity of the materials and mixtures and the manner of construction employed shall be conducted by the Project Engineer assigned to the project. And when such tests result to values less than that tolerated by standards set in applicable provisions of the ASTM Specifications referred to herein, or contrary to accepted good Engineering practice, the Contractor shall comply to any instructions given by the Project Engineer to upgrade the materials used and method of construction employed.

## 3. FOUNDATION PILES

### 3.1 GENERAL

This section covers the minimum requirements for the fabrication, hauling, spotting, driving and finishing of all foundation piles used in piers, wharves and other port work structures.

The Contractor may however, adopt, in addition to this minimum requirements additional provisions as may be necessary to insure the successful prosecution of the work related to foundation piling.

### 3.2 TYPES OF FOUNDATION PILES

Foundation piles may be precast reinforced concrete piles, prestressed piles, or tubular steel piles filled with concrete or sand shown in the drawings and called for in the proposal.

### 3.3 PRECAST REINFORCED CONCRETE PILES

As called for in the plans for this project, precast reinforced concrete piles shall be used in accordance with the details and sections shown in the drawings. The class of concrete and quality of reinforcing steel shall be in accordance with the provisions of the specification for "Reinforced Concrete" unless otherwise noted in the drawings.

Casting of the RC piles shall be done with the length lying horizontally. The pile yard must be reasonably level and the ground sufficiently compact or hard, stable and not subject to any settlement, scour or erosion.

The Contractor may, at his option, and at no additional cost to the PP A, use prestressed concrete piles or steel tubular piles of the same structural strength as the pre-cast RC piles, using the specifications indicated in sections 2.4 and 2.5.

### 3.4 PRESTRESSED CONCRETE PILES

Prestressed concrete piles shall be constructed in accordance with the normal practice employed for the particular system specified and as directed by the Engineer subject to the following clauses:

- 1) If an alternative system of prestressing to that shown in the Drawings is proposed by the Contractor, full details, procedures and explanations shall be submitted in writing to the Engineer for his approval. When approved for the work, the provisions of this Specification and such other provisions as he may require shall be fully satisfied.
- 2) Concrete strength, wires/strands, bars to be used for prestressed concrete work shall be as specified in the Drawings.
- 3) Casting of prestressed concrete piles shall be in a manner that there shall be no leakage of concrete or grout into the space to be occupied by the steel. The ducts shall be of the correct cross-section, the ends being formed out as shown on the Drawings or as required by the pre-stressing system in use. Adequate means, subject to the Engineer's approval, shall be employed to ensure that their location is maintained exactly throughout the concreting operations. Passage shall be provided in the locations indicated on the Drawings for the injection and escape of grout and the release of air.
- 4) Anchorages shall be made from steel of a suitable quality to withstand permanently the forces imposed upon them, and shall in general be in accordance with the normal practice of the proprietors of the pre-stressing system in use:
- 5) Application of stress, grouting of pre-stressing cables, protection of pre-stressing cable anchorages and other necessary steps to complete the pre-stressing process shall conform to the standard practice of the pre-stressing system in use or as directed by the Engineer.
- 6) Precast prestressed units shall be lifted only by lifting holes near the ends of the units, or when not provided can be lifted by slings placed securely at corresponding points. Units shall be kept in the upright position at all times and shock shall be avoided. Any unit considered by the Engineer to have become sub-standard in any way shall be rejected and replaced by an acceptable unit.
- 7) Each prestressed member is to be uniquely and permanently marked to show its type, date of casting and reinforcement.

### 3.5 STEEL TUBULAR PILES

Steel tubular piles required under this heading may either be fluted or plane, tapered or cylindrical, seamless or welded type or as indicated in the drawings conforming to the requirements of ASTM A 252 Grade 2, equal or better. Minimum shell thickness shall be 1/4 inch or as required in the drawings. Piles may be supplied knockdown in the sections then fabricated or welded to the required length in the field prior to driving.

Tip end closures for all steel piles shall be cast or forged steel nose points factory welded to all the tip sections of foundation piles. Tips must have adequate strength to withstand load stresses based on pile capacity and shall be attached to pile ends in a manner that will resist all forces and produce a watertight connection.

All exterior surfaces of pile shall be shop coated with red lead primer or as indicated in the drawings.

### 3.6 LENGTH OF PILES

The length of pile indicated in the drawings are predetermined lengths based on previous local pile data, or designs considering actual or observed soil classification and/or behavior.

The Engineer, however, may, in case of new construction, or when local pile data are not available, in case of reconstruction work, order test piles driven to the required penetration and refusal. The accepted test pile/s shall be integrated with the structure.

The length of all other piles shall then conform with the result of the test piles as approved by the Authority. However, pile driven to the required penetration but failed to develop the required bearing power shall be spliced and redriven to refusal.

### 3.7 TEST PILES

Test pile/s similar to the designated piles for the structures shall be driven at locations indicated by the Engineer. This pile shall be longer than ordinary piles shown in the pile schedule to provide for contingencies due to variations in soil behavior. Pile penetration observed per blow of the hammer shall be recorded. If refusal is observed while the required penetration is not yet obtained, the Contractor shall continue driving the pile with the aid of water jets. Water jets shall be carried out in all respect with rigorous control and not to detriment of the surrounding ground or any part of the Works.

If necessary, test pile/s shall be splice and redriven until the bearing power and penetration are acceptable to the Engineer.

### 3.8 HANDLING OF PILES

All piles shall be carefully lifted at the two outer quarter points of its entire length. Other practical and convenient methods may be used subject to approval of the Engineer.

### 3.9 DRIVING OF PILES

A steam or diesel pile hammer shall be used for driving reinforced concrete and tubular steel piles. For timber piles a gravity or drop hammer may be allowed.

When steam hammers are used, the energy delivered in the pile being driven shall not be less than 5,300 ft-lbs. The total energy developed by the hammer shall not be less than 6,000 ft-lbs. per blow. Self-powered or diesel hammers of corresponding energy may be used in lieu of steam hammer for the particular pile/s being driven.

For gravity hammers, the weight of ram shall be at least 50 of the weight of the pile being driven but should not be less than 907 kg. (2,000 lbs.) for piles weighing 1,814 kg. (4,000 lbs) or less.

The fall of hammer shall not exceed 6 m (19.18 ft.) and shall be of uniform frequency to avoid injury to the piles.

Piles driven shall be held firmly in position in axial alignment with the hammer by means of leads of adequate length. Approved cushions shall be provided to the pile butts.

### 3.10 BEARING POWER OF PILES

Each pile shall be driven to attain not less than the required bearing power shown in the pile schedule, as determined by the Hiley Formula or other formula acceptable to the Engineer, or to practical refusal.

Piles driven to refusal without attaining the required penetration may be accepted by the Authority.

### 3.11 INTERRUPTED DRIVING

When driving is stopped before final penetration is reached and/or refusal is attained, the record of pile penetration shall be taken only after a minimum of 30 cm. (12 in.) total penetration has been obtained on resumption of driving.

### 3.12 ALIGNMENT OF TOLERANCE

Piles driven shall be within the allowable tolerance in alignment of 10 cm. (4 in.) in any direction.

### 3.13 DAMAGED AND MISDRIVEN PILES

- a) Piles shall not be more than 10 cm. (4 in.) out of place at cut-off level. All vertical piles shall not be more than 2 out of plumb.
- b) Any pile damaged by improper driving or driven out of its proper location, or driven out of elevation fixed on the plans, shall be corrected correspondingly at the Contractor's expense by any of the following methods:
  - 1. Withdrawal of the pile and replacement by a new pile.
  - 2. Driving a second pile adjacent to the defective one.
  - 3. Splicing an additional length

The method to be adopted in each case shall be at the discretion of the Engineer.

### 3.14 OBSTRUCTION

Where boulders or other obstructions make it impossible to drive certain piles in the location shown and to the required bearing strata, the Engineer may order additional pile or piles driven at other suitable location after consultation with the Structural Engineer.

### 3.15 RECORDS

The Contractor shall keep records of each pile driven and shall furnish the Engineer two (2) signed typewritten copies daily. The records shall show the

number of blows per 0.75 m. penetration from the pile tip, attain a depth of 5.0 m., the penetration under the last 10 blows, and the calculated safe load according to the Hiley Formula or other formula acceptable to the Engineer.

### 3.16 LOAD TEST

Load test on one (1) pile to be designated by the Engineer is part of the contract and shall be conducted as follows:

- a. Pile shall be driven to the specified minimum penetration level below existing grade or to refusal before subjecting it to test loading.
- b. The total test load shall be three times the proposed safe load value. The load shall be applied in seven increments equal to 50, 75, 100, 125, 150, 175 and 200 of the proposed working load.
- c. Reading of settlements and rebounds shall be recorded to 0.5 m. for each increment.
- d. After the proposed working load has been applied, and for each increment thereafter, the test load shall remain in place until there is no settlement for a 2-hour period.
- e. The total test load shall remain in place until settlement does not exceed 0.5ft., in 48 hours.
- f. The total load shall be removed in decrements not exceeding ~ of the total load at intervals of not less than 1 hour.
- g. The rebounds shall be recorded after each decrement is removed, and the final rebound shall be recorded 24 hours after the entire test load has been removed.

Testing shall be conducted under the supervision of the Engineer and shall be conducted in a manner completely satisfactory to him.

## 4. MOORING AND FENDER SYSTEMS

### 4.1 GENERAL

#### 4.1.1 SCOPE OF WORK

1. The work includes furnishing of all labor, materials and equipment to complete the installation of mooring bollards, bitts, cleats and fenders in new piers.
2. The work shall include the supply, transport, handling, storage and installation of fender systems in the newly constructed piers.

- 3. The work shall include the furnishing, driving, cutting off and binding of timber piles in clusters (dolphins) in the new trestles as shown on the drawings and in accordance with this specification.
- 4. The Contractor shall furnish and install the necessary fittings for a complete job as shown on the drawings and/or as specified. Supplementary parts necessary to complete and install each item of works shall be included whether or not shown or specified. The Contractor shall furnish to relevant trades all anchors, fastenings, inserts, fittings, fixtures or the like to be installed on or required for securing the works.

The Contractor shall submit shop drawings of all fitting works prior to placing orders and commencement of any fabrication.

4.1.2 MOORING SYSTEM

- 1. Designated load capacity of mooring bollards, bitt and cleats shall be as shown on the drawings, and shall refer to the safe working load. The bollards shall be capable of withstanding a proof test load of 1.5 times the safe working load.
- 2. The following publications listed below shall form a part of these Specifications to the extent indicated by the reference thereto.

**Publication**

G 5101 SC 46, Carbon Steel  
G 3101 SS 41, Rolled Steel for General Structures  
JIS B0205 Standard M Screw  
JIS B1181 Hexagon Nut

- 3. Bollards at the new berth shall be installed at the edge of concrete decks of piers.

4.1.3 RUBBER FENDER SYSTEMS

- 1. Material for fender systems such as rubber fenders, anchor bolts and templates shall be supplied by the Contractor.
- 2. The Contractor shall install the fender system properly according to the drawings and the instructions prepared by the Engineer.
- 3. Performance Requirements

The fenders shall be procured in accordance with the performance characteristics, under 45%-50% fender deflection, specified hereunder:

Type of Fender	Min. Energy Absorption (Ton-M)	Max. Reaction Force (Ton)
(1)	1.0	15
(2)	1.8	20
(3)	2.8	32

4. Types of Fenders

- Type (1) = 200 mm in height and 1000 mm in length  
Type (2) = 250 mm in height and 1500 mm in length  
Type (3) = 300 mm in height and 1500 mm in length

5. Manufacturing Rubber Main Body Rubber fenders shall be manufactured at the factories of approved makers.

Basic manufacturing methods shall be as follows:

- Shape of rubber main body: refer to the Drawings
- Fabrication of rubber main body shall be completed at the factory
- No connection of main body shall be permitted out of the factory
- Steel plate shall be embedded in the deck sides of rubber main body.
- The Contractor shall submit manufacturer's methods of manufacturing for approval by the Engineer.

4.1.4 SUBMITTALS

1. Shop drawings and/or catalogues of mooring bollards, bitts, cleats and rubber fenders indicating size, weight and mounting requirements shall be submitted for approval of the Engineer.
2. No materials or fitting shall be ordered without prior approval of the Engineer.

4.2 MATERIAL REQUIREMENTS

1.2.1 MOORING SYSTEM

1. Mooring bollards, bitts and cleats shall be of the dimensions, weights, capacities and design in accordance with shop drawings approved by the Engineer and shall be fabricated by approved manufacturers with cast steel conforming to the following requirements or approved equivalent.

Part	Spec. (JIS or its equivalent)	Grade
Body	JIS G5101 3	Grade SC46
Anchor	JIS G3101 2	Grade SS41
Bolts	JIS B0205	M64-6
Nut	JIS B1181 1	Grade 1
	Class 3	4T, N64-6
Washer	JIS B1256	Steel Bars
Foundation Plate	JIS G3101 2	Grade SS41
	or JIS G5101	Grade 3 SC46

The size of the bolts, nuts and washers shall be in accordance with the specifications of the manufacturer. However, the length of the bolts shall be as indicated on the drawings. The anchor plate shall be connected to the holding down bolt with 12.5 mm weld, as shown on the drawings. All bolts, nuts, washers, etc. that are exposed shall be galvanized to the satisfaction of the Engineer. Provide lead cover for exposed threads of galvanized anchor bolts.

Samples of the bolts, nuts, washers and anchor plates shall be submitted to the Engineer for approval before being used in the Works.

- a) The upper parts of bollards, bitts, and cleats not embedded in concrete shall be painted. The surface of bollards and bitts shall be cleaned thoroughly by wire brush or other means prior to painting to remove rust or any other contamination which may interfere with bond of paint to metal.

The exposed surface shall be coated with rust proof paint and finishing paint, which shall be coal-tar epoxy of 120 micron thickness in accordance with JIS K5623 or the approved standard.

- b) Alternative

The Contractor can submit to the Engineer's approval cleats, bitts or bollards different from these specifications but with the capacities indicated in the drawings.

- d) Visual Inspection

All bollards, bitts and cleats delivered to site shall be inspected by the Engineer for any signs of flaws or defects inimical to usage.

- e) Mill Test Certificates

Two (2) copies of mill test reports shall be submitted certifying that materials meet the specified standards.

- f) Tests and Inspection

Inspection of all materials and methods of fabrication shall be carried out by the Contractor. However, the Engineer reserves the right to inspect all facilities at any time during the manufacture to ensure that the materials and workmanship are in accordance with the specifications and the best workmanship.

#### 4.2.2 RUBBER FENDER SYSTEM

##### 1. Physical Properties

Material for rubber fenders will be one of the international accepted materials.

Test methods shall conform to JIS K6301 or equivalent.

The rubber material used for rubber fenders shall be a compound of natural rubber and synthetic rubber of high quality having sufficient resilience, anti-aging, weather and wear resistant property according to the following table.

	Property	Requirement	Test Method (JIS K6301)
Tension test (before aging)	Hardness (HS)	77 max.	Spring type Hardness type
Tension test (after aging)	Tensile Strength (kg/cm <sup>2</sup> )	160 min.	Test piece Dumbell No. 3
	Elongation (%)	350 min.	
	Hardness	+8 max. from original value	Air heating 70 °C x 96 hrs.
	Tensile Strength (kg/cm <sup>2</sup> )	not less than 80% of original value	
Tear resistance (kg/cm <sup>2</sup> )	Elongation	not less than 80% of original value	
	Inner rubber	70 min.	Test piece
Compression Set (%)	Outer rubber	60 min.	
		30 max.	
Oil Resistance (volume change)	Industrial gasoline (%)	60 max. 20 max.	25 °C x 24 hrs.

2. Anchor

Anchor Bolts and connecting hardware shall be fabricated from type SUS 304 stainless steel to the required shapes and sizes as shown on the approved shop drawings, and conforming to JIS G 4303 or equivalent.

3. Testing

The Contractor shall be required to submit test certificates showing compliance to the above requirements. The test certificates should be certified by an independent inspection organization recommended by the Contractor and approved by the Engineer.

One fender of each type (1, 2 & 3) selected at random shall be tested for performance. The fender shall be compressed repeatedly three times to the minimum deflection at speed from 2 to 8 cm. per minute.

The load and deflection values shall be recorded with a precision of 0.5 mm. The results shall be plotted in the form of load-deflection-energy absorption curves. The average data obtained in the second and third test loadings shall be considered as performance values. The tests and reporting shall be carried by an approved laboratory and shall be supervised and certified by the independent inspection organization.

If any of the tested fenders fail to satisfy the performance requirements, retesting shall be conducted on one piece for every 10 fenders of the same type. If the second sample still fails the test, all the remaining fenders of this type shall be tested.

5. Sampling of Specimen

The specimens of rubber shall be taken at the mixing stage directly from each batch of rubber compound for manufacturing of fenders. The specimens shall be tested for compliance with the requirements.

6. Inspection for Dimension

The fenders shall be inspected by the independent inspection organization.

One fender out of five fenders of each type shall be inspected for compliance with dimensions.

Five percent (5%) of anchor bolts and fittings shall be selected at random and inspected. Materials for bolts and fittings to be covered by certified steel manufacturer's mill sheet shall be verified by the independent inspection organization.

7. Acceptance Tolerance

The acceptance tolerances shall be as stipulated in the following:

a. Fender Dimension

	Length	Width	Height	Thickness
Tolerance	+4% -2%	+4% -2%	+4% -2%	+8% -2%

b. Anchoring Bolt Holes in Fender

	Diameter of the Hole	Pitch of the Hole
Tolerance	+2 mm	+4 mm

c. As basis for acceptance of all finished fenders supplied, a tolerance of +10% on the performance requirements indicated will be acceptable.

The cost of tests and inspection required herein are all for the Contractor's account.

## 8. Marking

All fender units shall be clearly numbered and marked. Each fender shall have the following marking:

- a. Fender type and manufacturer's name or trademark
- b. Production serial number
- c. Date of manufacturing
- d. Main dimensions (length, height)
- e. Bill number in accordance with the project code specified in the Bill of Quantities.

## 9. Warranty

The Contractor shall guarantee the fenders against any defects that are attributable to faulty design and manufacture and shall also guarantee the performance of the fenders under normal working conditions. The guarantee shall be for a minimum period of 12 months from the date of the issuance of Taking-Over Certificate of the Works.

During the period of guarantee, repairs and replacement of defective fender units and/or material shall be carried by the Contractor at his own cost.

## 4.3 EXECUTION

### 4.3.1 MOORING SYSTEM

All bollards, bitts and cleats shall be installed at the locations shown on the drawings and in accordance with the approved manufacturer's recommendations and shop drawings, and as directed by the Engineer.

### 4.3.2 RUBBER FENDER SYSTEM

All fenders shall be installed at the locations shown on the drawings and in accordance with the approved manufacturer's recommendations and shop drawings.

## 4.4 MEASUREMENT AND PAYMENT

1. Measurement and payment of the quantities of bollards, bitts and cleats shall each be based on the number of sets of bollards, bitts and cleats completely installed (excluding concrete base/foundation) with anchor bolts and certified by the Engineer.

Reinforced concrete base/foundation of mooring bollards and bitts to be installed on piers shall not be paid separately and such shall be included under pay-item for Concrete Works of pier.

Separate measurement shall be made for reinforced concrete base/foundation of mooring bollards and bitts to be installed on structures other than pier which shall be paid for per cubic meters of concrete and per kilograms of reinforcing bars.

2. Measurement and payment of the quantities of rubber fender system shall be based on the number of sets of rubber fender systems completely installed with anchor bolts with necessary sleeves and certified by the Engineer.
3. Payment stated above shall be full compensation for all labor, materials and equipment and all preparatory and incidental works necessary to complete the work.