

***Part II***  
***Specifications for Civil Works***

**LA UNION PORT DEVELOPMENT PROJECT**  
**Bidding Documents**  
**for**  
**Package A : Civil and Building Works**

**Volume III-A**

**Specifications**  
**Part II: Civil Works**

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## SECTION 20100 GENERAL

### 20101 Scope of the Works

These Specifications shall include the furnishing of all labor, materials and equipment and the performance of all works necessary for construction of the following civil works for the Project in accordance with the Drawings, Specifications, and as may be further directed by the Engineer.

- 1) Quaywall
  - a. Container berth
  - b. Multi-purpose berth
  - c. Passenger berth
- 2) Revetment
  - a. Revetment for port area (West and East)
  - b. Temporary revetment for dumping area {A (A-north and A-west) and B}
  - c. Bund between port area and dumping area (West and East)
- 3) Reclamation and Excavation
  - a. Reclamation in the port area.
  - b. Excavation in the port area.
- 4) Road and Pavement
  - || Road  

The road in the port area consists of 1 main road and 3 feeder roads.

    - a. Main road
    - b. Feeder road No. 1, No. 2 and No. 3
  - ¶ Pavement  

The pavement work includes the following areas

    - a. Road
    - b. Yard area
    - c. Apron area
- 5) Storm Drainage  

The storm drainage work include the following areas.

  - a. The storm drainage in the port area
  - b. The diversion drainage in and out the port area.

**20102**

**General**

The Contractor shall supply all materials required for completion of the works in accordance with these Specifications.

If the Drawings do not contain particular materials and works which are obviously necessary for the proper completion of the works, all such materials and works shall be included in the unit price stated in the Bill of Quantities for the appropriate items of the civil works.

**(1) Standards**

Unless otherwise specifically provided, the quality of material, equipment and workmanship shall comply with JIS, AASHTO, ASTM or other equivalent international standards as specified hereinafter and as approved by the Engineer.

**(2) Working Drawings and Samples**

Workings drawings and shop drawings shall be prepared and submitted by the Contractor to the Engineer for his approval as specified herein at no extra cost. The Contractor shall also submit samples or catalogues of construction materials for approval as specified without extra cost. The Engineer shall check such samples or catalogues for the assurance of compliance with the design concept and the Specifications.

**(3) Temporary Constructions**

The Contractor shall furnish, erect and maintain during the work all temporary constructions as may be necessary for the construction of the works.

**(4) Cleaning**

The Contractor shall remove all dirt and rubbish caused by the work from the construction site. At completion of the work, the Contractor shall thoroughly clean the construction site.

## SECTION 20200 MATERIALS

### 20201 General

#### 20201.1 Local Sources

Where possible, maximum use should be made of locally obtainable materials for construction purposes.

#### 20201.2 Standards Specifications

Any materials not fully specified herein and for which there is no JIS or ASTM or AASHTO standard shall be approved by the Engineer.

### 20202 Inspection and Testing

- All materials and articles which the Contractor proposes to incorporate in the Permanent Works shall be subjected from time to time to inspections and tests if and when directed by the Engineer. Should the Engineer so require, the Contractor shall, at his own expense, present Test Certificates supplied by the manufacturers.

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

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

- All materials used in the Works are subject to further approval of the Engineer immediately before they are put to use, notwithstanding that the materials may have been accepted as satisfactory at the time of delivery to the Site.

- Any loss or damage which may be caused to the Contractor from the disapproval of any material by the Engineer shall be borne by the Contractor.

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

### 20203 Steel Reinforcement Bar and Binding Wire

#### 20203.1 Specification

Steel reinforcement bars for concrete works shall comply with the following JIS requirements or ASTM standard or approved equivalent.

- Equipping, furnishing, (see Appendices 101 to 102, maintaining and cleaning the building and supplying stores and consumable.
- Services including supplies of potable water, washing water and electric light and power.

Deformed bar	JIS G 3112	Hot-rolled deformed bar Class 2, SD-295 Class 2, SD-345
Round bar	JIS G 3112	Hot-rolled bar Class 1, SR-235 Class 2, SR-295
Binding wire	JIS G 3532	SUM-A, diameter 0.9mm or over.

Test certificates shall be provided for each consignment of steel which shall include the results of the cast analysis of the bar supplied, the carbon equivalent value, and the tensile bend and rebend test. The tensile test results shall include the cross-sectional area.

**20203.2 Tolerances on Shape and Dimensions**

The tolerances on shape and dimension shall comply with the JIS G 3112.

**20203.3 Test Certificates**

The Contractor shall obtain test certificates of the steel reinforcement bar from the manufacturer and shall submit to the Engineer. The test certificate shall state that the material has been tested and found to comply in all respects with the relevant JIS requirements. If considered necessary by the Engineer, he may send samples of the steel reinforcement bar to a laboratory for chemical and mechanical analysis.

**20203.4 Storage of Steel Reinforcement Bar**

When being stored, the steel reinforcement bar shall not be placed directly on the ground, but on suitable sleepers or racks and under covering to protect it against rain. The steel reinforcement bar shall be stored separately according to their diameter and length.

**20204  
Structural Steel  
Shapes and  
Plates**

**20204.1 Specification**

Structural steel shapes and plates shall comply with SS-400 Hot Rolled Section of JIS G 3101 or ASTM A35 and A283 or approved equivalents.

The chemical composition and mechanical properties of hot-rolled steel shall comply with the standards as shown in Table 20200.1 and Table 20200.2

**TABLE 20200.1 CHEMICAL COMPOSITION**

Symbol	Unit: %			
	C	Mn	P	S
SS 400	--	--	0.05 max	0.05 max

**TABLE 20200.2 MECHANICAL PROPERTIES**

Symbol	Yield Point (N/mm <sup>2</sup> )		Tensile Strength (N/mm <sup>2</sup> )	Elongation Shapes over 5 mm Up to 15 mm in thickness
	Thickness of rolled steel (mm)			
	16 or under	Over 18 up to 40		
SS 400	245 min	235 min	400 to 510	17% or over

The Contractor shall obtain mill certificates of the hot-rolled steel from the manufacturer and such certificates shall be submitted and approved by the Engineer.

**20204.2 Tolerances on Shape and Dimensions**

The tolerances on shape and dimensions shall comply with the JIS G 3191, JIS G 3192, JIS G 3193 and JIS G 3194.



**20204.3 Test Certificates**

The Contractor shall obtain test certificates of these structural steel from the manufacturer and shall submit to the Engineer. The test certificates shall state that the material has been tested and found to comply in all respects with the relevant JIS requirements. If considered necessary by the Engineer, he may send samples of the structural steel shape and plate to a laboratory for chemical and mechanical analysis.

**20204.4 Transport and Storage of Structural Steel**

During transportation, loading and unloading, all structural steel shall be handled in such manner that they will develop no damage.

When being stored, the structural steel shall not be placed directly on the ground, but on suitable sleepers or racks and under covering to protect them against rain, salty wind, dirt and etc. The structural steel shall be stored separately according to their dimensions and length.

**20205  
 Steel Pipe Pile**

**20205.1 Specification**

Steel pipe pile shall comply with SKK-490. Hot Rolled Section of JIS A5525 or ASTM A-252 or approved equivalents

Supplied steel pipe piles shall be coated on outside of surface by anti corrosion paint which will be approved by the Engineer from delivery to site until installation of petrolatum lining and cathodic protection.

The chemical composition and mechanical properties of steel pipe piles shall comply with the standards as shown in Table 20200.3 and Table 20200.4

**TABLE 20200.3 CHEMICAL COMPOSITION**

Unit: %

Symbol	C	Si	Mn	P	S
SKK 490	0.18 max	0.55 max	1.50 max	0.04 max	0.04 max

**TABLE 20200.4 MECHANICAL PROPERTIES**

Symbol	Tensile Strength	Yield Point	Elongation
SKK 490	490 N/mm <sup>2</sup>	315 N/mm <sup>2</sup> or over	18% or over

The Contractor shall obtain mill certificates of the steel pipe piles from the manufacturer and such certificates shall be submitted and approved by the Engineer.

**20205.2 Shape and Dimensional Tolerances**

The shape and dimensional tolerances of the steel pipe piles shall comply with the Table 20200.5 and Table 20200.6.

**TABLE 20200.5 SHAPE AND DIMENSIONAL TOLERANCES**

Description		Tolerances	
Outside Diameter (D)	Pipe end part	± 0.5%	
	Trunk part	± 1.5%	
Wall Thickness (t)	Thickness Up to 16 mm	Outside Diameter 500 mm and over, up to 800 mm	+ No specification - 0.7 mm
		Outside Diameter 800 mm and over, up to incl. 2,000 mm	+ No specification - 0.8 mm
Length (L)		+ No specification - 0.0 mm	
Warping (M)		Not more than 0.1% of the length	

**TABLE 20200.6 ALLOWABLE VALUE OF DISLOCATION BETWEEN BOTH PLATES OF SITE CIRCUMFERENTIAL WELDS**

Outside Diameter	Allowable Value
Up to 700 mm	2 mm, max
700 mm and over, up to and incl. 1,016 mm	3 mm, max
Over 1,016 mm and, up to and incl. 2,000 mm	4 mm, max

**20205.3 Test Certificates**

The Contractor shall obtain test certificates of the steel pipe piles from the manufacturer and shall submit to the Engineer. The test certificates shall state that the material has been tested and found to comply in all respects with the relevant JIS requirements. If considered necessary by the Engineer, he may send samples of the pile to laboratory for chemical and mechanical analysis.

**20205.4 Transport and Storage of Steel Pipe Piles**

In transportation steel pile piles, adequate measure shall be taken to protect them from being dented or developing the dent being permanently set and to protect their grips from being damaged or deformed.

In loading and unloading, all steel pipe piles shall be handled in such manner that they will develop no excessive deflection.

Where there is possibility of the piles being deformed, they shall be re-stacked immediately. When being stored, the steel pipe piles shall not be placed directly on the ground, but on suitable sleepers or racks and under covering to protect them against rain, salty wind, dirt, etc.

The steel pipe piles shall not be stacked higher than 3.5 m.

**20206  
Bolts, Nuts and Washers**

Unless otherwise specified on the Drawings, bolts (except anchor bolts in concrete) nuts and washers shall conform to the requirements of JIS G 3101, JIS B 1180, JIS B 1181, JIS B 0205, JIS B 1256 or ASTM A-325M, ASTM F-436M. or approved equivalents.

**20207  
Cement**

**20207.1 Specification**

The permanent concrete structure shall be of approved manufacture, and shall be comply with ASTM C-150. The type of cement shall be Type I for the structure placed above HWL, insitu or precast, and Type V for below HWL.

**20207.2 Manufacturers Certificate**

Each consignment of cement shall be accompanied by a certificate from the manufacturer showing that the cement offered has been tested and analyzed for its chemical composition and physical properties and that such tests and analyses comply in all respects with the relevant requirement of JIS R 5202 and JIS R 5201 or ASTM.

**20207.3 Tests after Delivery to Site**

Each consignment of cement shall, after delivery to the Site, be subjected to all the tests and analyses required by the relevant JIS or ASTM Standards. Samples shall be collected as directed by the Engineer and the tests carried out at an approved laboratory. The cement from which the samples have been extracted shall not be used in any works before the completion of the testing and analysis and until it has been accepted as satisfactory by the Engineer.

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

The costs of all the tests on cement are deemed to be included in the rates entered in the Bills of Quantities for related items of the Works.

The Engineer may reject any cement if the results of such tests are not satisfactory, notwithstanding the manufacturer's certificate. All rejected cement shall be immediately removed from the Site at the Contractor's own cost.

**20207.4 Transport and Storage**

The age of the cement at the time of delivery to the Site shall not be more than two (2) months, and the cement shall be used within three (3) months of delivery to the Site.

Bagged cement shall be delivered to the Site in original bags with the description of item, quantity, quality and name of the manufacturer clearly printed on the bag. Damaged bags shall forthwith be removed from the Site.

The cement shall be transported to the Site in covered vehicles adequately protected against the weather and shall be stored properly in approved, well-ventilated, weather-proof and water-proof stores to prevent damage due to moisture. The floors of such stores shall be raised at least 30cm above the ground.

Each consignment of cement shall be kept separately to permit easy access for identification, inspection, testing and issuance. Bagged cement shall not be stacked higher than 13 bags. On delivery at the Site, the cement shall immediately be placed in those stores and used in the order of delivery.

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

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

**20208  
Aggregate for  
concrete**

**20208.1 General**

The aggregate for concrete shall be taken from approved sources and shall comply in all respects with the requirements of JIS A 5005 or ASTM C-33 or other standards approved by the Engineer.

If supplies from the approved sources subsequently are found to deviate from the

approved samples and do not meet test requirements, then the sources will be liable to rejection by the Engineer.

A sufficient quantity of acceptable aggregates shall always be in stock on the Site to ensure that the concreting work continues for a period of one month without interruption.

**20208.2 Coarse Aggregate**

The coarse aggregates shall be approved gravel or crushed rock with the maximum particle size not exceeding the size specified in Table 20200.1

For all concrete work coarse aggregates shall comply with the grading requirements shown in the following Table of JIS A 5005 or given in ASTM C-33, for 40 mm to 5 mm, 25 mm to 5 mm and 20 mm to 5 mm nominal sizes.

**TABLE 20200.1 PERCENTAGE BY WEIGHT PASSING (JIS A5005 SIEVE)**

Unit: %

Aggregate Size		Test Sieve (mm)							
		50	40	25	20	15	10	5	2.5
%	40-5	100	95-100	-	35-70	-	10-30	0-5	-
	25-5	-	100	95-100	-	25-60	-	0-10	0-5
	20-5	-	-	100	9-100	-	20-25	0-10	0-5

If a grading analysis reveals the shortage of a specific size to the extent that may affect the density of the concrete, the Engineer may direct the Contractor to add the required amount of deficient aggregates.

Densities for the various classes of concrete shall be determined by the Engineer after tests have been carried out on the Site.

The Contractor shall take any step that may be necessary to prevent the segregation of coarse aggregates into separate sizes after they have been graded and stored.

The crushed stone shall be hard, durable and clean and shall not contain any clay or flaky or weathered rock. The crushed stone shall be crushed to the specified size by an approved type of crusher. Powder or fines passing a 5mm test sieve shall be kept apart and thoroughly washed by the approved method, if so directed by the Engineer.

The clay, silt and dust content for all aggregates shall be determined by the decantation method specified in JIS A 1137, ASTM C-33. In no case shall the clay, silt and dust content exceed:

**Coarse aggregates**

Natural crushed gravel 1% (by mass)

Crushed rock 3% (by mass)

**Fine aggregates**

Natural sand or crushed gravel 3% (by mass)

Crushed rock 3% (by mass)

The Flakiness Index of aggregates when determined in accordance with ASTM C-33 shall in no case exceed 30 nor, for concrete block pavement wearing surfaces, 20.

The Elongation Index of aggregates when tested in accordance with ASTM C-33 shall not exceed 35.

The total acid soluble chlorides as CL-ion in the aggregates shall not exceed 0.06% by weight of fine aggregates nor 0.03% by weight of coarse aggregate as determined in accordance with JIA A 1103, ASTM C-33, subject to the specified chloride content of the concrete mix not being exceeded.

The total acid soluble sulphates as SO<sub>4</sub> ion in the aggregates shall not exceed 0.4% by weight for either fine or coarse aggregates as determined in accordance with ASTM C-35, subject to the specified sulphate content of the concrete mix not being exceeded.

The Contractor shall provide all necessary equipment and materials as may be required by and for the use of the Engineer to enable rapid field tests for chloride in aggregates to be carried out in accordance with "Field Tests for Chlorides in Aggregates" published by the Cement and Concrete Association ISBN No 45039, 1982 as amended, but such tests shall be for guidance purposes and not relieve the Contractor of his obligations for meeting standard test requirements.

Aggregates shall be tested for soundness in accordance with ASTM C-88. The weight loss after 5 cycles in magnesium sulphate solution shall not exceed 15% and after 5 cycles in sodium sulphate shall not exceed 10%.

The shell content of aggregates shall not exceed the following limits by weight for:

40 mm aggregate	2%
20 mm aggregate	5%
10 mm aggregate	10%
fine aggregate	20%

except with the written approval of the Engineer.

The shell content shall be measured in accordance with the method given in JISA 1137, ASTM C-88. Hollow shells, or shells of unsuitable shape in quantities, which may adversely affect the quality of, or cause permeability in, the concrete, shall not be permitted.

The water absorption of aggregate when tested in accordance with ASTM C-88 in the "saturated surface dry" condition shall not exceed 2%. This test shall be carried out not less than 2 times a day or as directed by the Engineer.

Aggregate shrinkage shall be determined in accordance with the JISA 1121, ASTM C-88 and shall not exceed 0.05%.

The coefficient of thermal expansion shall be determined for each aggregates and

trial mix. Aggregate and/or trial mixes with a coefficient of thermal expansion of less than  $8 \times 10^{-6}$  per degree centigrade shall not be used without the approval of the Engineer.

The mechanical strength of aggregates shall be tested by the "10% fines value" of JIS A 1126, ASTM C-33, and in addition shall be subject to the Los Angeles abrasion tests of ASTM C-131 and ASTM C-535 as appropriate to the aggregate under test. The values by these Los Angeles tests shall not exceed 35% nor 30% for pavement wearing surfaces.

Single-sized coarse aggregates shall not be used.

**20208.3 Fine Aggregate**

Sand for concrete shall be well-washed, clean and free from clayey and organic matter or other impurities. It shall be so graded that when mixed with the coarse aggregate and water, a workable concrete of maximum density is produced.

The grading of the fine aggregate shall be within the limits given in Table 20200.2 of JIS A 1102.

**TABLE 20200.2 PERCENTAGE BY WEIGHT PASSING (JIS 1102 SIEVE)**

	Test Sieve (mm)						
	10	5	2.5	1.2	0.6	0.3	0.15
%	100	90-100	80-100	50-90	25-65	10-35	2-10

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

**20208.4 Sampling and Testing of Concrete Aggregates**

The Engineer may require the Contractor at any time to draw samples of aggregates on the Site or any other locations to be indicated by the Engineer for testing according to methods described in JIS A 1102 or ASTM C-33.

Aggregates which prove unsatisfactory in tests shall be either be replaced or washed until further tests prove them to be satisfactory.

All costs and expenses incurred in complying with this requirement shall be borne by the Contractor.

**20208.5 Water**

Water to be used for concrete shall be clean, fresh and free from organic or inorganic matter in solution or in suspension in such amounts as may reduce the strength or durability of the concrete.

The water shall be obtained from a public supply source, and shall be taken from any other sources only if approved. Only water of approved quality shall be used for concreting, for flushing and wetting of formwork, and for curing.

The Contractor shall make adequate arrangements to deliver and store sufficient water at the Works for use in mixing and curing the concrete, and for flushing and wetting the forms.

Where water is to be obtained from a source other than a public utility supply, or as required by the Engineer, the Contractor shall have testing carried out by an approved independent testing laboratory in accordance with ASTM C-94 and the results sent to the Engineer for approval.

Subsequently, samples shall be taken and tested at least once a month, or more frequently, if the quality of the water is subject to variations of the climate.

Sea water shall never be used in concrete mixes nor for the curing of concrete.

The temperature of water for concrete shall not be more than 25°C. Water may be

cooled to not less than 5°C by the gradual addition of ice but on mixing no ice particles shall be present in the mix. Ice-cooled water shall pass through a 1 mm BS sieve before incorporation into the mix. Ice shall not be added direct to the mix. Ice shall be the product of frozen water which complies with ASTM C-94.

Irrespective of any other criteria elsewhere in this specification the dissolved chloride content in the mixing water shall not exceed 500 ppm and the dissolved sulphate, alkali carbonate or bicarbonate content combined shall not exceed 1,000 ppm.

Dissolved solids other than those listed above shall not exceed 2,000 ppm.

Suspended solids shall not exceed 2,000 ppm.

**20209  
Sand Fill for  
Caissons**

**20209.1 Grading Sand**

Sand filling for the caissons shall be free from vegetation, organic matter or other deleterious matter. The grading of the sand shall comply with Table 20200.3 tolerances and be subject to the Engineer's approval

**TABLE 20200.3 GRADING OF SAND**

Sieve Size mm	Percentage Passing
100	95
37.5	92
19.0	90
9.5	88
4.75	78
2.00	68
1.18	60
0.60	55
0.30	35
0.15	12
0.075	3
0.063	0

**20209.2 Contamination**

The sand fill shall be free from vegetation, roots, organic matter, logs or other materials which are combustible or which can decay.

**20210  
Graded Rock**

**20210.1 Quality**

Rock used for the construction in the Works shall be granite or equivalent materials, sound and durable, free from flaws and from soft, weathered or decomposed parts. Rock that is laminated, fractured, porous or otherwise physically weak will be rejected.

**20210.2 Properties**

The properties shall conform to the following requirements:

The ratio of the least lateral dimension to the maximum length of each rock measured at right angles shall not be greater than 1:2.

Specific Gravity of saturated rock	
with dried surface	2.50 min.
Water Absorption	5% max.
(dry to fully saturated)	grain in weight
Compressive Strength	49.1 N/mm <sup>2</sup> (min)
(by cylinder crushing)	
Soundness	5% max.

(5 cycles sodium sulphate test)                      loss in weight

**20210.3 Tests**

The Contractor shall carry out any tests on rock samples required by the Engineer to assess their quality and suitability for use in the Works. The cost of such tests shall be borne by the Contractor.

**20210.4 Supply**

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

The quality of the rock at a quarry shall be uniform to such an extent that the necessary rate of delivery will not be adversely affected by testing and/or production delays.

Approval of a source of supply of rock shall not be construed as relieving the Contractor of his obligations to supply materials in the finished works in conformity with the requirements of this Specification and the Contractor shall carry out all such sampling and testing as is necessary to ensure compliance therewith.

**20211  
Rock for  
Caisson  
Quaywalls and  
Revetments**

a)     **Armour Rock**

This shall be evenly graded between the following limits:

Minimum            300 kg

Maximum           1.500 kg

Armour rocks shall be used for armour rock on the seaward face of the graded rock mound and to the seaward face of the rubble rock and revetment.

b)     **Rubble Rock**

This shall be evenly graded between the following limits:

Minimum           10 kg

Maximum           250 kg

Rubble rocks shall be used for:

Graded rock base of caisson, concrete block foundation, bund, and revetment.

c)     **Back Filling Rock**

This shall be evenly graded between the following limits:

Minimum           0.1 Kg

Maximum           150 Kg

Back Filling Rock shall be used for:

Back Filling of caisson and concrete block of revetment

d)     **Crushed Stone Rock**

This shall be evenly graded between the following limits:

Minimum           50 mm

Maximum           150 mm

Crushed rocks shall be used for seating layer for caisson quay wall on top of the graded rock base of caisson and concrete block foundation.



e) Quarry-run

This shall be evenly graded between the following limits:

Minimum 5 mm

Maximum 100 mm

Quarry-run shall be used for rock backfill behind caisson.

A bulk sample of 8 to 10 ton total weight, or such other size as the Engineer may determine, for each type of graded rock shall be displayed in a prominent place for reference in assessing the quality of rock delivered to the Site.

These samples shall be first separated into various sizes and average measurements of length, breadth and height determined for each size. The rock for each average size shall be weighed and its proportion of the weight of the whole sample determined.

The various sizes shall then be re-mixed, placed on a level concrete pad and fenced round with a label indicating the rock grade prominently displayed.

The gradings by weight and by average size shall be notified to the Engineer.

**20212**  
**Sand Protection**  
**Sheet for**  
**Caisson Quay**  
**walls**

Material for the sand release protection sheet to be used in the joints between caissons shall be of laminated soft polyvinyl chloride (PVC). The quality of sheet shall be conformed to the following specification.

**TABLE 20200.4 QUALITY OF SAND PROTECTION SHEET**

Item	Specification	Test Method
Specific Weight	1.3 ± 0.05	JIS K6350
Tensile Strength N/mm <sup>2</sup>	more than 7.36	JIS K6723
Tear Strength N	more than 2.55	JIS K6301
Elongation (%)	more than 180	JIS K6350

**20213**  
**Geotextile Sheet**  
**for Caisson**  
**Quay walls and**  
**Revetments**

The "Geotextile Sheet" shall be of approved non-woven filter sheet and shall be composed of polyester, polypropylene, polyethylene, polyamide or a combination of the above. The geotextile shall have the following properties:

**TABLE 20200.5 GEOTEXTILE SHEET**

Item	Specification	Test Method
For Geotextile		
Thickness	3.00mm (min)	(ASTM D4632-91)
(a) Mean Grab Tensile Strength : test in both direction	1200N (min) in each direction	(ASTM D4632-91)
(b) Mean Grab Extension at Maximum Load	30% (min) 80% (max)	(ASTM D4632-91)
(c) Mean Trapezoidal Tear strength	500N (min)	(ASTM D4632-91)
(d) Puncture	780N (min)	(ASTM D4632-91)

	Resistance	
(e)	Drop Test (400kg rock dropped from 1.5m height onto the designed stone layer laid on top of the geotextile)	No puncturing of geotextile
(f)	UV Resistance	Geotextile shall retain 80% of minimum Grab Tensile Strength after one year exposure to sunlight
	Equivalent Opening size	200 microns (max) (ASTM D4751-87)
	Permittivity	1.1 sec <sup>-1</sup> (ASTM D4491-92)
	Weight (g/m <sup>2</sup> )	400 (min) (ASTM D5261-92)

**20214  
Materials for  
Asphalt Mat**

**20214.1 Shape**

The asphalt mat is the one which was form in mat-shape by burying a core material and a lift material for the reinforcement in mixing asphalt, a filler, sand, and macadam.

The desing thickness of the mat is 8 cm, and it manufacturing allowable error is + 0.5 cm.

**20214.2 Quality of Asphalt**

Prior to use of asphalt, the Contractor shall submit a certificate of quality and a statement showing a specific gravity and temperature characteristics of viscosity for the approval of the Engineer.

**20214.3 Reinforcement core material**

The reinforcement core material uses the glass fiber net which did asphalt processing or resin processing.

It makes the reticulations of the glass fiber net from 1 cm to 4 cm.

It links the joint of the net sufficiently and the pull strength of the joint doesn't become below the strength of the Standards Department.

The strength of the standard section is shown in following table.

**TABLE 20200.6**

NAME OF TEST	VELOCITY OF DISPLACEMENT	SPACE OF GRIP	STANDARD STRENGTH
Tensile Test	100 -300 mm/min	150 -250 mm	70 kg/25 min

**20215  
Materials for  
Asphalt  
Concrete**

**20215.1 Quality Asphalt**

Prior to use of asphalt, the Contractor shall submit a certificate of quality and a statement showing a specific gravity and temperature characteristics of viscosity for the approval of the Engineer.

**20215.2 Quality of Aggregate**

Both the coarse aggregate (particles retained on a 2.5 mm test sieve) and the fine aggregate shall be hard, durable and clean and free from clay and organic matter or

other impurities. In the coarse aggregate retained on a 2.5 mm test sieve, the content of flat or long pieces shall not exceed 10 percent by weight.

The quality of coarse aggregate shall meet the test requirement for specific gravity absorption and abrasion loss specified by JIS A 5001. These tests shall be carried out according to JIS A 1110 and JIS A 1121 or equivalent standard. If screening is to be used for fine aggregate, it shall be of particle size meeting the requirement specified by JIS A 5001. Fillers used in asphalt concrete shall be lime stone powder meeting the requirement specified by JIS A 5008.

For all of the above mentioned aggregate, the Contractor shall submit a statement or certificate showing the test result meeting the required quality standard for the approval of the Engineer prior to their use.

### **20215.3 Storage of Materials for Asphalt Concrete**

For temporary storage of asphalt in tank lorry, the temperature of asphalt shall be maintained at appropriate levels with the use of heaters if necessary.

The asphalt transported in drums shall be stored separately according to delivery date and manufacturer and in such manner as to permit easy inspection and shall be used in the order of delivery.

Aggregates in storage shall be separated by type or grade.

In storing aggregates, necessary measures shall be taken to minimize segregation and intermixing of deleterious materials and also to provide adequate drainage of the entire storage area. Fine aggregates and aggregates containing fine particles shall be covered with a tarpaulin, etc. for protection from rain water. Fillers shall be stored at the place of low humidity and shall be issued in the order of delivery. Fillers in bag shall be stored in warehouse with floors raised at least 30 cm above the ground.

### **20215.4 Materials for Subgrade**

Where the pavement is provided on fill, the subgrade fill material shall be as specified as follows.

The subgrade fill material or the existing soil subgrade shall be compacted to a dry density of not less than 95% of the Maximum Dry Density as determined by JIS A 1210 or ASTM D1195 at a moisture content  $\pm 1\%$  of optimum. Compactions shall achieve CBR values not less than those shown in Table 300.

### **20215.5 Materials for Subbase**

Materials for subbase with CBR > 30 shall be of crushed stones from unsuitable materials such as vegetable and deleterious substances and conforming to the following requirements and JIS A 5001. The subbase material shall be approved by the Engineer prior to its use in the Works.

Grading requirements for crushed stones by nominal size are shown in Table 20200.7 Crushed stones not conforming to the requirements may be used in combination with other aggregates, such as crushed stone, sand or mineral fillers, provided the combined grading complies with the requirements.

**TABLE 20200.7 GRADING REQUIREMENTS FOR CRUSHED STONES  
BY JIS A 5001**

Designation	Nominal Size (mm)	Amount Finer than Each Laboratory Sieve, Weight Percent							
		50 mm	40 mm	30 mm	25 mm	20 mm	13 mm	5 mm	2.5 mm
C-40	40 to 0	100	95 to 100	-	-	50 to 80	-	15 to 40	5 to 25
C-30	30 to 0		100	95 to 100	-	55 to 85	-	15 to 45	5 to 30
C-20	20 to 0				100	95 to 100	60 to 90	20 to 50	10 to 35

Notes :

- 1) The sieves in this table correspond to the Standard Sieves designated in JIS Z 8801: 50.8 mm, 38.1 mm, 31.7 mm and 25.4 mm in that order.
- 2) The plasticity index, PI, of the fraction of the subbase material passing the 0.4 mm sieve should not be greater than 6 when tested in accordance with JIS A 1205 and JIS A 1206 or equivalent standards.
- 3) The maximum particle size should preferably be smaller than 50 mm.

**20215.6 Materials for the Mechanically Stabilized Basecourse**

Materials for the mechanically stabilized base course CBR>80 shall be a mixture of one, two or three aggregates, which include crushed run 02, crushed rock with or without sand, in a proper ratio, free from unsuitable materials such as vegetables and deleterious matters and conforming to the following requirements and JIS A 5001.

- a) The grading shall conform to the requirements of Table 20200.8

The material shall be obtained as an all-in product of the stone crushers with the grading requirement or alternatively, two or three aggregates shall be blended to produce a mechanically stable grading.

**TABLE 20200.8 GRADING REQUIREMENTS FOR MECHANICALLY  
STABILIZED CRUSHED STONE BY JIS A 5001**

Designation	Nominal Size (mm)	Amount Finer than Each Laboratory Sieve, Weight Percent										
		50 mm	40 mm	30 mm	25 mm	20 mm	13 mm	5 mm	2.5 mm	1.2 mm	0.4 mm	0.074 mm
M-40	40 to 0	100	95 to 100	-	-	60 to 90	-	30 to 65	20 to 50	-	10 to 30	2 to 10
M-30	30 to 0		100	95 to 100	-	60 to 90	-	30 to 65	20 to 50	-	10 to 30	2 to 10
M-25	25 to 0			100	95 to 100	-	55 to 85	30 to 65	20 to 50	-	10 to 30	2 to 10

Notes:

- 1) The sieve in this table correspond to the Standard Sieves designated in JIS Z 8801: 50.8 mm, 38.1 mm, 37. mm, 25.4 mm, 19.1 mm, 12.7 mm, 4,760 μ , 2,380 μ , 1,190 μ , 420 μ and 74μ in that order.
- 2) The Plasticity Index, PI determined by JIS A 1205 and JIS A 1206 or equivalent standard of the fraction of the base materials passing the 0.4 mm should not be greater than 4.
- 3) The maximum particle size of aggregate should neither be greater than 40 mm nor be greater than one half (1/2) of the finished thickness of a single construction layer.

**20216  
Expansion  
Joints in  
Caisson and  
Revetment Cope  
Concrete**

The material of expansion joints shall comply with the Table as herein.

Typical physical properties of the expansion joint filler are given in Table 20200.9

**TABLE 20200.9 EXPANSION JOINT FILLER PROPERTIES**

	Item	Unit	ASTM 1751 - 79	
			10mm thick	20mm thick
Normal Condition	50% compressive strength	N/mm <sup>2</sup>	07 – 8.62	0.7. – 5.17
	Extrusion	mm	<6.4	<6.4
	Recovery	%	>70.0	>70.0
	Water absorption	%	<20.0	<15.0
	Resistance to handling		No deformation or break	No deformation or break
	Density	g/ sq cm.	>0.304	>0.304
After Weathering	Weathering Test		No desintegration 0.7 – 8.62	No desintegration 0.7 – 5.17
	50% compressive strength	N/mm <sup>2</sup>	<6.4	<6.4
	Extrusion	mm	>70.0	>70.0
	Recovery	%		

**20217  
Materials Used  
in Revetments**

**20217.1 Rock for Revetment**

Rock for revetments shall be hard, angular, sound and durable. It shall be free of laminations and weak cleavage or fracture planes and shall be of such a quality that it will not disintegrate or erode from the action of air, water, wetting and drying and impact due to current/wave actions. The Contractor shall carry out such tests as may be necessary to prove that it shall be capable of being handled and placed without fracture or damage and that it does not break down if traveled upon by equipment used to place it.

Individual pieces shall be prismatic in shape and the maximum dimension of rocks shall generally not exceed the minimum dimension of 10-250 Kg.

It will be the Contractor's responsibility to obtain all necessary permits, approvals etc. and to establish the suitability of the proposed rock material to the approval of the Engineer, and to provide and maintain all necessary temporary works, haul roads etc. required for the extraction, transport and placing of the rock, to the approval of the Engineer and relevant authorities.

**20217.2 Material for Revetment**

Material for replacement shall be free from vegetation, organic or other deleterious matter. The grain size of material for replacement shall not be cover spans the "possibility of liquefaction" range, shown in Figure 20200.1 and 20200.2.

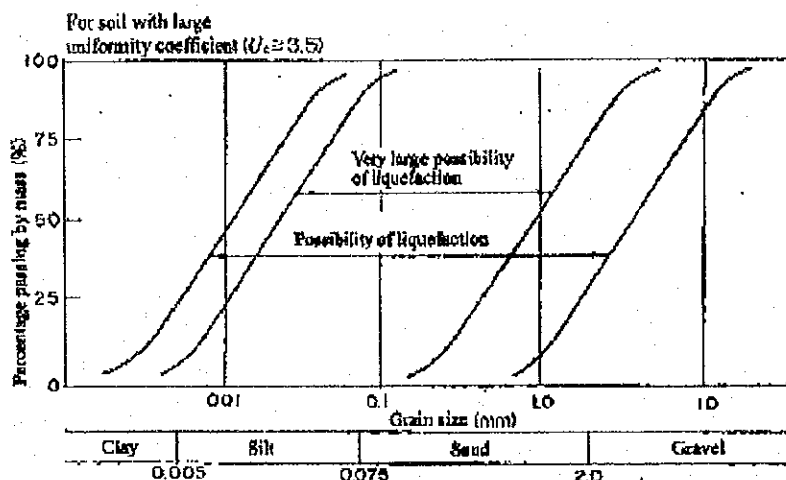


Figure 20200.1 Range of Possible Liquefaction ( $U_c \geq 3.5$ )

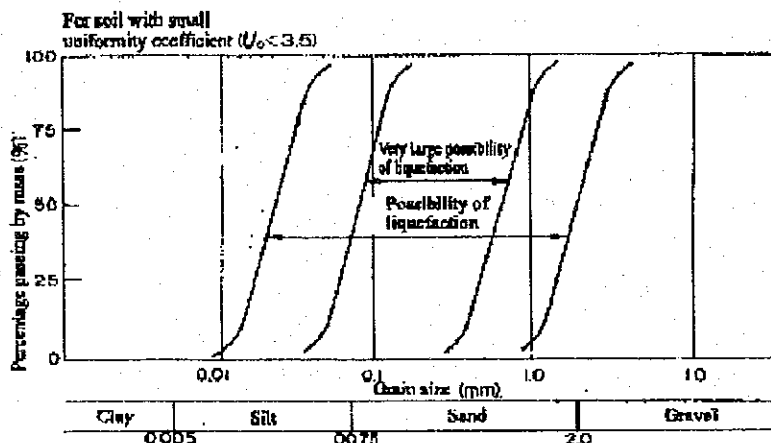


Figure 20200.2 Range of Possible Liquefaction ( $U_c < 3.5$ )

The grading of material for replacement shall comply with TABLE 20200.10. Tolerances shall be subject to the Engineer's approval.

TABLE 20200.10 Grading of Material

Seize Size (mm)	Percentage Passing
9.5	75
4.75	50
2.00	25
1.18	5

**20218  
 Gratings Used  
 for Open  
 Drainage,  
 Manholes and  
 Cat Walks for  
 Breasting  
 Dolphin**

Grating to be used for open drainages, manholes and cat walks for breasting dolphin station shall be shop made by cutting, processing, fabricating, welding and galvanizing steel plate.

Galvanization of gratings shall be as specified in JIS H 8641 or the equivalent standard.

The gratings shall be durable and sufficiently safe against a uniform load of

0.8 N/mm<sup>2</sup> and 0.5.6 N/mm<sup>2</sup> respectively.

The angle in contact with the grating shall be straight, and its surface flat.

The gratings shall be coated as directed by the Engineer.

The Contractor shall obtain prior approval of the Engineer for the type of material, manufacturing method and the strenght of the gratings.

**20219**

**Materials of  
Joint Filler**

Expansion joint Filler to be used for Cemment Concrete Pavement, specified is ASSHTO M33.