

TABLE OF CONTENTS

SECTION TS 21. GATES

21.1 GENERAL.....	TS 21-1
21.1.1 Scope of Work.....	TS 21-1
21.1.2 Submittals	TS 21-1
21.2 DESIGN OF GATES.....	TS 21-2
21.2.1 General	TS 21-2
21.2.2 Standards.....	TS 21-3
21.2.3 Loading Conditions	TS 21-3
21.2.4 Allowable Stresses.....	TS 21-4
21.2.5 Friction Coefficient	TS 21-5
21.2.6 Safety Factor of Mechanical Components.....	TS 21-6
21.2.7 Other Requirements.....	TS 21-6
21.3 MATERIALS	TS 21-6
21.3.1 General	TS 21-6
21.3.2 Structural Steel and Other Steel Materials	TS 21-7
21.3.3 Bronze Castings.....	TS 21-7
21.3.4 Rubber Seals	TS 21-7
21.4 MANUFACTURE	TS 21-8
21.4.1 General	TS 21-8
21.4.2 Castings	TS 21-8
21.4.3 Machine Work	TS 21-9
21.4.4 Balancing	TS 21-9
21.4.5 Small Bore Piping.....	TS 21-9
21.4.6 Joint of Structural Members	TS 21-10
21.4.7 Embedded Steelwork, Openings, etc.....	TS 21-10
21.4.8 Welding.....	TS 21-10
21.4.9 Lubrication.....	TS 21-11
21.4.10 Protection Coating.....	TS 21-11
21.4.11 Mechanical Equipment Parts.....	TS 21-11
21.5 PACKING, DELIVERY AND STORAGE.....	TS 21-12
21.5.1 Packing	TS 21-12
21.5.2 Delivery	TS 21-13
21.5.3 Storage at Site	TS 21-13
21.6 INSPECTION AND TESTING AT SHOP	TS 21-13
21.6.1 General	TS 21-13
21.6.2 Certificate of Inspection.....	TS 21-14
21.7 FIELD ERECTION AND TEST	TS 21-14
21.7.1 Field Erection	TS 21-14
21.7.2 Field Tests.....	TS 21-14
21.8 MAINTENANCE.....	TS 21-15
21.8.1 Maintenance Equipment and Special Tools	TS 21-15
21.8.2 Spare parts.....	TS 21-15
21.9 MEASUREMENT AND PAYMENT	TS 21-15
21.9.1 Drainage Sluiceway Gate.....	TS 21-15
21.9.2 Flap Gates for Drainage Outlets.....	TS 21-16

SECTION TS 21. GATES

21.1 GENERAL

This section covers the requirements for the slide gate, flap gates and all related facilities to be provided by the Contractor.

21.1.1 Scope of Work

The work shall include the design, material arrangement, manufacturing, testing, inspecting, painting, packing, insurance, transportation from the shop to the site (including customs clearance), storage, installation, in-situ tests and inspections, taxes, completion and rectification of defects in the gates as described in this section.

General descriptions of the gates are as follows:

Drainage Sluiceway Gate at WF 172 R +15m (1 No.)

(1) Gate Leaf

Type : Steel Slide Gate

Dimension : Clear span 1.60 m x Clear height 1.60 m

Sealing System: Top, bottom and sides at downstream side of gate

(2) Hoist System

Type : Single spindle

Operation : Manual

(3) Gate Guide Frame

Type : Steel Guide Frame (Bottom, Sides and Top)

Flap Gates for Drainage Outlets (1 No of each)

Steel Flap Gate (H=1.0m W=1.0m)

Steel Flap Gate (H=1.0m W=1.0m)

Steel Flap Gate (H=0.7m W=1.1m)

Steel Flap Gate (H=0.9m W=1.1m)

Steel Flap Gate (H=2.2m W=1.6m)

Steel Flap Gate (H=0.8m W=1.4m)

21.1.2 Submittals

The Contractor shall submit working drawings and shop drawings including relevant data showing details of gate structure to the Engineer, for approval, sixty (60) days before starting manufacture in accordance with Clause 1.4 of the General Specification. These drawings and data shall contain, but not limited, to the following items :

- General layout drawings of steel slide gates and steel flap gates;
- Detail drawings and data related to civil works such as the drawings showing the blockouts, foundations of the hoist, loading condition, size and location of anchor bars, hooks, etc;
- General and shop fabrication drawings, calculation sheets and data;

- Detailed drawings of gate leaf, guide frame, spindle, hoist and its appurtenant equipment, and all other parts of gate structure;
- Detailed drawings of flap gates, hinges, frame, seals and all other parts of flap gate structures;
- Erection instruction and test procedure at the shop and at the site;
- Qualification documents for welding procedure and for welder and welding operator's qualification;
- Painting specifications, colour scheme and painting sample; and
- Operation and maintenance instructions, spare parts list, and maintenance equipment and tools list.

The working drawings and shop drawings shall be prepared based on the Drawings or as directed by the Engineer, with complete design calculations showing how the details of gates as have been determined.

21.2 DESIGN OF GATES

21.2.1 General

- (a) Design of gates shall be carried out referring to the following design condition and the material requirements stipulated in clause 21.3.
- (b) Magnitude of loading effect shall be calculated as specified in this Specification or in accordance with good engineering practice if not specified. Where maximum and minimum are given, the selection of maximum or minimum shall be made so that it affects the result most unfavourably and provides the greatest factor of safety in design.
- (c) The design, dimensions and materials of all parts shall be such that they will not suffer damage under the most adverse conditions nor result in deflections and vibrations which might adversely affect the operation of the equipment.
- (d) Mechanism shall be so constructed to avoid sticking due to rust or corrosion.
- (e) All part which will have to be dismantled or which might have to be dismantled for purposes of servicing or replacement shall be held in place with non Cordoba fasteners.
- (f) The type, material and size of all fastener shall be selected to safely withstand the maximum superimposed load. Complete information regarding the design assumption, loading and operating conditions, deflections and unit stresses used in the design together with the appropriate drawings shall be provided by the Contractor to the Engineer.
- (g) It should be noted that this Specification and the Contract Drawings show only the outline of the structure and the governing dimensions and are not intended to define the exact details of the equipment to be furnished. All recesses required in this structure for alignment shall be determined by the Contractor upon the approval of the Engineer.
- (h) In all correspondence, in all technical schedule and all drawings, metric unit of measurement shall be employed. On drawings or printed pamphlets where other units have been used, the equivalent measurement shall be marked in addition.
- (i) In choosing materials and their finishes, due regard shall be given to the humid tropical conditions under which the equipment will be called upon to work. The Contractor shall submit details of his practices which have been proven satisfactory and which he recommends for application on the parts of

the plan which may be affected by the tropical and local conditions. The material and finishes used shall be approved by the Engineer.

- (j) The Contractor shall not make any change to the equipment or in the materials to be incorporated in the plant from that specified or implied by this Specification without the written approval of the Engineer. Such changes or alternations shall in no way be detrimental to the interests of the Employer and shall not result in any increase to the contract price.

21.2.2 Standards

- (a) Materials and methods of test shall be furnished and tested in accordance with the Standard Industri Indonesia (SII) or the Japanese Industrial Standart (JIS) or equivalent approved by the Engineer.
- (b) If the Contract Documents conflict in any way or all of the above standart or codes, the Contract Documents shall govern, only upon confirmation of the Engineer.

21.2.3 Loading Conditions

- (a) Effects of the following loads shall be combined so as to make the most unfavourable loading combination:
- (i) Water load corresponding to the specific water level acting on the specific side(s) or parts of the gates
 - (ii) Dead weight of the gates
 - (iii) All force components caused by friction and other effects
 - (iv) Buoyancy
- (b) The loads specified herein shall be considered as minimum requirements and the Contractor shall use additional loads and combination thereof which the he consider to be applicable and necessary.
- (i) Leaves applied
All loads applied during operating the slide gate due to the imposed loads of the hoist during normal operation or in gate jammed condition.
 - Hydrostatic Load
Hydrostatic load shall be of the water head difference between upstream and downstream sides of the water gate, slide gates and for the case of the flap gates with the river side level at design flood level and empty on the other side.
 - Dead weight
Reaction due to self weight and ballast weight mounted on the gate leaf, if any.
 - Sediment Load
Sediment load shall be of sedimentary depth of silt in front of the gates.
 - Operating Load (for slide gate)
Operating load for slide gates shall be as for hoist loads.
 - (ii) Hoist
The hoist shall be designed taking the following loads into account:
 - Dead weight of the gate leaf. Such connecting devices with the hoist as wire rope, sheave, spindle, etc., shall be included in the dead weight of the gate.
 - Friction force due to rolling and/or sliding parts.

- Friction force due to seal rubbers
- Buoyancy
- Uplift force and down pull force
- All loads imposed during raising the gate due to gate jammed condition.

21.2.4 Allowable Stresses

(a) Structural Steel

The allowable stresses for normal loading condition of structural steel members with a thickness of 40 mm or less shall be shown in the following table :

Table 21.1 – ALLOWABLE STRESSES FOR STRUCTURAL STEEL
(Unit: kgf/cm²)

	Steel Material	SS41	(Thickness < 40 mm)
(1)	Axial Tensile Stress (per net sectional area)		1,200
(2)	Axial Compressive Stress (per gross sectional area) Where; 1: Buckling length of member (cm) R: Radius of gyration of member (cm) Compressive splice member	1/r < 20 20 < 1/r < 93	1,200 1,200-75 x (1/r - 20) 1,200
(3)	Bending Stress (a) Bending tensile stress (per net sectional area) (b) Bending compressive (per net sectional area) Where; Aw : Gross sectional area of web (cm ²) Ac : Gross sectional area of compressive flange (cm ²) l : Supporting length (cm) b : Width of flange (cm) K : (3 + Aw/2Ac) ^{1/2} , if Aw/Ac < 2 K = 2 When directly fixed y kin plate	l/b < 9/K 9/K < l/b < 30	1,200 1,200 1,200-11 x (Kx l/b - 9)
(4)	Shearing Stress (per gross sectional area)		700
(5)	Bearing Stress		2,100

(b) Forged Steel and Cast Steel

Table 21.2 -- ALLOWABLE STRESSES FOR FORGED STEEL AND CASTE STEEL

(Unit: kgf/cm²)

Steel Material	SC46	SF45
Axial Compressive Stress	1,200	1,200
Axial Tensile Stress	1,200	1,200
Bending Stress	1,200	1,200
Shearing Stress	700	700
Bearing Stress	1,200	1,200

The above allowable stresses are applicable under the normal conditions.

(c) Concrete

Type C1 K250 will be utilised for sluice and for flap gate outlet structures. Allowable stresses under normal conditions are as follows:

Table 21.3 - ALLOWABLE STRESSES FOR TYPE C1 CONCRETE UNDER NORMAL CONDITION

Axial Compressive Stress	55 kgf/cm ²
Axial Tensile Stress	70 kgf/cm ²
Bending Stress	3.6 kgf/cm ²
Shear Stress	7 kgf/cm ²
Bearing Stress	60 kgf/cm ²

(d) Other allowable Stresses

Other allowable stresses which are not provided herein or allowable stresses of other materials shall be referred to the Engineer.

21.2.5 Friction Coefficient

Friction coefficient of rubber seals be as follows :

Table 21.4 – FRICTION COEFFICIENT FOR RUBBER SEAL

Rubber Seal Condition	Friction Coefficient	
	Maximum	Minimum
(a) Rubber on stainless steel plate in wet condition	0.7	0.5
(b) Rubber on stainless steel plate in dry condition	1.2	0.9

Other friction coefficients shall be referred to the Engineer.

21.2.6 Safety Factor of Mechanical Components

All mechanical components including spindle, pin, gear, wheel, etc., shall be designed based on the following safety factor to be applied to the ultimate strength of the materials. (Table 21.3)

Table 21.5 -- SAFETY FACTOR FOR MECHANICAL COMPONENTS

Material	Safety Factor for Tensile Stress	Safety Factor for Compressive Stress	Safety Factor for Shearing Stress
Rolled steel for general or welded structure	5	5	8.7
Carbon steel forgings	5	5	8.7
Carbon steel for machine structural use	5	5	8.7
Corrosion-resisting steel	5	5	8.7
Carbon steel castings	5	5	8.7
Grey iron castings	10	3.5	10
Bronze castings	8	8	10

21.2.7 Other Requirements

(a) Minimum Thickness of Steel Plates

Except for appurtenances, all significant parts of components of structures shall be constructed by using at least 6 mm thickness steel plates. The minimum thickness of rolled shapes can be at least 5 mm thickness. These minimum thickness shall be considered including the corrosion allowance specified in the next paragraph.

(b) Corrosion Allowance

Gate leaves, guide frames, and other parts which contact with water shall take the corrosion allowance of 1.0 mm into consideration. Corrosion allowance may not be taken for corrosion resistant metals and ferrous embedded in concrete.

21.3 MATERIALS

21.3.1 General

(a) All materials shall be new and of first class quality conforming to the requirements of JIS and SII or equivalent approved by the Engineer, and be suitable for the purpose, free from defects and imperfections, and of the classifications and grades listed herein, or their equivalents.

(b) Defective material shall not be repaired and used in the construction of the equipment without the prior approval of the Engineer. No peening, caulking, or filling shall be permitted in repairing cracks, pinholes, or blowholes. Defects in welds shall be repaired by chipping out to sound metal and rewelding. For defects in casting, the method of repair shall be mutually agreed upon by the Contractor and the Engineer.

- (c) The Contractor shall not make any change to the materials from that specified or implied by this specification without the written approval of the Engineer. Such changes or alterations shall not result in any increase to the contract price.

21.3.2 Structural Steel and Other Steel Materials

- (a) Skin plate, guide plate and other structural steel plates shall be of SS400 specified in JIS G3101 or equivalent approved by the Engineer.
- (b) Channels for guide frame, main beam and vertical beam, round bar for spindle/stem and other steel shapes such as H-shape, flat bar and angle shall be of SS400 specified in JIS G3101 or equivalent approved by the Engineer.
- (c) Stainless steel plate for watertight sheet and other corrosion resisting plates, nuts, bolts and washers shall be of SUS 304 specified in JIS G4303 to G4307 or equivalent approved by the Engineer.
- (d) Steel pipe in small diameter shall be of SGP specified in JIS G3542, SUSTP specified in JIS G3459 or equivalent approved by the Engineer.
- (e) Forged steel shall be of SF45 specified in JIS G3021 or equivalent approved by the Engineer.
- (f) Cast steel shall be fully annealed and be of SC46 specified in JIS G5101 or equivalent approved by the Engineer.
- (g) Cast iron shall be of FC25 specified in JIS G5501 or equivalent approved by the Engineer.
- (h) Carbon steel for machine structural use shall be of S35C specified in JIS G4051 or equivalent approved by the Engineer.

21.3.3 Bronze Castings

- (a) Bronze casting shall be BC2 specified in JIS H5111 or equivalent approved by the Engineer.
- (b) Phosphor bronze casting shall be of PBC2 specified in JIS H5113 or equivalent approved by the Engineer.
- (c) Aluminium bronze casting shall be of ALBC2 specified in JIS H5114 or equivalent approved by the Engineer.
- (d) Lead tin bronze casting shall be of LBC2 specified in JIS H5115 or equivalent approved by the Engineer.

21.3.4 Rubber Seals

Rubber seals shall be moulded from high grade, grade type compound. The basic polymer shall be butadiene and styrene, or a blend or both. The compound shall contain not less than seventy percent (70%) by volume of the basic polymer, and the remainder shall consist of reinforcing carbon black, zinc-oxide accelerations, anti-oxidants, vulcanising agents and/or plasticizer. The compound shall have the following physical properties. (Table 21.6)

Table 21.6 -- PHYSICAL PROPERTIES OF RUBBER SEAL

Property	Limits
Tensile strength	150 kgf/cm ² minimum
Ultimate elongation	300% minimum
Durometer hardness	40 to 80
Specific gravity	1.1 to 1.6
Water absorption (70 C for 48 hours)	5% maximum by weight
Compression set (as a percent of total original deflection)	30% maximum
Tensile for strength after oxygen bomb ageing for 48 hours at 70 C	80% minimum tensile strength before ageing

21.4 MANUFACTURE

21.4.1 General

- (a) All workmanship shall be of the highest class throughout the works to ensure smooth and vibration free operation under all possible operating conditions, and the design, dimensions and materials of all parts of the plant shall be such that the stresses to which they may be subject shall not render them liable to distortion, undue wear, or damage under the most severe conditions encountered in service.
- (b) All parts of the plant shall conform to the dimensions shown on and shall be built in accordance with working drawings approved by the Engineer. All joints, datum surfaces, and matching components shall be machined and all castings shall be spot faced for nuts. All machined finishes shall be shown on the Drawings. All screws, bolts studs and threads for pipes shall conform to the latest standards of the International Organisation for Standardisation (ISO) covering these components and shall conform to the standards and size system accepted and incorporated in the Contract.

21.4.2 Castings

- (a) All castings weighing 226.8 kg or more shall have test coupons attached from which test specimens may be prepared. The number, size and location of the test coupons shall be to the approval of the Engineer. Faulty material or materials found to be inferior to that specified shall be rejected and removed at once, and shall not be used in any part of the Plant.
- (b) All casting shall be dense, sound and true to pattern, of workmanlike finish and uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage, cracks or other injurious defects, and shall be satisfactorily cleaned for their intended purpose. All castings shall checked for defects before final machining.
- (c) Casting shall not be repaired, plugged, or welded without permission of the Engineer. Such permission will be given only when the defects are small and do not adversely affect the strength, use or machinability of the castings. Excessive segregation of impurities or alloys at critical points in a casting will be cause for its rejection. The largest fillets compatible with the design shall be incorporated wherever a change in section occurs.

- (d) Surfaces which do not undergo machining and are exposed in the final installation shall be dressed to provide a satisfactory appearance so that they will not require surface smoothing at Site prior to painting.

21.4.3 Machine Work

- (a) All tolerances, allowances and gauges for metal fits between plain cylindrical parts shall conform to the appropriate standards for the class of fit as shown or otherwise required. Sufficient machining stock shall be allowed on locating pads to ensure true surfaces of solid material. Bearing surfaces shall be true and exact to secure full contact. Journal and sliding surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to ensure proper operation when assembled. Parts entering any machine shall be carefully and accurately located and drilled from templates.
- (b) Surfaces finished shall be indicated on the Contractor's drawings and shall be in accordance with the appropriate standards. Compliance with specified surface will be determined by sense of feel and by visual inspection of the work compared to standard roughness specimens, in accordance with the provisions of the above stated standards.
- (c) So far as is practicable, all works shall be arranged to obtain proper machining of adjoining unfinished surfaces, they shall be chipped and ground smooth, or machined, to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown on the Drawings and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts may be filled in an approved manner.
- (d) Pin holes shall be bored to gauge, smooth and straight, and at right angles to the axis of the member. The boring shall be done after the member is securely fastened in position. Pins shall be of hardened and ground steel and positively held in position. Wheels or rollers for use in gates shall be mounted on removable pins and have self lubricating bushings and brass washers.

21.4.4 Balancing

All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds and at any load up to the maximum, there shall be no excessive vibration due to lack of such balance and the plant shall operate with the least possible amount of noise.

21.4.5 Small Bore Piping

- (a) All necessary studs, bolts, screws, nuts washers, gaskets, packing, supports, etc., required in connection with the field assembly of the piping system, shall be supplied by the Contractor. All gaskets and packing shall be of approved material and of type that has proved satisfactory for the service conditions, to which they will be subject.
- (b) Piping shall be installed in the locations, elevations, and to the lines shown on the working drawings. All lines shall be sloped to allow drainage at the low point.
- (c) All piping unions, flexible joints and dismantling flanges shall be fitted where necessary to facilitate installation or maintenance of equipment, as directed and approved by the Engineer. The Contractor shall supply and install all pipe hangers, brackets and supports required for support of piping, including drilling and caulking for expansion anchors or inserts in concrete.

21.4.6 Joint of Structural Members

- (a) The connections between each structural member shall be made by means of bolting or welding and designed in such a manner that all forces are transmitted by one of such method of connection as bolting or welding. No sharing load by two types of connection shall be accepted.
- (b) When bearing type bolts are used, they shall be so proportioned that unthreaded part of the bolts shall resist the load at the reamed holes of the materials together with washers having a minimum of 5 mm thickness. For all sloping surfaces, bevelled washers shall be provided. For high strength tensile bolt connections, lock nuts and washers shall be provided.
- (c) All edges of plates to be welded shall have the edge prepared by machine or other approved methods so as to be suitable for the type of weld employed. Sheared edges of all stress carrying plates shall be flattened to at least 3 mm.

21.4.7 Embedded Steelwork, Openings, etc

- (a) The Contractor shall supply and install all anchors, fasteners, embedded steelwork, piping, conduits and sleeves associated with that required for the equipment being provided and installed under this Section, except as otherwise provided in this Specification and Drawings
- (b) The Contractor shall show the location and full details of all embedded components on his drawings and shall be responsible for the completeness and accuracy of his drawings.

21.4.8 Welding

- (a) Welding shall be carried out in accordance with the requirements of the American Institute of Steel Construction (AISC) or approved equivalent and shall conform to the standard code of the American Welding Society (AWS) or equivalent approved by the Engineer.
- (b) The Contractor shall submit, for approval, details of the experience and qualifications of proposed welders. The welders shall have sufficient experience and qualifications for welding work, and hold certificates issued by "Balai Latihan Kerja, Departemen Tenaga Kerja (Employment Training Centre, Department of Labour)" or other approved training course approved by the Engineer.
- (c) When so directed by the Engineer, welded seams shall be tested by radiographic test specified in JIS 3104 or other testing method approved by the Engineer.
- (d) Field welding shall not be performed under adverse weather conditions of rain, temperature, moisture and wind unless the welding work is protected in an approved manner.
- (e) The welding electrodes shall conform to JIS Z3211 to Z3211 or equivalent approved by the Engineer.
- (f) If the workmanship is not satisfactory to the Engineer, the welding shall be chipped out to sound metal, tested and repair-welded, subject to approval of the Engineer. The welding work containing such defect shall be inspected and tested all along the line by the same method used first as instructed and to the satisfaction of the Engineer.

21.4.9 Lubrication

- (a) Provision shall be made for lubricating all bearings including ball and roller bearings, by a pressure gun system. All lubrication nipples shall be readily accessible.
- (b) Where accessibility to a bearing for lubricating purposes is so hard, provision shall be made for remote lubrication of safe access to the lubrication point. Ball and roller bearings shall be packed with grease during initial assembly.
- (c) All bearings and gear cases shall be made grease and oil-tight and drip pans shall be provided where necessary to prevent excess oil or grease dripping to the floor or deck. The oil and grease shall be of a type available in Indonesia as approved by the Engineer. The type available in Indonesia shall be investigated by the Contractor himself.

21.4.10 Protection Coating

- (a) The Contractor shall carry out the protective coatings approved by the Engineer in accordance with Section TS20, Protective Treatment of Metalwork, system 1, of the Technical Specification.
- (b) Bronze, brass, machined parts surfaces of gear teeth, finished ferrous surfaces, surfaces in rolling or sliding contact after field assembly and hoist ropes shall not be painted. All corrosion resisting steel surfaces for bearings and machinery parts shall not also be painted.

21.4.11 Mechanical Equipment Parts

The mechanical equipment and parts shall conform to the following requirements unless otherwise specifically mentioned :

(a) Gearing

All gears shall be machine cut, preferably by hobbling, from solid blanks and, wherever possible, they shall be a forced fit on their shafts. The minimum requirements for materials are as follows :

Table 21.7 – MINIMUM REQUIREMENTS FOR GEAR

(i)	Wheels	Rolled or forged steel
(ii)	Pinions	Rolled or forged steel
(iii)	Worm Wheels	Steel with bronze rims
(iv)	Worms	Steel or forged steel

Where worm gearing is used as a first motion drive, it shall be designed to have the same load and time rating as the driving motor so as to prevent undue movement and to have oil tight removable housings with lubrication oil plug, drain cock and oil level indicator. The temperature rise of the oil bath, when measure by thermometer, shall not exceed 40' C.

All gear wheels and pinions shall be completely covered by steel or other metal guards, unless effectively guarded by adjacent structures.

Key in gear trains shall be so fitted and secured that they cannot work loose.

(b) Manual Operating Devices

The operation force on the manual operating device shall be less than 10 kgf under normal design condition. The diameter of the handle shall be 600 mm

in maximum which shall be located within 600 to 800 mm in height from the operation deck.

(c) **Structural Base Frames of Hoist**

The structural base frame of hoist shall be of all welded steel construction using rolled structural shapes and plates. Necessary anchor bolts and nuts for the base frames be supplied by the Contractor.

(d) **Screwed Spindles**

The screwed spindles having a minimum diameter of 40 mm shall be made of corrosion resisting steel which shall be machine-cut with trapezoid thread at the necessary length. Lock nuts shall be provided to limit the upper and lower travelling of gate leaf.

(e) **Spindle Supports**

The spindle support for each hoist mechanism shall be provided at proper position(s) to avoid the buckling of spindle due to over loading force when the gate is jammed or closed.

The support shall be removable to permit drawing out the gate from hoist deck opening. Corrosion resisting steel bolts, nuts and washers shall be used for fixture of the support.

21.5 PACKING, DELIVERY AND STORAGE

21.5.1 Packing

- (a) Each items shall be packed properly or protected for shipment from the manufacturer's shop to the site.
- (b) Each crate or package shall contain a packing list in a waterproof envelope and a copy in triplicate shall be forwarded to the Engineer prior to delivery. All items of material shall be clearly marked for easy identification against the packing list.
- (c) All cases, packages, etc., shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating them to the appropriate shipping documents.
- (d) Cases which cannot be marked as above shall have metal tags with the necessary marking on them. The metal tags shall be securely attached to the package with strong steel wire or equivalent.
- (e) The Engineer shall be reserve the right to inspect the packing before delivery to the Site. The Contractor shall be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not relieve the Contractor of responsibility for any loss or damage due to faulty packing.
- (f) All packing materials shall remain the property of the Contractor and shall be removed from the Site at the earliest opportunity and be disposed at places/areas instructed by the Engineer.
- (g) The shipping mark shall consist of the following information in sequence and in frame commensurate with the size of container:
 - (i) Consignee
 - (ii) Contract No.
 - (iii) Port of Destination
 - (iv) Item number, if applicable package number in sequence, and quantity per package
 - (v) Description of contents
 - (vi) Net and gross weight, cubic measurement

21.5.2 Delivery

- (a) The Contractor shall deliver all plant including Contractor's equipment provided under this Section to the Site in adequate time for its preparation and erection according to the construction time schedule.
- (b) No part of the plant and Contractor's equipment shall be delivered to the Site until approval in writing has been obtained from the Engineer for such delivery.
- (c) Notification of such delivery shall be given to the Engineer in writing not later than thirty (30) days prior to the actual shipping date for any equipment to be shipped. Each notification shall include a complete shipping list of the contents of each package to be delivered and shall indicate the expected date of delivery and the serial number for each component to be used for identification and copies of the insurance policy arranged for it.
- (d) The Contractor shall be responsible for the receipt at the Site of all deliveries for the purpose of the Contract.
- (e) The Contractor shall at his responsibility inspect the cargoes at the Site upon arrival of the cargoes and shall report in writing the particulars, quantities, conditions, damages, if any, of the cargoes to the Engineer within three (3) days after arrival.

21.5.3 Storage at Site

- (a) The Contractor shall be responsible for all routine maintenance, i.e., lubricating, inspection and adjusting of all equipment of the plant, until the issuance of certificate of completion.
- (b) The Contractor shall arranged at his own expense for covered storage or other protection of all materials and equipment against corrosion and mechanical damage. Any corrosion and damage that may occur to any item of the plant shall be made good before that item is to be installed.
- (c) The Contractor shall provide all drainage and weather protection for storage of the plant to meet the requirements of the Engineer.
- (d) The minimum requirement is that all items shall rest on wooden blocks with elevated base of at least 150 mm above floor or ground level. No item shall rest directly on the floor or the ground.
- (e) All cases containing important machinery and electrical parts shall be stored in the warehouse which shall be provided by the Contractor.
- (f) Weatherproof items and structural steel members may be stored in the open, but in all instances shall be protected to the Engineer's approval. The Contractor shall be responsible for the adequacy of all protection.

21.6 INSPECTION AND TESTING AT SHOP

21.6.1 General

- (a) The Engineer shall be entitled at all reasonable times during manufacture to inspect, examine and test on the Contractor's premises, materials and workmanship of all gate to be supplied under the contract, and if part or whole of the said gates is being manufactured on other premises, the Contractor shall obtain for the Engineer permissions to inspect, examine and test. The Contractor shall submit an outline of the procedures of test he plans to perform to demonstrate fulfilment of the requirements of the Works.

- (b) The Contractor shall provide the Engineer with five (5) copies of all inspection and test report for every shipment/delivery, together with the written application for issuance of the Certificate of Inspection within thirty (30) days after completion of such inspection and test.

21.6.2 Certificate of Inspection

- (a) As soon as the inspection and test as specified above have been satisfactorily complete and the corresponding report have been accepted by the Engineer, the Engineer will issue a "Certificate of Inspection" for every shipment/delivery in which he shall certify the date on which the said inspections and test have been completed. Issuance of such inspection certificate shall not release the Contractor from any of his obligations under the Contract.
- (b) All deficiencies revealed by the test and inception shall be rectified by the Contractor at his own expense and to the approval of the Engineer. Rectified components shall be subject to retesting and reinspection.

21.7 FIELD ERECTION AND TEST

21.7.1 Field Erection

- (a) All gates shall be erected and installed by utilising conventional techniques and practices. The Contractor shall submit, to the Engineer for approval, a field erection plan showing method of installation, equipment to be used, and schedule of installation. All gate components shall be assembled and installed as shown on such approved field erection plan. Item to be embedded in secondary concrete shall be supported rigidly in lines and position shown on the said plan.
- (b) All rubber seals shall be accurately attached on the skin plate as shown on the drawings and the gate leaf shall be installed with such special care that side and bottom rubber seals shall uniformly contact on the watertight sheet of the guide frame.
- (c) The hoist for the slide gate shall be placed at the correct position of the operation deck. The spindle and the spindle case shall be then installed and fixed with secondary concrete.
- (d) All parts shall be stored on wooden blocks with a minimum clearance from the ground of 0,15 m.
- (e) Flap gates shall be installed at outlets in the blockouts in accordance with the approved working Drawings. Supporting hinges shall be correctly positioned in blockouts so provided and fixed rigidly to anchor previously set in the blockouts to prevent movement during placement of the secondary concrete.

21.7.2 Field Tests

After installation, each gate will be tested under dry condition in the presence of the Engineer. The slide gate and hoist will be operated several times to ensure proper operation. Water-tightness of gate shall be tested in due time under with-water condition.

Flap gates will be visually inspected under dry conditions. The flap gates shall be opened and closed to demonstrate proper action under simulated flow conditions and proper sealing under no-flow conditions.

21.8 MAINTENANCE

21.8.1 Maintenance Equipment and Special Tools

The Contractor shall furnish one (1) lot of maintenance equipment and special tools sufficient for the proper maintenance of the slide gate and flap gates. The cost of maintenance equipment and special tools shall be deemed to be included in the lump sum prices entered in the priced Bill of Quantities.

21.8.2 Spare parts

(a) The Contractor shall furnish spare parts as listed below :

- (i) For the steel slide gate, two (2) sets of watertight rubber seal with appurtenant bolts, nuts and washers.
- (ii) For the gates, two sets of rubber seals with appurtenant bolts nuts and washers.

(b) Any spare part supplied shall be packed or treated in such a manner as to be suitably stored in the climate at the Site for a period of not less than five (5) years, and each part shall be clearly marked with its description and purpose on the outside of the packing.

21.9 MEASUREMENT AND PAYMENT

21.9.1 Drainage Sluiceway Gate

Payment for the slide gate and hoist shall be made following completion and testing of the gate in accordance with the Specification and to the approval of the Engineer at the lump sum prices as entered in the priced Bill of Quantities which shall be full compensation for the cost of all materials, labour, equipment, maintenance tools and spare parts and incidental costs for completing the work in accordance with the Drawings and the Specification.

Measurement shall be made of the anchor bars and metal guide frames and converted to mass in kilograms based on the cross sectional areas of the steel sections used and the density of the parent metal.

Payment for anchor bars and metal guide frames shall be made at the rate entered in the priced Bill of Quantities which shall be full compensation for the cost of all materials, labour, equipment and incidental costs for completing the work in accordance with the Drawings and the Specification.

The following pay item shall be measured and paid for under this clause:

Pay Item No.	Description	Unit of Measurement
F.2.12	Furnishing and Installing Slide Gate, H=1.6 m x W=1.6 m	L.S.
F.2.13	Furnishing and Installing Hoist	L.S.
F.2.14	Furnishing and Installing Anchor Bars and Metal Guide Frames	kg
F.2.15	Furnishing and Installing Hand Rail and Ladder (with anti-corrosion painting)	kg

21.9.2 Flap Gates for Drainage Outlets

Measurement will be made of the number of steel flap gates installed in accordance with the Drawings and the Specifications and approved by the Engineer.

Payment for the various sizes of flap gates shall be made at the rates entered in the priced Bill of Quantities which shall be full compensation for the cost of all materials, labour, equipment, maintenance tools and spare parts and incidental costs for completing the work.

The following pay item shall be measured and paid for under this clause:

Pay Item No.	Description	Unit of Measurement
G.3.1	Furnishing and Installing Steel Flap Gate (H=0.7 m x W=1.1 m)	No.
G.3.2	Furnishing and Installing Steel Flap Gate (H=0.8 m x W=1.4 m)	No.
G.3.3	Furnishing and Installing Steel Flap Gate (H=1.0 m x W=1.0 m)	No.
G.3.4	Furnishing and Installing Steel Flap Gate (H=1.0 m x W=1.0 m)	No.
G.3.5	Furnishing and Installing Steel Flap Gate (H=0.9 m x W=1.1 m)	No.
G.3.6	Furnishing and Installing Steel Flap Gate (H=2.2 m x W=1.6 m)	No.
G.3.7	Furnishing and Installing Stop Log (H=2.6 m x W=1.2 m)	No.

DIVISION C

TECHNICAL SPECIFICATION, OTHER WORKS

TABLE OF CONTENTS

SECTION TS 22. MAINTENANCE EQUIPMENT

22.1	GENERAL	TS 22-1
22.2	SUBMITTALS	TS 22-1
22.3	REQUIREMENTS	TS 22-1
22.3.1	Backhoe	TS 22-1
22.3.2	Truck	TS 22-1
22.3.3	Bulldozer	TS 22-1
22.3.4	4 WD Patrol Car	TS 22-1
22.3.5	Outboard Motor Boat	TS 22-2
22.4	MEASUREMENT AND PAYMENT	TS 22-2

SECTION TS 22. MAINTENANCE EQUIPMENT

22.1 GENERAL

This section of the Technical Specification covers the requirements of maintenance equipment to be supplied by the Contractor.

All equipment shall be complete, new, of first class quality and suitable for the intended applications and shall comply with all regulatory requirements in Indonesia.

All equipment shall be delivered to the site or to other location in the City of Semarang as directed by the Engineer.

All equipment shall be from well-known suppliers with established histories of sales and service and shall have full-time representatives in Indonesia for the purposes of after-sales service.

Documentation to be supplied with each item of equipment shall include, but not be limited to, ownership documentation, warranties and guarantees, log books, operation and maintenance manuals, coupons for routine after-sale service (if applicable) and other documents normally supplied with such equipment.

All equipment supplied shall be complete with special tools and spare parts as recommended by the manufacturers for a minimum of two years of normal operation.

22.2 SUBMITTALS

The contractor shall supply with his bid technical specifications of each of the various items of equipment to be supplied.

22.3 REQUIREMENTS

Equipment shall meet the following minimum technical requirements.

22.3.1 Backhoe

The backhoe shall hydraulic, crawler-mounted back-acting excavator. The bucket volume shall be not less than 0.35 cubic metres. The swing radius shall be not less than 2.1 metres.

22.3.2 Truck

The truck shall be a dump truck with a load capacity of at least 8 tonne. The tipping mechanism shall be hydraulic and operable from the cabin or externally. The truck shall be suitable for transporting spoil excavated from the river and transporting it over public roads.

22.3.3 Bulldozer

The bulldozer shall be a crawler-mounted dozer having an operating mass of not less than 11 tonne, a rated power of not less than 78 kW and a blade width of not less than 3.0 metres. All dozer controls shall be hydraulically operated.

22.3.4 4 WD Patrol Car

The patrol car shall be a 4-wheel drive, 5-seat, motor car, powered by a diesel or petrol engine. The vehicle shall be complete with all standard accessories plus a

low-bar suitable for the towing and launching of the outboard motor boat described below.

22.3.5 Outboard Motor Boat

The outboard motor boat shall be of sufficient size and of sufficient power to carry a minimum of 5 persons at a speed of 25 knots. The boat shall be of aluminium or glass-reinforced plastic construction of length not less than 5 metres. The hull shall be of rugged construction with all-round fenders, shall have in-built buoyancy tanks and shall be operated from a forward position with remote steering and motor controls.

The motor shall not less than 100 hp.

The boat shall be supplied complete with all equipment for the normal and safe operation and shall include, but not be limited to fuel tank, spare fuel tank, fenders, boat hook, 5 life jackets, ropes, anchor etc.

A purpose-made tilting road trailer fitted with a manually-operated winch shall be included. The trailer shall be of galvanised steel construction and be suitable for launching and retrieving the boat from a ramp.

22.4 MEASUREMENT AND PAYMENT

The following pay items shall be measured and paid for under this clause:

Payment for each of the items of equipment shall be made in accordance with the prices entered in the priced Bill of Quantities which shall include full payment for supplying the respective items of equipment.

Payment shall be made following delivery, testing, inspection and approval of respective items which are complete and in compliance with the requirements of this specification and the approved proposal for each item of equipment submitted by the Contractor with his bid.

Pay Item No.	Description	Unit of Measurement
J.1	Backhoe, 0.35 m ³	No.
J.2	Truck 8t	No.
J.3	Bulldozer, 11t	No.
J.4	Patrol Car, 4WD	No.
J.5	Outboard Motor Boat	No.

DIVISION D
TECHNICAL SPECIFICATIONS, BUILDING WORKS

SECTION TS 23. BUILDING WORKS

23.1 GENERAL

This section of the Technical Specification covers the general and specific requirements for building works.

For the purpose of this contract building works shall mean the following elements of the Gauging House as shown in the Drawings and referred to in Section TS 19:

- Hollow Block Masonry
- Plastering
- Waterproofing
- Steel Flush Door

23.2 SPECIFICATIONS FOR BUILDING WORKS

The building works shall be completed in accordance with the following specifications which are appended hereto.

ITEM OF WORK	SPECIFICATION
Hollow Block Masonry	AR 401 Unit Masonry
Plastering	AR 404 Cement Mortar
Waterproofing	07100 Waterproofing
Steel Flush Door	08110 Steel Doors and Frames

Painting of steel work shall be in accordance with Technical Specification TS 20, Protective Treatment of Metalwork, System 11.

23.3 MEASUREMENT AND PAYMENT

Measurement and Payment for Building Works will not be made exclusively and all costs incurred by the Contractor in complying with the requirement of this section shall be deemed to be included in the lump sum entered in the priced Bill of Quantities for Gauging House which incorporate the requirements of this section. These shall include the entire cost of completing the work including materials, labour, equipment, transportation and any other associated costs.

TECHNICAL SPECIFICATION FOR BUILDING WORKS: AR-0401-UNIT MASONRY

1.0 DESCRIPTION OF WORK

This work shall consist of hollow block unit masonry laid contiguously in mortar, including all related masonry work as indicated in the Drawings and/or herein specified.

2.0 REFERENCE STANDARDS

- a. Persyaratan Umum Bahan Bangunan di Indonesia (PUBI-1982).
- b. Peraturan Beton Bertulang Indonesia (NI-2, 1971).
- c. Australian Standard (AS).
- d. Standar Industri Indonesia (SII).
- e. American Society for Testing and Materials (ASTM).
- f. Technical Specification AR-0404 - Cement Mortar.

3.0 GENERAL PROCEDURES

3.1 Samples

Samples of unit masonry shall be submitted for approval before deliveries are commended.

All subsequent deliveries shall generally be up to the standard of the approved samples.

Spot samples of representative batches may be ordered periodically by the Engineer.

3.2 Handling and Storage

Care shall be taken in unloading, stacking and handling of materials, and any damage incurred thereby shall cause the unit masonry to be affected. Therefore they shall be replaced by the Contractor at no cost.

Unit masonry shall be stacked under cover and off the ground. Cement materials shall be stored in a weatherproof, ventilated shed upon platforms above the ground and effectively protected from weather or moisture unit used. Logistically it shall be first in - first out.

All unit masonry shall be brought to the site and stored. Storage shall be arranged in a manner as to keep the blocks dry, either by tarpaulin or shed roof or combination of same.

Unit masonry shall be stored at secure place without giving disturbance at flow of work.

Blocks stored in contact with ground shall not be used. Storage shall be free from water (dried place).

4.0 MATERIALS

4.1 Brick Unit Masonry

Brick unit masonry shall be made from fine material and shall conform with PUBI and/or SII.

Minimum ultimate crushing strength over the gross area shall be 25 kg/cm².

Brick unit masonry shall have nominal dimension of 230 mm x 110 mm x 55 mm.

4.2 Cement Mortar.

Cement mortar shall conform with Technical Specification AR-0404. Cement mortar for concrete block masonry unless otherwise specified shall be composed of three (3) parts of sand : one (1) part of Portland cement. Waterproofed mortar shall be made by adding to the base mixture, a waterproofing compound such as Calbond or approved equal which shall be mixed in accordance with the manufacturer's direction, and as approved by the Engineer. Contractor must submit the sample of mixing materials.

4.3 Anchor Ties.

Anchor ties shall be of mild steel with dimensions as shown by the Drawings.

4.4 Reinforcement.

Stiffening members and columns shall be made in accordance with the Drawings. Reinforcing steel shall be in accordance with PBI (NI-2, 1971) and/or Technical Specification TS 3 in Division B.

5.0 CONSTRUCTION REQUIREMENTS.

5.1 General

Wall shall be classified as 150 mm thickness of brick unit masonry, laid contiguously in mortar and bonded as specified herein.

All units shall be laid with full mortar joints and all head, bed and other joints shall be completely filled with mortar.

5.2 Brick Laying.

All bricks shall be kept damp during construction and shall be laid in running bond pattern on a full bed of mortar. On one day, the brick unit masonry shall not exceed 100 cm in height. End of masonry shall be left in staggering steps and shall not clogged to prevent cracks in the future. Brick laying shall follow the proper regulation for which between one layer with the other shall have half length difference of brick length.

All joints between bricks shall be filled with mortar mix and joints shall be of the same spread and equal thickness. The average spread distance shall be 12.5 mm with a tolerance of 2.5 mm.

Brick unit masonry shall be dampened before laying, and before contact with mortar.

Vent block unit shall not be dampened before laying, however the surface shall be moistened before contact with mortar.

No damaged units shall be used.

Blockwork shall be built in a uniform manner in truly plumb and level courses, shall be true to vertical or battered lines. Corners and other advanced work shall be rack back and not raised above the general level more than 100 cm. The maximum vertical tolerance for out of vertical is 10 cm in 400 cm.

Where so described or directed, reveals and piers shall be built, fixing and/or railing blocks and embedded items, for the work of other trades shall be incorporated as the work proceeds in location as shown by the Drawings.

Brick shall be required to chip and/or level wherever necessary to gain the required heights.

Reinforcement shall be used at least every 300 cm in length of walls and at all piers, corners, plates, beams and others.

On places or openings where wooden or metal frames shall be installed, the brick unit masonry shall be left until it is strong enough to proceed with anchors, dowels and fastening devices for the frame, and shall be covered with concrete or grout.

All brick unit masonry on which ends bear a steel or concrete beam, shall be grouted with concrete to the bearing course, and shall also be reinforced with 8 mm diameter bar.

All embedded items associated with the main or secondary structure, shall be set in said grout at time of pouring.

5.3 Parging and Jointing

The inner surface of all face block shall be fully parged. Bed and head joints shall have square profiles, which shall be accomplished with a tool suitable for the purpose, joints in masonry below grade and in pipe tunnels above ceilings, behind cabinets, shelving and others, shall be struck smooth, and pointed with waterproof mastic below grade or equal water proofing agent, as approved by the Engineer.

5.4 Interior Wall and Partitions.

Jointing between brick wall and partition wall should be made carefully as shown in the Drawing or proposed and approved Shop Drawings.

5.5 Anchoring Doors and Windows

The adjustable steel fixing lugs supplied with metal window and door frames shall be anchored into suitable courses in the walls. Jambs in brick wall openings shall be plumbed true and any apertures between door/window frames and brick wall shall be mortared and neatly pointed. Wherever practicable, these items are to be built-in during wall construction.

Fischer or other type fasteners are permitted where concealed, or grouted in new opening.

Whenever needed, a Shop Drawing proposal must be submitted for approval by the Engineer.

5.6 Auxiliary Ancillary Items

5.6.1 Anchor Ties

Anchor ties shall be welded to structural steel members or embedded in concrete masonry at a maximum of 450 mm centres.

5.6.2 Reinforcements

- Stiffening members shall be located at every 12 m² wall area and corner.
- Stiffening columns shall consist of 4 reinforcement bars of 8 mm in diameter.
- Reinforcement concrete stiffening members to masonry walls and reinforcement lintels shall be in accordance with Technical Specification CS-0301.
- Stiffening columns shall consist of 4 reinforcement bar of 8 mm corner.

- Walls higher than 300 cm shall have also horizontal reinforcement bars consisting of 4 reinforcement bars of 8 mm in diameter.

5.6.3 Chases

Chases in block work for conduits and others shall be accurately cut as required, in positions and dimensions as directed in the Drawings and by the Engineer.

5.6.4 Reinforced Concrete Stiffening Members

Reinforcement concrete stiffening members to masonry walls and reinforcement concrete lintels shall be in accordance with Technical Specification TS 3 in Division B.

Stiffening members shall be placed at every 12 m² of wall surface or as in this case there shall be one stiffening member between columns.

5.6.5 Protection and Cleaning.

Architectural fixtures and finished surfaces shall be protected against damage during the progress of the works. Sills, jamb and heads shall be protected by casings as soon as built.

Newly laid block work shall be protected from the harmful effects of rapid drying, running or surface water and detrimental impact.

Newly laid block work shall be dampened continuously at least until 7 (seven) days after being laid.

5.6.6 Plaster

All plastering shall be carried out in accordance with the requirements of Technical Specification AR-0404.

**TECHNICAL SPECIFICATION FOR BUILDING WORKS:
AR-0404-CEMENT MORTAR**

1.0 DESCRIPTION OF WORK

This work shall comprise the supply of manpower, materials and machine mixers, and execution of all work for the cement mortar. It shall include but not limited to plastering of walls, grouting of stone masonry, jointing and waterproofing with the required quantity of admixtures. Such work shall be performed in accordance with the correct lines, grades and alignments as shown in the Drawings, or as determined by the Engineer.

2.0 REFERENCE STANDARDS

- a. American Society for Testing and Materials (ASTM).
- b. American Concrete Institute (ACI).
- c. Peraturan Beton Bertulang Indonesia (NI-2, 1971).
- d. Persyaratan Umum Bahan Bangunan di Indonesia (PUBI-1982).
- e. Technical Specification TS 3 in Division B.

3.0 GENERAL PROCEDURES.

3.1 Samples

Prior to construction, the Contractor shall submit to the Engineer samples of all materials for cement mortar work, for approval.

3.2 Delivery and Storage

All cement in bag or bulk shall be delivered and stored according to Technical Specification TS 3.

Fine aggregates shall be stored in a clean ground area, free of surface water runoff, provided the area has sufficient drainage and is free from foreign materials. Height of stockpile shall not exceed 1.20 m in order to prevent segregation.

4.0 MATERIALS

4.1 Cement

Portland cement of type I shall conform to and be tested according to the requirement of ASTM and SII, such as Cibinong or approved equal.

Portland cement shall be from one trade mark, unless otherwise specified by the Engineer.

4.2 Fine Aggregates

Fine aggregates shall be clean, hard, solid, rough edges and shall not contain harmful amounts of mud, clay or organic matters. Fine aggregate shall conform to and be tested according to ASTM C 33. Test shall start 30 days prior to the start of the work.

4.3 Water

Water for mixing shall be clean and free from harmful and deleterious substances such as alkali, acids, salt and other inorganic matters.

Water of known quality and suitable for human drinking consumption need not be tested. However, as the case may happen, all water except what as mentioned herein shall be tested and shall be approved by the Engineer.

4.4 Waterproof Admixture

Waterproof admixture for cement mortar shall be from approved product.

5.0 CONSTRUCTION REQUIREMENTS

5.1 Composition

Unless noted and/or shown on the drawings, cement mortar shall compose of Portland cement and sand or fine aggregate. The mortar shall have a compressive strength of at least 50 kg/cm² in 28 days. The proportions of Portland cement and sand for cement mortar shall be 1 cement and 3 sand, or as indicated on the Drawings.

Sample of mixture shall be tested and approved.

Waterproof admixture shall be applied in the cement mortar in accordance with the manufacturer's recommendations in order to provide effective waterproofing.

5.2 Mixing

All materials except water shall be properly mixed in a tight box or in an approved mortar mixer, until the mixture attained a uniform colour after which the correct amount of water shall be added and the mixing continued.

Mortar shall be mixed for the required quantity to be used and minimum mixing time shall be 1 to 2 minutes prior to application. Mixed mortar that is not used within the period of 45 minutes after mixing shall be discarded or rejected. Retempering will be strictly prohibited.

5.3 Application.

All surfaces to receive cement mortar shall be free of laitance, loose carbonate scale and other objectionable matter.

5.4 Inspection and Testing.

All works shall be free of access for inspection and testing. The Contractor shall provide assistance to the Engineer at all times necessary to get samples on completed finishes. Any portion found out unsatisfactory shall be repaired and worked out in same manner of what was previously done without any additional expense to the Owner.

**TECHNICAL SPECIFICATION FOR BUILDING WORKS:
AR-0705-WATERPROOFING**

1.0 DESCRIPTION OF WORK

This work shall include furnishing material, labour, tools and installation of waterproofing at places as indicated in the Drawing.

The works shall include but not be limited to the following :

- Exterior and interior horizontal waterproofing where shown
- Flashing and sealing treatment
- Setting flashing collars, clamping rings and like devices for pipe, conduit or structural penetration.

2.0 REFERENCE STANDARDS

- a. American Society for Testing and Materials (ASTM).
- b. Japanese Industrial Standard (JIS).
- c. Technical Specification AR-0404 - Cement Mortar.

3.0 GENERAL PROCEDURES

3.1 Samples and Technical Data

Prior to delivery, sample and technical data of materials to be used shall be submitted to the Engineer for review and approval.

3.2 Shop Drawing

The Contractor shall prepare and submit Shop Drawings for Engineer's approval. All Shop Drawings shall be submitted sufficiently in advance of field requirements to allow ample time for checking. All submittal shall be complete and shall contain all required and detailed information.

In the event of any discrepancy between one Drawing and another or between the Drawing and this Specification, the Contractor shall bring such a discrepancy to the attention of the Engineer for resolution.

3.3 Handling and Storage

All materials shall be delivered in good condition, free from any defect, and shall be completed with label, technical data and data required as specified.

All materials shall be orderly kept in their packages and shall be kept free from damage.

4.0 MATERIALS

4.1 General

All material for waterproofing shall come from a proven product approved by the Engineer.

4.2 Waterproofing.

Waterproofing membrane shall have a minimum 1.0 mm thick phable self-adhesive membrane composed of high strength polyethylene, factory coated on one side with a layer of rubberised asphalt.

It shall adhere tightly and permanently to the substrate to form a continuous water barrier without using job applied adhesives, hot materials, mechanical fastening or special equipment.

Waterproofing membrane shall have the following characteristics :

- Shall not rot or mildew,
- Withstands extreme climates,
- Shall have uniform thickness,
- Quick installation,

such as Bituthene 2000 or approved equal.

4.3 Primer

Primer for all concrete or masonry surface shall be from the same manufacturer of waterproofing membrane.

4.4 Screed

Screed material shall be in accordance with the requirement of cement mortar as specified in Technical Specification AR-0404.

4.5 Synthetic Rubber Coating

Synthetic rubber coating waterproofing shall be an organic solvent type composed mainly of neoprene rubber and hypalon rubber.

It shall adhere tightly and shall have a big advantage of being able to be used on all kinds of surfaces.

Synthetic rubber coating shall have the following characteristics :

- Light,
- It can be coloured,
- Flame retardant,
- It can be formed,

Such as NS Pearl by Nisshin Kogyo or approved equal. Colour shall be as determined by the Engineer.

5.0 CONSTRUCTION REQUIREMENTS

5.1 General

Installation work required in this Specification shall be performed only with manufacturer's authorised representative in attendance.

For surface with drain outlet, they shall have slope $\pm 1\%$ toward the drain outlet.

Prior to installation of the membrane. The drain outlet shall have been installed.

5.2 Installation.

5.2.1 Surface preparation

Smooth, monolithic concrete or masonry surfaces are required for proper membrane adhesion.

Surfaces shall be free of voids, spalled areas, loose aggregate and sharp protrusions, with no coarse aggregate visible.

Broom finishes shall not be used.

Concrete must be cured and dry before application of waterproofing membrane. Clean surface to removed dust, loose stones and debris by using broom, vacuum cleaner or compressed air.

5.2.2 Priming

Apply primer to designated concrete or masonry surface with a lambs wool roller in appropriate thickness as specified by the waterproofing membrane manufacturer.

Allow primer to dry or until tack free.

Prime only the area which will be covered with membrane in a working day. Metal or other dense surfaces do not require priming, but shall be clean, dry, free from loose paint, rust or other contaminants.

Areas not covered with membrane in 24 hours shall be re-primed.

5.2.3 Temperature

Apply waterproofing membrane only in fair weather when air and surfaces temperature are above 5°C.

5.2.4 Sealing Edges.

For vertical applications, waterproofing membrane should be applied over the edge of the slab or over the top of the foundation or parapet wall. If the membrane is terminated on the vertical surface, a reglet or counter flashing may be used or the membrane may be terminated on the concrete by pressing very firmly to the wall. Press edges with a metal or hardwood tool such as a hammer or knife handle.

Failure to use heavy pressure at terminations can result in a poor seal. Nailing of the membrane is usually not required.

Apply mastic or caulking to all vertical and horizontal terminations.

5.2.5 Sealing Seams.

All edge and end seams shall be overlapped at least 65 mm, or as recommended by the membrane's manufacturer.

For this purpose, a guideline shall be printed on the membrane.

5.2.6 Corner Details.

Cover all inside and outside corner with an initial strip a minimum of 30 cm wide centred on the axis of the corner, followed by the full with membrane application. Outside corners shall be free of sharp edges. Inspect surfaces adjacent to all corners and repair if necessary to provide a smooth dense surface. Inside corners shall receive a fillet formed with latex modified cement mortar and a double coverage of membrane as described above.

5.3 Protection

Waterproofing membrane shall be protected to avoid damage from other trades, construction materials or backfill.

Protection shall be used on foundation wall and horizontal surface with light traffic. Protect horizontal decks with heavy construction traffic with 3 mm asphalt hardboard.

For reinforced concrete structural slabs placed over the waterproofing membrane, a heavy protection layer such as 25 mm sand : cement screed or equivalent is recommended. Protection shall be installed the same day the membrane is applied or immediately after 24 hour flood testing. No waiting before backfilling or applying tapping slabs is necessary.

**TECHNICAL SPECIFICATION FOR BUILDING WORKS:
08110 – STEEL DOOR AND FRAME**

1.0 DESCRIPTION OF WORK

The work shall cover the furnishing of materials, labour, tools, equipment, fabrication and installation of steel door and frame as shown in the Drawings or as specified herein.

2.0 REFERENCE STANDARDS

- a. American Society for Testing and Materials (ASTM).
- b. Standar Industri Indonesia (SII).
- c. Japanese Industrial Standard (JIS).
- d. American Welding Society (AWS).
- e. Technical Specification TS 20 in Division B.

3.0 GENERAL PROCEDURES

3.1 Samples and Technical Data

Sample and technical data of proposed materials specified herein, shall be submitted to the Engineer for approval prior to delivery and fabrication.

Technical data shall be completed with mill certificate.

3.2 Shop Drawing

The contractor shall prepare and submit Shop Drawings showing details of various parts, method of suspension, dimensions and any other required details to the Engineer for review and approval.

3.3 Handling and Storage

Doors and frames shall be delivered in a package to prevent damage due to handling or weather. All parts of frame shall be packaged together. Each door shall be packaged individually.

Immediately after delivery, doors and frames shall be properly stacked and protected prior to and after installation.

3.4 Identification

Each door and frame assembly shall be marked with the appropriate door number which shall be die-stamped on the hinge jamb of frames and on the hinge edge of doors near the top hinge, and legible in the completed installation.

3.5 Hardware

The contractor shall submit to the Engineer for approval a comprehensive schedule of proposed hardware listing by each door and frame, using door numbers, clearly indicating manufacturer, catalogue number, design or pattern, material and finish for each item of hardware. Hardware samples shall be submitted to the Engineer for approval, as specified in Technical Specification 08700.

4.0 MATERIALS

4.1 Door and Frame

Steel door and frame shall be constructed from steel material complying to SII, AS, ASTM standard or equal which shall consist of the following materials :

- Steel plate for door panel in specified thickness and size.
- Steel profile for door frame in specified shape and size.

Steel door and frame shall be constructed and fabricated in accordance with the design and dimension as specified in the Drawings.

4.2 Hardware

All locks and fittings shall be corrosion proof, provided by one manufacturer, and shall have provision to be incorporated in a master key system by means of interchangeable cylinders, and shall be in accordance with the Technical Specification 08700.

4.3 Glass and Glazing

Glass and Glazing, if required, shall be in accordance with the requirements of Technical Specification 08800.

5.0 CONSTRUCTION REQUIREMENTS

5.1 Fabrication

5.1.1 Doors

Doors shall be nominally 45 mm thick, formed of two panels of minimum 1,2 mm thick, full flush to both faces of the frame, with seamless faces and bevelled vertical edges. Seams or vertical edges shall be welded continuous full length. Top and bottom edge seams shall be spot welded or continuous welded.

Internal stiffeners shall be spaced and specified by the Drawings and according to the approved Shop Drawings.

Adequate plate reinforcement shall be provided for hinges, lock boxes and other surface hardware.

Vision panel openings for glass lights in doors shall have fixed glass stops one side and removable glazing beads on the other side.

Where external doors have openings for glass panels, fixed glass stops shall be on outside door face.

5.1.2 Frames

Frames for doors shall be combination of steel profile as specified in the Drawings and the approved Shop Drawings. Frame shown fastened to the structure by means of exposed bolts shall have anchors fabricated to detail. Frames not otherwise shown shall have anchors fabricated to standard pattern for the wall construction indicated.

Adequate plate reinforcement shall be provided for hardware.

5.1.3 Installation

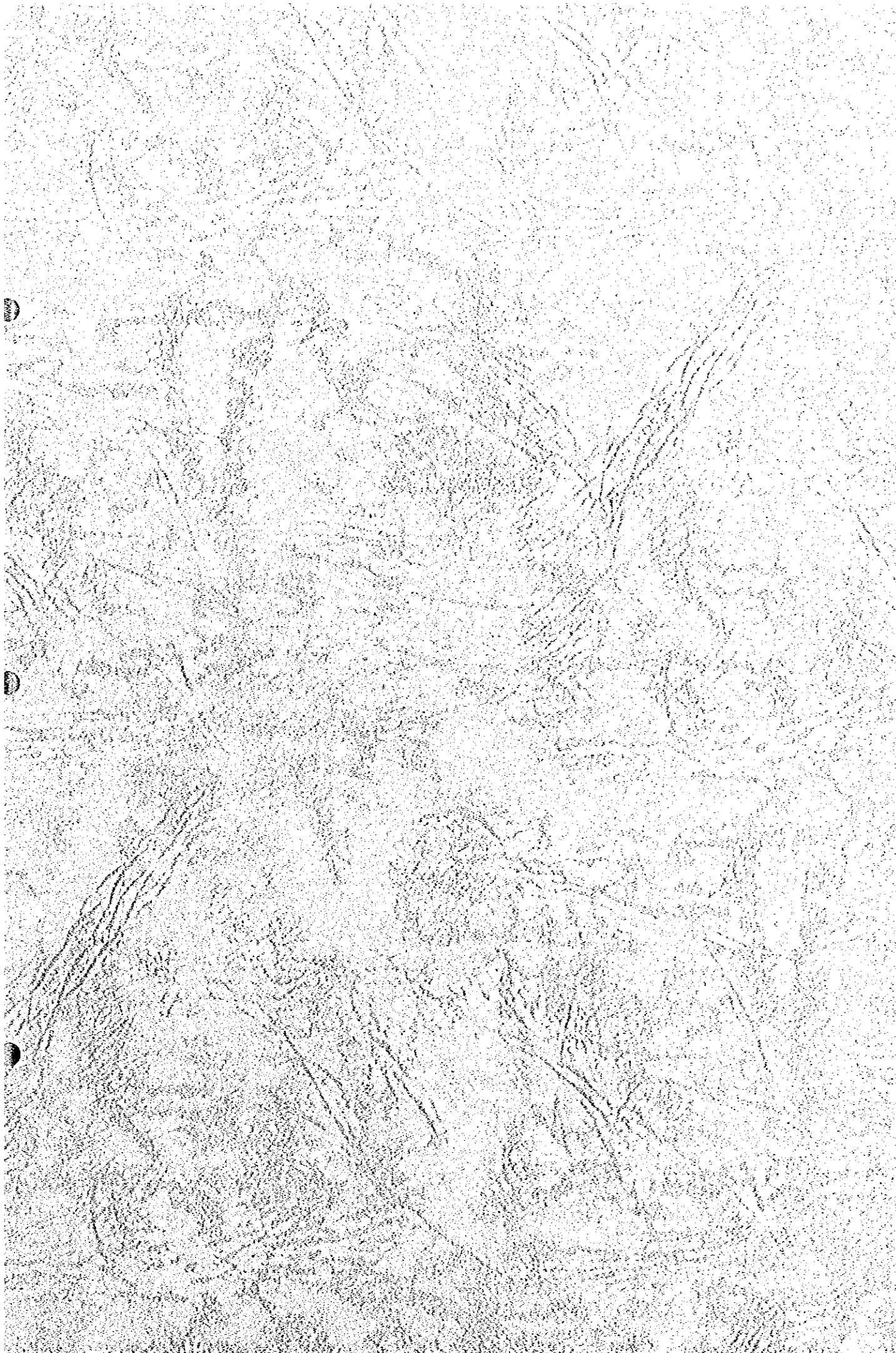
Frame shall be aligned parallel to the wall, vertical members shall be plumbed in two directions and horizontal head members shall be levelled. Frame anchors shall be built-in and fastened rigidly to the wall.

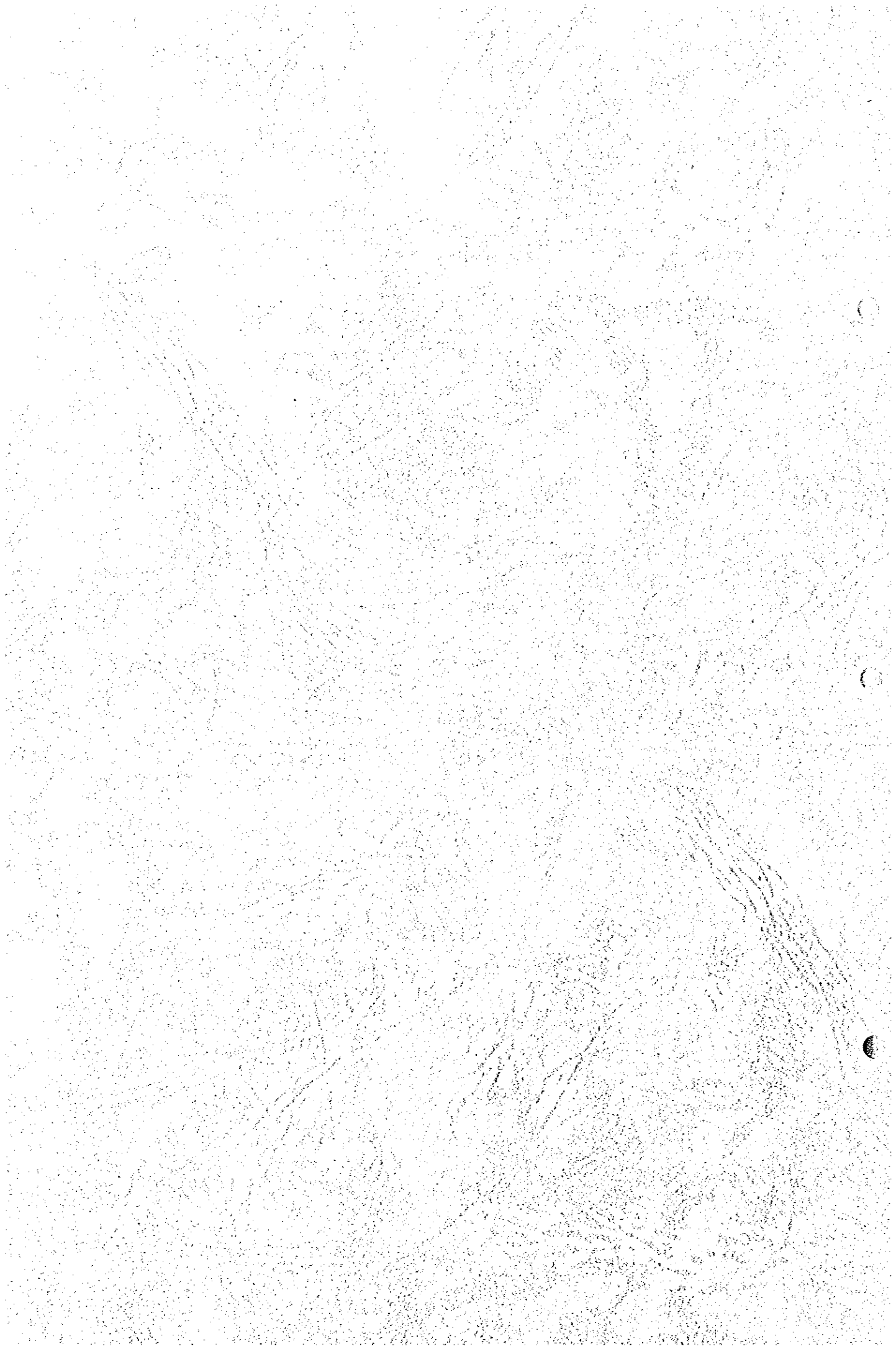
Welded unit frames shall have removable temporary spreaders fitted so that the spreaders may be easily removed after installation of the frames.

Doors and hardware shall be installed and adjusted to operate smoothly and freely without binding, sticking or excessive clearance. Openings for glass lights shall be left ready for glazing.

5.2 Painting

Where required to be rust-proofed by zinc chromate primer, all internal doors, door frames and reinforcing plates shall be shot blasted and thoroughly cleaned before treatment. The outer part of steel doors and frames shall be painted and finished in colour as directed by the Engineer. Primer and finish paint shall be in accordance with Technical Specification TS 20 of Division B.





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