

# **SPECIFICATION**

## **For Irrigation Projects**

### **CHAPTER – 26**

## **GATES**



**CHAPTER – 26**  
**GATES**  
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## CHAPTER – 26 GATES

**26.1**

IS:210 -1978  
IS:226 – 1975

IS: 306 – 1983  
IS:318 – 1962

IS: 800 – 1993

IS: 808 – 1973

IS: 816 – 1956

IS: 817 – 1987

IS: 819 – 1957

IS: 822 – 1970  
IS : 823 – 1964  
IS:1024-1968

IS : 1030 – 1982

IS : 1068 – 1976

IS : 1068 – 1968

IS : 1181 – 1967

IS: 1323 – 1959

IS : 1393 – 1961

IS : 1570 – 1961

IS : 2004 – 1978

IS : 2062 – 1980

IS : 2595 – 1978

IS : 2825 – 1969

IS : 3042 – 1965

IS : 4622 – 1978

IS : 4623 – 1984

IS : 5620 – 1978

IS : 5905 – 1970

IS : 6527 – 1972

IS : 6603 – 1972

IS : 7718 (Pt.I)  
- 1975

IS : 7718 (Pt.II)  
- 1978

IS : 7718 (Pt.III)  
- 1979

IS : 8500 – 1977

IS: 9349 – 1979

**REFERENCES**

Specifications for gray iron casting (reaffirmed in 1991)  
Specifications for structural steel.(Standard quality)  
(Superseded by I.S. 2062-1992)  
Specifications Bronze in gate & casting. (Reaffirmed in 1988)  
Specifications for loaded Tin Bronze & casting  
(Revised in 1981 and reaffirmed 19910  
Code of practice for use of structure steel in general building  
Constructions (Revised in 1984 and reaffirmed in 1981)  
Specifications for rolled steel beam, channel and angle sections.  
(Pt. III, V &VI) (Revised in 1989)  
Code of practice for use of Metal arc Welding for general  
Construction in Mild Steel. (Reaffirmed in 1992)  
Code of practice for Straining and resting of metal arc Welders.  
(Reaffirmed in 1991)  
code of practice for resistance spot welding for light Assemblies in Mild steel.  
(Reaffirmed in 1992).  
code of practice for inspections of welds. (Reaffirmed in 1991)  
code of practice for Metal Arc Welding of Mild steel.  
Code of practice for use of welding in bridge and structures.  
Subject to dynamic loading (Revised in 1979 and reaffirmed in 1992)  
Carbon steel castings for general engineering purpose (Revised in 1989)  
Specifications for carbon steel castings for general engineering  
Purpose. (Revised in 1985 and Reaffirmed in 1991)  
Electroplated casting of nickel & chromium Iron & Steels (Revised in 1985 and  
reaffirmed in 1991)  
Qualifying test for Metal arc Welders. (Superseded) By 7318 – 1974)  
Code of practice for Oxygen – Acetylene welding for structural Work in Mild steels,  
(Revised in 1982 and Reaffirmed in 1987)  
Code of practice for training & testing of oxygen acetylene welding  
(Reaffirmed in 1991)  
Schedule for wrought steels for general engineering purpose. (Reaffirmed in 1987)  
Specifications for steel forgings for general engineering purpose. (Revised in 1991)  
Specifications for structural steel. (Fusion Welding quality) Revised in 1992  
Code of practice for Radiographic Testing. (Reaffirmed in 1991)  
Code of practice for stress relieving of welding joints.(Reaffirmed in 1984)  
Specifications for single faced sluice gates. (200 mm to 1200 mm size)  
Recommendations for structural design of fixed wheel gates. (Revised in 1992)  
Recommendations for structural design for radial gates. (Reaffirmed in 1990)  
Recommendations for structural designs for low head slide gates. (Revised in 1985  
and reaffirmed in 1980)  
Specifications for sprayed aluminum and zinc coating on iron & steel  
(Revised in 1989)  
Specifications for stainless steel Roads. (Reaffirmed in 1992)  
Specifications for steel bars and flats. (Reaffirmed in 1991)  
Recommendations for inspection testing and  
Maintenance of fixed wheel and slide gates at  
manufacturing stage. (Revised in 1991)  
-do- at the time of erection. (Revised on 1991)  
-do- after erection. (Revised in 1991)  
Weldable structural steels medium and higher strength quality: (Revised in 1992)  
Recommendations for structural design of Medium and high Head Slide gates.  
(Revised in 1986 and reaffirmed in 1991)

IS : 10096 (Pt.I, Recommendations for structural design of Medium and high Sec.I) – 1963 Head Slide gates. (Revised in 1986 and reaffirmed in 1991)  
 IS : 10096 (Pt.III) -do- after erection. British Steel Corpn. Corrosion prevention - 1982 booklet No. 5 (Revised in 1992)  
 IS: 10210 – 1982 Specifications for hydraulic Hoist.

## **26.2 GENERAL**

### **26.2.1 Classification of Gates**

The gates shall be classified on the basis of water head above the sill level as below:

- a) High head gates – A gate which operates under a water head of 30 M and above
- b) Medium head gates – A gate which operates above a water head of 15 M but less than 30 m.
- c) Low head gates – A gate which operates under a water head of less than 15 M.

### **26.2.2 Types of Gates**

Under all water head conditions, different types of gates use in river valley projects shall be of following types.

- (a) Slide gates
- (b) Fixed wheel gates
- (c) Stoney or roller gates
- (d) Caterpillar gates
- (e) Radial Gates
- (f) Single faced Sluice gates

#### **26.2.2.1 Vertical lift Gates**

- (a) Slide gates
- (b) Fixed wheel gates
- (c) Stoney or roller gates
- (d) Caterpillar gates

#### **26.2.2.2 Redial gates or Tainter Gates**

- (a) Spillway gates

#### **26.2.2.3 Gates for Hydropower purpose**

- (a) Penstock or Conduit Gates
- (b) Draft Tube Gates
- (c) Bulk Head Gates

#### **26.2.2.4 Stop logs or Guard Gates**

### **26.2.3 Components & Material Specifications for different gates.**

The materials to be used in the fabrication/ manufacture of gates shall conform to relevant latest Indian Standards. For other items viz. castings/forging, manufactures test certificates shall be checked to ensure quality, if prescribed by the department. For bough out items viz. motor, wire ropes, bearings, bushings, seals etc. department shall specify in advance quality standards. The general components of various gates shall have following materials qualifications.

- (a) For fixed gates - As per Appendix A
- (b) For slide gates - As per Appendix B
- (c) For radial gates - As per Appendix C

### **26.2.4 Design Criteria**

The general design consideration for all kinds of gate, lays down that

- (a) The gate shall be closing type under its own weight
- (b) The gate shall be power operated or manually operated (if provided)
- (c) In case of regulation requirement, the gate shall be capable of being held in partially open position without cavitations and under vibration.
- (d) The gate should be reasonable water tight within the specific limits of 5 to 10 lit/minute/meter length of seal.

Following Indian Standards shall be referred for design aspects of various gates.

- (a) Fixed wheel gates - IS : 4622 – 1922
  - (b) Slide gates - IS : 5620 – 1978
  - (c) Radial gates - IS : 4623 – 1990
  - (d) Single faced sluices - IS : 3042 – 1965
- gates (200 – 1200 mm)

**26.2.5 Typical installation of various types of gates**

Following diagrams showing the typical installation of various types of gates are given:

- Fig 1 : Typical arrangement of various components of fixed wheel gates  
(Ref. Para 26.7.3.7 also)
- Fig. 2A: Typical diagram showing low head slide gates (full face gates frame)
- Fig. 2B: Typical diagram showing low head slide gates leaf.
- Fig. 2C: Typical diagram showing embedded frame of low head slide gate.
- Fig. 2D: Low head slide gate showing gate & frame.
- Fig. 2E: Low head slide gate-sealing arrangement (stop log with rubber seal).
- Fig. 2F: Low head slide gate-sealing arrangement (stop log with wood seal)
- Fig. 2G: Low head slide gate (with rubber & wood seal)
- Fig. 3A: Radial gate with parallel arm.
- Fig. 3B: Radial gate with inclined arm.
- Fig. 3C: Provision for elongation in anchors.
- Fig. 4A: Dimensions of single faced sluices 200 mm to 600 mm (rising type).
- Fig. 4B: Dimensions of single faced sluices 200 mm to 600 mm (non-rising type).
- Fig. 4C: Dimensions of single faced sluices 200 mm to 1200 mm (rising type).
- Fig. 4D: Dimensions of single faced sluices 200 mm to 1200 mm (non-rising type).
- Fig. 4E: Dimensions of single faced sluices 300x375 mm to 1050x1200 mm (rising type).

**26.3 SCOPE**

The scope of the specification laid down after is to make recommendations and issue guide lines in respect of hydraulic structures used on river valley projects for controlled releases of water. These gates are the steel structures and are manufactured through standard coded of practices involving selection of materials, fabrication under specified tolerance by welding/riveting inspection of manufactured assemblies and their accuracies, erection of gate components through embedment, with the help of embedded parts, into the civil structures and finally testing installation and final checks involved.

Following stages have been discussed in these specifications in all types of gates:

- (a) General workmanship
- (b) Manufacture/fabrication of gate structure/ components, embedded parts.
- (c) Shop assembly.
- (d) Erection-Inspection & Testing.

**26.4 General specifications for workmanship, welding/riveting finishing & painting of steel structures (Gates).****26.4.1 Straightening**

All materials shall be straight and if necessary before being worked shall be straightened and or flattened by pressure, unless, required to be of curvilinear form and shall be free from twists.

**26.4.2 Cutting**

**26.4.2.1** Cutting may be affected by shearing, chopping or sawing. Gas cutting by mechanically controlled torch shall be permitted for mild steel only. Gas cutting of high tensile steel shall also be permissible provided special care is taken to leave sufficient metal to be removed by machining so that all metal that has been hardened by flame is removed. Hand flam cutting shall be permitted subject to the approval of purchaser.

**26.4.2.2** Shearing, Chopping and gas cutting shall be clean, reasonably square and free from distortion. The edges shall be grounded afterwards if considered necessary.

**26.4.3 Holding**

**26.4.3.1** Holes through more than one thickness of the materials for members such as compound stanchion and girder flanges, where possible, be drilled after the members are assembled and tightly champed or bolted together. The punching shall be permitted before assembly, provided the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter. The thickness of the material punched shall not be greater than 16 mm.

**26.4.3.2** When the holes are drilled in one operation through two or more separable parts, these parts when so specified by the purchaser shall be separated after drilling & burrs removed. (IS : 800-1991)

**26.4.3.3** Matching holes for rivets and black bolts shall register with each other so that a gauge of 1.5 mm or 2 mm (as the case may be, depending on whether the diameter or rivets or bolts is less than or more than 25 mm) less in diameter than the diameter of the hole will pass freely through the assembled members in the direction at right angle to such members. Finished holes shall not be more than 1.5 mm or 2 mm (as the case may be) in diameter longer than the diameter of the rivet or black bolt passing through them, unless otherwise specified by the purchaser.

**26.4.3.4** Holes for turned and fitted bolts shall be drilled to a diameter equal to a nominal diameter of the shank or barrel subject to HB tolerance specified in IS:919-1990 Recommendations for engineering preferable, parts to be connected with close tolerance, shall be firmly held together by tacking bolts or clamps and the holes drilled through all.

The thickness at one operation & subsequently reamed to size. All holes not drilled at one operation shall be drilled to a smaller diameter and reamed out after assembly. Where this is not practicable, the parts shall be drilled and reamed separately through hard bushed steel jigs.

#### **26.4.4 Riveting**

**26.4.4.1** The rivets shall be heated uniformly throughout their length, without burning or excessive sealing, and shall be of sufficient length and of standard dimension. They shall, when driven fill the holes completely and if countersunk, the countersinking shall be fully filled by the rivet, any protrudeness of the countersunk head be dressed off flush, if required.

**26.4.4.2** Riveted members shall have all joints firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single or multiple riveted connections.

**26.4.4.3** All loose burned, or otherwise defective rivets shall be cut out and replaced before the structure is loaded and special care shall be taken to inspect single riveted connection.

**26.4.4.4** Wherever practicable, machine riveting shall be carried out by using machines of the steady pressure type.

#### **26.4.5 Bolting**

**26.4.5.1** Where necessary, washers used shall be tapered or otherwise suitable shaped to give the heads and nuts of bolts a satisfactory bearing.

**26.4.5.2** The threaded portion of each bolt shall project through the nut at least one thread.

**26.4.5.3** In all cases where full bearing area of the bolt is to be developed, the bolt shall be provided with a washer of sufficient thickness under the nut to avoid many threaded portions of the bolt being within the thickness of parts bolted together.

#### **26.4.6 Welding**

For welding of any particular type of joint, welders shall give evidence of having satisfactorily completed appropriate tests as described in the following relevant Indian Standards:

- (a) IS : 817-1991-Code or practice for training and metal arc welders.
- (b) IS: 7318-1974 AA qualifying tests for metal arc welders engaged in structural welding.
- (c) IS: 1393-1991 – Code of practice for training and testing of oxygen- acetylene welders.

All welding shall be in accordance with any of the following standards, as appropriate.

- (a) IS: 816-1992 – Code of practice for use of metal arc welding for general instruction in mild steel.
- (b) IS: 822 – 1991 – Code of practice for resistance spot welding for tight assemblies in mild steel.
- (c) IS: 822 – 1991 – Code of practice for inspection of welds.
- (d) IS : 823 – 1964 - Code of procedure for metal arc welding of mild steel.
- (e) IS : 1024 – 1992 – Code of practice for use of welding in bridges and structures subject to dynamic loading.
- (f) IS : 1023 – 1987 – Code of practice for Oxygen – Acetylene welding for structural work in mild steel.

#### **26.4.7 Casting and forgings**

**26.4.7.1** The castings and the forgings are the bought out items used in the gate installation and as such these are intended to be strictly as per the specified drawings. All such work shall be laid out to secure good matching between adjoining unfinished surface. Casting shall be cleaned and shall be chipped and ground free from projections. Defects in castings involving repair by welding, shall preferable be disallowed in case of large discrepancies. Castings with minor defects may be repaired by welding. But shall necessary be stress-relieved according to the requirement.

**26.4.7.2** The casting or forgings of non-ferrous nature shall conform to the following Indian Standards as appropriate.

- (a) The Stainless steel (Corrosion resistance Steel) used for pins embedded parts shall conform to;  
IS : 1570 – 1991  
IS : 6911 – 1991
- (a) IS : 210 – 1991 – Gray Iron casting (III revision)
- (b) IS : 306 – 1988 – Tin Bronze ingots and castings.
- (c) IS : 1030 – 1989 – Carbon steel castings for general Engineering purpose.



- (d) IS : 1570 – 1991 – Schedule for wrought steels for general Engineering purpose.
- (e) IS : 2004 – 1991 – Carbon steel forgings for general Engineering purpose.
- (f) IS : 2062 – 1992 – Structural steel (fusion welding quality)
- (g) IS : 2595 – 1991 – Code of practice for radiographic testing.
- (h) IS : 2825 – 1984 – Code of procedure for stress relieving of welding joints.

#### **26.4.8 Tolerances**

Fits and tolerances of various components and parts shall be according to the best shop practice keeping in view the functional requirement of the parts. Tolerances and allowances of the matching parts during manufacturing and erection have been recommended in relevant paras and also at appendix D and E.

#### **26.4.9 Paintings**

The code of practice laid down hereinafter, is to be adopted for protection of iron and steel structures against atmospheric corrosion under all climatic conditions.

##### **26.4.9.1 Surface preparation**

26.4.9.1.1 The surface shall be thoroughly cleaned and roughened by compressed air blasting or centrifugal blasting with a suitable abrasive grit. Immediately before spraying the surface shall be free from grease, scale, rust moisture or other foreign matter.

26.4.9.1.2 The roughness of blasted surface shall be specified by the department or a criterion of acceptability shall be laid down by the department on the basis of the adhesion test, the method of which is laid down in para 5.3.1 of IS : 5805-1991.

##### **26.4.9.2 Spraying**

26.4.9.2.1 The metal spraying shall be carried out without delay after the surface has been prepared by suitable grid blasting but in any case within such period that the metal is sprayed on to a surface within is still completely clean, dry and without visible oxidation.

If deterioration in the surface to be coated is observed, the surface preparation treatment shall be repeated on the surface in question.

26.4.9.2.2 The coating metal and its purity requirement shall be specified by the department as conforming to the IS : 2590-1992 and IS: 209-1992.

26.4.9.2.3 The surface to be sprayed shall be coated of uniform texture and free from lumps, coarse area and loosely adherent powder. The nominal thickness of the coating shall be specified by the purchaser with the limits of 100 to 300 mm. The minimum local thickness, department by the magnetic method described in IS:3203-1992, shall not be less than 75% of the specified nominal thickness.

26.4.9.2.4 Sealing and finishing coats wherever applied on zinc and aluminium to provide additional protection shall be applied without undue delay. Contamination of the sprayed surface with oil, grease, dirt, finger marks etc. shall be avoided.

26.4.9.2.5 The schedule of painting during different stages of manufactures, assembly, erection shall be specified by the department. The type of painting, number of coats, coverage rate, surface to be painted shall also be specified by the department. The method of painting viz. hand brushing, metal spray painting and metal paint qualifications shall be specified by the department in the tender specifications.

#### **26.5 Fixed Wheel And slide Gates - Manufactures**

##### **26.5.1 General**

For proper functioning of gates, the manufacturer shall lay down a quality control programme for each and every stage of manufacture. Certain criteria have been laid down which will facilitate proper installation and assembly, better maintenance and efficient working of the gates.

##### **26.5.2 Materials**

26.5.2.1 All materials and components required for the fabrication/manufacture of gate structures shall conform to the requirement of latest relevant Indian Standards. In absence of Indian Standard for any material or component, specifications must be laid down by department who may also specific the specifications for bought out items like bearings, castings, forgings, seals etc. However original manufacturers 'test' certificate for bought out item shall be referred.

26.5.2.2 All casting or forgings shall conform to the relevant Indian Standards.

26.5.2.3 Visual examination shall be carried out to find out the general soundness of casting and may if required be subjected to non-destructive tests.

**26.5.2.4** All forgings shall be suitably heat treated (if required) and shall be smooth and free from tool marks.

### **26.5.3 Welding**

**26.5.3.1** All Welding shall conform to the relevant to the relevant Indian Standards, Qualified welders according to IS: 7318-1974 shall be employed for welding work. Welding procedure for all major welds shall be drawn up and carried out. Test peaces may be made to ensure the soundness of the welding, if necessary.

**26.5.3.2** Visual examination shall be carried out of all welders joints to ensure that welding is free from.

- (a) Cracks on the surface of joints or parent metal located in the heated zones of the joint.
- (b) Undercuts in the parent metal.
- (c) Sponginess and porosity in the welding metal
- (d) Non-uniform width of fillet joints.
- (e) Mis-alignment and distortion of welded member and
- (f) Irregular reinforcing bads of weld.

**26.5.3.3** All major stress carrying parts of all welds shall be examined by non-destructive tests namely X-ray, ultrasonic etc. The stress relieving of part, if deemed necessary, shall be done as per procedure laid down in IS:2825-1984.

### **26.5.4 Manufacturing tolerances.**

The embedded parts and the gates shall be manufactured to such accuracy as are required for the safe and efficient operation of the gates. As a general guide following tolerances may be used.

#### **26.5.4.1 Embedded parts**

- (a) Deviation of any points on the face of seal seats or track from a 2.0 mm machined straight edge held against it shall not exceed 0.5 mm.
- (b) Variation in distance between the face of the seal seat and the face of its respective wheel track shall not exceed 1.0 mm.
- (c) Deviation from straightness of the guide track shall not be more than 2.0 mm in 2 metre length.
- (d) There shall be no off-sets or gaps at any adjoining field joints between seal seats, wheel track and guide tracks.

#### **26.5.4.2 Fixed Wheel Gates**


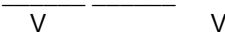
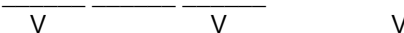
- (a) These gates shall be so assembled that when a machined straight edge is held against all the wheels on either side in zero position it will not be possible to insert a feeder gauge thicker than 1.5 mm between any of the wheel and straight edge.
- (b) The distance between the slide guide block or guide roller on one side of the gate to the corresponding guide block or guide roller on the other side shall not vary from the dimension shown on the drawing by more than 1.5 mm.

**26.5.4.3 Slide gates** – The gates and the components shall be so manufactured that on assembly the top side and top seal bases are in common plane within the tolerances as given below:

- (a) When s straight edge is held against seal bases, it shall not be possible to insert a 0.2 mm feeder gauge between the seal base and the straight edge.
- (b) When a machined straight edge is held against the metallic seal faces (after fixing metallic seals) it shall not be possible to insert 0.2 mm feeder gauge between seal face and the straight edge at any point.
- (c) The distance between the slide guide blocks or the guide rollers on either side of the gate shall not exceed the dimensions shown on the drawing by more than 1.5 mm.

### **26.5.5 Shop Assembly & testing for Gates Embedded parts.**

**26.5.5.1** The manufacturing tolerance shall include surface finish tolerances (when specified) as specified under IS : 696-1960

~>	-	80 microns
	-	40 – 80
	-	16-40
	-	up to 16 microns

(One micron = 0.001 mm)

**26.5.5.2** Shop assembly of embedded parts shall necessarily be done for high head gates. For medium and low head gates, it shall be done, if required.

**26.5.5.3** Gate shall be assembled complete with seal, wheels and guides either in horizontal or vertical position for proper alignment and inspection.

**26.5.5.4** Side guide blocks and rollers may be shimmed, if necessary, to maintain required tolerances.

**26.5.5.5** Variation in the distance between axes of each pan of seal seats, wheel tracks or side guide tracks for any gate shall not exceed 1.5 mm.

**26.5.5.6** Embedded parts shall be so assembled that the deviation of their axes from the respective alignment shall not exceed 1.5 mm.

**26.5.5.7** All the wheels of the gate be rotated times to ensure free movement.

**26.5.5.8** The marking and match marking shall be made before actual dispatch of the components.

## **26.5.6 Painting**

- 1) All the metal surface of the gate after thorough cleaning shall be given one coat of primary paint immediately. Each coat shall be allowed to dry or hardened thoroughly before the succeeding coat is applied.
- 2) Bronze, finished ferrous surface and hoist rope shall not be painted.
- 3) The unfinished interior surfaces of oil tank, and the unfinished surfaces of gates that will run in oil, shall be given 8 coats of oil resistant paint.
- 4) All finished surface of ferrous metal, including screw, threads that will be exposed during transport shipment or while awaiting installation shall be cleaned as specified and given a gray uniform coating of gasoline soluble rust preventive compound.
- 5) Field painting should be carried out at each stage step by step as it will be convenient with proper appropriate paints and the final painting shall be done after the complete assembly of gates.

## **26.6 FIXED WHEEL AND SLIDE GATES – ROPE DRUM HOIST**

### **26.6.1 General**

These specifications shall be applicable for rope drum hoists for all types of gates viz. Radial, fixed or slide gates etc.

### **26.6.2 Material**

**26.6.2.1** All material and components used in the manufacture or assembly of the hoist shall conform to the latest Indian Standards. The duty of the hoist shall be specified by the purchaser. The purchaser has to specify the quality and standard of material and components.

**26.6.2.2** All material used shall be of tested quality. Original manufactures test certificates for brought out items like the castings, forgings, worm reducers, wire ropes, motor and brakes etc. shall be furnished by the manufacturer of the hoist on demand.

**26.6.2.3** All castings and forgings used shall conform to relevant Indian Standards. Any repair to casting, if necessary, shall be carried out in accordance with the relevant Indian Standards. Forgings shall be free from any defect, tool mark and shall have smooth surface. Forgings used shall be heat treated where deemed necessary.

**26.6.3 Hoist Unit of gates and Checking.**

Following components of the hoist unit shall be checked.

- (a) Drive unit consisting of gear box, motor, brake, all mounted on a base frame.
- (b) Hoist drum and gear reduction unit mounted on a base frame and connected to drive unit by line shafts, limit switches and dial indicators.
- (c) Hoist rope, rope fixture with accessories.
- (d) Arrangement for manual operation of gate.
- (e) Control panel.
- (f) Any other components.

**26.6.3.1 Drive unit gear box** – It shall be checked for proper seating arrangement of the shafts oil in gear box.

**26.6.3.2 Hoist motor** – It shall be of approved manufacture capacity insulation and speed (R.P.M.) It shall conform to IS: 325-1991 unless otherwise specified and shall be checked for its performance. Manufacturer's test certificate shall be furnished for motor by supplier to purchaser.

**26.6.3.3 Brake** – It shall be of approved manufacture capacity. It shall be checked for alignment and tightness. Brake lines shall be of approved manufacture and shall conform to the approved specifications.

**26.6.3.4 Base Frame** – the base frame for mounting of drive unit/ gear reduction unit with hoist drum shall be checked for the dimensional accuracy.

**26.6.3.5 Hoist Drum** – This shall be checked for dimensional accuracy. Cast iron/cast steel drums shall be checked for below holes, cracks, etc. specially at groove centers. Fabricated drums shall be checked for stress relieving in approved manner. Rope grooves shall be checked for orientation. Arrangement of rope attachment to the drum shall be checked for security.

**26.6.3.6 Reduction unit gear box** – It shall be checked for proper assembly, dimensional accuracy, sealing finish of machined parts, and surface preparation for painting gears, pinions and other internal components shall be checked for alignment. Meshing of gear and pinion teeth shall be checked for alignment. It shall also be checked.

For contact surface and backlash by suitable methods such as applying a thin film of paint or grease on either pinion of gear wheel and running the assembly and noting the impression, Gears and pinions shall be checked for hardness. Tolerances of gears and pinions shall conform to IS : 919 – 1987 and backlash shall conform to IS: 4460-1991.

**26.6.3.7 Line shaft** – It shall be checked for straightness and other dimensions the straightness shall be in accordance with relevant Indian Standards. Mounting of couplings shall be checked for alignment.

**26.6.3.8 Limit Switch** – It shall be checked for satisfactory operation. It shall be weather proof.

**26.6.3.9 Dial Indicators** – It shall be checked for satisfactory operation and accuracy.

**26.6.3.10 Hoist Rope** – It shall be of approved manufacture and shall conform to relevant Indian Standards. The rope shall be checked for diameter, length, freedom and kinks, proper thimble end, connections and splicing. If the wire ropes are of galvanized type. The galvanization shall be in accordance with class II of IS : 1573-1991. Manufacturer's test certificates shall be furnished on demand by supplier for hoist ropes.

**26.6.3.11 Rope Fixtures** – It shall be checked for dimensional accuracy and their corrections.

**26.6.3.12 Arrangement for manual operations** – It shall be checked for satisfactory operation. It shall be ensured that the gates are kept at required position during their travel for specified speed as envisaged in the design and specified for operational requirements of the gate.

**26.6.3.13 Control panel** – Panels shall be checked for their suitability for the purpose envisaged in the specification. The checks shall include items such as weather proofing of conducting wires, proper construction of panels, high voltage tests, insulation resistance of cable calibration of meters, earthing of installation, checking of connections and concealment if required.

**26.6.4 Lubrication of Gears and Bearings**

**26.6.4.1** For gears and points lubricating oil/grease or lubricating compound used shall be of approved grade and quality.

**26.6.4.2** Bearing closed from outside and open outside from inside shall be checked for splash lubrication and bearing cover shall be free from leakage. For bearings closed from both sides. Proper injection of grease of approved quality and grade shall be checked.

**26.6.5 Inspection of hoist assembly and checks**

**26.6.5.1** The assembled hoist shall be checked for the following:-

- (a) Quality of workmanship
- (b) Overall dimensions
- (c) Optimum sound and vibrations
- (d) Speed of operation allowing for variation in accordance with Indian Standards.
- (e) Any mechanical jamming.

**26.6.5.2** Painting of different compounds of hoist shall be according to relevant Indian Standards.

**26.7 FIXED WHEEL & SLIDE GATE – ERECTION**

**26.7.1 General Inspection**

**26.7.1.1** It shall be ascertained that the gate parts received at the site of erection have been manufactured/fabricated according to the drawings and have necessary markings of shop inspection. It shall be ensured that all exposed surface of embedded parts are protected by painting, greasing etc. The surface of embedded parts in contact with concrete shall be free from greases, paints etc. for better bonding with concrete. A coating of cement wash/cement latex may be given, if necessary.

**26.7.1.2** Dimensional difference, If any shall be accounted for before erection and the drawings corrected accordingly for erection. Critical dimensions shall be worked out from the drawings.

**26.7.1.3** The reference lines, center line of openings and levels relations to the completed civil structure shall be established on site so as to facilitate erection at proper locations.

**26.7.1.4** Shall be ensured that the various component of the hoisting arrangement such as motors, reduction gear assembly, switches, wire ropes and shafting are provided according to the specifications.

**26.7.2 Inspections of block outs**

Concreting behind the gate groove may be done in one or two stages. If done in two stages, it shall be ensure that correct blocks are kept for accommodating the gate parts as manufactured according to the specifications/drawings. It is also to be ensure that the required dowel bars having adequate length are left out in the block outs. The entire block out is roughened to ensure proper and necessary bondage to the second stage concreting.

**26.7.3 Inspection of embedded parts**

**26.7.3.1** It shall be ensured that the sill beam is correctly positioned both in level and location. All the nuts and bolts of anchorages of sill beam shall be tightened so as to prevent dislocation during and after concreting.

**26.7.3.2** The embedded part that is track plates, guides, seal seats, gate groove lining etc. shall be checked when all parts are in final position at least upto double the gate height, in one operation. The check shall be carried out both in location and levels, with respect to sill beam already established in the position. Each part shall be first individually and thereafter relatively with the other parts. It shall be ensured that the manufacturing tolerances, as specified are considered while creating these parts and even after accounting these tolerances, the erection work is carried out according to the provisions in design and drawings.

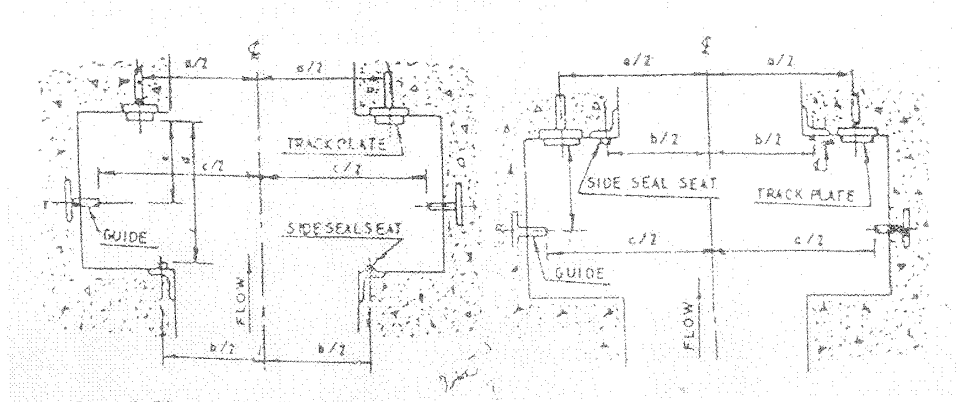
**26.7.3.3** The track plates and seal seat shall be absolutely in true alignment. The alignment shall be checked by means of a plump bob feeler gauge or micrometer, preferable at each 300 mm intervals from bottom to topside of the gate opening. Alternatively, diagonal checking or any other satisfactory method may be adopted for checking the alignments. (This check requires special attention).

**26.7.3.4** After having checked the track plates and seal seats on both sides, it shall be ensured that they are in their respective planes. It shall also be checked that top seal seat, wherever provided, shall also be in the required plane. (This check requires special attention).

**26.7.3.5** Guide and counter guide, if provided, shall be checked for true location and alignments.

**26.7.3.6** Groove lines and corner protection angle, when provided, shall be checked for true location and alignment.

**26.7.3.7** Following critical dimensions shall be checked at intervals of 300 mm from bottom to double the gate height. (See Fig. A & B)



- a) Center to center distance of track plates.
- b) Center to center distance of side seal seats.
- c) Face to face distance of guides.
- d) Face of track plate to face of the side seal seat &
- e) Face to face plate to center line of guide.

**Note –1** Use of suitable template for checking (d) & (e) (See fig. A & B) is recommended to maintain corresponding portions of vertical embedded parts from sill level up to top of embedded parts.

**Note – 2** Above double the gate height, the checking interval may be increased to one metre.

**Note – 3** In case top seal is provided the dimensions between the face of the track plate and face of top seal seat shall also be checked.

**26.7.3.8** Eccentricity or some such arrangement, if provided to a gate for its fine adjustment in the groove, shall not be accounted for while erecting embedded parts.

**26.7.3.9** Anchorage shall be fastened or welded rigidly, after final adjustment of embedded parts so as to prevent dislocation of parts while pouring second stage concrete.

**26.7.3.10** The gate groove concreting shall be done after satisfying for all these details and keeping proper records there of. Rechecking of embedded parts shall be done after concreting.

#### **26.7.4 Inspection of the gate at site of erection**

**26.7.4.1** The gate which is received at site duly inspected in workshop shall be inspected at site before answering into the gate groove. Overall dimensions shall be checked to ensure that the gate fits correctly in the gate groove. It shall also be ensured before lowering, that the gate has been painted according to specifications.

- 26.7.4.2** Following critical dimensions shall be checked at an interval of 300 mm wherever applicable.
- (a) Center to center distance between wheel treads.
  - (b) Center to center distance between side seal/bases.
  - (c) Face to face distance between guide shoes/rollers.
  - (d) Face to face base to wheel tread.
  - (e) Center line of guide shoes/roller to wheel tread in zero position.
- 26.7.4.3** The seal & seal bases shall be checked to ensure that they are coplanar. All the wheels shall be adjusted to ensure that wheel treads are in their proper alignment. The wheel pins shall be locked after making the adjustment.
- 26.7.4.4** The seal bolts shall be tightened adequately and uniformly.
- 26.7.4.5** The gate wheels shall be checked for free rotation to ensure that they are not jammed during transport/handling. To check effectiveness of the seal, actual seal interference shall be compared with that provided in design, because on this aspect will depend to a great extent the efficiency of sealing arrangement and easy operation of gate.
- 26.7.4.6** In case of counterweighted gate of gates with ballast, it shall be ensured that correct weight is added.
- 26.8 FIXED WHEEL AND SLIDE GATES, INSPECTION OF COMPLETE GATE INSTALLATION**
- 26.8.1** It shall be ensured that the installation of various parts of the hoisting arrangements have been done to specified location and alignment particularly in respect of correct positioning and attachment of rope/stem of the gate as well as hoist.
- 26.8.2** There are several type of hoisting arrangement and the following considerations shall be looked into at the time of erection and subsequent inspection.
- a) Connections like shaft coupling, connections of wire ropes to the drum and to the gates connections of the stem rod to the gate and hoist, connection of stem links, connection of hoist components to the base etc. have been properly made.
  - b) Intermediate support for stem rods are provided the required levels and permit free movement of stem rod for the entire gate travel.
  - c) In case of double stem hoists both the hoist shall be properly synchronized.
  - d) The ends of wire ropes are properly looped and sufficient "U" clamps shall be provided.
  - e) The rope is not loose and has been tightly wound over the rope drum. The rope shall be properly lubricated and shall have no kinks.
  - f) The wire or chains at both ends of the gate and counter weight (if provided) shall have equal initial tension.
  - g) Electrical installations shall be properly earthed.
  - h) The limit switches shall be properly adjusted to the operational requirements.
  - i) This may be checked by putting a spirit level on the horizontal top surface of gate or weight. The bubble of spirit level should be in the center with the weight gate is hung and not resting on the sill or plate-from.
- 26.8.3** It shall be ensured that the gate groove, sill and the embedded parts are thoroughly cleaned and no foreign material is present in the groove. Before lowering the gate it shall be perfectly ensured that the gate groove is free from any obstruction.
- 26.8.4** The hoist for the operation of the gate shall first be allowed to turn under no load (without connections to gate) to ensure its satisfactory working and that there is no undue temperature rise due to friction in the rotating/moving components.

**26.9 FIXED WHEELS AND SLIDE GATES – TESTING**

**26.9.1** The gate shall be tested first in the dry condition with the hoist duly connected to the gates. The gate shall be moved up, and down in the groove to ensure its smooth working and that there is no obstruction and no undue effort required for its operations. In case the gate is not going down of its own weight or found tight in some position reasons shall be investigated and remedied instead of forcing the gate down. While testing the gate in dry condition, the rubber seals should be kept wet by water jetting or other suitable methods to avoid damage and to wear to the seals.

**26.9.2** The testing of the gate seals in dry conditions shall be done by viewing the contact surface against a tight sources. It shall be ensured that the top seal rides smoothly over the top seal seat at the time of its approach to the latter.

**26.9.3** In case of rubber seal, water should be poured over the seals so that there shall not be dry friction of the seals. In case of metal contract oil or grease is to be used no greased or lubrication to be used for rubber seals.

**26.9.4** There shall be no noise of friction any other noise no signs of excessive friction, no jerky performances, no dug in any position, no dangling of the gate, no twist in the rubber seals, top seal does not leave its plane and the rubber seals are not over presses.

**26.9.5** The gate, after lowering, if to be kept resting on the sill beam, i.e. in close position, the leakage test may be taken in this position by using suitable plump with necessary arrangement of jetting water at 1.5 times the designed pressure on sealing positions from bottom to top. Particularly all corner joints and other joints, if any are in to be tested to ensure perfect working of the gate.

**26.9.6** The gate shall be fully opened or closed to ensure full opening and satisfactory closing. The time needed for 300 mm opening or closing of the gate is to be recorded for calibration purpose at the time of actual operation.

**26.9.7** In rope drum hoists, it is to be tested that the gate is going down of its own weight, or Ballast provided and no additional force is needed. The gate is also going down or coming up vertically and there is no uneven pull to the gate. Also winding of rope over the drums is uniform and is according to the design provision.

**26.9.8** The tests as provided from 26.8.1 to 26.8.7 shall also be performed against water load when conditions permit.

**26.9.9** The torque required for movement of the gate on load shall be measured and checked against designed value.

**26.9.10** Under the designed water head conditions the leakage through the gate should not exceed 15-liters/meter length of the seal.

**26.9.11** When the gate is operated under water load, it is to be ensured that there is no vibration to the gate, hoist or civil structures at various gate openings.

**26.9.12** By pass arrangement made for water and air vent, when provided shall be checked for proper working of the system.

**26.12 FIXED WHEEL AND SLIDE GATES – ROPE DRUM HOIST****26.12.1 General**

These specifications shall be applicable for rope drum hoist for all types of gates viz. Radial, Fixed Wheel or Slide gates etc.

**26.12.2 Materials**

All materials and components used in the manufacture or assembly of the hoist shall be specified by the purchaser. The purchaser has to specify the quality and standard of such material and components.

**26.12.2.1** All materials used shall be of tested quality. Original manufacturer's test certificates for bought out items like the casting, forgings, worm reducers, wire ropes, motor and brakes etc. shall be furnished by the manufacturer of the hoist on demand.

**26.12.2.2** All casting and forgings used shall conform to relevant Indian Standards. Any repair to castings, if necessary, shall be carried out in accordance with the Indian standards. Forgings shall be free from any defect, tool mark and shall have smooth surface. Forgings used be heat treated where deemed necessary.



**26.12.3 Hoist Unit of Gate and Checking**

Following components of the hoist unit shall be checked.

- a) Drive unit consisting of gear box, motor, brake, all mounted on a base frame.
- b) Hoist drum and gear reduction unit mounted on a base frame and connected to drive unit by line shafts, limit switches and dial indicators.
- a) Hoist rope, rope fixtures with accessories.
- d) Arrangement for manual operation of gate.
- e) Control Panel
- f) Any other components.

**23.12.3.1 Drive unit gear box** – It shall be checked for proper seating arrangement of the shafts and oil on gear box.

**26.12.3.2 Hoist motor** – It shall be of approved manufacture capacity, insulation and speed (R.P.M.). It shall conform to IS : 325-1991 unless otherwise specified and shall be checked for its performance. Manufacturer's test certificate shall be furnished for motor by supplier to purchaser.

**26.12.3.3 Brake** – It shall be of approved manufactures and capacity. It shall be checked for alignment and tightness. Brake lines shall be of approved manufactured and shall conform to the approved specifications.

**26.12.3.4 Base Frame** – The base frame for mounting of drive unit/gear reduction unit with hoist drum shall be checked of the dimensional accuracy.

**26.12.3.5 Hoist drum** – This shall be checked for dimensional accuracy. Cast iron/cast steel drums shall be checked for blow holes, racks etc. specially at groove centers. Fabricated drums shall be checked for stress relieving in approved manner. Rope grooves shall be checked for orientation. Arrangement of rope attachment to the drum shall be checked for security.

**26.12.3.6 Reduction unit gear box** – It shall be checked for proper assembly, dimensional accuracy, sealing, finish of machined parts, and surface preparation for painting gears, pinion and other internal components shall be checked for alignment. Meshing of gear and pinion teeth shall be checked for alignment. It shall also be checked for contact surface and backlash by suitable methods such as applying thin film of paint of grease on either pinion or gear wheel and running the assembly and noting the either pinion or gear wheel and running the assembly and noting the impression. Gears and pinions shall be checked for hardness. Tolerance of gears and pinions shall conform to IS : 919-1987 and backlash shall conform to IS : 4460-1991.

**26.12.3.7 Line Shaft** – It shall be checked for straightness and other dimensions. The straightness shall be in accordance with relevant Indian Standards. Mounting of couplings shall be checked for alignment.

**26.12.3.8 Limit Switch** – It shall be checked for satisfactory operation. It shall be weatherproof.

**26.12.3.9 Limit Indicators** – It shall be checked for satisfactory operation and accuracy.

**26.12.3.10 Hoist rope** – It shall be of approved manufacturer and shall conform to relevant India Standards. The rope shall be checked for diameter, length, free from bends and kinks, proper thimble end, connections and splicing. If the wire ropes are of galvanized type, the galvanization shall be in accordance with Class II of IS : 1573 – 1991 Manufacturer's test certificate shall be furnished on demand by supplier for hoist ropes.

**26.12.3.11 Rope Fixtures** – It shall be checked for dimensional accuracy and their corrections.

**26.12.3.12 Arrangement for manual operation** – It shall be checked for satisfactory operation. It shall be ensured that the gates are kept at required positions during their travel for specified speed as envisaged in the design and specified for operational requirements of the gates.

**26.12.3.13 Control Panel** – Panels shall be checked for their suitability for the purpose envisaged in the specifications. The checks shall include items such as weather proofing of conducting wires, proper construction of panels, high voltage tests, insulation resistance of cable, calibration of meters, earthing of installation, checking of connection and concealment if required.

**26.12.4 Lubrication of gears and bearings.**

**26.12.4.1** For gears and pinions, lubricating oil/grease or lubricating compound use shall be of approved grade and quality.

**26.12.4.2** Bearing closed from outside and open from inside shall be checked for splash lubrication and bearings covers shall be free from leakage, For bearings close from both sides, proper injection of grease of approved quality and grade shall be checked.

**26.12.5 Inspection of hoist assembly and checks**

**26.12.5.1** The assembled hoist shall be checked for the following:

- a) Quality of workmanship.
- b) Overall dimensions
- c) Optimum sound and vibrations
- d) Speed of operation allowing for variation in accordance with Indian Standard.
- e) Any mechanical jamming.

**26.12.5.2** Painting of different components of hoist shall be according to relevant Indian Standards.

**26.12.6 General inspection**

**26.12.6.1** It shall be ascertained that the gate parts received at erection site have been manufactured according to the drawings and have necessary marking of shop inspection as prescribed. It shall be ensured that all exposed surfaces of the embedded parts have been protected by painting, greasing etc. as specified. The embedded parts in contact with concrete shall be free from grease paint etc. for better bonding with concrete a coating of cement wash/cement latex may be applied, if prescribed.

**26.12.6.2** The reference/center lines of piers and bays and the levels having relations to complete, civil structure shall be established at site so as to facilitate erection at proper indications.

**26.12.6.3** It shall be ensured that the various components of the hoisting arrangement, such as meters, reduction gear assembly, switches, wire ropes etc. are provided according to the manufacturer's instructions and erected according to the hoist supplier's drawings remitted by the purchaser.

**26.12.6.4** The permissible tolerances for the embedded parts and the components of gate shall be in accordance with the appendix D of IS: 4623-1990

**26.12.6.5 Inspection of blockouts** – It shall be ensured that correct blockouts are kept for accommodating the embedded parts as manufactured according to the design and drawing approved by the purchaser.

**26.12.6.6 Block Out** – The block out should have sufficient gap left out in the concrete, so that a band with spanners etc. should be able to work freely inside the block out. The minimum block out gap for first stage concrete in the sill beam portion should be 800x600 mm and for second stage concrete it should be 600x400 mm. similarly for wall plate the gap should be 750x650 mm and for second stage concrete it should be 750x250 mm. it shall also be ensured that the required dowel bars having adequate lengths are left out in the block outs during first stage concrete. The entire block out is roughened properly for further concreting to give necessary bondage to second stage concreting.

**26.12.7 Inspection of pier anchorage**

**26.12.7.1** The inspection of pier anchorage shall be carried out at following stages :

- a) Trunnion bracket and support girder.
- b) Load carrying anchors or ties and embedded girder (if insulated anchors or ties are used)
- c) Anchors girder of yoke girder.
- d) Thrust block/trunnion tie.

**26.12.7.2** The pier anchorages shall be checked with to the center line of the pier and the trunnion axis (line parallel to the crest axis and passing through the center line of trunnion pins) Control survey marks shall be given on each pier to check the location/alignment of pier anchorages. These shall include the lines parallel to the end at right angles to the dam/barrage axis and a bench mark for level.

**26.12.7.3** Center to center distance to the adjacent piers shall be checked by a steel tape. It will be preferable to put a steel girder across the span for taping the distance over the spa.

**26.12.7.4** The trunnion bracket/supports shall be placed on the top of a steel and kept in position with the help of struts and their position shall be checked with respect to center line of pier and trunnion axis. A dummy trunnion assemble may be used to check the distance center line of trunnion and sill beam center. The slope of trunnion assembly shall be checked with help of an inclination gauge. The two trunnion assemblies for each gate shall be checked with respect to each other.

**26.12.7.5** The yoke girder/anchor girder shall be checked for its alignment and slope in both directions. For this checking holes may be picked up from dummy trunnion bearing.

**26.12.7.6** Before erection the tie bars/rods shall be checked on a level platform for straightness and defect, if any, shall be rectified forthwith. After erection the slope and spacing of the tie bars/ rods shall be checked. For checking the spacing, a spacer gauge shall be used. After assembly the entire pier anchorages shall be checked. The two anchorages for each gate shall be checked with respect to each other.

The length of the anchor flat or bolt should be  $0.6 R$  where  $R$  is the radius the curvature of the radial gate.

The measurement of  $0.6 R$  May be measured to the face of the anchor. Girder to the face of the pier i.e. the total embedded portion should be  $0.6 R$ .

The inclination of anchor flat or tie bar or the flat should be checked with the inclination of the arm of the gate, that they should not interfere at the time of opening of the gate.

**26.12.7.7** Before concreting the pier after erection of pier anchorages. It is necessary that a second check of all the parts is made to ensure against any possible displacement during welding, riveting etc. For safety or erected anchorages, the grouting/concreting operations shall be commenced after minimum possible intervals. For insulated anchors/ties. The insulation shall be provided and checked before starting the grouting/concreting operations. To allow for the elongation of the insulated load carrying anchors and trunnion tie if used to trunnion bracket shall be so fixed so as to be able to slide on the anchorage girder. Bronze pads shall be used for this purpose on the top of the anchorage girder and at the bottom of the trunnion bracket as shown in fig. 3C.

**26.12.7.8** Anchor bolts shall be provided in the first stage concrete with suitable block out openings, to hold the track base and seal seat assemblies. The anchor bolts shall be with double nuts and washers. For adjustment purpose enclosed holes in the seal base parts be provided so as to allow for misalignment of anchor bolts. The minimum size of holes shall not be less than that given in table 1. The first stage and second stage concrete should be one grade above than the concrete of surroundings crest or piers.

**Table 1 – Holes and Washers for anchor bolts**

Bolt dia (mm)	Hole in member Dia (mm)	Hole in washer Dia (mm)	Washer
12	28	14	50 <sup>2</sup> x6
14	29	16	50 <sup>2</sup> x6
16	30	18	50 <sup>2</sup> x6
18	32	20	60 <sup>2</sup> x6
20	34	22	60 <sup>2</sup> x6
22	36	24	65 <sup>2</sup> x6
24	40	26	75 <sup>2</sup> x10
27	45	29	75 <sup>2</sup> x10
30	50	32	80 <sup>2</sup> x10
33	55	35	90 <sup>2</sup> x10
36	60	38	90 <sup>2</sup> x10
39	65	42	100 <sup>2</sup> x12
42	70	46	105 <sup>2</sup> x12
45	75	50	110 <sup>2</sup> x12
48	80	54	120 <sup>2</sup> x12

#### **Inspection of sill beam**

**26.12.8.1** Before erection, center line of the sill beam shall be marked on the pier faces. The center line of the gates shall be inscribed on the crest shifted by 300 mm or so on upstream side. The sill beam center line shall be checked in relation to the trunnion center line.

**26.12.8.2** After erection, the alignment and the angular setting of the sill beam shall be checked. For the angular setting of soil beam 3 to 5 frames may be used.

**26.12.8.3** After aligning the sill beam, all the bolts and nuts shall be put in position. The reinforcement bars and dowels be welded with anchor bolts so that the complete assembly is firmly held in position and is not disturbed during concreting/grouting.

**26.12.8.4** The aggregate used for concreting/grouting shall not be more than 20 mm. The concrete mix shall be hand compacted by using rods. No mechanical vibrators shall be used.

**26.12.9 Inspection of wall plates (slide seal seats)**

**26.12.9.1** The wall plates shall be in true alignment with respect to center line of trunnion pin. The dummy trunnion assembly with extension rods shall be used for checking the alignment of wall plates. The verticality of the wall plates shall be checked to ensure that wall plates are truly vertical.

**26.12.9.2** After setting of wall plates, all the bolts and nuts shall be put in position. The reinforcement bars and dowels in the blockout shall be accurately welders to the side seats in such a manner that wall plates are not displaced during concreting or otherwise.

**26.12.9.3** The shuttering planks for concreting the wall plates shall be at least 1.5 to 3 mm clear from the metal parts of wall plate. Maximum aggregate size used for concreting the blockouts shall not exceed 20 mm. All concrete mix shall be hand compacted and done in conversant stages as the shuttering progress in the upward direction. Compaction may be done by 20 mm rods. No mechanical vibrators should be used.

**26.12.10 Inspection of gates**

**26.12.10.1** The sub-assemblies of the gate which are received at site duly inspected in workshop shall be re-inspected at site before lowering of assembly in the day.

**26.12.10.2** Checking of all dimension of the gate shall be done after skeleton assembly of each gate is made and before final welding/riveting is allowed. This dimensional check shall be repeated after welding is done.

**26.12.10.3** Visual inspection of all welds and bolts/rivets shall be made to the extent of 100 percent.

**26.12.10.4** Following critical dimensions shall be checked:

- a) Center to center distance between side guide rollers and shoes.
- b) Center to center between the side seal and bases.
- c) Distance to bottom seal/base from center line of trunnion pin.

**26.12.10.5** The seal bolts shall be tightened adequately and uniformly and the guide wheels be checked for free rotation.

**1212.10.6** To check the effectiveness of the seals, active seal and bases.

**1212.10.7** Inspection of complete gate installation and hoists including electrical items.

**26.12.10.8** Visual inspection of all gates and hoists shall be carried out as per the detailed drawing. It has to be ensured that the erection tolerances have been maintained during and after erection.

**26.12.11** In case hoists, following points shall be looked into:

- a. Connections like shaft coupling, connections of wire ropes to drum and gate, connections of hoist components to the base etc, have been properly made.
- b. In case of double hoists both hoists are properly synchronized.
- c. Intermediate supports at required intervals are provided to permit free movement of shaft.
- d. The ends of the wire rope are properly looped and sufficient "U" clamps have been provided. The rope has been tightly wound over the drum, has no links and is properly lubricated.
- e. The wire ropes or chains at both ends of the gate and counter weight have equal initial tension.
- f. Electric installations have been properly earthed and the limit switches have been properly adjusted.

**26.12.11.1** The hoist provide for the operation of the gate shall first be independently checked and tested when it is connected to the gate to ensure its satisfactory working.

**26.12.11.2** It shall be ensured that the gate sill, wall plates and other embedded parts are thoroughly cleaned and no foreign matter is present to obstruct the movement of the gate.

- 26.12.11.3** Before operation of the gate the following final checks shall be made.
- Electrical connection and fuses.
  - Over load relay, if provided, to see that it trips the starter.
  - All bearing and wire ropes for proper greasing.
  - All bolts of gear boxes, hoists drum and shafts, coupling for tightness.
  - The oil level in gear reduction unit.

**26.12.12 Testing**

**26.12.12.1** The gate shall be tested in a dry condition with hoist duly connected for its smooth working. The gate shall be fully closed or fully opened and it shall be ensured that there is no obstruction and no undue effort required for its operation. If the gate is not going down of its own weight of found tight in some position, reasons shall be investigated and remedied instead of forcing the gate down. While testing the gate in dry condition the rubber seals should be kept wet by water jetting or suitable methods to avoid damage to the seals.

**26.12.12.2** The testing of gate seals shall be checked in the same manner as explained in case of fixed wheel or slide gates.

**26.12.12.3** Under the designed water head conditions, the leakage through the gate shall not exceed 15 litres/minute/metre length of the seal.

**26.12.12.4** The gate is to be kept on the sill beam, that is in closed position. The leakage test, (if provided in the terms of execution of work), can be done in the position by using suitable pump with necessary arrangements of jetting water at 1.5 times, the designed pressure, on sealing positions from bottom to top. All joints, if any, shall be tested to ensure perfect working of the gate.

**26.12.12.5** The arrangement provided for preventing the travel of the gate or hoist beyond the designed limit are tested and checked for proper working. The time required for 300 mm opening or closing of the gate shall be recorded for calibration purpose.

**26.12.12.6** The full load current required for the movement of the gate on load shall be measured and checked against the designed value.

**26.12.12.7** When the water starts overflowing, the gate shall be lowered to hold water to half the height of gates. In this position the seals may be tested and any leakage shall be attended. The gate shall be operated up and down under these loading conditions to observe the operation of the hoist. The gate shall also be checked in a similar way against full water load.

**26.12.12.8** Following observations shall be recorded for testing of gate under dry condition and under water pressure.

- Movement of gate and indication of jamming if any
- Effective stop is achieved by the gates stops wherever provided.
- Speed of opening and closing and the current requirement at specified voltage.
- Operation of brakes and limit switches.
- Manual operation of gate, if provided.
- Efficiency of guide rollers to check the side swaying of the gate.
- Correctness of indication by local position indicator.
- Synchronization of remote position indicators, if provided.
- Vibration of gate, hoist and civil structures.

**26.13 Single faced sluice gates (200 to 1200 mm size)**

**26.13.1 General**

These specifications cover the single sluices from 200 mm to 1200 mm sizes of different shapes with rising (sliding) and non-rising (rotating) spindles.

**26.13.1.2** The specification is limited to sluice which are suitable for general use only and for the following types of special use:

- a. For wall mounting in situation where small and medium volumes of raw or filtered water, storm water of sewage are to be controlled and a single faced seal is required on the waterway for isolating purpose.
- b. For water supply draw-off and purification work, sewage plants, ordinary land drainage and irrigation canals, hydro-electric collecting aqueducts and tail races,
- c. For unbalanced head restricted to 15 meters, tending to push the door on to the frame and there by helping stanch leakage past sealing face.
- d. For manual operation by hand wheel/toe-key/frame or floor mounting head stocks without gearing.

#### **26.13.2 Classification**

**26.13.2.1** Single faced sluices are of class 1 or class 2 types. Class 1 covers sluices suitable for a maximum sealing unbalanced head of 6 meters of water. Class 2 covers sluices suitable for maximum sealing unbalanced head of 15 meters of water.

**26.13.2.2** Shapes and types of sluices may be circular, square or rectangular and may either be with rising or non-rising spindle.

**26.13.2.3** Nominal sizes and dimensions. Single faced sluices shall be manufactured according to the nominal sizes and dimensions as given in Table No. 2 Tolerances on the dimensions shall be closely taken into account and the manufacturing shall be as close to nominal dimensions as possible. The range and rating of different types with rising and non-rising are given in Table No. 3.

#### **26.13.3 Materials**

Followings materials are in use for the manufacture of various components of the gates.

S.No.	Component part	Recommended Material	Reference
1.	Frame & door side guide strip	Grade 20 cast Iron	IS210-1991
2.	Spindles, nuts & bolts	mild steel	IS:2062-1992
3.	Face, face rings/trid, spindle nuts.	Gunmetal	IS:2654-1991

#### **26.13.4 Manufacture & Workmanship**

##### **26.13.4.1 Frame**

**26.13.4.2** The frames shall have a robust spigot of an appropriate length, cast integral at the back for case of support in the waterway and to provide an effective seal sluices having circular opening or waterway may have a spigot dimensions conforming to IS:1538-1976. For square and rectangular openings the dimensions shall be as per the tendered specifications.

**26.13.4.3** The back of the frame shall be flat. The frame for non-rising sluices shall have a machined face on the top to support the thrust plate.

**26.13.4.4** A cast iron side guide strip having a machined taper face on the underside shall be fixed to the frame on each side by mild steel studs and extending over the height of the waterway to provide effective guide throughout the travel of the door. A stopper shall be casted integrally immediately below the water way and center with it to limit the travel of the door.

##### **26.13.4.5 Door**

**26.13.5.1** Door shall have reinforcement ribs integral at the back for strength. On each side there shall be tapered sung or gunmetal or bronze taps strips on the frame.

**26.13.5.2** Two integrally cast drilled to take steel bearing pin shall be provided on doors for use with rising spindles. Integrally cast pocket suitable reinforced to accommodate a nut shall be provided on doors with non rising spindles.

**26.13.5.3** A stopper to match that on the frame shall be casted integrally at the bottom.

**26.13.5.4** Face (Door) and seat (frame) rings.

**26.13.6.1** Facings for different types of sluices shall conform to the dimensions given in table 4 to 8 read with figures 4A, 4B, 4C, 4D, & 4E.

**26.13.6.2** Facings shall be so secured by brass rivet pins in the machined grooves of the frame and door and machined and hand finished, that with the door fully shut a satisfactory watertight seal is formed on the waterway. The contact between the facings shall be sufficiently close at every point in the perimeter so as to produce a uniform bearing all around.

**26.13.6.3** The attachment of the facings to the frame and door shall be so carried out that when finished they shall remain in place free distortion or loosening during effective life of the sluice.

**26.13.6.4** Face rings and seat rings used shall be as per shape and sections given below:

S.No.	Sluice gate	Type of section of A face ring	Type of section of seat ring
1.	Sluice upto & below 300 mm.	'L' Section	'L' section
2.	Sluices above 300 mm	Rectangular section	Strips/rings of rectangular section

#### **26.14.1 Guides :**

Guides shall be adequately secured to the main frame by stud bolts and provision shall be made for appropriate longitudinal movement to adjust degree of welding consistent with sealing property. There shall be little lateral movement and tongues, keys, shoulders or lugs may be provided for the purpose.

#### **26.14.2 Spindles**

**26.14.2.1 Rising/Sliding type** – The dimensions shall conform to those specified in table No. 4, 6 & 8 and shall terminate at the top of the sluice door and operated through either frame or floor mounted head stock. The threaded portion of the spindle shall be completely clear of the liquid being handled and shall be accessible for lubrication.

**26.14.2.2 Non rising/relating type** – These shall conform to the dimensions given in table no. 5 & 7 and shall be threaded at the bottom. They shall be restrained axially by a trust plate on the top of the sluice frame and shall work in a nut located in a pocket on the top center of the door. The screeded portions of the spindles shall have machine cut square of some thread.

**26.14.2.3** The length of rod may vary for each installation, the number of couplings required may be computed from the table No. 9 for lengths exceeding 6 meters, it is recommended that only sliding rods be employed, but if the prevailing conditions do not permit their use the rotating type may be considered.

**26.14.2.4 Thrust bearings** – For non rising spindles, bearing shall be provided in the yoke of the frame of a design that will develop and safely transmit the full thrust at the time of opening or closing the door.

#### **26.14.3 Operating mechanism**

**26.14.3.1** Provision may be made in the tender specification for operation of sluices by hand, electric, hydraulic or pneumatic power.

**26.14.3.2 Hand Wheels** – For gates having rising or non-rising spindles the diameter of hand wheel is dependent on the factors viz. unbalanced load, type of actuating gear employed (spur or worm), length of operating rod. The diameter of hand wheel suitable for use on ungeared hand stock are given in table No. 11 for general guidance.

**26.14.3.3 Height of sluices** – The overall heights and the dimensions of the sluice frame and doors shall be in accordance with table No. 12.

**26.13.3.4 Workmanship** – All castings shall be clean, sound and without defect of any kind. They shall be free from sand and no casting shall be burned. Plugged, stopped, patched or welded and no repairs of defect shall be permissible. All foundry and machine work shall be done in accordance with best modern practice and all component parts shall be carefully and accurately machined to jigs and templates so as to make them fully interchangeable on site without additional work.

**26.14.3.5 Painting** – Immediately after casting and before machining, all cast iron parts shall be thoroughly cleaned and before rusting commences, these shall be coated by at least two coats of bitumastic rust-proof compound at satisfactory quality and specification. The final coats shall be applied shall be applied to the exterior surfaces, excluding machined portion, after assembly and testing.

**26.14.3.6 Testing** – After completion each sluice gate shall be tested in the shop for smooth working of the component parts including operating gear.

**APPENDIX A  
MATERIALS FOR THE COMPONENTES OF FIXED WHEEL GATES**

S.No. (1)	Component part (2)	Recommended material (3)	Reference (4)
i)	Wheel	Cast steel Cast iron Wrought steels Forged steel	IS:1030-1989 IS:210-1991 IS:1570-1987 IS:2004-1991
ii)	Bushing	Bronze	
iii)	Wheel pins or axis	Chrome nickel steel or corrosion resisting Steel, mild steel with Nickel or chromium Platting.	IS:1570-1987 IS:2004-1991  IS:2062-1992 IS:1060-1992 IS:1337-1991
iv)	Structural parts gate, leaf, track base etc.	Structural steel	IS:2062-1992 IS:8500-1992
v)	Seal	Rubber	Appendix – F
vi)	Wheel track	a) Stainless steel b) Corrosion resisting Steel c) Cast steel d) Structural steel e) Corrosion resisting  Cast iron Material (a) to (e) may Be specified depending Upon the actual requirements Of wheel loads.	IS:1570 (Pt.V) 1991 IS:1570-1987  IS: 1030-1989 IS:2062-1992 IS:2749-1991



S.No. (1)	Component part (2)	Recommended material (3)	Reference (4)
vii)	Seal seat	Stainless steel plate or stainless steel clad plate	IS:1570 Pt. V) 1991
viii)	Seal base seal seat	Structural steel of convenient shape	IS:2062-1992 IS:8500-1992
ix)	Seal clamp	Structural steel	IS:2062-1992 IS:8500-1992
		Stainless steel	IS:6527-1992 IS:6603-1991
x)	Guide	Structural steel or corrosion resisting steel	IS:2062-1992 IS:8500-1992 IS:6603-1991
xi)	Springs	Spring steel	IS:1570-1987 IS:6527-1992
xii)	Anchor bolts	Structural steel	IS:2062-1992 IS:8500-1992
xiii)	Guide rollers and guide shoes	Structural steel or corrosion resisting Steel, cast iron, cost Steel or forged steel	IS:2062-1992 IS:8500-1992 IS:210-1991 IS:1030-1989 IS:2004-1991

**Note : 1.** Grade of the material conforming to the specifications mentioned above shall be specified by the designer to suit to the particular requirement.

**Note :2.** Cast iron shall not be used for wheel and tracks for high head gates.

**Note : 3** The choice of material is governed by the type of installation, accessibility for maintenance, reservoir water properties silt, etc.

1. Specifications for carbon steel castings for general engineering purpose (second revision).
2. Specifications for grey iron casting (second revision)
3. Schedule for wrought steels for general engineering purposes.
4. Specifications for carbon steel forgings for general engineering purpose (First revision).
5. Specification for structural steel (standard quality) (First revision).
6. Specifications for structural steel (fusion welding quality) (second revision).
7. Electroplated coatings of nickel and chromium in iron and steel (First revision)
8. Specifications for hard chromium coatings on iron and steel (First revision)
9. Weld able structural steel, medium and high strength quality.
10. Specifications for stainless and heat resisting steels (First revision)
11. Specification for stainless iron castings (First revision)
12. Specification for stainless steel wire rod.
13. Specification for stainless steel bars and flats.

**APPENSIX – B**  
**RECOMMENDED MATERIALS FOR VARIOUS COMPONENTS**  
**(FOR LOW HEAD SLIDE GATES)**

The recommended materials for various components are given below:

- |    |                               |                           |
|----|-------------------------------|---------------------------|
| a) | Gate leaf                     |                           |
|    | Cast iron                     | IS:210-1991               |
|    | Structural steel              | IS:2062-1992              |
|    |                               | IS:8500-1992              |
|    | Cast Steel                    | IS:1030-1989              |
| b) | Gate frames                   |                           |
|    | Cast iron                     | IS:210-1991               |
|    | Structural steel              | IS: 2062-1992             |
|    |                               | IS: 8500-1992             |
| c) | Seal Plates/Seals             | IS: 306-1988              |
|    | Bronze                        | IS: 1458-1991             |
|    |                               | IS:318-1991               |
|    | Brass                         | IS:291-1989 (Grade I)     |
|    | Wood                          | (commercial good quality) |
|    | Stainless steel               | IS: 1570 (Pt. V) 1991     |
|    |                               | IS: 6911-1992             |
|    | Rubber                        | Appendix F                |
| d) | Seal seats/Bearing Plats      |                           |
|    | Bronze                        | IS: 306-1988              |
|    |                               | IS: 318-1991              |
|    |                               | IS:1458-1991              |
|    | Brass                         | IS:291-1989 (Grade I)     |
|    | Steel                         | IS:226-1992               |
|    |                               | IS : 8500-1992            |
|    |                               | IS : 2062-1992            |
|    | Cast iron                     | IS : 210-1991             |
|    | Stainless steel clad plate or | IS : 6911-1991            |
|    | Stainless steel               | IS : 1570-(pt.V) 1991     |
| e) | Guides                        |                           |
|    | Structural steel              | IS : 2062-1992            |
|    |                               | IS : 8500-1992            |
|    | Corrosion resisting steel     | IS : 6603-1991            |
1. Specifications for grey iron casting (second revision)
  2. Specifications for structural steel (Standard quality) (fifth revision)
  3. Specifications for structural steel (fusion welding quality) (second revision).
  4. Specifications for weld able structural steel, medium and high strength quality.
  5. Specifications for carbon steel castings for general engineering purpose (second revision).
  6. Specification for tin bronze (second revision) ingots and casting.
  7. Specification for loaded tin bronze ingots and castings (Revised)
  8. Specification for railway bronze ingots and casting (Revised)
  9. Specification for naval brass rods and sections (suitable for machining and gorging (Second revision)
  10. Schedule for wrought steel Part V Stainless and heat resisting steels (first revision).
  11. Specifications for stainless steel plate, sheet and strip.
  12. Specifications for stainless steel bars and flats.

**APPENDIX – D**  
**TOLERANCES FOR EMBEDDED PARTS AND IN COMPONENTS OF GATE.**  
**(FOR FIXED WHEEL AND LOW HEAD SLIDE GATES)**

		<b>Classification</b>	
<b>Components</b>	<b>Low</b>	<b>And medium Head</b>	<b>High Head</b>
<b>(1)</b>		<b>(2)</b>	<b>(3)</b>
<b>A. Embedded parts.</b>			
1. Track Plates			
1.1 Alignment in plane parallel to flow		+1.0	+0.5
1.2 Distance between center line	+1.5		+1.0
1.3 Coplanariness	+1.0		+0.5
<b>2. Guide</b>			
2.1 Alignment in plane parallel		+1.0	+1.0
2.2 Distance between center line	+1.0		+1.0
<b>3. Slide Seal Seats</b>			
3.1 Alignment in plane parallel		+2.0	+1.0
3.2 Distance between center line	+1.5		+1.0
3.3 Coplanariness	+1.0		+0.5
<b>Classification</b>			
<b>Components</b>	<b>Low</b>	<b>And medium Head</b>	<b>High Head</b>
<b>(1)</b>		<b>(2)</b>	<b>(3)</b>
<b>4 Top Seal Seat</b>			
4.1 Alignment		+2.0	+1.0
4.2 Weight above sill		+3.0	+2.0
4.3 Coplanariness with aid steel	+1.5		+1.0
<b>5. Critical Dimensions</b>			
5.1 Center to center distance between track plates		+3.0	+2.0
5.2 Center to center distance between side seal seats		+3.0	+2.0
5.3 Face to face distance between guides	+2.0		+2.0
5.4 Face to track to face of aids Seal seat		-1.0	-1.0
		+0.0	+0.0
5.5 Face to track to center line of guide		+2.5	+2.0
<b>6 Gate</b>			
1 Wheels			
1.1 Alignment of treads in Zero eccentricity position	1.5		1.5

Classification		
Components	Low And medium Head	High Head
(1)	(2)	(3)
2. Side and Top Seal Bars		
2.1 Alignment	±1.0	±0.5
2.2 Coplanariness	±1.0	±0.5
3 Critical Dimensions		
3.1 Center to center distance between seal bases	±2.0	±1.0
3.2 Center to center distance between center line wheel treads.	±2.0	±1.0
3.3 Face to face distance between faces of guide shoes or guide rollers.	±3.0	±2.0
3.4 Face to face distance between wheel tread to side seal base	±2.0 -0.0	±1.0 -0.0
3.5 Distance between faces of wheel tread and center line of guide shoe/roller	±2.5	±1.2

#### APPENDIX – F SPECIFICATIONS FOR RUBBER FOR SEAL

##### DETAILS OF SPECIFICATIONS (As per IS 11855 – 1990)

The rubber seals be moulded from natural or synthetic rubber containing not less than one percent by weight of copper inhibitor, and shall have the following physical properties.

- Minimum Shore A durometer hardness .....65+5
- Minimum elongation ..... 450 percent.
- Ultimate tensile strength (minimum) ..... 14.5 N/mm<sup>2</sup>
- The rubber compound shall not absorb more than 10 percent by weight of water in a 7 days test and
- The tensile strength of the test specimen, after being subjected to an acceleration against test of 48 hours in oxygen at 70°C and 2.1 N/mm<sup>2</sup> pressure, shall not be less than 80 percent of strength of the test specimen before ageing.

##### TYPES OF RUBBER SEALS RECOMMENDED FOR DIFFERENT CLASSES OF GATES.

- High Head – double atom type (preferably with cladding)
- Medium head – solid bulb note type, and
- Low Head – hollow/solid bulb music note type of flap or premoulded L-type

**Note –** Wedge type seal may be used at the bottom of the gate when it comes to rest on the sill. If the gate slides on the face of an opening, musical note or double atom type seals may be used.

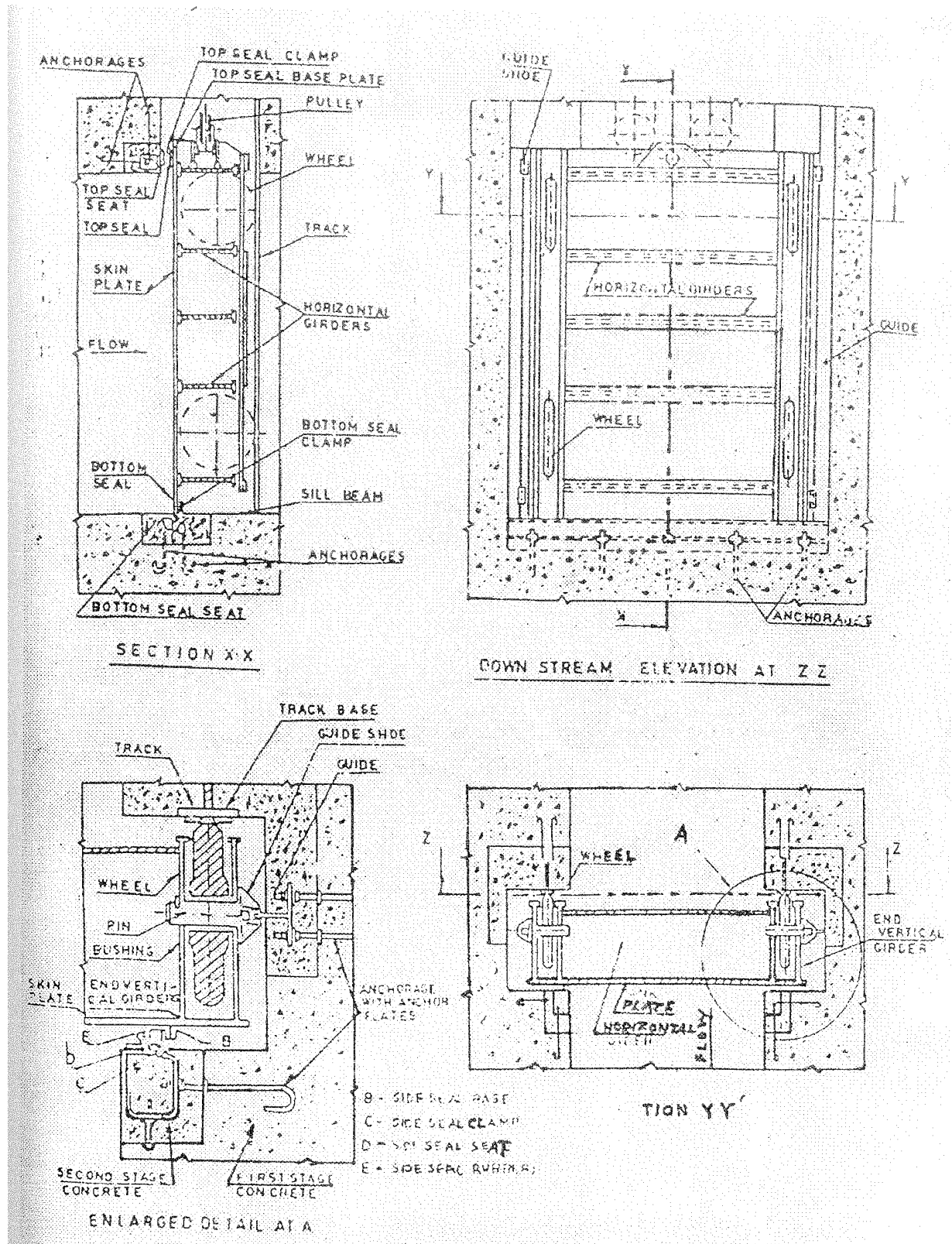


FIG-1 TYPICAL ARRANGEMENT OF VARIOUS COMPONENTS OF FIXED WHEEL

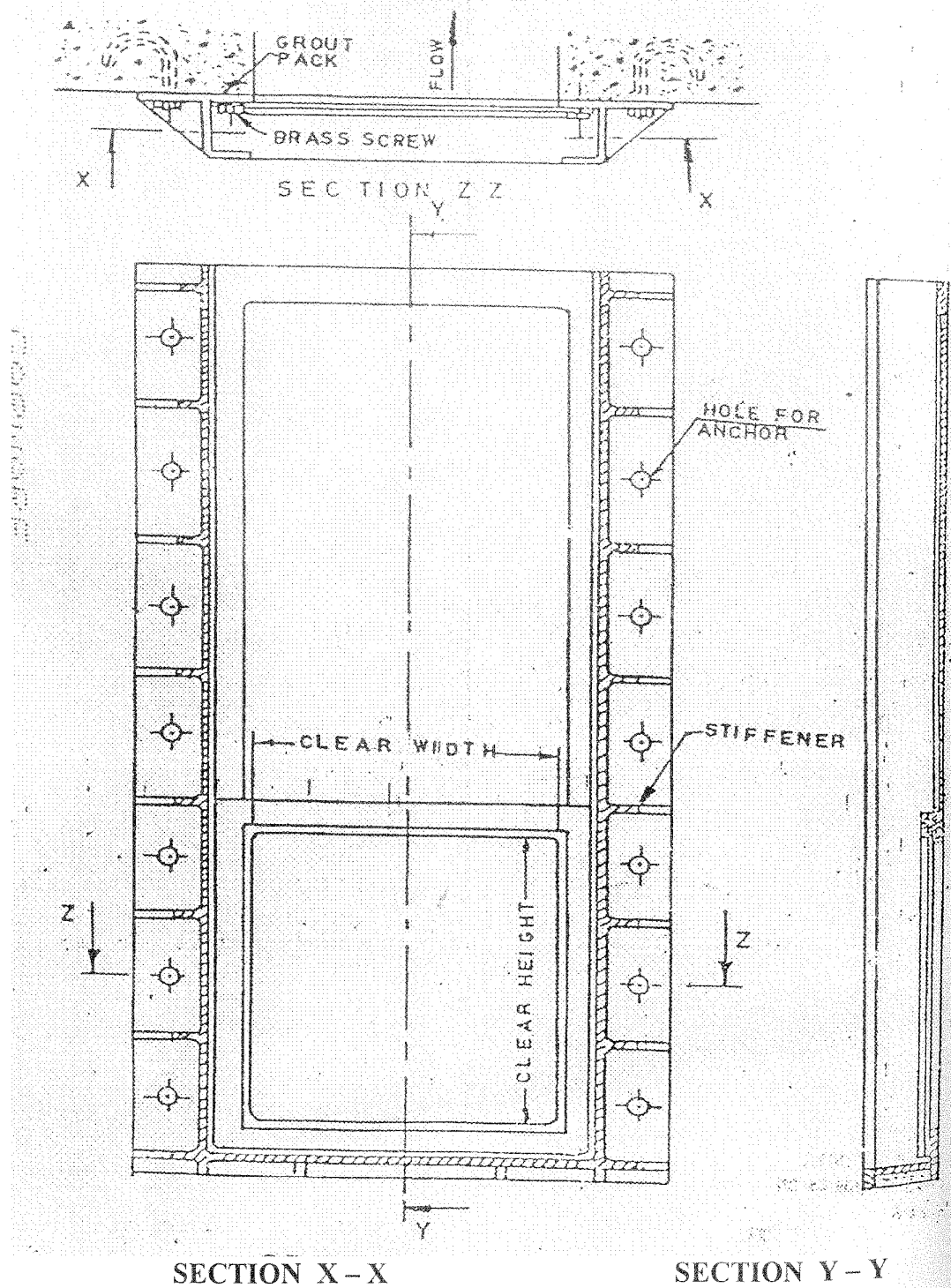


FIG. 2A TYPICAL DIAGRAM SHOWING LOW HEAD SLIDE GATE  
(FULL FACE GATE FRAME)

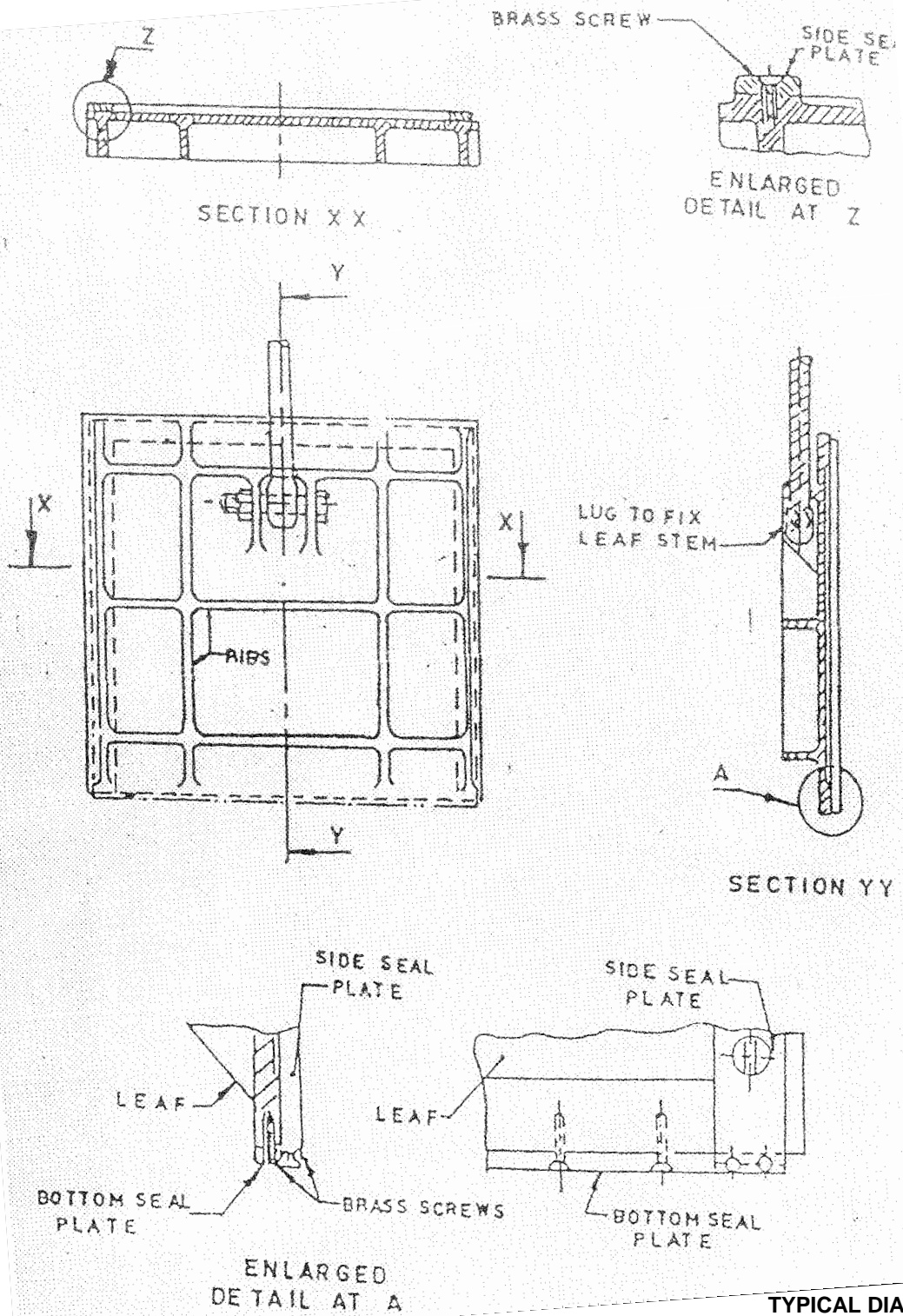
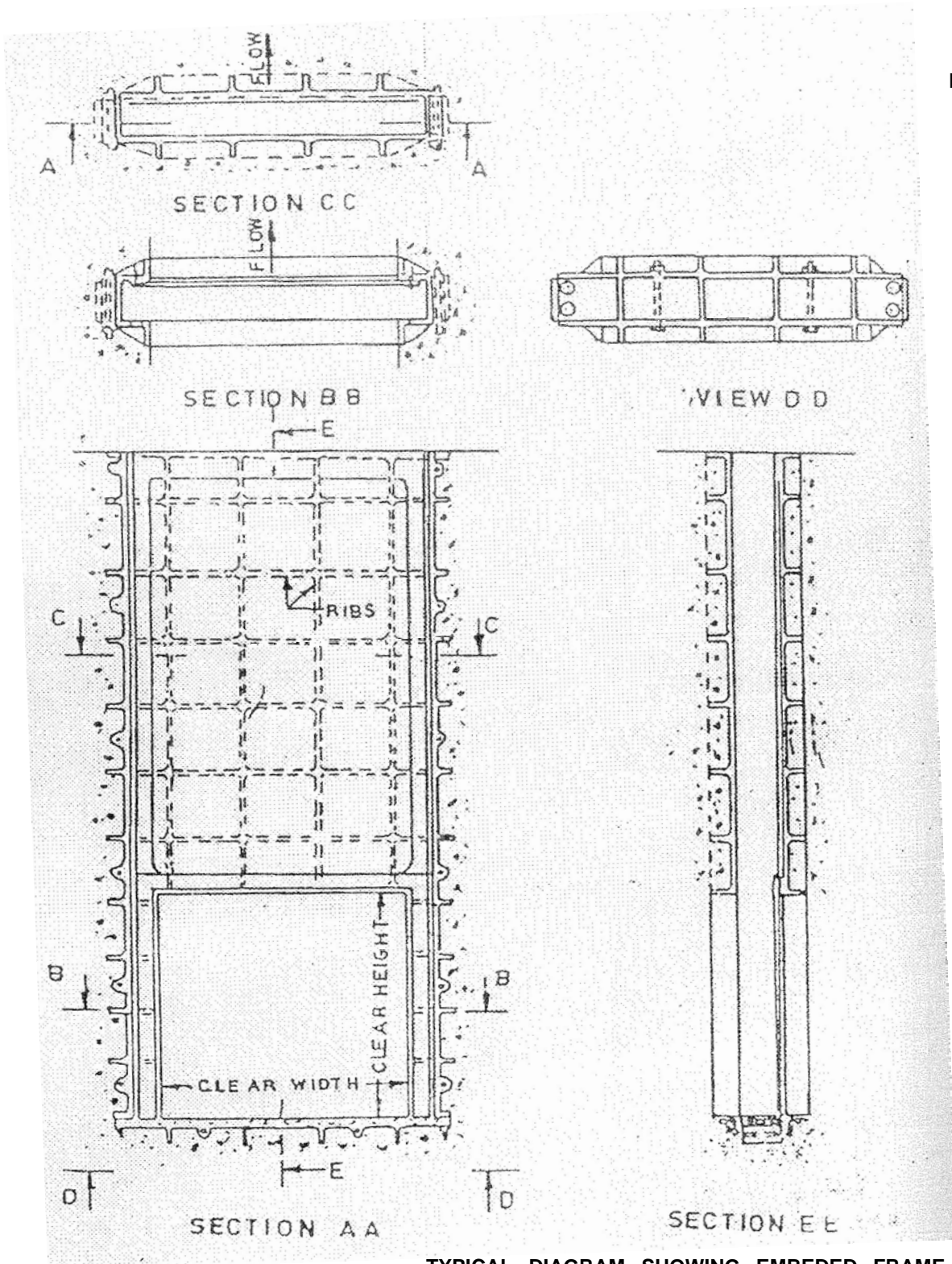
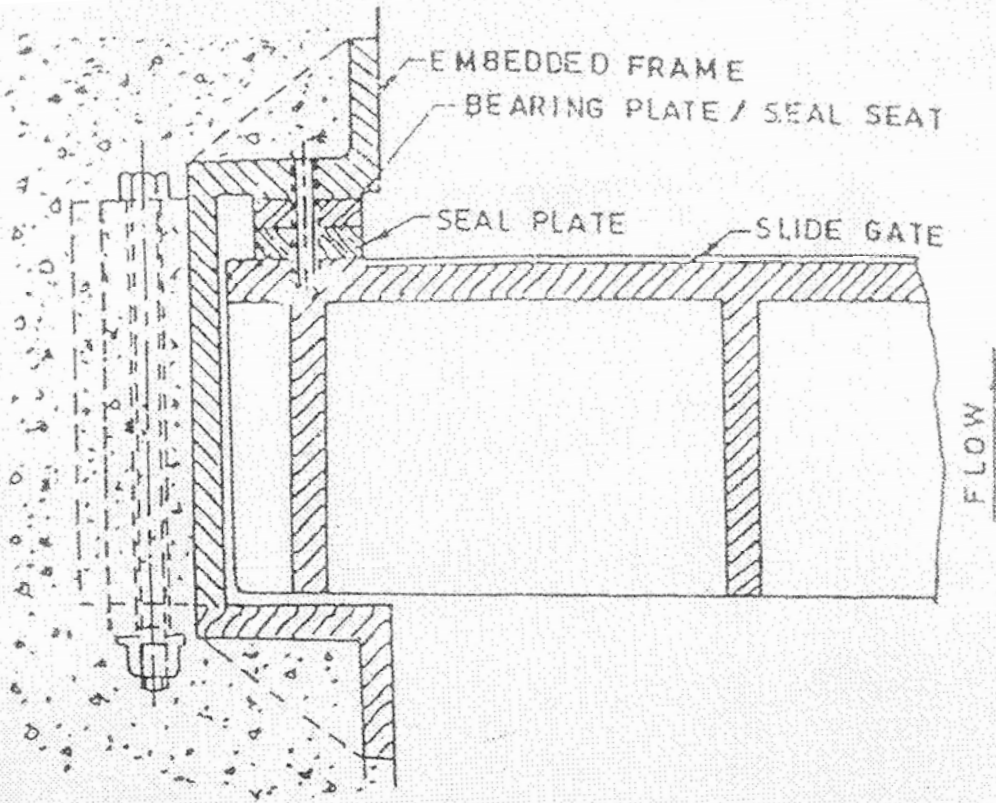


FIG.  
2B

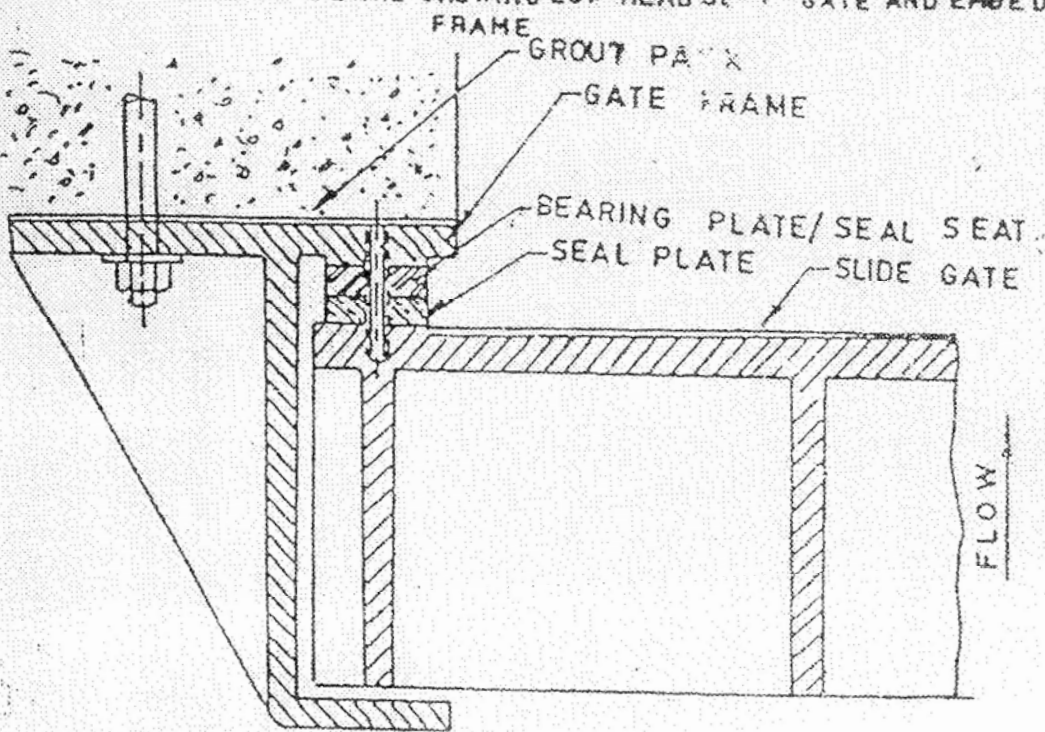
TYPICAL DIAGRAM  
SHOWING LOW HEAD SLIDE GATE LEAF

FIG-  
2GTYPICAL DIAGRAM SHOWING EMBEDDED FRAME OF  
LOW HEAD SLIDE GATE.





TYPICAL SLOT SECTION. DETAIL SHOWING LOW HEAD SLIDE GATE AND EMBEDDED



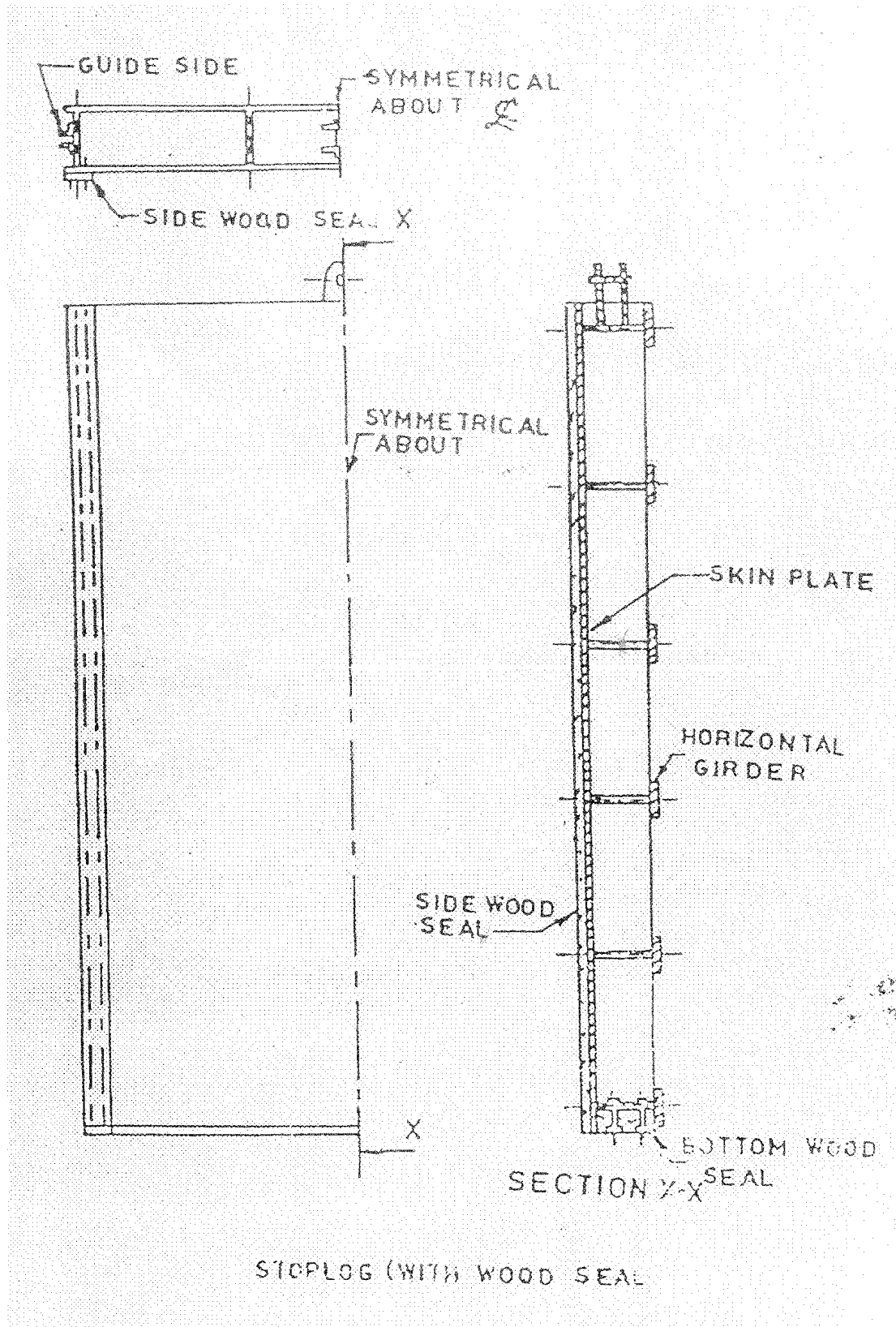
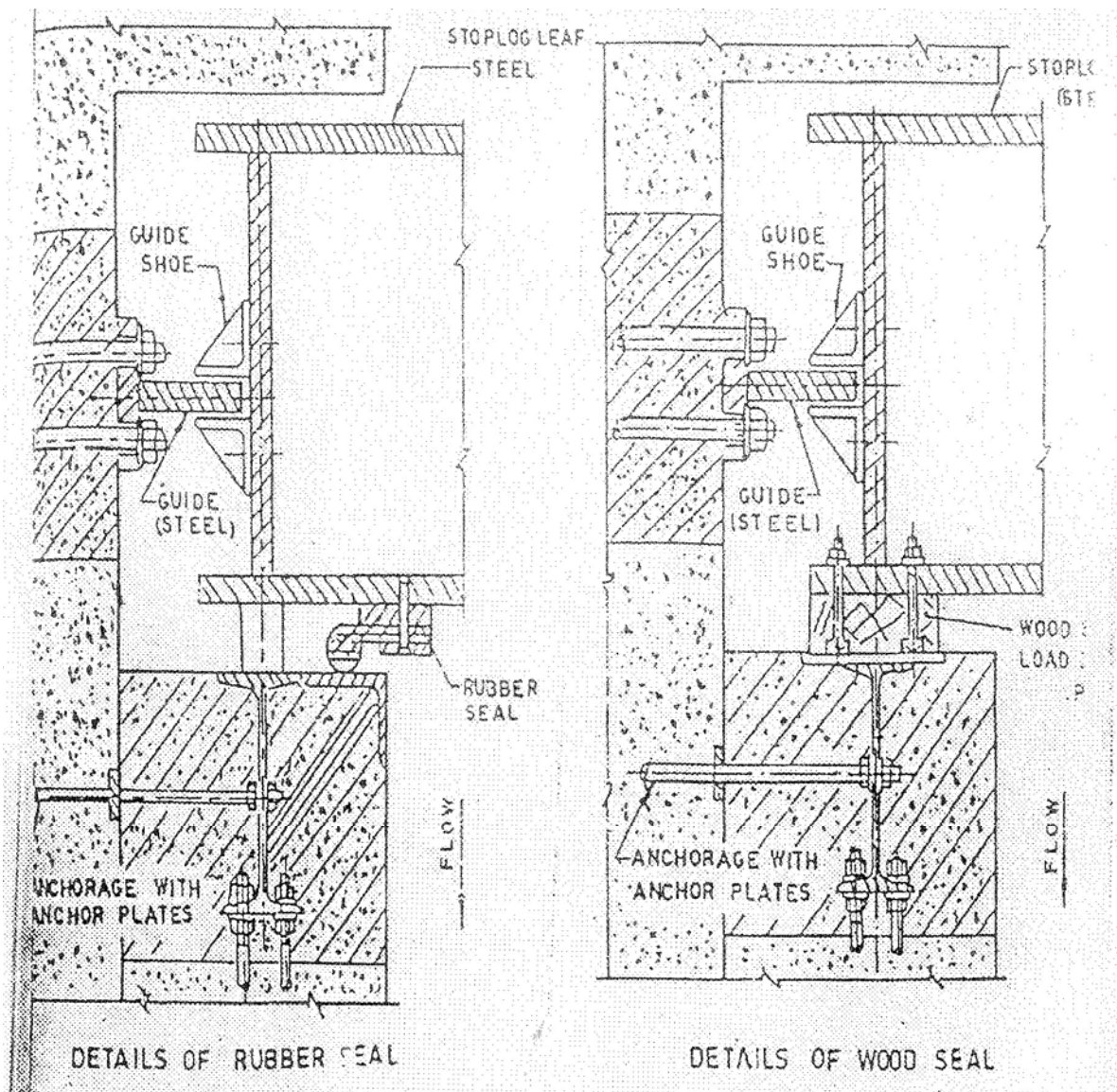


FIG-2F LOW HEAD SLIDE GATE SEALING ARRANGEMENT



**FIG-2G LOW HEAD SLIDE GATE SEALING ARRANGEMENT**