5.5.3 *Initial Interference*

The seal interference of double stem or music note type seal shall vary from 2 mm to 5 mm depending upon shall vary from 2 mm to 5 mm depending upon the requirement and type of installation at the discretion of the designer. The projection of bottom wedge seal shall vary from 2 mm to 5 mm depending upon the requirement and type of installation at the discretion of the designer. Suitable chamfer shall be provided at the bottom of the skin plate and clamp plate to accommodate the bottom wedge seal in compressed position (*see* IS 11855).

5.5.4 *Seal Friction*

For the purpose of calculating the frictional forces to overcome, the following friction coefficients shall be used:

For	*Starting*	*Moving*
Rubber seal on stainless steel	1.50	1.20
Fluorocarbon on stainless steel	0.20	0.15

5.6 Guide Rollers and Guide Shoes

5.6.1 Gate guide roller/shoes shall be provided on the sides of the gates to limit the lateral motion of gate to not more than 6 mm in either direction. The rollers shall be flanged and travel on steel plates or rails securely attached to anchor bolts. In case of rollers it shall be provided with bronze bushing or self lubricating bushing turning on fixed steel pins. Suitable arrangement for lubrication of these rollers shall also be provided. Where necessary, counter guide rollers shall be provided to limit the transverse movement of gates.

5.6.2 A minimum of two guide rollers or shoes should be provided on each side of the gate to resist the transverse and lateral movement of the gate and at same time to prevent the gate from jamming. A clearance of 3 mm to 6 mm between the guide rollers and guide surface is normally recommended. The guide rollers or shoes should be structurally adequate to withstand the load, they are likely to be subjected to, depending upon the type of installation, hoist and hydraulic condition. Guide rollers may also be provided with suitable springs, whenever required. Guide rollers may be preferred for high head gates and gates to be handled by lifting beams.

5.6.3 Suitable spring assembly may be provided beneath the guide shoes or guide roller assembly to restore the gate to normal position after any deflection, specially for high head gates.

5.6.4 The guide roller/shoes shall be designed to the maximum loads to which they maybe subjected during operation. A minimum load of 5 percent of the total dead weight of the gate is recommended for the design of each guide roller.

5.7 Wheel Track and Track Base, Dogging Beam

5.7.1 The wheel pin shall provide a true and smooth machined surface for the wheels to roll and transmit the loads through the wheels to the pin base.

5.7.2 The hardness of wheel pin surface shall be kept minimum 50 points Brinell Hardness Number (BHN) higher than that of the wheel tread to reduce wear. For gates which may not be put to frequent use, the difference between the BHN of wheel and wheel pin may be reduced suitably at the discretion of the designer.

5.7.3 *Thickness of Pin Plate (Wheel Pin with Line Contact)*

The thickness of pin plate shall be calculated from the following formula:

$$b = 1.55\sqrt{\frac{p}{l} \times \frac{r}{E}}$$

$$Z_1 = 0.786\ b$$

Where,

l = Tread width, in mm;
b = Half contact width, in mm;
P = Wheel load, in N;
r = Radius of wheel, in mm; and
E = Modulus of elasticity, in N/mm^2.
Z_1 = Depth to the point of maximum shearing stress.

5.7.3.1 The thickness of the wheel pin shall not be less than 6 times the depth to the point of maximum shearing stress (Z_1) as calculated in **5.7.3.**

5.7.4 *Thickness of Pin Plate (Wheel Pin with Point Contact)*

The thickness of pin plate shall be calculated by the following formula:

$$t = \frac{1.27\ P}{2c \times f_1}$$

Where,

t = Pin thickness, in mm;
P = Wheel load, in N;
$2c$ = Pin width, in mm; and
f_1 = Allowable pin bending stress, in N/mm*(*0.4* YP of pin material).

NOTE — The minimum thickness of pin plate shall be 10 mm.

"Pin" to be replaced by "track"

5.7.5 The pin base shall be embedded in concrete. It shall be designed as a beam on elastic foundation. The stresses in concrete under the pin shall be found from the following formula. The stress in bearing for concrete shall not exceed the values specified in IS 456. Second stage concrete shall be of at least M 20 grade.

$$p = 0.281\,3 \times P\left(\frac{E_c}{E_s \times I \times w^2}\right)^{1/3}$$

Where,

p = Bearing stress in concrete, in N/mm²;

P = Total wheel load, in N;

E_c = Modulus of elasticity of concrete, in N/mm*;

E_s = Modulus of elasticity of steel, in N/mm*;

I = Moment of inertia of pin base, in mm⁴; and

w = width of pin base in contact with concrete, in mm.

5.7.5.1 The edge distance of the bearing flange of pin base from the groove face shall be determined on the basis of the following criteria:

a) The wider flange, in case of double flanged pin base, shall be considered as bearing flange for the purpose of transferring load from the pin base to the concrete.

b) The minimum distance '*e*' of the bearing plate flange shall not be less than 150 mm. It can be further reduced if steel plate claddings (armored plating) are installed on the concrete surface and if these are sufficiently anchored by reinforcement bars which are provided in *Y*-direction.

c) The load shall be assumed to be distributed at 45° dispersion as shown in Fig. 2.

d) In case shear stress in second stage concrete is not within the permissible limit (with or without provision of shear bars), the width of loaded area at the interface of primary and secondary concrete should fully lie in the primary concrete. Clear cover of the reinforcement is to be neglected as shown in Fig. 2.'

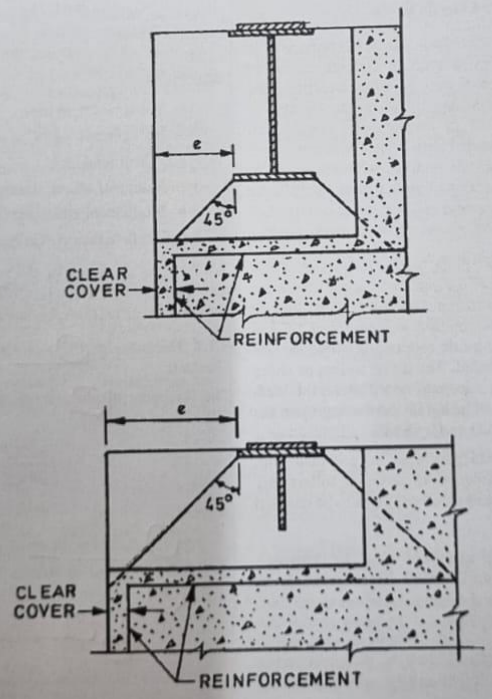

FIG. 2 EDGE DISTANCE CRITERIA FOR PIN BASE

5.7.5.2 The length of influence of the parabolic distribution under the pin base may be found from the following formula:

$$L = \frac{3}{2} \times \frac{P}{w \times p}$$

Where,

L = Length of influence under pin base, in mm,

P = Total wheel load, in N,

w = Width of pin in contact with concrete, in mm, and

p = Stress in concrete in N/mm.

5.7.5.3 If pressure distribution under adjacent wheels overlaps, superposition of the pressures shall be adopted and checked for the worst condition.

5.7.5.4 The pin base shall be checked for bending and shear also. Bending stress shall be calculated from the following formula:

$$\sigma_b = 0.5 \frac{p}{Z} \left(\frac{E_s}{E_c} \times \frac{I}{w} \right)^{1/3}$$

Where,

σ_b = Bending stress, in N/mm^2;

p = Load on roller, in N;

Z = Modulus of section of the pin base about the neutral axis, in mm^3;

E_c = Modulus of elasticity of concrete, in N/mm^2;

E_s = Modulus of elasticity of steel, in N/mm^2;

I = Moment of inertia of the pin base about the neutral axis, in mm^4; and

w = Width of pin base in contact with concrete, in mm.

5.7.5.5 The flange of the pin base shall be checked for local bending. The web of the pin base shall also be checked for compression. Permissible stress in compression for web shall be taken as 85 percent of yield point for normal condition and equal to yield point for MWL/occasional load condition.

5.7.6 The permissible stresses in pin base shall be those as specified in Annex B.

5.8 Guides

5.8.1 The guides shall be fixed inside the groove in piers.

5.8.2 The guide shall be flat plate or a rail section (in case of gates fixed with guide rollers) anchored into concrete for gates fixed with guide rollers. The thickness of the plate shall not be less than as given below:

Type of Gate	*Thickness of Plate* mm
Low head gate	20
Medium head gate	32
High head gate	40

5.8.3 The guide shall be suitable for the type of guide rollers or shoes provided on the gate.

5.8.4 The guides shall continue to the full range of travel of the gate.

5.8.5 If the gate is intended to be supported on dogging beams above the gate grooves, the guides may be extended up to the top of the gate at the discretion of the designer. Suitable supporting structure shall be provided above the deck to hold the guides. The guides and their supporting structures shall be of dismountable type and shall cover full height of the gate. The guide extensions and their supporting structure shall be checked for bending, shear and stability due to imposed wind and other applicable loads.

5.9 Seal Seat, Seal Seat Base, Seal Base and Sill Beam

5.9.1 The minimum width of seal seat shall be 80 mm excluding the required chamfer.

5.9.2 The minimum thickness of the stainless steel plates for low head gates may be adopted as 6 mm and for medium and high head gates to 8 mm.

5.9.3 The seal seat shall be welded or screwed with corrosion resisting steel screws to the seal seat base. The number of screws shall be sufficient for rigidity of the seat on base and water tightness.

5.9.4 The seal seat shall be finished smooth to present a smooth surface to the gate seal.

5.9.5 The seal seat base shall be embedded in concrete.

5.9.6 The edges of side and top seal seat shall be rounded/chamfered (*see* Fig. 3) to prevent damage to rubber seal during gate operation.

5.9.7 The sill beam, may be provided, with the corrosion resistant steel flats welded or screwed with corrosion resistant steel screws. The surface of the sill beam may be machined smooth, wherever required, and made flush with the surrounding concrete.