stiffeners transmit the total end reaction to the web plate where it is converted into shearing stresses. As these stiffener angles are ground to fit the curved fillet of the flange angles, it is evident that a large part of the reaction is transmitted to the stiffeners by direct bearing of the outstanding leg on the flange angles, and it is therefore necessary to have this leg as wide as the flange angles will permit, and care should be exercised in the shop to ensure that these angles have an exact fit and true bearing. In arriving at the sections

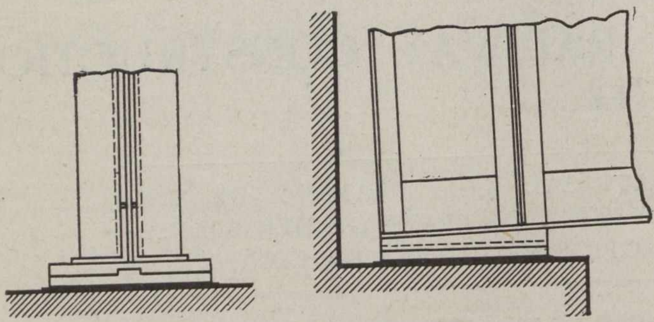

Fig. 1.—Sliding Bearing.

of end stiffeners, it is usual to consider that they act in conjunction with the filler plates, as a column of length equal to the depth of the girder, and that the end reaction produces a compression which is constant throughout the length of the column, whereas in reality, the stress diminishes from a maximum at the bottom to zero at the top. As the filler plates cannot be considered to bear on the flange angles in actual practice, the stiffener angles must take the entire stress at the break between the filler and toe of the flange angles; and it is at, or below this point, that the failure of end stiffeners would usually occur. Taking this into account, and also the fact that the bearing of the outstanding leg does not transmit all the end reaction, but that part of it will go into the other leg through bearing on the fillet and rivets at the bottom, it is a common practice to use end stiffener angles, the gross

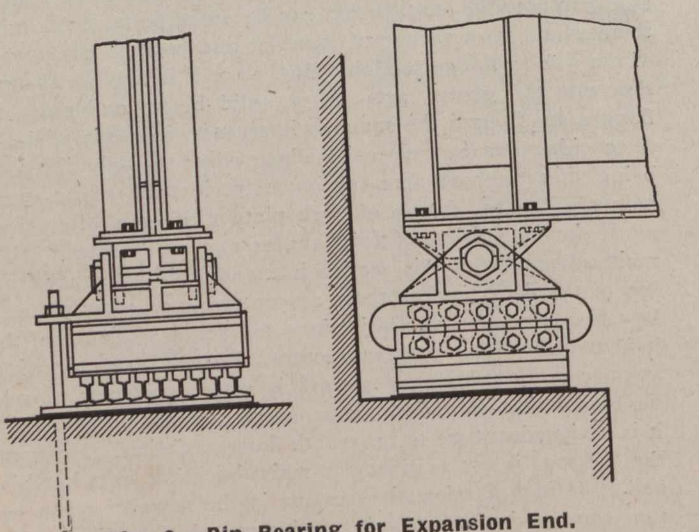

Fig. 2.—Pin Bearing for Expansion End.

section of which is considered to resist the reaction at 12,000 pounds per square inch. In addition to these considerations, the designer must use judgment in the selection of the angles, so that the outstanding leg will be thick enough to prevent its buckling near the bottom, where it is highly stressed. There should also be sufficient rivets connecting these stiffeners to the web to transmit the reaction intended.

Intermediate stiffeners which are merely intended to prevent the web plate from buckling, do not cause the designers of girders much worry, as all railroads have adopted standard sections for different depths of girders and certain limitations as to the spacing of them, but it is a satisfaction to know that their failure in actual structures has been very rare. They have been generally determined by formulae based on compression in the web plate due to shearing forces acting upon it. This seems the most reasonable method. The spacing of these intermediate stiffeners should therefore depend on the shearing stresses, and this would necessitate their being spaced closer towards the end of the girder.

Theoretically there is no reason for the intermediate stiffener angles to bear on the bottom flange, but it is always done in practice and makes a neater job. It is necessary, however, in the top flanges because it tends to prevent the outstanding leg of the flange angles from buckling and in deck girders it helps to transmit the loads from the track into the web plate.

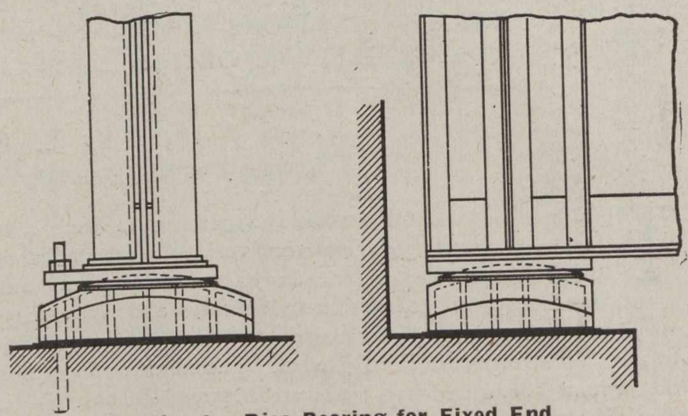

Fig. 3.—Disc Bearing for Fixed End.

Pier Members.—They are determined in area, by the unit, 400 pounds per square inch for concrete masonry. For spans up to 75 feet in length sliding masonry plates only are used, as indicated in Fig. 1, with a tongue and groove to resist side motion. The groove should be on the upper shoe plate as shown, so that dirt and water cannot lodge in it.

With this type of bearing it is advisable to consider that the stiffeners over the inside edge might have to take 75 per cent. of the total end reaction, because any deflection in the span tends to move the end reaction to this point.

For spans 75 feet long or over, pedestals are necessary to properly distribute the bearing pressure, and to adjust themselves to deflection and camber. Fig. 2 indicates the pin type which is generally used in the United States, and it may be made up of structural shapes, or cast steel. By means of the pin the bridge is securely anchored to the bottom pedestal.

Nearly all Canadian railroads use the disc bearing, as shown in Fig. 3, and it is superior to the pin type in many ways. It is sure to have a true bearing, as it adjusts itself in all directions to suit uneven masonry and deflection in the span. It is also convenient in erection as the girders can be dropped into place with a minimum trouble in adjustment.

In the disc type most of the end reaction should be considered to enter the girder over the centre of the disc with a small proportion at each edge, while in the pin type, where the shoe is deeper, all the end stiffeners can be considered to take an equal share.

Expansion in Girders.—This condition should be provided for to the extent of one inch for each 80 feet of span, and for all spans over 75 feet in length roller nests must be used at one end. These should be constructed so that the sides may be taken off and the rollers cleaned and oiled; also in such a way that they will shut out as much dirt as possible and not hold water. Fig. 2 represents a good design