made square to the track, as this is a better arrangement for the deck. The character of the skew is termed right-handed when it is in the direction shown in **Fig. 7.**

The depth of the deck is the distance from the base of rail to the top of the girder, and when the track is on a tangent this depth is ½-inch less than the depth of tie required to support the wheel loads. Fig. 8 illustrates the C.P.R. standard track for deck girder bridges, and it shows the methods of securing the deck to the girders, and the amount of material required. When the track is on a curve, the base of the low rail is referred to in giving the elevations. The outer rail is given a super-elevation to suit the degree of curvature. This is usually made to suit a medium speed of train, rather than a maximum, as the rails are considered to wear longer with this arrangement.

This super-elevation may be arranged by tilting the whole bridge until the webs of main girders are normal to the plane of the track. By this method the standard deck can be used, similar to the case where the alignment of the track is tangent. This arrangement gives a minimum side thrust at the top flanges where the ties rest on the girders, and also a minimum strain on the bracing, because the direction of the axis of the bridge is midway between the vertical direction of the load, when the train is moving slowly, and the direction of the resultant force of the train at high speed. The more general practice, however, is to place the girders in a vertical position and provide for the super-elevation of the track in the framing of the ties. With this arrangement the bridge has a better appearance as well. The cheapest arrangement of the deck is to use regular ties with wood shims on the outer girder to provide super-elevation, but this is dangerous practice and should not be used. The best construction is the use of bevelled ties which can be detailed in the drawing room and ordered to suit. In this arrangement the depth required for the deck depends on the minimum depth of ties, over the inside girder, that is considered necessary to properly resist the shear stresses in the ties. This depth should never be less than 6½ inches, the worst position with the track on a curve being at the centre of the

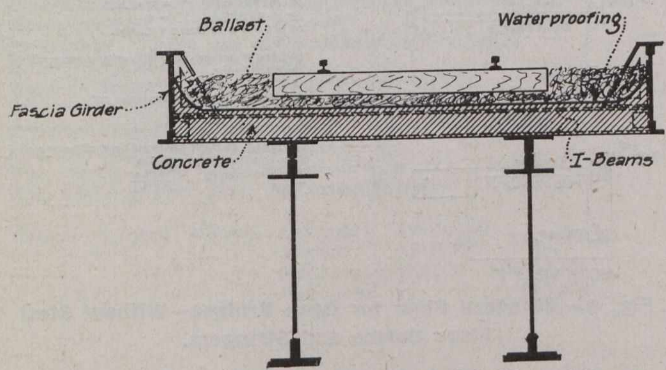

Fig. 5.—Cross Section Through Solid Floor I-Beam Construction.

span, where the camber is the greatest, the cover plates the thickest, and the lower rail farthest from the inside girder. So that if the depth of deck is decided at this point, the ties will have a greater depth towards the end of the span.

It is a common occurrence for engineers who do not correctly foresee the depths required for bridges, in the deck, in the girders themselves, and in the pedestals, to make mistakes in the construction of the masonry; and to overcome such errors it is often necessary to belly the bottom flanges of girders at the ends. This costs the contractor at least $200 a span for the steel, and is usually a total loss to him.

Camber.—This allowance is usually insisted upon for plate girder spans. The intention is to put sufficient camber in the span to more than overcome any possible deflection from loading, because a girder constructed straight might have a reverse camber when erected, which would have an unsightly appearance. A great many bridge engineers consider that this is unnecessary refinement, but if it is specified, good results can only be obtained by proper details and rigid shop inspection. Cases are known where two girders on the same span have reverse camber, although built from the same drawings and in the same shop. Another difficulty in regard to camber is in double track bridges when one track

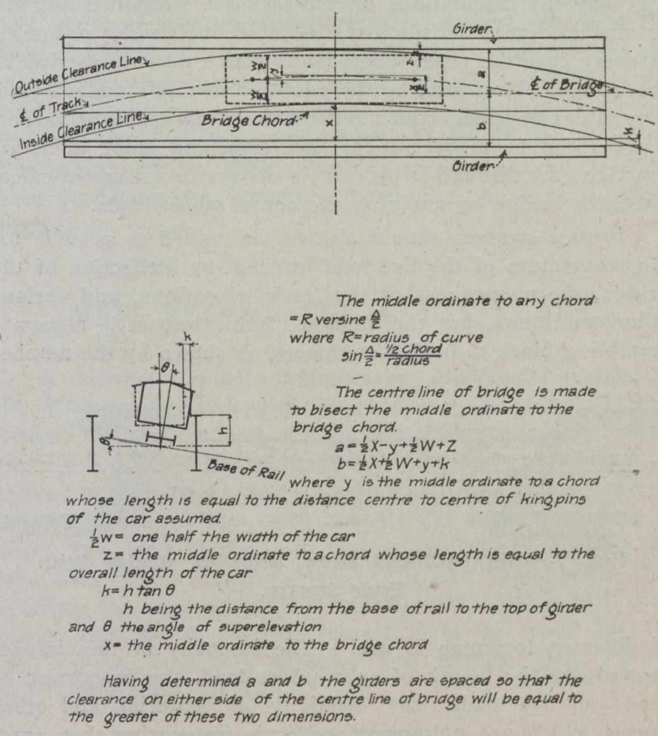

Fig. 6.—Clearance in Through Bridges on Curves.

only is loaded. Where there is one centre girder there is more deflection in the outer and lighter girder and where there are only two main girders there is more load carried by the one girder than the other, and therefore unequal deflection exists. The only arrangement to avoid this difficulty is to place two girders under each track, as if they were separate spans. This is a more expensive arrangement, but it is the best design, because the wear and tear on the bridge is lessened and each half is free to move and deflect by itself when loaded, without straining the other half which would probably be unloaded. It is often an advantage, too, in erection, as one track can be completed first, without interrupting traffic on the other track.

Calculation of Stresses.—In plate girder spans, as in all types of railway bridges, this calculation is based on the following loads: 1, dead load; 2, live load; 3, impact; 4, wind stresses; 5, centrifugal force when track is on a curve, and 6, traction. The methods, both analytical and graphical, for obtaining the dead and live load stresses, are fully covered in all text books on this subject and universally recognized in practice. As these basic methods are unaffected by evolution in construction it seems unnecessary to consider them here.

The dead load per lineal foot of track must be assumed to begin the calculations. It consists of the weight of material in the deck and the steel in the structure. In determining the deck it is usual to consider first the maximum axle load plus impact, distributed over three ties. This will determine the size of ties needed, and as the rails and guards and fastenings are standard, the weight of the deck is then