For the designing of the top flanges of through plate girder spans engineers differs as to what formula to use to resist the deflection sidewise. Reliable tests are lacking, which would definitely determine the resistance necessary to prevent buckling. All engineers, however, are agreed that the ratio of "l" over "r" should come within certain limits, and in addition thereto the floor beams are extended by means of brackets, within the line of train clearance, to connect to the top flange. Sometimes assumptions are made, such as treating the top flange as a column free at both ends and with an effective length equal to two-thirds of the length of the girder.

For length of girder spans up to 60 ft. the expansion ends slide on castings, the effect of the deflection not being considered except that the casting should not be too wide on top. For longer spans shoes with pins are used to permit deflection. Roller nests should be used for the expansion ends. Segmental rollers about 6 ins. in diameter are better than the circular rollers, as more rollers can be used within a given area.

Pin shoes should be designed of cast steel instead of being built up of plates and angles. The distribution of bearing necessitates the use of stiffeners which in the shop are extremely difficult to secure a perfect bearing at the bottom, certainly from a theoretical standpoint a perfect and equal bearing of all stiffeners is impossible.

When designing end posts of girders the bearing areas required should be confined to as small a space as possible to prevent unequal transmission of the shear under deflection. The centres of the end stiffeners are placed exactly over the bearing casting. It is best to lay out the bearing castings with the end of the girder to make sure that the walls of the castings are placed under the bearing surfaces of the girders.

The chamfered legs of the end post angles which fit the fillets of the flange angles should not be counted in bearing, as the shop does not get a fit perfect enough to transmit bearing. The outstanding legs are figured only for bearing. The value of the rivets through the flange angles which are above the sole plate or bearing shoe will add to the strength of the bearing, but should not be counted in the computations.

Through plate girders are frequently designed with round ends; the reason commonly given is that the round ends will deflect any material protruding from the side of the car. This method of construction is very expensive and should be discouraged, at least be restricted to the ends of the girders having considerable projection above the base of rail. The speaker does not believe that from an æsthetic point of view the round ends are better.

Where side plates are used with round ends the side plates should be cut where the bottom edge meets the curvature of the flange angles. The space under the flange angles beyond the side plates and above the end reinforcing plates should be filled with plates. This detail will simplify the shop work.

Deck girder spans, to make the most rigid structure, should have a top and bottom lateral system with cross frames at the lateral points to carry the wind stresses from the bottom to the top system. The laterals should be designed with only a few changes in section to avoid a variety of different pieces.

The cross frames should be connected directly to the top lateral plates, but for ease of erection the cross frames should be raised about 2 ins. above the bottom lateral plates. Avoid the use of lug angles for laterals where the stress or section does not require over six rivets. The small fittings add to the cost of fabrication and are not necessary for the laterals transmitting small stresses.

Engineers differ as to the use of stiffeners in stringers. Where stiffeners are not used a common specification is that the unsupported distance between the flanges should not be more than 60 times the thickness of the web. The thickening up of the web to conform to this specification and the omission of the stringers does not alter the weight materially; sometimes the weight becomes greater and sometimes smaller, and in addition has the advantage of simpler fabrication to the manufacturer and reduced cost to the buyer.

For all skew span work it is advisable for simple fabrication to study the design with the object of squaring the end frames, end stringers, etc. Frequently the skews of various spans vary by small amounts which, for practical purposes, could be modified slightly to make as many spans of one skew as possible. When designing more than one span the location of piers or bents should be studied with the idea of making as many spans of the same lengths as possible.

Truss Spans.—Inclined top chords are generally used for spans over about 200 ft. in length. For spans over about 300 ft. in length sub-verticals are used in order to give a better inclination to the diagonals. In the designs of the longer spans it is usual to connect the compression members which are built up of structural steel with riveted connections and the eye ears are connected with pin connections.

The interior columns should be designed not merely to conform to the column formula, but also to give good connections for the floor beams and bottom laterals.

Generally the flanges of the built-up members should turn out and not in, where for good packing it is necessary to turn in the flanges of the posts and diagonals; the flanges of the top chords and end post should always turn out. By turning out the flanges of built-up members the rivets in the tie plates and lacing bars can be more easily driven. To resist the thrust of the drivers as the engine comes upon the bridge the end bottom chords are generally made up of built sections for two panel lengths.

The top chords and end posts are built up of web plates, top and bottom flange angles and a cover plate. The bottom angles, which are laced, are made heavier than the top angles, so that the centre of gravity of the section may be more nearly in the centre of the member. Heavier angles give simpler shop work than the addition of bars riveted to the angles. If the desired section cannot be obtained with single webs, the webs should be doubled rather than by adding side plates between the angles. The plates between the flange angles are not connected to the angles and do not give as rigid a section as the additional webs do. Double webs may be held together in the centre by one line of rivets about 12 ins. centre to centre.

When designing sections for chords and columns of trusses the designer should draw the sections of the various members, taking into account the fitting of the posts to the top and bottom chords, so that there is clearance enough for lacing posts and bottom chords. Sometimes designs are received in which the posts are too narrow to permit a floor beam connection; again the chords are too narrow to allow the riveter to rivet the lacing bars when the angles are "turned in," and again the angles of the chords are too small to give room enough to drive the cover plate rivets where pin plates occur.

The working lines of the top chords and end posts on which the pins and intersections of posts and diagonals are located should be approximately the centre of gravity of the sections, but the fact should not be overlooked that the weight of the member itself lowers the centre of pressure. Consequently, if the eccentricity is small, the working lines may be taken on the centre lines of the chords. To reduce the eccentricity of the main truss connections to a minimum