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PLATE GIRDER BRIDGES IN RAILWAY CONSTRUCTION
PART II.

CONSIDERATION OF SECTIONS OF MATERIAL—THE FRAMING OF THE VARIOUS SECTIONS—SHIPMENT AND ERECTION OF PLATE GIRDER SPANS—ADAPTABILITY OF DESIGN TO SHOP PRACTICE AND ERECTION CONDITIONS

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THE first part of this article, appearing in June 26th issue, after enumerating the various advantages of plate girder construction, for example, simplicity and uniformity of construction, solidity and durability, speed in erection, and low office cost, went into the calculation of the stresses due to the loads. The methods by which the ordinary dead and live loads are obtained do not form a part of the article as the reader may refer to any authoritative text on the subject for them. Following, the various sections of material to be used in design are next in consideration.

The web plate is first determined, as its depth is already decided, and 10,000 pounds per square inch of gross section is the unit which is generally used in obtaining the required thickness of web. It may, however, be necessary in some cases, to use a thicker web than is required by this unit in order that the end shear may be transmitted to the flange angles in a length equal to the depth of the girder. This is only probable when the web is connected to the flanges by single lines of rivets and the number of rivets is, therefore, more limited.

The flanges of girders are determined, as in trusses, by dividing the total bending moment at any point by the product of the effective depth and the unit tensile stress. The difference between girders and trusses is that the flange stress varies gradually throughout the length of the girders, while in trusses it is constant between panel points. The bottom flange is usually figured at 16,000 pounds per square inch of net section, and the top flange is made the same total gross section as the bottom, with the restriction that the unsupported length of the flange must not exceed twelve times its width. This limits the spacing of floor beams and cross-brace frames.

As the centre of gravity of flanges cannot be known until the sections are determined, a great amount of time is usually wasted in assuming a centre of gravity and making approximate calculations, and this operation repeated several times until the section is finally settled. Table 1 gives a useful table for railway girders. By use of it the required flange can be determined by one calculation and the labor of figuring the net sections and centre of gravity is avoided.

The effective depth used should never be greater than the distance, back to back, of flange angles.

There is a wide diversity of opinion among engineers as to whether part of the web should be counted as flange area. For this to be so, the flanges and web must act as a solid beam and theoretically 1/6 of the gross section of web would act as flange section, but it is considered to be 1/8 on account of deduction of rivet holes.

Since the bending stresses in the web do not act at any one point, but over the total depth of the web, having a maximum intensity at the edge of the web and zero at the centre, it is very difficult to properly splice the webs to take care of these stresses. It involves a great many rivets and extra material, which, in cases of heavy girders, is worth more than the material saved in the flanges. Moreover, if the web is considered to take tension, it is good practice to plane its edges to avoid tearing, and this is additional expense.

In some cases where the web does not need to be spliced, owing to possible lengths that can be procured from the mills, there would be a saving of material and cost, to consider 1/8 of the web as flange section. But, since it is only an assumption that the girder acts as a solid beam, and since the flanges are figured the same as in trusses, it seems advisable to consider that the web resists shear only; the only difference being that the web acts continuously instead of at panel points. The top flange of deck plate girders is often made an H-shaped section of four angles and side plates. The main advantage of this section is its suitability to easy framing of the deck ties, as there are no rivets or cover plates to be taken care of. The objections to such a section are, that it is more difficult to manufacture, because extra drawings are necessary and the shop work is more expensive; this for the reason that in modern shops equipped with spacing tables, it is a big advantage to have both flanges similar. Moreover, the H-flange is not as strong to resist buckling from handling and from compression stresses, as is the more common section composed of two angles and cover plates. Hence, if it is used, the brace frames should be made with the top strut the same depth as the flange section. This is necessary because the top laterals are at the elevation of the bottom of the H-section, which is some distance below the deck, and because the web stiffener angles must break at the bottom of the H-shaped flange, which is a marked weakness.

Stiffener Angles.—These are an important factor in the strength of girders and, as their duty is not generally understood, they deserve some explanation. They may be divided into two classes, viz., those that resist concentrated loads and those which merely prevent web buckling. The end