

comparative merits of constructing beams in almost every variety of detail, it certainly appears, as far as I am able to form a judgment, that much error still prevails regarding the simple principles that should, and indeed must, govern the arrangement of every beam-bridge.

The tubular system is openly declared by some to be a wasteful expenditure of material for the attainment of a given strength; in short, that in the scale of comparative merit, it stands at the lowest point. This, if it were the fact, would not be extraordinary, since it was the first proposed for carrying railways over spans never before deemed practicable; but in the following remarks I hope to convince you in the simplest manner, that (except in particular cases) whilst it is not a more costly method of construction, it is the most efficacious one that has hitherto been devised.

At present there may be regarded as existing three methods of constructing wrought-iron girders or beams for railway purposes:—

*First.*—The *tubular girder*, or what is sometimes called the *box-girder*, when employed for small spans, with which may also be named the *single-ribbed girder*,—the whole belonging to the class known as “boiler-plate girders.”

*Second.*—The *trellis girder*, which is simply a substitution of iron bars for the wood in the trellis-bridges which have been so successfully employed in the United States, where wood is cheap and iron is dear.

*Third.*—The single triangle girder, recently called “Warren,” from a patent having been obtained for it by a gentleman of that name.

Now, in calculating the strength of these different classes of girders, one ruling principle ascertains and is common to all of them. Primarily and essentially the ultimate strength is considered to exist in the top and bottom, the former being exposed to a compressive force by the action of the load, and the latter to a force of tension; therefore, whatever be the class or denomination of girders, they must all be alike in amount of effective material in these numbers, if the spans and depths are the same, and they have to sustain the same amount of load.

On this point I believe there is no difference of opinion amongst those who have had to deal with the subject. Hence, then, the question of comparative merit—amongst the different classes of construction of beams or girders—is really narrowed to the method of connecting the top and bottom *webs* so called. In the tubular system this is effected by means of continuous plates, riveted together; in the trellis girders it is accomplished by the application of a trellis-work, composed of bars of iron forming struts and ties, more or less numerous, intersecting each other, and riveted at the intersections; and in the girders of the simple triangular or “Warren” system, the connection between the top and bottom is made with bars, not intersecting each other, but forming a series of equilateral triangles; these bars are alternately struts and ties.

Now in the consideration of these different plans for connecting the top and bottom *webs* of a beam, there are two questions to be disposed of,—one is, which is the most economical; and the other, which is the