

of the lower chords by means of single octagonal intermediate plates. These angle-irons, which are to be rivetted together into T form, should project four and a half or five feet outside of each truss, and a side brace of a single angle-iron should extend from each end to the top chord as shown and described in the Memoir. Four or five such pairs of angle-irons should be used for a one hundred foot span, and the positions for their attachment should be chosen where there are no splices in the lower chords.

In addition to these transverse struts there should be diagonals of single angle-iron attached by rivets to the under side of the bottom chords close to the connections of the transverse struts. As these diagonals may be relied on to resist both tension and compression, if made of sufficient sectional area, only one will be needed per panel of wind bracing. Care should be taken to make the connections very strong, and rivets should be used unsparingly provided that the holes therefor do not too greatly weaken the bottom chords.

The side braces thus provided at once strengthen the top chords by reducing the ratio of length to least diameter, and prevent the overturning of the trusses when subjected to heavy wind pressure.

The third danger, viz., that from derailment, may be entirely avoided by adopting the arrangement of ties and guard rails together with the rerailing and ditching apparatus described in the Memoir.

In the letter before mentioned I indicated weakness and inferiority of design in the Japanese railway bridges in seven other, but minor, particulars.

The first, viz., weakness of the web struts, owing both to their section and to the trussing employed, can be corrected with considerable difficulty by rivetting along the outer edges of the bars, frames composed of light angle-irons latticed together. These cannot extend to the eyes of the bars, but as there is more iron near the ends than in the body of the strut, stiffening will not be required there.

The second point, viz., the thickening of the bars at the eyes, although indicative of very crude ideas in designing, is not of vital importance; which is well, for it is an evil that cannot be remedied.

Third, the stay plates of the top chord and batter braces should be taken off and replaced by a system of lacing bars with a wide stay plate (say 8" or 10") on each side of each panel point and as near thereto as possible.

Fourth, if water lodge in the bottom chords, a small hole should be drilled through the plate at the deepest part of each pool.

Fifth, the smallness of the connecting plates of the top chord cannot well be corrected; by relying upon abutting ends (which first-class American specifications do not allow) the chords in this respect may be considered as not dangerous.

The sixth error, too many panels, is a fundamental one; and, of course, cannot be corrected. It affects the economy of design, but not the strength of the structure.

Seventh, the supporting of floor beams between panel points cannot be avoided in the present Japanese bridges; but the method of so doing may