FLOOR SYSTEM.

There is probably no part of a railway bridge subjected to such destructive effects from the moving load as the floor system and its attachments to the truss proper at the chord joints. The design of these parts has, therefore, received the care required by the difficult character of the duty which they have to perform. Our floor systems combine that degree of flexibility which enable them to sustain, with the least fatigue of the metal, the shock of a rapidly-passing train with such a judicious rigidity as to secure complete lateral stability and a perfect attachment to the truss proper. This attachment consists of two suspension loops at each panel point, by means of which the floor-beams are drawn tightly up against the posts, materially increasing the lateral stability of the truss, and effectually preventing any motion of the floor system as a whole or in any of its parts.

WIND PRESSURE.

During the past few years American experience has shown that high-wind pressures cannot be safely neglected in the design of any bridge structure. All our lateral and transverse systems of bracing are carefully designed both in reference to the highest recognized wind pressure and the lateral vibration caused by rapidly-passing trains.

ROLLING LOADS.

The steady increase in railway rolling loads, which has taken place during the past ten years, has now caused it to reach a value of 96,000 pounds on a wheel-base of 14 feet 9 inches, or 111,000 pounds on a wheel-base of 22 feet 10 inches; or, again, 171,000 pounds on a base of 45 feet 3 inches. This corresponds to about the heaviest pattern of "consolidation" engine at present in use.

The moving or rolling load, however, should depend on the length of span, for the following simple reasons: If the span is very short, the four drivers (or a less number) of a consolidation engine may cover it, and thus subject it to an enormously heavy load, which will take a very high value per foot, perhaps 5000 or 6000 pounds.

If, on the other hand, the span has a length of 100 feet and upwards, the general rolling load per foot will fall to an average of 3000 pounds, even if loaded with a train of consolidation locomotives. Hence it is that the rolling load varies from a very high value per foot for short spans to a comparatively low one for long spans.

But, again, a recognition of this difference is not sufficient. The stresses in many of the truss members will be very much reduced above their proper value if the loads on the drivers and at other points be considered uniformly distributed. A correct system of computation, therefore, demands that the actual moving load, concentrated at drivers and other points, should be so placed as to give the greatest possible stress to the different truss members. This is of special importance in connection with the floor system and its attachments to the chords. Our system of designing is based upon a correct recognition of these conditions.

GREATEST ALLOWABLE STRESS.

The greatest stress to which it is permissible to subject any portion of a bridge structure varies much both with its position in a given truss and the length of span. The floor system and its attachments to chords are subjected to sudden loads and, comparatively speaking, violent shocks. The fatigue of the metal is correspondingly greater, and the greatest allowable stress should be correspondingly lower.

In the chords and main-web members the variations are much more gradual and less in relative amount; hence the working stress may be larger. Again, the fixed load or weight of structure is much less in proportion to the moving load on short spans than for long ones. Hence the variation of stress, both relative and absolute, in passing from a loaded to an unloaded state, or vice versa, will be much greater in short spans than in long ones, thus necessitating the smaller working stress for short spans.

The effects of these indirect influences, the importance of which has only been more fully developed by late investigations, have had almost their earliest application by this Company, which has, consequently, been among the first to be in position to utilize the advantage of investigations in the fatigue of metals.

UPSET SCREW-ENDS.

All of our upset screw-ends are from one-sixteenth of an inch to one-eighth of an inch larger at the bottom of screw-threads than the diameter of the rods, the ends of the rods being upset before the threads are cut. Many tests have shown the necessity of this arrangement, in order to develop the full strength of the body of the bar.

PLATE GIRDER.

In the design of plate girders, it is to be borne in mind that the connection between the web and chords or flanges is not so intimate as in the case of rolled beams, and, further, that the stress in the cover-plates must be carried from the web to those plates first through the rivets between the web and chord angles, then through the chord-angles to the rivets between the angles and cover-plates, and finally through the latter rivets to the cover-plates; hence, if there are a number of cover-plates, it will be essentially impossible to produce a satisfactory action in those farthest from the web, however accurately and solidly the riveting may be done. At the same time considerations of economy frequently forbid carrying the full centre section of the chord to the ends of the beam. The most judicious design is one which avoids piling a number of thin plates at the centre of the span, but at the same time makes such a proper selection of angle-iron for chords that reduction to their section at and near the ends of the girders will produce the most economical construction.

Tests on full-sized girders have shown that, when the riveting is properly done, part of the web may be included with the chords in the resistance to bending. Parties, however, may specify whether they wish to have the web included or not.

Experiments on full-sized girders have also shown that a comparatively thin web will safely resist a much greater shear than is frequently allowed by many engineers. Indeed, it is a question whether there is not frequently a waste of material in the webs of large girders. Very thin webs are not permissible, on the ground that a very little deterioration, from corrosion or other cause, produces the destruction of a relatively large amount of metal; but web-plates of moderate thickness are not open to that objection, and if well stiffened at the ends, as well as at intervals of about one and a half times the depth, are sufficient for the heaviest girders.