These are some of the external causes generating transverse action, and motion of the structure. But in addition to these, the upper chord itself, acting by thrust, is, at best, in unstable equilibrio, and liable at all times to exert more or less transverse action, and, if not kept in line by an efficient system of transverse bracing or tying, will lose its equilibrium, and be deprived of the power of performing its appropriate functions in the structure.

Now, these disturbing lateral forces are quite small, compared with the vertical action upon the trusses; and, the vertical strength of the truss does not necessarily imply any power of resistance transversely; the tendency of the lower chord to preserve a straight line, being essentially balanced by that of upper chord or arch to buckle laterally;* provided the chords be so dependent upon one another that both must sway to the right or left at the same time.

Hence, it is always expedient to provide some especial means for counteracting these lateral forces, which is usually done by the introduction of a system of horizontal diagonal ties or braces (small iron rods in iron, and the same, or timber braces, in wooden bridges), below the track or platform, in the horizontal panels formed by consecutive beams, and the chords of opposite trusses. Also, when trusses are sufficiently high, diagonals and cross-struts are introduced between upper chords, to prevent lateral buckling.

No attempt will here be made to assign specific stresses as liable to occur in sway rods or braces, based upon calculations from the uncertain and indeterminate elements upon which the lateral action upon

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* The only truss known to the author, not liable to this lateral buckling, is the Whipple Independent arch truss, shown in Fig. 27.