machine constructed on purpose. This reduction will somewhat enlarge the body of the cast-iron block at the bearing surface. The section of the block should not be made less than the drawing shows. They must have a certain mass and weight to stand blows, else they will break. Blocks of 5 inches depth and 18 inches long will weigh about 70 lbs. They should be cast with a chilled surface of good car-wheel iron. I am well satisfied that these splices would pay for themselves in one month, by the reduced wear and tear, on all our leading railways. But I recommend their introduction more particularly upon all bridge superstructures.

To allow for contraction and expansion, the bolt-holes in the block as well as in the opposite plate must be elliptical; or, if they are made round, those in the rails must be elongated.

STORM-CABLES.

The arrangement of the storm-cables is fully explained by an inspection of Plate 1. Two wire-ropes of an ultimate strength of 100 tons each are suspended below the floor in such a manner as to form parabolic curves. By this plan no longitudinal strains are thrown upon the superstructure. All the strains are directed upon the floor-beams, and are regulated by screw-bolts to give the cables a proper tension. The horizontal deflection of these cables in the centre span is 4 feet, or about \( \frac{1}{8} \) of the span, and therefore the coefficient of tension is 1.70. If we assume now that the force of a high wind should be so great as to produce a uniform horizontal pressure against the structure equal to 20 tons, then the strain on the cable would be 1.70 \( \times \) 20 = 34 tons, or about \( \frac{1}{8} \) of its breaking strength. But this tension might be increased even to 50 tons without at all endangering the safety of the cables. From my experience on other works I consider the provision here made against high winds sufficient in ordinary localities. But little surface is exposed to the wind vertically as well as horizontally.

It is well known that on a structure suspended at a high elevation, the wind exerts more of an uplifting power than of a horizontal action. The uplifting force is amply met by the weight of the structure itself. Estimating the vertical area exposed to horizontal action at 3,000 square feet and a pressure of 30 lbs. per sq. foot applied all over, the aggregate pressure would be 90,000 lbs., and would be met by the strength of the cables. In this calculation no allowance is made for the inherent stiffness of the horizontal framing at the upper and lower chords and the top of the arches.

As has been remarked before, an objectionable feature in the plan before us, is the great height of the arches in the centre of the main span, and its tendency to lateral oscillations under the action of fast-moving trains or from the effects of heavy gales of wind. Where, therefore, a necessity exists to preserve the whole space below the lower chords clear of all obstruction, either a double bridge must be erected at once, the two connected together, or a more effective horizontal bracing must be put up in localities which are exposed to very high winds or hurricanes. This horizontal security can be increased by heavier diagonal ties between the upper chords and arches, by doubling the storm-cables and also by adding diagonal bracing. Any amount of security may thus be obtained. It will be noticed that the contractions and expansions of the storm-cables from changes of temperature are not at variance with those of the trusses, because they form one connected whole, and will always move together. But there is scarcely a locality in the whole West where the wants of navigation would not permit of the arches being extended below the floor, next to the piers. The plans, therefore, exhibited on Plate 7 and farther on, with the spring of the arches below the floor, and no rise above the upper chords, will always receive the preference in point of strength, economy, beauty, and lateral safety. I will add here, that the plan before us is the most difficult in the adjustment of its proportions, and I have therefore treated it first.

Descending below the floor simplifies the case, because the harmony of the arches is more fully preserved between the central and side spans.