GENERAL DESCRIPTION.

The weight of the central span is, in tons ............................... 642 T.

We will assume it at .................................................. 650 T.

The greatest possible transitory load which can be placed upon this span, would be a train of locomotives, estimated at the rate of 11 tons per linear foot, or for a length of 500 feet, at .............. 750 T.

Therefore, aggregate weight of superstructure and load .................................................. 1400 T.

Deduct the supporting power of 24 stays, allowing 1/8 of their ultimate strength .............. 324 T.

Leaves for the support of the arches and the cables .................................................. 1076 T.

In order to avail ourselves fully of the economical principle of the Parabolic Truss, it is very evident that the tension produced by the cables should be exactly balanced by the compression of the arches, because the one supports the other. This exact balance of the two forces must exist at the anchor-plates, located at the ends of the superstructure, on the abutments, or on the piers, which serve as such.

These plates firmly hold the ends of the cables, and at the same time serve as supports for the ends of the arches. To further simplify this investigation at its present stage, we will assume that if the tension of the cables and the compression of the arches are equal to each other in the central span, then also the same balance will exist at the anchor-plates. This may not strictly be the fact; but for the purpose of making the question plain, and to avoid intricate mathematical formulas, such as would not prove palatable to the practical engineer, and would, moreover, add nothing to the accuracy of this investigation, but, on the contrary, would tend to obscure the subject, I have at present assumed it as a fact.

The length of span from centre to centre of towers is 530 feet, and the deflection of the cables is 60 feet. The ratio of deflection, therefore, is 1:8.83. From the table of coefficients, we find the ratio of weight and tension for \( i = 1.23 \). It will be near enough to assume it here at 1.22.

The span of the lowest tier of arches is 516" feet and its versed sine or rise .......................... 40 feet

and the ratio of deflection is ........................................ 12.90 "

The corresponding coefficient of compression in the table we find to be ......................... 1.70 "

Let us represent the weight to be borne by the cables by \( x \), and the weight to be supported by the arches by \( y \), then will be

\[
\begin{align*}
\text{The tension of the cables} & = 1.22 x \\
\text{The compression of the arches} & = 1.70 y
\end{align*}
\]

And since the condition is that the tension of the cables should equal the compression of the arches, therefore is

\[1.22 x = 1.7 y.\]

But the aggregate weight to be borne by the arches and cables was found to be 1076 tons. Therefore,

\[x + y = 1076,\]

or \[y = 1076 - x.\]

Substitute this value in the previous equation, and we have

\[1.22 x = 1.7 (1076 - x),\]

and \[x = 626.43 \text{ Tons};\]

and also,

\[y = 1076 - 626.43 = 449.57 \text{ Tons}.\]

From the foregoing we now find that the tension of the cable is 626.43 \( \times 1.22 = 764.24 \) T.

Compression of the arches is ........................................ 449.57 \( \times 1.70 = 764.27 \) T,

both about the same.

The question may be asked here, why the weight resting upon the arches and cables is not equally divided between the two? If this was done, then it would be necessary to observe the same ratio of span and versed sine for the cables as well as for the arches. But this would reduce the deflection of cables, and thereby diminish their supporting power; or it would increase the rise of the arch and make the structure too top-heavy and too deep in the centre.