

assumed to be adopted by Mr. Ross and myself in making the estimate. In approving of the method proposed by Mr. Hodges, I was actuated by the feeling that the engineers would not be justified in controlling the contractors in the adoption of such means as they might consider most economical to themselves, so long as the soundness and stability of the work were in no way affected. This new method has been hitherto acted upon, with such modifications as experience has suggested from time to time during the progress of the work, and although successfully, I learn from the contractors that experience has proved the bed of the river to be far more irregular than was at first supposed, presenting, instead of tolerably uniform ledges of rock, large loose fragments, which are strewed about, and cause much inconvenience and delay.

They are, therefore, necessitated to vary their mode of proceeding to meet these new circumstances; and it may be stated, that all observations up to this time show the propriety, notwithstanding the difficulty with dams, of carrying the ashlar masonry of the piers down to the solid rock, and that any attempt at obtaining a permanent foundation by means of concrete, confined in "caissons," would be utterly futile. However, if it were assumed to be practicable, there would be extreme danger in trusting such a superstructure of masonry upon concrete, confined in cast-iron "caissons" above the bed of the river; indeed, considering the peculiarities of the situation, and the facts which have been ascertained, this mode of forming foundations is the most inappropriate that can be suggested, as it involves so many contingencies that to calculate the extreme expense would be utterly impossible.

These considerations lead me therefore to the conclusion that the present design for the foundation is as economical as is compatible with complete security.

We are now brought to the question as to whether the upper masonry is of a more expensive description than necessary, or whether it can be reduced in quality. This question is exceedingly important, since the cost of the masonry constitutes upwards of 50 per cent. of the total estimated cost of the bridge and approaches. The amount of the item of expenditure for the masonry is clearly dependent upon the number of piers, which is again regulated by the spans between them.

The width of the openings in bridges is frequently influenced, and sometimes absolutely governed, by peculiarities of site. In the present case, however, the spans, with the exception of the middle one, are decided by a comparison with the cost of the piers; for it is evident that so soon as the increased expense in the roadway, by enlarging the spans, balances the economy produced by lessening the number of piers, any further increase of span would be wasteful.

Calculations based upon this principle of reasoning, coupled to some extent with considerations based upon the advantages to be derived from having all the tubes as nearly alike as possible, have proved that the spans which have been adopted in the present design for all the side openings, viz., 242 feet, have produced the greatest economy. The centre span has been made 330 feet, not only for the purpose of giving every possible facility for the navigation, but because that span is very nearly the width of the centre and principal deep channel of the stream.