

BRIDGE AND TUNNEL CENTRES

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Bridge and Tunnel Centres by John B. McMaster

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JOHN B. MCMASTER

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1875.



PREFACE.

It is the purpose of the following essay to present in as brief a manner as the nature of the subject will allow, the rules and principles, the application and observance of which is of really vital importance in the planning and construction of Bridge and Tunnel Centring. It is not offered as a highly elaborated and exhaustive treatise on this branch of engineering, nor is it intended to furnish a variety of designs likely to be useful to the carpenter and bridge-builder ; it does not claim to be analytical ; it is purely practical.

Very much, therefore, of what, under other circumstances, might most fittingly have been introduced, has been carefully omitted, and nothing set down which does not bear directly

on the subject in hand, and had not been verified, time and again, by actual experiment. It will be observed, for instance, that what may be termed the mathematics of the subject finds no place here. There are no mathematical demonstrations, no lengthy discussions of the various formulæ introduced; they are simply set down as expressing established truths, the proof of their correctness in many cases suppressed, and the reader requested to accept them as true. In the form in which this essay first appeared, this was done to save space; in the present form it has been strictly adhered to, because it is believed that those to whom the work will be of the most use, are precisely those who will be content to take as true the formulæ given, caring very little for the steps by which it has been reached.

In connection with the matter of estimating the load on a centre, four methods have been selected, either of which will give results close enough to the absolute truth for all practical purposes. The first, that of M. Couplet, is extremely simple, and if it errs at all, does so on the side of safety. The second or "graphic-

al" is constantly growing in favor, and most deservedly so ; the third, that by calculus, disregards friction and give results greatly in excess of the truth, while the fourth, or trigonometrical, is perhaps the most exact of all, and admits the application of logarithms.

The remarks on the subject of uncentring are believed to be sufficiently extended, though the subject is one of great importance. The principles, however, to be observed in striking centres are quite few and simple, the observance being all that is necessary to secure success. The sand method cannot be too highly commended.

The remarks coming under the head of tunnel centres, have been limited to pointing out the essential difference between the centre proper for bridging, and that suitable for tunnelling, to calling attention to the peculiar variability of the strains, and to the care to be observed in guarding against the accidents so liable to produce injury to the ribs, and to offering a few practical suggestions as to economy. A few designs have also been added as illustrative of the principles laid down, and as

affording examples of cheap and durable frames. The patent centre of Mr. Frazer is worthy of some attention.

JOHN B. McMASTER.

NEW YORK, November, 1875,



BRIDGE AND TUNNEL CENTRES.

In the construction of stone and brick arches, of whatever shape and span, and to whatever use applied, whether as supports for roadways or roofs of tunnels, there is nothing which requires more careful attention on the part of the constructing engineer, than the centres. Independent of the choice of material, of the exactness with which each stone is cut, and the care with which it is laid in place, the success of arches of great span, their settlement and ultimate stability depends essentially on the care given to the framing, setting up and striking of the centres. The slightest change in the shape of the frame caused by the shrinking of an ill-seasoned tim-

ber, or the yielding to compression of a badly proportioned brace, will assuredly be followed by a change in the curve of the intrados, which may possibly result in the ruin of the arch itself.

Well constructed centring, therefore, is indispensably necessary to a well constructed arch, and in the following papers it is our intention to offer a practical investigation of the principles which must be followed out in the planning and mechanical execution of all such centre frames ; to determine what strains must be withstood, at what point they act with most vigor, and by what combination of beams and by what system of bracing, the greatest strength and stiffness may be combined with the utmost lightness and the strictest economy of material.

BRIDGE CENTRES.

Of all classes of centres, the most complicated in structure is, beyond doubt, that of a large span stone bridge. Like a roof frame, it consists of a number of vertical pieces, placed in the direction of