

(All rights reserved.)

ADVANCE PROOF—(Subject to revision).

This Proof is sent to you for discussion only, and on the express understanding that it is not to be used for any other purpose whatsoever.—See Sec. 39 of the Constitution)

Canadian Society of Civil Engineers.

INCORPORATED 1887.

TRANSACTIONS.

N.B.—This Society, as a body, does not hold itself responsible for the facts and opinion stated in any of its publications.

**CONCRETE AS A SUBSTITUTE FOR MASONRY
IN BRIDGE WORK.**

By M. MURPHY, M. Can. Soc. C. E.

To be read Thursday, February the 23rd.

For the last five years the author has been using concrete as a substitute for masonry, with a fair degree of success. With a few introductory observations, his paper will be confined to remarks on the theory and practice of Portland cement concrete as a building material, and to its employment in the construction of highway bridges, and other works coming within the scope of his own supervision in the Province of Nova Scotia.

In Nova Scotia, as well as in other new countries, the improvised wooden bridges of the early settlers supplied their wants for crossing rivers and streams, and, as at each successive stage of progress their numbers necessarily increased, the desirability of more permanent construction became more and more important. The frequent replacement of these timber structures taxed the Provincial resources to such an extent, that it became urgent to adopt means whereby the annual drain on the revenue for their renewal and maintenance might be lessened.

In 1883, an Act authorizing a Provincial Loan of \$500,000 was passed for rebuilding the old wooden bridges where advisable, with materials such as stone and iron. Encouraged by the successful operation and results of this measure, the Government provided two further grants of \$250,000 each, in the years 1885 and 1887, respectively, making one million of dollars available towards rebuilding those bridges in a more substantial form. Even with the additional votes of the two years last named, two-thirds of the highway bridges of the whole Province could not be erected in the permanent manner contemplated. Nor was it desirable that they should all be erected of iron superstructure, because there were many instances where wooden structures or cheap pile bridges could subserve more economically and accommodate equally well the public requirements. In positions favorable for solid foundations; in places where rapid currents are spanned; in situations prone to ice-jams, necessitating longer spans; and in saline water where the *tereds navalis* or the *liguria lignorum* are active, all things else being equal, iron bridges on stone concrete and iron supports were preferred, whilst in locations of an alluvial nature, in peaty or marshy deposits, or in quicksands, or where fresh water streams keep aloof or exclude those destructive agents, and where artificial foundations would be necessary, but too expensive, wooden structures or cheap pile bridges or other bridges of wood suited to the situation were adopted.

In carrying out the public works in any country, it is desirable as far as possible, to use the material of the district, and though Nova Scotia can furnish both free stone and granite of excellent quality, it cannot furnish either of them, in the majority of instances, with the means at the disposal of the engineer. If stone suitable for masonry could be had so that the work could be performed for eight or nine dollars per cubic yard, that material was invariably used; if it could not, concrete was substituted.

In the construction of these highway or public road bridges, concrete has borne an important part. It was at first—in 1883—employed sparingly and with hesitation, but of late it has been used largely and with much confidence. Its use, for the support of the superstructure of iron bridges, was prompted by necessity, because of the scarcity of materials suited for ashlar masonry, the cost of transportation, the want of skilled workmen, and the rapidity with which it could be erected with ordinary labor.

This leads to the more immediate object of this paper, which is to introduce to the notice of the Society what has been done in Nova Scotia towards the substitution of concrete for masonry, and the results so far observable.

The introduction of concrete was at first treated as an expensive innovation. It was not expected to receive favorable public consideration, and it did not. It was alleged that in the climate of Nova Scotia