Volume 27. Toronto, July 9, 1914

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The Canadian Engineer

A weekly paper for engineers and engineering-contractors

SUBSTRUCTURE OF THE QUEBEC BRIDGE.

COMPLETE RÉSUMÉ OF THE CONSTRUCTION OF THE PIERS AND ABUTMENTS—SOME INTERESTING CAISSON SINKING FOR THE SOUTH MAIN PIER—PLANT OPERATION.

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NOTE :—The construction of the new Quebec Bridge is a most illustrative piece of engineering, and has been closely followed, since its beginning, in the columns of THE CANADIAN ENGINEER. *The substructure, now complete with the exception of a few finishing details mentioned in the first paragraph below, is a vital part of the world renowned undertaking, and engineers of all countries have been interested in its progress. In the following article Mr. Borden has reviewed for us its entire construction. For greater detail respecting the piers and abutments the reader is referred to previous issues of* THE CANADIAN ENGINEER *as follows : July 14, and Oct. 6, 1910 ; June 13, 1911 ; Oct. 31, 1912 ; Feb. 13, 1913, and April 9, 1914. These deal with their design and constructional progress. Other articles appearing in various issues refer similarly to the superstructure.*

—EDITOR.

THE contract for the construction of the piers for the Quebec Bridge was awarded to Messrs. M. P. and J. T. Davis, of Quebec, in February, 1910. This work has been continued constantly since that date, and is now practically completed with the exception of pointing and cleaning the masonry and dressing the bridge seats.

This contract, as finally completed, is divided into the following units: North abutment (alterations), 404.5 cu. yds. ; north intermediate pier, 1,665.6 cu. yds. ; north anchor pier, 17,736.0 cu. yds. ; north main pier, 31,870.4 cu. yds. ; south main pier, 38,279.4 cu. yds. ; south anchor pier, 16,073.0 cu. yds. ; south abutment (alterations), 61.1 cu. yds. Total, 106,090 cu. yds.

At the start, a careful study was made by the board appointed by the government, to determine whether it was possible to use the old masonry. After a thorough investigation it was found that, owing to the increased weight of the steelwork, all the old masonry, with the exception of the abutments, would have to be taken down and new piers constructed. It was, therefore, decided to move the whole bridge to the south about 65 ft., retaining the original longitudinal centre line. This brought the north main pier further into the water and the south main pier the same distance towards shore, the same centre to centre length of span of 1,800 ft. being retained. It was impossible to place the south main pier nearer the river on account of the wreckage which lies in the water at that point.

Before the contract was awarded, a series of borings were made at and about the location of the two main and anchor piers. Nineteen borings in all were taken, each boring penetrating at least 15 ft. into solid rock in order to make sure that it was bed rock rather than a boulder that had been struck. These borings showed that bed rock would be encountered approximately at El. 0.0 on the location of both north and south main piers, which elevation was about 101 ft. below extreme high water and 70 and 85 ft. below the bed of the river on the north and south sides respectively. The formation of the bed of the river on the two sides, however, was found to be totally different. On the north side heavy boulder formation was encountered for the entire depth, the boulders being closely packed together with coarse sand and gravel. On the south side the borings showed sand formation for the entire depth with only a sprinkling of boulders at various points. The bed rock was a hard sand-stone, called "Sillery grit," overlaid with a red and gray shale. On the south side 2 ft. of hardpan overlaid this shale.

The caisson for the north main pier was started first and was constructed at Sillery, about 3 miles down the river. This caisson was 180 ft. long and 55 ft. wide. It was constructed of 12 x 12-in. southern pine with a cutting edge of the same material 30 in. square. This cutting edge was shod with a 6 x 12-in. oak timber instead of the steel shoe, as usually used. It was claimed in this case that if any distortion of the caisson took place the steel shoe would tend to prevent the caisson from readily readjusting itself—as would be the case with a wooden shoe—and that the wooden shoe gave sufficient service during the process of sinking. The caisson had a working chamber 8 ft. high in the clear, divided by longitudinal and transverse bulkheads into 18 compartments. It was built in the winter under a construction shed, thus enabling the men to work without interruption from the weather. The caisson was built over launchways with a 10% grade which led out into deep water. The walls of the caisson were built up about 40 ft. before it was launched. When ready for launching, the caisson was lowered down to its inclined position on the launchways by means of heavy jacks. When everything was ready an impetus was given by jacks placed at the rear horizontally, and launching was effected without mishap.

It was towed to the bridge June 14, 1910, and placed in position over the site which had been previously dredged to an average depth of about 20 ft. in order to push ahead the work of sinking as fast as possible.

The work of filling it with concrete was started immediately and some 2,000 yds. of concrete had been deposited before the caisson began to touch bottom as its