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CONTENTS OF THIS NUMBER:

MASONRY PIER MOVED BY ICE AND REPLACED.*

BY R. W. LEONARD, M. CAN. SOC. C.E.

During the winter of 1895-96 the masonry for the four spans of the bridge which carries the St. Lawrence and Adirondack Railway (since leased to the New York Central and Hudson River Railway) over the Chateauguay River, Province of Quebec, was constructed.

The river at the crossing is 600 feet wide, and is spanned by four through steel spans of 150 feet each. The river is from 8 to 12 feet deep at low water, the bottom being clay, with some gravel in places and a few scattered boulders.

The abutments were built on shore; 75 piles were driven through the ice for each pier, and cut off by hand with a cross-cut saw carried in a light, stiff hardwood frame, just above mud-line. Field stone were filled in between piles to a level with top. A caisson was framed with double 12 x 12 bottom caulked, and double plank sides with tar paper between the planks, and sunk in place by the masonry as it was built inside. Rip-rap was finally placed round the piers to a height above the timber platform to prevent scour.

The abutments and two westerly piers were completed and two spans erected and resting on them. The easterly pier was just erected and two men were pointing the masonry on a warm spring day, when the ice shoved in the river and went out very suddenly. The winter had been exceptionally severe, with but little snow-fall, and the ice was strong, especially where it had been worked on all winter close to the bridge, at which place it was about three feet in thickness. A very large field of ice drifted down from the basin, lodged against the west shore and the westerly piers and swung against the unfinished pier, striking it obliquely on the westward side of the ice-breaker.

The field of ice was immediately broken in pieces by the piers and passed on, apparently doing no damage. On close inspection and measurement, however, I found that the easterly pier had moved out of position.

To replace the pier I built a crib as shown on the plan, sunk it in place, drove a row of piles behind it, loaded the top of crib with stones, and set four hydraulic 50-ton jacks between crib and pier. These moved the pier two inches, and the bottom of the platform then stuck on the head of the corner pile from which it had been pushed. A diver, who had been employed to remove the rip-rap around the pier and to examine the foundation, was instructed to cut this pile down half an inch, and a second and successful attempt was made with three jacks, two of 100 tons and one of 50 tons capacity. The pier was moved back to its proper position without showing the slightest crack in the pointing, or any other damage.

Additional rip rap was placed around the pier, the crib removed and piles cut off close, at a total cost of about $800.

There has been no further difficulty.

The weight of the pier is about...960,000 lbs. in air
Hemlock platform " ..... 50,000 "

1,010,000 " or 500 tons

Plan shows level of water when ice moved, and level of water at time when pier was replaced.

The facts may be interesting to Canadian engineers, as they show the dimensions of the masonry and the conditions existing in the case of a pier that just moved, and the force necessary to shift it on its foundation.

WEIGHTS ON FOUNDATION WHEN PIER WAS PUSHED BY ICE.

S.G. Limestone = 2.7

S.G. Hemlock = 0.7 say:

5/6 of masonry submerged say, therefore

Weight of pier at H.W.M. would be $\frac{960,000}{6}$ 160,000 lbs.

$+\frac{17}{27} \times \frac{5}{6} \times 960,000$ 503,700

663,700

Less flotation of platform 3/10 × 50,000. 15,000

Net weight of east pier when pushed by ice 648,700

150-foot span weighed about 350,000 lbs., therefore weight on piers not moved would be

Centre pier 648,700 × $\frac{350,000}{2}$ 823,700

West pier 648,700 × 350,000 990,780

WEIGHT ON FOUNDATION WHEN EAST PIER WAS REPLACED.

½ masonry submerged.

weight of pier would be ½ × 960,000 480,000 lbs.

$+\frac{17}{27} \times \frac{1}{2} \times 960,000$ 302,222

782,222

Say 391 tons.

*From a paper read before the Canadian Society of Civil Engineers.