This span was operated as a lift span whenever the occasion arose, the derrick car furnishing the power. The clearance for vessels going through this opening was just about the minimum, and called for expert seamanship on the part of the skippers. On one occasion a 400-ton schooner frightened everyone badly. Part of her rigging fouled the deck of the bridge, and only some very lively play with axes and prompt action by the tug, saved a very nasty situation.

Construction of a new bridge 50 ft. downstream and parallel to the old one was begun in June, 1912, and completed in June, 1914. The design, starting from the west end, called D. T. swing span, one 150-ft. D. P. G., one 100-ft. D. P. G.; one 156-ft. D. P. G.; one 144-ft. D. T. swing span; three 156-ft. D. P. G.; six 100-ft. D. P. G.; and one 85-ft. D. P. G.; the total weight, 2,500,000 lbs. of steel. These spans are carried on concrete piers on pile foundation, with the exception of piers 3, 4 and 5, which rest on a bed of coarse gravel and boulders.

Proximity of Old Bridge

The proximity of the old bridge to the proposed work provided another reason for the expenditure of money to strengthen its foundations. With a distance of only 50 ft. between lines, the noses of corresponding piers on the two bridges lay side by side, and as dredging proceeded for the new pier, in some cases being carried below the points of the piles in the old, the tendency was for the old pier to slide bodily into the excavation. Therefore the work had to be carried on with the greatest care and divers were freely employed to keep the old foundations under close observation. Of course the old bridge in many ways helped in the construction, the contractors being able to utilize it for the running of water lines and trolley lines for conveying materials, etc., and the engineering party for laying out the work and as a ready means of communication from shore to shore. But it was not a blessing, as the cofferdams were on several occasions hung up by old timber and piles.

Layout of Work

From pier 8 to the west abutment, the bridge is on a 6 deg. 10 min. curve to the left, with a central angle of 59 degs. 20 mins. A base line was carefully run over the centre line of the old bridge, and permanent hubs set on each bank, well clear of the work, from which the bridge tangent was located by off-setting 50 ft., and marked by permanent hubs which were used for giving the centre line of all piers on tangent. The transverse centre line of these piers were given from points on the deck of the old bridge. Owing to the movement of the deck, as mentioned above, these points had to be located anew for each day that it was necessary to use them. In order to eliminate as much as possible any chance of error in locating the piers on the curve, it was decided to determine the exact geometric centre of the curve and erect there a sight which would be visible at all stages of the tide. The transverse centres of the piers, being on radial lines, could then be located from hubs on the semi-tangent, using the centre of the curve as a foresight.

Accordingly the P. I. of the curve was found, and as it came on the beach at high water mark, a concrete pedestal 18 by 18 ins. and 2 ft. high was put in on pieces of 4 by 4-in., 8 ft. long, as piles, and on this the P. I. (hub A) was definitely set after repeated checking.

To establish the centre of the curve was more difficult, as the water only left it for about two hours each day. With the transit on A and backsighting on T on the west end of the bridge tangent, an angle of 60 degs. 20 mins. was laid off, and the point of intersection found with a line at right angles to the tangent of the curve at the E. C. Around this point a rock-filled crib 6 ft. square and 4 ft. high was built, and a 2 in. pipe, 24 ft. long, was securely guyed there. (Hub C).

As a check, the calculated distance from P to C was measured on the ground with 100 ft. steel tape over stakes driven to the same elevation and 100 ft. apart. The distances along the semi-tangent from P, where the radial lines for each pier intersected, were then calculated and hubs set.

The distances along the radial line from the hubs to the curve were also calculated and recorded for use when required. A hub was put in at M, the mid-point of the curve, from which the angles of the centre of each pier could be turned as a check on the above method. All measurements were made with a 100-ft. steel tape and corrections made for temperature.

Foundations

The west abutment and piers 1 and 2 were built on solid rock, and the concrete poured in the dry, no pumping being necessary. The foundation of the east abutment is on sand and gravel. The excavation for this was taken down 6 ft. below original ground and piles driven to refusal at a penetration averaging 18 ft.

Piers 12 to 14 were on typical Bay of Fundy mud and dry at low water. Cofferdams of 10 by 10 in. hemlock were built in place and sunk as the excavation progressed, being loaded with old rails to a depth of 18 ft., and piling driven. The penetration averaged 25 ft., the penetration under the last blow being from ½ in. to ¾ in., a 2,400-lb. hammer being used, with a fall of 25 ft. These cofferdams were pumped out and the piling cut off 2 ft. above the bottom and the concrete poured in the dry.

The foundations of piers 9 to 11 inclusive were built in the same manner, but the penetration and number of the piles used increased as they approached mid-stream.

In pier 8 the cofferdam was 21.7 ft. deep and the average penetration of the piles 58 ft. The piles, about 90 in number, were cut off under water and the concrete deposited with a bottom dumping bucket; the bottom of this pier covers an area of 749 sq. ft. and there are 451 cu. yds. of concrete in the footing course. In all the piers the footing course is carried about 4 ft. above low water. Between low water and extremely high water the concrete is sheathed with 4 by 6-in. southern pine, with ½-in. iron plates 2 ft. wide on the angles, attached by galvanized iron bolts 15½ ins. long. All concrete below high water mark is 1: 2: 4: mixture; above 1: 3: 6.

The remaining piers, 3 to 7 inclusive, were a somewhat different proposition. At extreme low water the depth of water varied from 20 to 27 ft., and with a rise of the tide of 28 ft., this meant a depth of 55 ft. at high water for pier 3. Borings showed for piers 3, 4 and 5, a belt of fine sand about 8 ft. thick, followed by 8-ft. of mud and then 5 ft. of gravel. At pier 6, 12 ft. of mud, 5 ft. of sand and 60 ft. of mud.

The borings were taken after the work of construction had begun and were very hurried and the information obtained not very dependable. They were taken from a platform in some cases, or from a scow moored over the site of the pier. A 3-in. casing pipe with a 1-in. water pipe attached to a force pump working inside of it, to which the bit was attached, was driven down and the washings examined. A diamond drill was used to penetrate the gravel.

No Solid Rock Encountered

At pier 7 a penetration of about 90 ft. was obtained, at which depth solid rock was reported. The platform from which the borings were taken had to be above high water mark so that the work might go on continuously; so after penetrating the overlying mud there would be about 70 ft. of casing pipe when the gravel was reached. When the inner pipe was raised and allowed to drop on this compact mass of gravel, it bounced up again, giving the impression that solid rock had been encountered. This idea was strengthened when the drilling made no further progress until the diamond was put on. I may say here that no solid rock was encountered at any of these piers when the work was completed.

It was finally decided to sink foundations for piers 3, 4 and 5 down to the gravel, or about 20 ft. of excavation by open dredging. Pier 3 was started first. A double wall cofferdam was constructed with a space of 4 ft. between the walls. The inner wall stopped about 12-ft. short of the outer and they were connected by a solid floor of 10 by 10 in. hemlock, forming a cutting edge. Projecting below this was about 16 ins. of ½-in. steel plate. The cofferdam, about 30 ft. high, was floated into position, the space between the walls filled with concrete, and old rails piled on. Dredging was

(Concluded on page 320)