

the number of locks rather than by the lift. And this is the policy he has pursued in building the Soulanges canal.

The general features of lock 12, which is typical of the others, are as follows: The lock is filled & emptied through culverts in the side walls, from which cast iron pipes 30 inches in diameter, 10 on each side, lead into the bottom of the chamber. The pipes have 40% greater discharging capacity than the culverts themselves. The lock will be filled in about 5 or 6 minutes, & this will be effected without subjecting the vessel to much surging or strain. At the head of each culvert there is placed in an 8 by 4 ft. shaft, operated from the coping, a 6 by 6 ft. sluice of the Stoney pattern. These are for the first time introduced into a Canadian canal, their operation is very simple, & they have given the highest satisfaction in controlling large bodies of water in Europe, where they are in extensive use, being employed for that purpose on the Manchester ship canal. The method of emptying & filling locks through tunnels in the side walls is considered to be very much the best; filling & emptying through valves in the gates, as in the Welland canal, having proven decidedly objectionable. Each lift lock is provided with a heavy breast wall at its upper end, corresponding in height to that of the lift. These walls have been reintroduced for the purpose of removing the cause of about 1/4 of the accidents that have occurred on the enlarged canals, namely, vessels carrying away the upper gates of the locks by striking them whilst entering from the lower reach. If a vessel goes ahead too far in a Soulanges canal lift lock, it will strike against the breast wall, & damage itself instead of the gates. The gates are built on what is called the 'solid' plan, which consists of a number of superimposed timbers shaped to the required horizontal pattern & fastened together. The method is simple, & in this case the strength is superabundant. One leaf of the lower gates of the high lift locks at the Cascades' end of the canal weighs over 90 tons in the air. The timber used is principally Douglas fir, which was hauled across the continent for the purpose.

It is proposed to work a lock from one point on the south side & about 20 ft. back from the coping, where a switch cabin will be placed. This will be connected with the motors actuating the sluices & operating bars. When a vessel enters the lock from the lower level & her stern is up to the breast wall she will signal & the lower gates will be closed. The machinery will effect this in a perfect manner. The gates will shut precisely & synchronously, & avoid any trouble from overlapping, which often occurs now in other locks. This should be done in 1 minute. The lower sluices are then dropped & the upper ones hoisted, the lock being filled as indicated. When the water has risen to the full height, the upper gates are opened & the vessel passes out. The lockages are expected to be made easily in from 12 to 15 minutes. The capacity of the canal, at 4 lockages an hour, on the basis

of 1/3 westbound freight, would be about 20,000,000 tons in an ordinary season.

In the construction of these locks, concrete has been used to a greater extent than in any previous works of this kind in Canada. Mr. Monro specified that cement of a certain quality should be supplied by the government to the several contractors, and should not be purchased by them at all, & thus there was no inducement on the part of the latter to use cement of an inferior quality. In the preparation of the cement some 70,000 briquettes have been made for testing purposes in a quantity of about 200,000 barrels. Good, clean sand and properly broken stone have been insisted upon, & it is believed that this work is excellent throughout. Mixing has been done both by hand & by machine, but in either case the product when carefully laid & rammed make an exceptionally good hydraulic wall, while its cost per cubic yard was less than half that of masonry, on the Soulanges canal. There its use was clearly suggested by the fact that in the excavations for the prism, about 300,000 cubic yards of rock had to be taken out which was unfit for masonry, but excellent for concrete. This supplied the 15,000 cubic yards required for concrete; also, about 120,000 cubic yards for stone protection lining; together with over 50,000 cubic yards for macadam, repairs, etc., leaving a large surplus to be thrown away.

Mr. Monro was transferred from the Welland canal at the close of 1888 & assigned the duty of determining the best location for a canal, having a navigable depth of 14 ft., between Lakes St. Louis & St. Francis. After extensive surveys & examinations, he submitted a report in 1889 to the late J. Page, Chief Engineer of Canals, in which reasons were given why the new canal ought to be constructed on the north side of the St. Lawrence. Mr. Page died in 1890, & in June of that year, a second report was addressed to the Secretary of the Department, confirming the views previously expressed. In that document the projected work was for the first time named the Soulanges canal. In a memorandum in Jan. 1891, prepared for Sir John Macdonald, by T. Trudeau, Deputy-Minister & Chief Engineer of Canals, the scheme submitted by Mr. Monro was approved of in general terms. This view was subsequently confirmed by the government, and, in Aug. 1891, \$300,000 was voted by Parliament towards the construction of the Soulanges canal, which was then estimated to cost \$4,750,000. Plans and specifications were prepared, and, in May, 1893, all the 13 sections between Cascades Point & Coteau Landing were under contract. Between the time of Mr. Monro's report of June 18, 1890, & the letting of the works, however, the bottom plan of the summit level, 10 1/2 miles long, & the foundations of the structures on it, were lowered about 1 1/2 feet, largely increasing the quantities, & adding about \$500,000 to the cost of construction, making the total estimated cost \$5,250,000, instead of \$4,750,000.

For the sake of clearness in showing the present condition of the different sections,

they will best be described in the order visited by the writer.

Section 13.—Contractors Manning & McDonald, Toronto. Date of contract, Sep. 24, 1892. Approximate value of work, \$635,000. This contract, comprising entrance walls, guard lock, waste weir & two swing bridges, is now complete, & has been partially tested.

Section 12.—Contractor M. J. Hogan, Montreal. Date of contract, April 5th, 1897. Approximate value of work \$220,000. Before Mr. Hogan took hold of it, this work had been twice under contract & in each case the contractor failed to prosecute the work to completion owing to its costly character. This work is composed of hard clay, intermixed with nests of boulders of large sizes, fissured rock & quicksand. He expects to get finished by the end of August. He is already beginning to move his machinery out of the cutting.

Section 11.—The first contractor for this was G. Goodwin, & the contract was dated May 11, 1892. This was afterwards transferred to T. Feeney, & later to Poupore & Fraser, of Ottawa. Approximate value of work, \$325,000. This section, which was composed of rock & hard material, is completed.

Section 10.—Contractors Rogers & Taylor, Montreal. Date of contract, Dec. 24, 1892. Approximate value of work, \$292,000. This work was practically all earth, the only structure upon it being one large road bridge, & it was completed last fall. Small slides occurred upon the north side of this section, but these were soon repaired.

Section 9.—Contractors Manning & McDonald. Date of contract, Jan. 30, 1893. Approximate value of work, \$180,000. Rather extensive slides took place on this section, but these have been repaired & the work is now finished. The restoration was effected by placing stone for support & drainage at the base of the slopes, & then filling in. The slope of the north bank was also altered from 2 to 1 to 4 to 1.

Section 8.—Contractor C. H. Raynor, Syracuse, N.Y. Date of contract, Dec. 29, 1892. Approximate value of work, \$312,000. This, with the previous section, has given the contractors & the engineers a great deal of trouble, owing to the slides. A heavy slide took place on the north side of this section on Oct. 25, 1897, at the crossing of the St. Emmanuel road. This swept the abutments of the road bridge, containing 1,100 cubic yards of concrete, off its pile foundations, & threw it bodily some 50 ft. into the bottom of the canal, where it sank into the soft blue clay for a depth of about 19 ft. About 40,000 or 50,000 cubic yards of earth accompanied it. This was being repaired & the slope was changed from 2 to 1 to 4 to 1, but, much to the surprise of all concerned, without the least warning, another extensive slide took place the day before the writer visited the canal, carrying away the bank for about 350 ft. Men & teams were working upon it at the

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