

shut down, the height of the old dam was raised 4 feet by means of flash boards faced with gravel, thus forcing the entire flow through the 14-foot opening and the penstock.

Unfortunately, the old dam leaked badly, and although a diver was procured and everything possible was done to caulk it, it was necessary to construct a coffer-dam immediately below. A coffer-dam was also built about 10 feet below the tail of the new dam.

A flume 3 feet wide and 4 feet deep was built between these two coffer-dams. The nature of the river bottom (huge boulders and gravel) made it impossible to get these tight: Three turbine pumps, an 8-inch on the upstream coffer-dam, and a 6-inch and a 4-inch on the lower coffer-dam, were installed. The excavation for the overflow section was then begun.

Perhaps the most interesting point in the construction of the dam was the manner in which the first 20 feet of concrete was put into this section. The water situation stood thus:—the leakage of the old dam which was being used as upstream coffer-dam amounted to about 2,000 cubic feet per minute. This was caught by a coffer-dam, as above mentioned, and carried across the site of the dam in a flume. Nearly all the leakage of the coffer-dam was held by a natural wall of gravel and shale, and pumped into the flume by an 8-inch turbine pump.

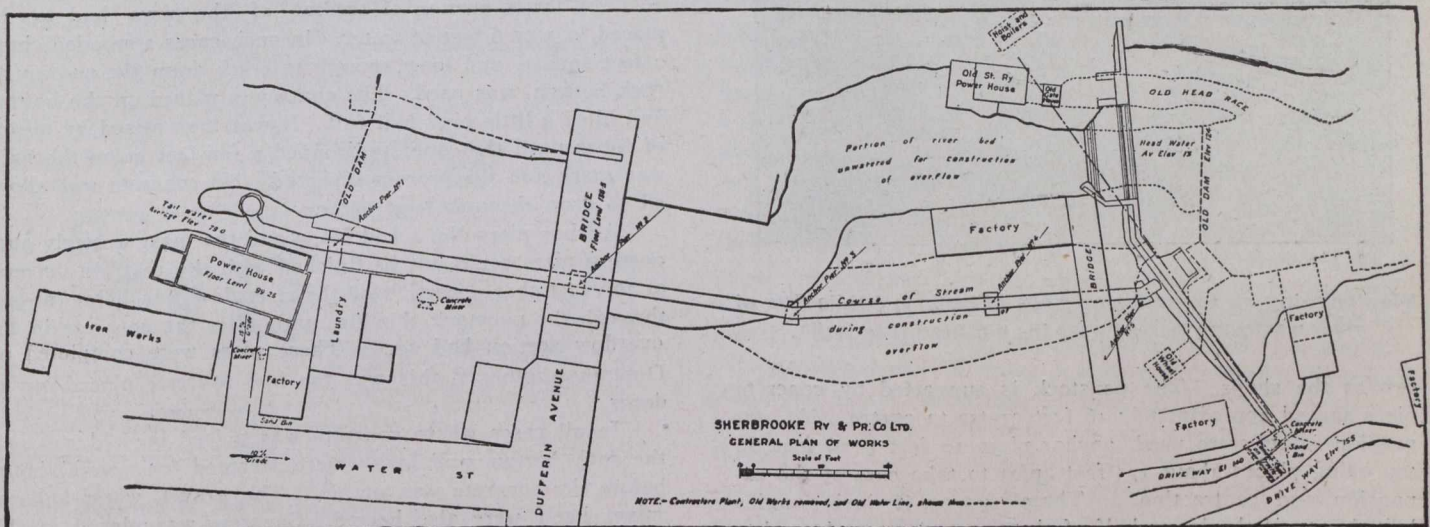
done quickly, as the volume to be filled was so small that the water rose very rapidly.

The concrete was then carried up to about 14 inches below the flume. This permitted the 6-inch pump (No. 2) to be taken out. The flume was cut off at the downstream coffer-dam and the old power house put in operation.

No form for the upstream face had been built up to this time, and although this involved the placing of some 40 yards of concrete in front of the intended face of the dam, it seemed to be the only practicable solution of the problem.

A form of temporary sluice through the dam was then built, the leakage water directed through it and the old flume pulled out. The forms for the upstream face and the remainder of the downstream face were then erected and the overflow section completed. The 70-ft. overflow section is built without an expansion joint, and in order to prevent cracks five 60-lb. steel rails were embedded near the crest. The strength of the concrete mixture was also increased to $1-2\frac{1}{2}-4\frac{1}{4}$ in the upper portion.

Four days after the completion of the crest the temporary sluice was closed by a reinforced concrete slab, and filled up through the opening provided. That portion of the Street Railway headrace wall between the dam and the Street Railway head gates was then lowered to the normal head-water level of the Street Railway plant, and the 14-foot opening in



A 4-inch pump, which was moved up from the lower coffer-dam after the river-bed was unwatered, was installed in a sump hole made with sandbags and blue clay just below this natural wall to take the leakage, which amounted to about one-half the capacity of the pump. Below this again, a diaphragm hand pump was placed to take the leakage of the sump hole wall.

The river-bed below the downstream coffer-dam had been pumped out, but the leakage from that side still amounted to about $\frac{3}{4}$ the capacity of a 6-inch pump. The form for the downstream face was built up to elevation 105, and the suction of the 6-inch pump placed between it and the downstream coffer-dam.

The concrete work was then commenced. A temporary form was built, as shown, just below the sump hole. When the concrete reached the suction of the diaphragm pump, the pump was removed and the leakage of the sump hole wall was forced back through the temporary form by the rising concrete.

When the concrete behind the temporary forms was about 2 feet above the suction of No. 1 pump, No. 3 pump was taken out, the sandbags and clay of the sump hole wall were removed and the temporary form pulled out. This had to be

the northern bulkhead section was closed by means of stop-logs, checks for these having been provided. Additional stop-logs were also placed in the new head gates to prevent too much water passing through the penstock when the water came up.

In filling the 14-ft. opening it was found impossible to caulk the stop-logs tight enough to put in the concrete, and the following device was used. The back of the stop-logs was 4 inches in front of the face of the dam. A form made of inch boards was built and a 4-inch iron pipe inserted draining into a box 2 feet square at the downstream face. The concrete was put in and the pipe blocked by means of a wooden plug 3 feet long and a cap. The purpose of the plug was to prevent the pipe from freezing and bursting. The box was afterwards taken out and the void filled with concrete.

Two weeks after the completion of the overflow section, stop-logs were placed in the Railway headrace stop-log section and the water was forced over the overflow. The forms, however, were left on until spring. In putting in the stop-logs a space was left underneath them sufficient to pass the water necessary for the Street Railway, the idea in passing the water underneath being that the flow was in that way kept practically constant in spite of fluctuation of level in the river.