

not to endanger in any way the water supply conduit, and is particularly cautioned regarding the sections between Stations 10 and 14, and from 80 to 85, it is not found that there is any particular provision made by which the contractor is obliged to follow up his earth excavation immediately with the construction of the retaining walls. Moreover, the contract provides that the contractor construct test sections of the wall when ordered by the engineer and before proceeding with the general construction. This would seem to indicate that the city engineers did not expect the contractor to follow up his earth excavation very closely with the retaining walls. It also seems to indicate that the city engineers themselves were not quite satisfied that the wall as designed was sufficiently strong for the purpose intended.

It is obvious from what has already occurred and from the present condition of the north bank in the earth section, that unless the wall construction followed the excavation very closely, the conduit would be greatly endangered, as there are points east of where the break occurred where the plans show that the excavation was to be carried much closer to the conduit than at points already excavated.

As one of the recommendations, made immediately after the first inspection of the conduit by the Board and confirmed by its interim report, was to the effect that all work on the north side of the aqueduct should be suspended by the contractor for the time being, we have felt obliged, in preparing this report, to make an analysis of the design of the reinforced concrete retaining wall which the Cook contract provides shall be built in the earth section. From this analysis we have found that the wall would not be stable for the loads which we believe it prudent to assume it would have to sustain.

Another apparent weakness in this design is that the bottom of the concrete base is only 1 ft. 9 in. below the bottom of the canal. If the structure were left exposed during construction in the winter time, or if, at a later period, the canal should be emptied of water in the winter time, there would, we believe, be great danger of frost penetrating under the base, causing serious damage to the wall.

Conclusions.—From a review of the features which have been described in this report, we have arrived at the following conclusions:—

1. That the plans and specifications of the conduit did not call for sufficient reinforcement, nor is the steel properly placed in the concrete section, to provide a sufficient factor of safety, especially in view of the fact that the conduit would be the only means of supplying the city with water during the enlargement of the aqueduct.

2. That in the construction of the conduit the quality of the concrete and the workmanship generally were good, but that the weight and strength of the steel reinforcement was much less than called for by the specifications submitted to us.

3. That the insecurity of the conduit was greatly increased by the proximity of the excavation involved in carrying out Enlargement No. 2.

4. That the method of performing the work by means of a heavy drag-line excavator travelling on top of the bank above the conduit imposing a heavy vibrating load concurrently with the removal of the earth which provided lateral support to the conduit further endangered the structure.

5. That the leakage of water from the conduit is an additional source of danger at points where the conduit is located in easily eroded soil, and the excavation car-

ried sufficiently close to permit the water finding an outlet into the aqueduct.

6. That the failure of the conduit was due to the proximity of the excavation, to the methods employed in the execution of the work, and to the inherent weakness of the conduit itself.

7. That the conduit, as a permanent means of supplying water to the city, is not now to be depended upon.

8. That it would be unsafe to proceed with any further excavation in the earth section on the north side of the aqueduct with the conduit in its present condition and while there is no other water supply available.

9. That it is unsafe to do any blasting in the rock section on the north side of the aqueduct.

10. That it is unsafe to allow the travelling excavators or locomotives or any other similar heavy machinery to be operated on or moved at any point over the top of the conduit.

11. That the reinforced concrete retaining wall as designed by the city and to be built by the Cook Construction Company along the banks of the aqueduct in the earth section is not, as designed, a safe structure to build for the purposes intended.

12. That a revision of the design of this wall, in order to make it safe, will greatly increase the cost of the project.

With the above facts as a basis, we beg to make the following recommendations:—

1. That before any further work is proceeded with, at least on the north side of the aqueduct, an investigation be made by a commission of engineers into the entire aqueduct scheme, which will include revised estimates of the cost of construction, and the quantity and cost of the power developed.

2. That the city at the earliest date possible make arrangements for providing a new and independent water supply of a suitable character, so located that it cannot be affected by any further accident which might happen to the present conduit.

3. That a permanent coffer-dam or intake be at once constructed at the entrance to the aqueduct including proper gates or sluices that may be required, so that the flow of water into the aqueduct may be at all times under control.

4. That until another suitable water supply has been provided, the present one should be kept continuously under observation so that in case the present leaks become serious prompt remedial measures may be taken.

5. That the suction pipes of the pumps at the pumping station be lowered by at least six feet as soon as possible so that the conduit may be run partly full or may be quickly emptied.

Respectfully submitted,

(Signed) J. A. JAMIESON,
R. S. LEA,
G. R. HECKLE.

[A detailed description of the emergency repairs to the break and the subsequent repair work is to follow as an appendix to the report.—Editor.]

A proposition, recently announced, which will ease considerably the meagre traffic facilities of Iceland, is a million-dollar railroad to be started in Iceland at an early date, extending from the capital, Reykjavik, in an easterly direction across the plain of Thingvala, a distance of about 58 miles, to the Olfusa Bridge. Ultimately it is proposed to extend this line to Thorsjaa, where the line will branch off in two directions, one going to the geysers and the other to Cerbak.