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Storm Sewer Extensions at Toronto Harbor

Drainage Problems Arising From Waterfront Improvements and How They Are Being Solved—Description of Keele Street, Spadina Avenue and Bathurst Street Outfalls—Carlaw Avenue and Other Smaller Extensions Not Yet Constructed

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ONE of the many interesting branches of the whole scheme for the development of Toronto's waterfront, is the drainage problem. While in one sense it is not strictly a part of the development, but rather is incidental thereto, yet it afforded an opportunity for considerable study both in design and construction.

In general terms, the drainage problem consists in arranging for the extension of the various storm overflow sewers discharging at present either into Toronto Bay or into Lake Ontario between the Humber River and Woodbine Ave. Some of these extensions are now completed or are under way.

One feature which is common to all of these extensions is that of the partial or total submergence of the outlets during high water in the lake. Insofar, then, as the capacity of the storm overflow was concerned, the invert grade was not a factor in the majority of cases. In arriving at the hydraulic grade, the maximum lake level was assumed to be 248 ft. above mean sea level of New York harbor. This elevation is slightly below the maximum high water ever recorded in Lake Ontario; but the assumption was considered a reasonable one in view of the fact that this extreme lake level has been reached only once since 1887.

In regard to the hydraulic grade, the limiting head to which it was assumed the water would back up in any extension was such as not to cause flooding in any connection joined to it. In all the storm overflow sewers for which extensions have been planned, the invert grade of the present outlet has been so comparatively steep in every case, and the distance to which the water would back up so proportionately short, that in times of heavy flow, even if the storm water within the sewer rose to an elevation of from 6 to 8 ft. above high water level in the lake, there would be no danger of it backing up far enough to cause damage through flooding. These comparatively steep inverts made it possible to obtain, without difficulty, such hydraulic grades as to keep the cross sections of the proposed extensions within reasonable limits, even though they were carrying largely increased quantities in many cases.

The storm water sewers at present in use along the water front were designed and constructed to take care of the storm water run-off from certain areas, making what was then considered ample provision for the run-off from future additions to these areas. However, the growth of the city beyond the limits was underestimated. This, together with a readjustment of the areas drained, will necessitate increasing the capacity of some of these overflow sewers at some time in the not distant future. The extensions so far designed and constructed in connection with the waterfront development are of such cross section that, with the hydraulic grade available, they are of ample capacity to take the increased flow arising from the new conditions.

The extensions of the sewers at Ellis, Roncesvalles and Sunnyside avenues presented no particular difficulty either in design or construction.

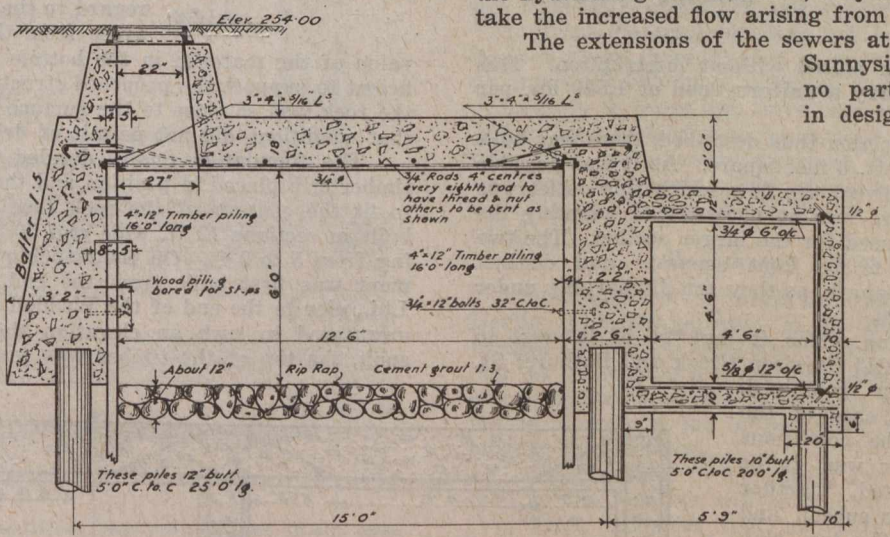

FIG. 1—CROSS-SECTION, KEELE ST. EXTENSION

The Keele St. extension, about 400 ft. in length, has a number of interesting features. It has the same dimensions as the existing outlet and was built through sand recently placed by hydraulic dredges. This material was considered as having a more or less uncertain bearing value and it was therefore deemed advisable to carry the walls of the extension on 25 ft., round bearing piles, spaced at 5 ft. centres.

Provision had to be made for taking care of the discharge from the sewer resulting from storms occurring during the construction period. The scheme adopted is illustrated by Fig. 1. Four by twelve-inch timber sheet piling, 16 ft. long, was first driven. This sheeting formed the channel to take care of the discharge from storms, and, being left in place as part of the permanent structure, was used also as the inner form for the concrete wall.

The tops of these piles were capped with 4 x 4 structural angles, and the two walls of piling tied together at intervals of 2 ft. 4 ins. by nuts on the reinforcing bars. The outside row of sheeting was then driven and the excavation taken out to an elevation 1 ft. below the line of permanent saturation, thus allowing for 1 ft. penetration of the round piles in the concrete wall. The round bearing piles were then driven to place, after which the outer form for the wall was built and the concrete placed.

A bulkhead was then built across the end of the extension and the channel excavated to a depth of about 12 ins. below grade. To prevent scouring, which is liable to occur in the case of heavy storms unless specially guarded against, boulders were placed by hand to form the invert and the