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STANDARD PLANS AND SPECIFICATIONS FOR RETAINING WALLS.

The City of Seattle, Wash., through its City Engineer, Mr. R. H. Thomson, and its Board of Public Works, has formulated complete standard plans and specifications for the various classes of municipal structures employed. These standards are interesting as showing the practice of a large municipality in its city engineering work and as a source of suggestion for the engineers of other municipalities. Incidentally too they are worth notice as an example of business management and systematic organization in city engineering.

Concrete Retaining Walls.

Foundation.—The foundation for any retaining wall shall be excavated to the depth called for on the plan, or to such depth as the City Engineer shall determine as necessary to insure a proper footing for the wall. Where the location of the wall comes on soil which, in the opinion of the City Engineer, is not firm enough to insure its safety, piling or other suitable form of sub-foundation shall be placed, as the City Engineer shall direct. The foundation pits shall at all times be kept dry and free from water by pumping or otherwise as may be directed. Where permanent drainage of the foundation, or other than that shown on the plan is necessary, a suitable tile or sewer pipe drain shall be laid and connected with the sewer or suitable outlet.

Forms.—Forms for retaining walls shall be constructed in accordance with the details given on the plan or, where no details are given, in a manner satisfactory to the City Engineer. They shall be constructed of sound merchantable lumber, thoroughly braced and stayed, so as to produce the finished surfaces true to line and grade, and free from wind or warp or objectionable depressions and projections. Lumber used for forms shall be evenly sized and free from knot holes or other imperfections affecting the finished work. Where monolithic construction is required, particular care shall be taken to construct the forms of sufficient strength to prevent bulging.

All grooves, joints, moldings, pilasters, panels and copings shall be formed true to line and dimensions. Particular care shall be exercised in constructing the forms for copings or other projecting parts of the wall or parapet that the same may be released and allowed to settle slightly after the concrete has partially set in order to prevent the expansion of the form from lifting or cracking the concrete at such projecting portions.

All forms shall be so constructed that in stripping them from the finished work, the edges of moldings, etc., shall not be defaced.

Concrete.—The concrete used in retaining walls shall be mixed in the proportions of 1 part Portland cement, 3 parts sand and 6 parts gravel. The proportion of cement to the total aggregate used shall be invariable but the relative proportion of sand and gravel may be varied by the engineer from time to time.

The materials used shall be of the same quality and mixed in the same manner as herein provided for "Concrete Sidewalks" except that in plain or gravity walls, gravel up

to maximum diameter of $2\frac{1}{2}$ ins. may be used. The concrete shall be deposited uniformly in layers but shall not be deposited in any part of the wall faster than it can be properly handled and spread into place. Depositing the material from a height into place, without properly remixing and spreading the same will not be permitted. Unless otherwise directed, the concrete shall be mixed wet enough to readily spread and fill the forms but it shall not be mixed so wet that there is any tendency to wash the gravel free from the grout coating. All concrete shall be thoroughly spaded as soon as deposited. The face of the wall shall be formed by spading back the gravel therefrom in such a manner as to leave a smooth cement finish. Before any concrete is deposited on top of a previous day's work, the latter shall be made rough by picking or chipping. All loose material and cement scum, or laitance, shall be thoroughly removed, the surface washed clean and then grouted with neat cement. The scum, or laitance, shall be removed before the concrete has set hard.

All walls shall be constructed as monoliths, where practical, that is, any section of a wall shall be deposited in one continuous operation, including the final finish at the top. Where monolithic construction is impractical, for the purpose of keeping each successive step of the work together, a recess 6 ins. deep and of a width equal to one-third the width of the wall shall be left at the end of each day's work for the entire length of such work in all walls where the cross-section is 2 ft. or more in thickness. In thinner walls the contractor shall furnish and set steel dowel pins not less than $\frac{3}{4}$ in. square and 2 ft. long at intervals of not less than 3 ft. for the entire length of each day's work where the same is not brought to the finished height.

In all walls, the forms, moldings, etc., along the finished sides shall be kept cleaned of any dry mortar or concrete which may mar the finished appearance.

Joints.—Joints shall be made in all walls as indicated on the plan or as directed by the City Engineer. Where joints are required the wall shall be built in alternate sections. In the ends of each completed section shall be formed a recess 4 ins. deep and of a width equal to one-third the thickness of the wall, but not exceeding 1 ft., for the purpose of keying the sections of the wall together, or steel dowel pins $\frac{3}{4}$ in. square and 2 ft. long shall be set at intervals of 2 ft., as may be directed.

Before the intermediate sections are built the ends of the alternate sections shall be coated with one coat of tar pitch or asphalt and four layers of No. 2 tarred roofing felt, each layer of roofing felt being coated with pitch or asphalt as laid.

At the finished face of the wall, the joint shall end in a "V" shaped groove 2 ins. wide and 1 in. deep unless otherwise shown on the plan.

Finish.—The faces of all retaining walls shall be finished as called for on the plan. Where the kind of finish is not stated it shall be carried out as follows: As soon as the forms are stripped, the surface of the wall shall be gone