

SPECIFICATIONS FOR DRAIN TILE.

AMONG the committee reports that were presented at the recent convention in Atlantic City of the American Society for Testing Materials, that of Committee No. C-6, on standard tests and specifications for drain tile, contained something more definite and valuable than has heretofore been published. The following considerations, relating to strength tests, quality and recommended practice in design and construction are extracted therefrom:

Proposed Specifications for Strength Tests.—1. The specimens shall be unbroken, full-size tile. They shall be carefully selected so as to represent fairly the quality of the tile.

2. A standard test shall comprise five individual tests. The result for each specimen and the average of the five shall be given in the report of the test.

3. The materials of the tile shells shall, at the time of testing, be in a thoroughly wet condition, such as may be obtained by covering with sacks kept wet for 8 hours.

4. No test specimen shall be exposed to water or air temperatures lower than 40° F. from the beginning of artificial wetting until tested. Frozen tile shall be completely thawed before artificial wetting begins.

5. Each specimen shall, if practicable, be weighed on a reliable scales just prior to testing.

6. The load shall be applied by any machine or hand method which will apply the load continuously, or in uniform increments not exceeding 0.05 of the total load necessary to break the tile. The tile shall not be allowed to stand any considerable time under load. All solid parts of the bearing frames or bearing blocks shall be so rigid that the distribution of the load shall not be appreciably affected by the deflection of any part. All bearings and the test specimens shall be so accurately centered as to insure in every direction a symmetrical distribution of the loading on each side of the centre of the tile.

7. The inspector, in specifying test requirements for drain tile, shall prescribe in advance one of the three following kinds of bearings: sand bearings; hydraulic bearings; three-point bearings.

8. The test results shall be reported in terms of the ordinary supporting strength. This term shall be defined to mean the supporting strength of a tile when the load is applied with such a distribution as to produce a maxi-

imum bending moment of $0.20 \frac{RW}{l^2}$, where W = the ordinary supporting strength, and R = radius of middle line of tile shell, in inches. The ordinary supporting strength shall be obtained by multiplying the test breaking loads, by the following factors: For sand bearings, 1.00; for hydraulic bearings, 1.25; for three-point bearings, 1.50.

The ordinary supporting strength shall be reported in pounds per linear foot.

9. The modulus of rupture shall be calculated from the maximum bending moment prescribed in Section 8 by the formula

$$p = \frac{6M}{t^3}$$

where p = modulus of rupture in pounds per square inch, M = maximum bending moment in shell in inch-pounds per inch of length, calculated as prescribed in Section 8, and t = thickness of tile shell in inches.

Five-eighths of the weight of the tile per lineal foot for sand bearings, or three-fourths for hydraulic or three-point bearings, shall be added to W in computing the

maximum bending moment, when such addition exceeds 5 per cent. of W .

10. Where sand bearings are used, each specimen shall be accurately marked in quarters, with pencil or crayon lines, prior to the test. Specimens shall be carefully bedded, above and below, in sand, for one-fourth the circumference of the pipe, measured on the middle line of the pipe shell. The depth of bedding above and below the pipe at the thinnest points shall at each place be equal to one-fourth the diameter of the pipe, measured between the middle lines of the pipe walls.

The sand used shall be clean sand which will pass a No. 4 screen.

The top bearing frame shall not be allowed to come in contact with the pipe or with the test load. The upper surface of the sand in the top bearing shall be carefully struck level with a straight edge, and shall be carefully covered with a heavy, rigid, top bearing plate, with lower surface a true plane, made of heavy timbers or other rigid material, capable of uniformly distributing the test load without appreciable bending. The test load shall be applied at the exact centre of this top bearing plate, in such a way—either by the use of a spherical bearing or by the use of two rollers at right angles—as to leave the bearing free to move in both directions. In case the test is made without the use of a machine, and by piling on weight, the weight may be piled directly on a platform resting on the top bearing plate, provided, however, that the weight is piled in such a way as to insure uniform distribution of the load over the top surface of the sand.

The frames of the top and bottom bearings shall be composed of timbers so heavy as to avoid appreciable bending by the side pressure of the sand. The frames shall be dressed on their interior surfaces. No frame shall come in contact with the pipe during the test. A strip of soft cloth may be attached to the inside of the upper frame on each side along the lower edge to prevent the escape of sand between the frame and the tile.

11. Where hydraulic bearings are used, each specimen shall be accurately marked in halves, with pencil or crayon lines, prior to the test.

A hydraulic bearing shall be composed of a wooden platen to which is attached, as hereinafter described, a section of rubber hose. The hose shall lie against the tile, and the pressure shall be applied to the hose through the platen.

The platen shall be built of yellow pine, and shall be at least 4 by 4 in. in section, and its least length shall be the length of the pipe plus 8 in. One-inch quarter rounds with their convex surfaces facing shall be firmly attached to each edge of one side. The straight portion of this face shall extend at least the length of the pipe, and the platen beyond this length may be cut to the arc of a circle.

Between the quarter rounds shall be laid a piece of $2\frac{1}{2}$ -in. hose, which shall be closed in a water-tight manner at each end by clamps. The hose shall contain a volume of water not less than one-half nor more than two-thirds its capacity, when completely distended. This hose may be attached to the platen at either end in any satisfactory manner which will not induce wrinkling when under test pressure.

The test load shall be applied at the exact centre of the top bearing, in such a way as to leave the bearing free to move in the vertical plane of the axis of the pipe.

It is recommended that stops be screwed to the platen symmetrical with the point of application of the load, and at a distance apart not greater than the length of the tile plus $\frac{1}{2}$ in. This will help centre the load coming upon the pipe.