

**Required Average Ordinary Supporting Strength for Class No. 1 Extra A Tile.**

Diameter of tile, in.	Lb. per linear foot.
12	1,000
14	1,200
16	1,500
18	1,700
20	2,100
22	2,300
24	2,500
26	2,600
28	2,800
30	3,000
32	3,200
34	3,300
36	3,500

8. Tile not meeting the above specifications shall be rejected.

**Proposed Recommended Practice in Design and Construction of Tile Drains.**—The selection of a class of tile suited to a particular case requires a knowledge of the pressures to which the tile will be subjected. This in turn depends upon the character of the soil and the manner of laying the tile as well as upon the depth and width of ditch. The following is recommended as good practice in design and construction:

**Methods of Tile Laying.**—1. Three grades of work are recognized, namely, Ordinary, First Class, and Concrete-Cradle. Generally the engineer will specify the grade of work required, but in some cases it may be advisable to allow the contractor a choice between using a superior method of laying, or a stronger tile.

2. In Ordinary tile laying the contractor shall shape the bottom of the ditch approximately to fit the lowest one-quarter of the outside circumference of the tile, taking pains to secure an extra firm bearing near the outer edges of the bearing area.

In hard material he shall bed the tile in a thin layer of granular earth where, in the judgment of the engineer, it is necessary to secure a good bearing.

After the tile is bedded truly to line and grade, the contractor shall carefully place the earth around and over the tile by hand to the depth of at least 1 ft. over the tile, using shovels or other suitable tools to work the earth filling down the sides, and underneath the tile so far as practicable.

Whenever the ordinary supporting strength of the tile, as determined by actual tests, and calculated as prescribed in Section 8 of the proposed Standard Specifications for Strength Tests of Drain Tile, is 50 per cent. or more in excess of the strength specified, the bottom of the ditch need not be shaped to fit more than the lower one-eighth of the outside circumference of the tile.

3. In First-Class tile laying in hard material, the contractor shall shape the bottom of the ditch approximately to fit the lowest one-quarter of the circumference of the tile, taking pains to secure an extra firm bearing near the outer edges of the bearing area. Upon the concave surface so prepared the contractor shall spread a layer, 1 to 2 in. thick, of pulverized soil, or sand free from pebbles larger than 1/4 in. diameter, and shall firmly bed each tile truly to line and grade thereon.

Where the bottom of the ditch is so wet and soft as to enable the thorough bedding of the lowest one-quarter circumference of the tile without the use of the layer of pulverized earth or sand, and still is firm enough to afford good, safe support to the tile and its load of ditch filling, the engineer may authorize the omission of the layer of

granular material, but such authorization shall not excuse imperfect bedding.

The space between the tile and the bottom and sides of the ditch shall be filled with selected earth, thoroughly tamped as fast as placed, up to the level of the top of the tile. The side filling shall be carried up as rapidly on one side of the tile as on the other.

The tile shall then be covered by hand with earth to a depth of at least 1 ft. above the top of the tile.

No tile laying shall be considered as First-Class unless the laying and tamping of each tile are watched and directed by an inspector kept constantly on the work for that purpose.

4. Two grades of Concrete-Cradle tile laying shall be recognized, one for solid material and the other for yielding material.

(a) *Solid Material.*—Solid material shall be defined as that which is as solid as average, firm, clay sub-soil. Concrete-Cradles, Solid Soils, shall be made as follows:

The contractor shall shape the bottom of the ditch to fit approximately the lowest one-fourth of the circumference of the tile. Upon the concave surface so prepared there shall be spread at least 2 in. of soft concrete, stiff enough to sustain the weight of the tile, and the tile shall be firmly bedded truly to line and grade thereon.

The space between the tile and the bottom and sides of the ditch shall then be thoroughly tamped or spaded full of soft concrete, up to a level one-quarter of the diameter of the tile above the mid-height. The thickness of the concrete at any point shall not be less than 2 in.

Each joint shall be promptly cleaned on the inside of the tile, as soon as the concrete is in place for that joint.

The concrete used in this method of strengthening tile shall be made of 1 part Portland cement and 8 parts of gravel, or 1 Portland cement, 5 parts sand, and 8 parts broken stone. No pebbles or stone shall exceed in size 1 in. less than the thickness of the concrete.

(b) *Yielding Materials.*—Yielding materials shall be defined as including all materials not solid, as defined above.

Concrete-cradles for yielding material shall be designed by the engineer to carry safely to the soil foundations both the vertical load on the tile from the ditch filling and a side thrust at the mid-height of the tile, such as would exist if the tile were cracked at the top, bottom and each side. The thickness of the concrete at the lowest part of the bottom of the tile shall be at least one-eighth, and on each side at the mid-height at least one-fifth the internal diameter of the tile, and the side concrete shall extend about one-quarter of the diameter above the mid-height of the tile. Each joint shall be promptly cleaned on the inside of the tile as soon as the concrete is in place for that joint.

The concrete used in this method of strengthening pipe shall be made of 1 part of standard Portland cement and 5 parts of good, coarse, clean gravel, or 1 part of standard Portland cement, 3 parts clean, coarse sand, and 5 parts broken stone. No pebbles or stone shall exceed 2 1/2 in. in greatest diameter, nor exceed 1 in. less than the thickness of the concrete.

5. Tile in the trench shall not be subjected to freezing weather during construction without a sufficient depth of cover to prevent cracking.

6. In Table I. are given the approximate values in pounds per linear foot of the ordinary maximum loads on drain tile and sewer pipe from common ditch-filling materials, as determined by tests<sup>1</sup> at Ames, Iowa, and Bos-

<sup>1</sup>For both the tests and the data of actual drains and sewers, see the Report of Committee C-6 on the Investigations on Drain Tile, American Society for Testing Materials, published as Bulletin No. 36, Iowa Engineering Experiment Station.