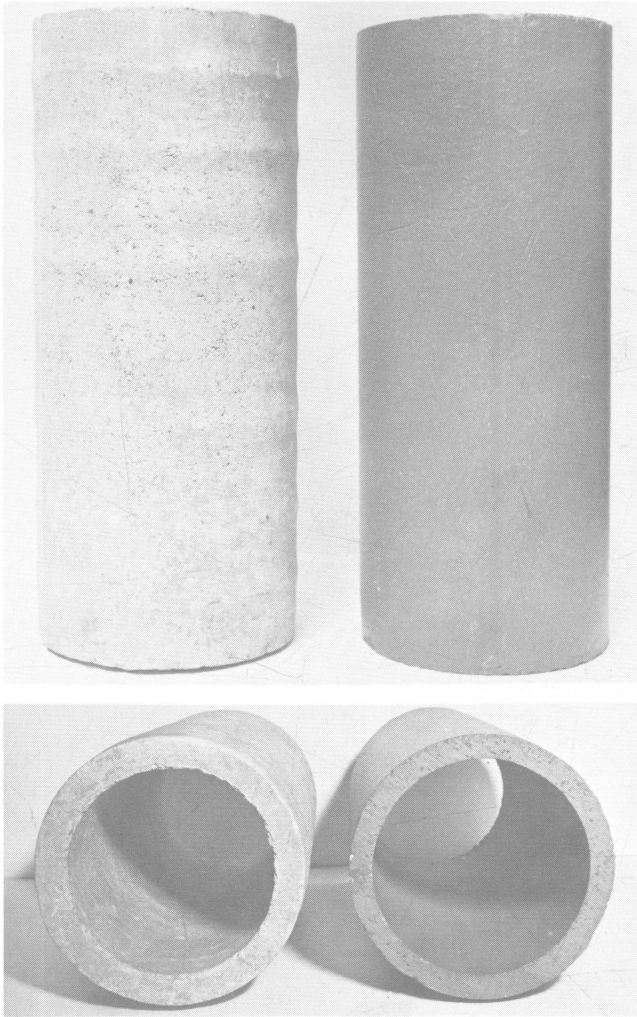


Selecting

# GOOD DRAIN TILE

COOPERATIVE EXTENSION SERVICE  
THE OHIO STATE UNIVERSITY



Sound, well-shaped concrete (left) and clay (right) tile.

Revised 6/67—5M

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The Ohio State University Cooperating with the United States Department of Agriculture,  
Cooperative Extension Service, Roy M. Kottman, Director, Columbus, Ohio 43210.  
Distributed in furtherance of Acts of May 8 and June 30, 1914.

## Selecting

# GOOD DRAIN TILE

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Drain tile quality has a major influence on the performance of a tile drainage system. Failure of a single tile can stop a tile line or even a whole drainage system from functioning. Field operations may be delayed, or a crop may be damaged by excess water before repairs can be made. Repair work is often costly.

Four main factors determine tile quality. These are soundness, shape, strength and absorption. Soundness and shape can be determined by visual inspection. Strength and absorption can be determined accurately only in the laboratory with proper testing equipment.

## CHARACTERISTICS

### 1. Soundness

Sound tile give a clear ring when tapped with a light hammer or steel rod. They have no large cracks or checks to weaken them or allow soil to get into the tile line. If the tile are clay, they have no lime spots or pebbles. If concrete, they have no honeycombing in the walls and contain well-graded sand and gravel. They are reasonably smooth on the inside.

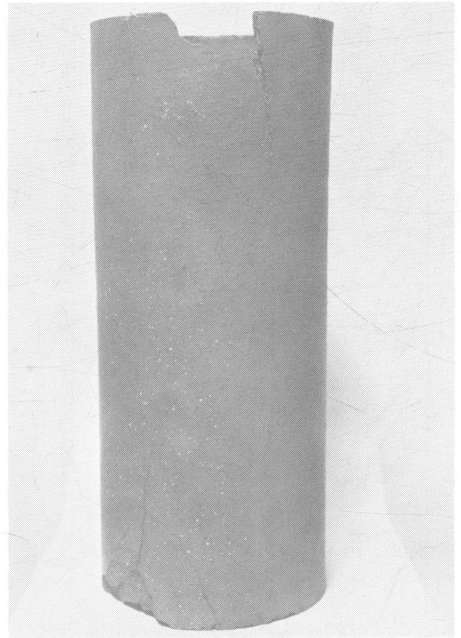
### 2. Shape

Well-shaped tile are straight lengthwise and circular in cross-section. The ends are square-cut with smooth edges. The tile are of uniform size. Shape is important for proper tile alignment

and for proper fit of the tile ends in the trench.

### 3. Strength

Strong tile give a clear ring when tapped with a light hammer, but this test and a visual inspection give only a rough indication of strength. The proper strength test consists of crushing the tile in a hydraulic press. Tile must be strong to withstand the weight of earth loads and of heavy farm equipment crossing over the lines.



Clay tile weakened by cracks and checks.

#### 4. Absorption

Absorption is one of the best indicators of tile durability. The less water absorbed by the tile, the better they will resist frost action, soil acids and sulfates. Porous clay tile, when exposed on the ground surface or installed in the frost zone, are subject to frost damage. Porous concrete tile are subject to damage from acids or sulfates in some kinds of soil. Except for peat and muck soils that are high in acids, few soils in Ohio contain enough acids or sulfates to be injurious to concrete tile.

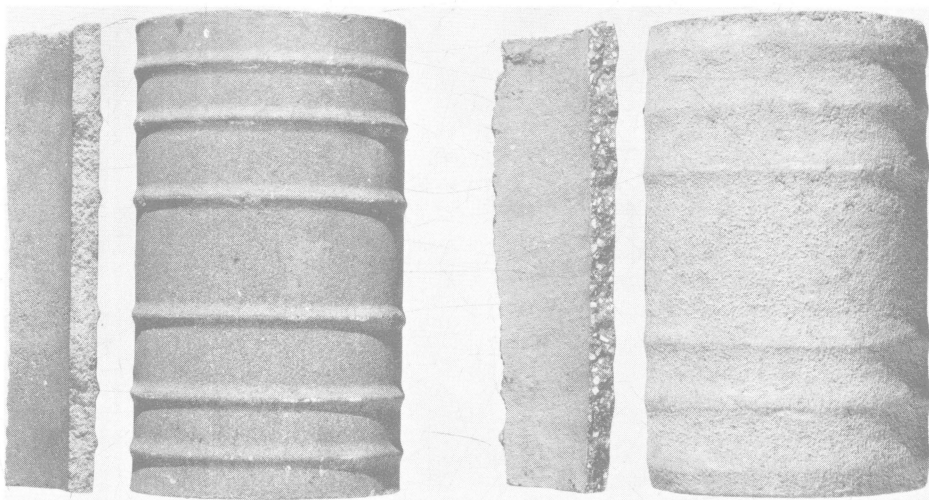
An absorption test is made by boiling the tile in water for five hours and measuring the per cent of water absorbed. A rough estimate of absorption can be made by applying the tongue to a dry specimen of tile. Porous tile will cause the tongue to stick to it. Another estimate of absorption can be made by soaking the tile in water for about five minutes and then breaking the tile in small pieces. If water has penetrated nearly through the tile wall, the tile likely has high absorption. If water has



**Clay tile with flaking caused by lime spots and pebbles.**

only slightly penetrated the tile wall, it likely has low absorption.

An additional test for clay tile is the freezing and thawing test. The tile are



**Poor quality concrete tile (left) and good quality concrete tile (right).  
(Photo courtesy University of Minnesota)**

frozen and thawed out several times to determine their frost resistance. This test is often omitted, since absorption generally gives a good indication of frost resistance.

adopted specifications for both clay and concrete drain tile. These specifications are recognized by manufacturers, contractors, public agencies, and others who are concerned with tile drainage installations. Tile users should purchase tile that meet these specifications. Tile designated No. 1 or No. 2 by the manufacturer have no official standards and are not recognized in the ASTM specifications.

## STANDARDS OF QUALITY

The American Society for Testing Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103 has

### Strength and Absorption Requirements for Tile

There are three classes of drain tile for both clay and concrete materials. The physical test requirements for these classes, based on a random sample of five tile, are as follows:

- (A) **Clay Drain Tile** (made from clay, shale, fire clay or mixtures thereof, and burned)  
 Sizes 4 to 12 inches—ASTM Designation C4

Class	Minimum Average Crushing Strength—lb. per lin. ft. (3-Edge Method—See Photo Page 7.)	Maximum Average Absorption—Per cent (5-hr. boiling test)
Standard Drain Tile—	800	13
Extra-Quality Drain Tile—	1100	11
Heavy-Duty Drain Tile—	*1400	11

\*To 6 inch dia. only—for 8, 10, and 12 inches the requirements are 1500, 1550 and 1700 respectively.

- (B) **Perforated Clay Drain Tile**

Sizes 4 to 12 inches—ASTM Designation C 498

Physical test requirements are the same as those for ASTM Designation C4. In addition, there are several requirements concerning the perforations. They must be circular, cleanly cut, and have no burrs projecting into the tile which would interfere with the free flow of water. Perforations must be arranged in rows parallel to the axis of the tile and specified by the purchaser as either  $\frac{1}{4}'' \pm \frac{1}{16}''$  or  $\frac{1}{2}'' \pm \frac{1}{8}''$  in diameter. Table I gives details on the required number of perforations for various sizes of tile.

TABLE I—NUMBER OF PERFORATIONS FOR PERFORATED CLAY DRAIN TILE

Tile Size Diameter (in.)	Minimum Number of Rows of Perforations	Minimum Number of Perforations per Row				
		Nominal Lengths of Tile (ft.)				
		1	1½	2	2½	3
4, 5, 6	4	3	5	7	9	11
4, 5, 6	2	5	8	11	13	15
8, 10, 12	4	3	5	7	9	11

**(C) Concrete Drain Tile** (non-reinforced concrete)  
 Sizes 4 to 12 inches—ASTM Designation C412

Class	Wall Thickness (in.)	Crushing Strength—lb. Minimum average per lin. ft. (3-Edge method)	Maximum Average Absorption—Per cent (5-hr. boiling test)
Standard-Quality			
Drain Tile (none specified)		800	10
Extra-Quality			
Drain Tile 4" - 1/2"		1100	9
Extra-Quality			
Drain Tile 5" - 9/16"		1100	9
Drain Tile 6" - 5/8"		1100	9
Drain Tile 8" - 3/4"		1100	9
Drain Tile 10" - 7/8"		1100	9
Drain Tile 12" - 1"		1100	9

**Special-Quality**

Drain Tile—Same as Extra-Quality except 8 per cent maximum absorption and closer limits on wall thickness. This class is intended for special situations such as where tile are subjected to unusually heavy loads.

Wall thickness of Extra-Quality concrete tile must not be less than thickness specified by more than 1/16" for 4" 5" and 6" tile, 3/32" for 8" and 10" tile and 1/8" for 12" tile. Wall thickness of Special-Quality concrete tile must not be less than thickness specified at any point. Special-Quality tile must also meet a 10-minute soak test or a hydrostatic test in addition to crushing strength and absorption tests.

To meet these specifications, tile must be sound and properly shaped. In addition, all tile up to 12 inches in diameter must meet the strength and absorption requirements listed on pages 5 and 6.

Additional details are given in the publication, "Standard Specifications for Drain Tile," available from ASTM headquarters at a nominal cost.

Some tile manufacturers make these tests regularly in their own plants. Others have independent laboratories make the tests. To insure the production of good drain tile it is necessary to maintain a constant check on quality.



Clay tile damaged by frost.

## BUYING DRAIN TILE

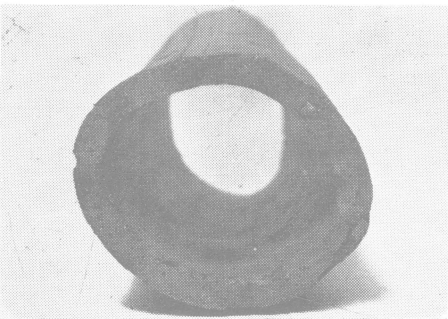
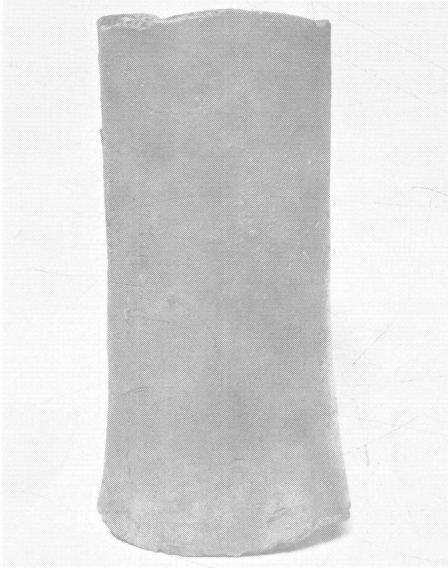
1. Require from the manufacturer a written certification that the tile meet ASTM specifications for one of the drain tile classes described here.

Standard drain tile are satisfactory for most farm drainage work. They can be used in trenches up to eight feet deep if the trenches are not more than 18 inches wide. However, extra-quality tile are better and will give greater assurance of long life.

2. If you have any doubt about quality of the tile, have ASTM tests made



**Tile being tested for strength in hydraulic press.**



**Crooked and out-of-round clay tile.**

by an independent laboratory. Your county Extension office or Soil Conservation Service technician can help you locate a laboratory.

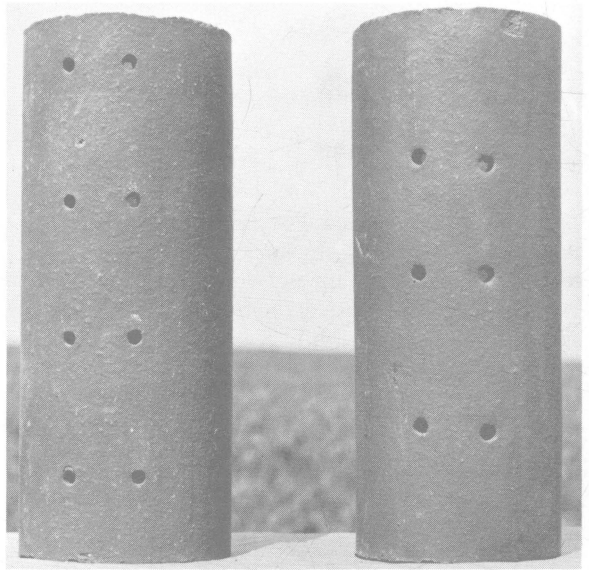
3. Clay, perforated clay, and concrete tile are acceptable for most farm drainage work in Ohio, provided they meet ASTM specifications. Perforated tile can be substituted for plain tile with joint spacings, since tile inflow rates are closely related to the area of openings. In soils that are highly acid, with a pH of 6.0 or lower, concrete tile should be special-quality.

4. Color is of little importance provided the tile meet ASTM specifications. Salt glazing gives a glossy finish to clay tile, but does not necessarily indicate high quality. Quality depends more on the raw material used and on how it is handled and burned.

## CARE AND INSTALLATION

1. To meet ASTM specifications, concrete tile should not be removed from the plant until properly cured.

Two types of perforated tile.



2. Care should be taken in unloading tile from the truck to prevent breakage.

3. Each tile should be inspected for soundness and shape before installation. Poor quality tile should be discarded. It is not practical for a manufacturer to test every tile that is shipped from the plant.

4. During construction, the ends of all tile lines should be closed after completion of each day's work to pre-

vent soil from entering the line in the event of rain.

5. Tile lines should be blinded and backfilled as soon as possible after laying.

**Note**—Under certain conditions you may receive assistance in installing a tile drainage system through the cost-sharing features of the Agricultural Conservation program. **Drain tile installed under this program must meet ASTM specifications.**



Concrete tile of the same quality exposed five years in mineral soil and peat soil, respectively. Note deterioration caused by acids in the peat soil. (Photo courtesy of University of Minnesota)