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COMPRESSION AND ABSORPTION TESTS
ON
DRAIN TILE MANUFACTURED IN MICHIGAN

A Treatise Submitted
to
The Faculty
of
The Michigan Agricultural College

by
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Wayne A. Gingrich

Candidate for the Degree of Bachelor of Science

June 1922

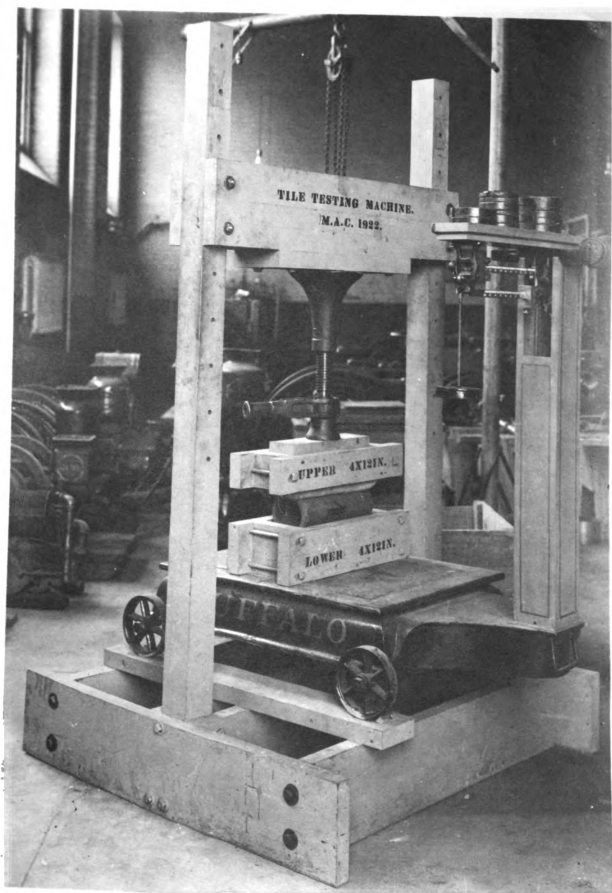
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I am indebted to H. A. Vedder and C. E. Robey for
information and aid in preparing this treatise.

W. A. Gingrich



Compression and Absorption Tests

on

Drain Tile Manufactured in Michigan

The discussion and experimental tests for compression and absorption qualities was the subject developed by me to be submitted to the faculty for the degree of Bachelor of Science.

The drain tile used in the compression and absorption tests were secured by the Farm Mechanic Department from the tile manufacturers in Michigan, except one. An Ann Arbor concern would not favor us with test specimens.

Each factory sent three to five samples of each size manufactured by them. The tile were shipped to the testing room packed in straw in barrels. Occasionally a specimen was broken during shipment.

The compression tests were made in a home-made machine. See picture.

A Fairbanks scale was used to determine the compressive breaking strength. The pressure was applied by a ratchet jack-screw fastened rigidly upside down to a framework several feet above the middle of the scale platform.

The specimen to be tested was placed in a box of sand the depth of sand being equal to the diameter of the tile. Another box of sand with a fairly loose canvas bottom was placed on top of the specimen. A wooden block was placed

in the top of the box free to move up or down. Both boxes of sand with the tile between were placed upon the scales and the scales balanced. Pressure was then applied to the moveable block in the top box thru the sand to the specimen by the jack screw. The scale beam was kept balanced while the pressure was being applied. As soon as the specimen broke the compressive load was recorded. The lines of failure were also noted. Failure usually occurred in four places, namely where the horizontal and vertical axes intersected the tile shell.

The compressive strength of tile varied from about three hundred to eighteen hundred pounds per foot of length. This variation was probably due to two things, the first being the grade of material used and the second the workmanship in manufacturing the tile. A third reason for the variation might be a combination of material and workmanship together.

The absorption tests were made on three pieces of each tile tested, a piece from each end and one from the middle. These pieces were about two by two inches to three by three inches.

The test pieces were baked in a hot oven for five hours and then weighed accurately. They were then boiled for five hours and weighed again. From these operations the percent

of water absorbed was computed. The percent of absorption varied from fifteen to thirty in soft clay tile. The cement tile averaged about seven percent and the glazed clay tile varied from five to eleven percent.

Absorption is a quality tile should NOT have, because it decreases the quality of the tile. When in use if the drain tile absorb water and are not buried below the freezing line, the result will be freezing, expansion and breaking of the tile, and drainage will cease. Tiles that absorb a large percent of water, if left piled up and exposed to the elements for a year will be worthless because of deterioration.

It also seems evident that tiles that absorb water are porous, and if porous, will be weak in compression. Porous tile also increase the coefficient of friction, and usually the drainage grade in drain tile is too low to over-come any extra frictional resistance because of a poor grade of tile.

Soft clay tile are made and used more than any other kind of tile because the first cost is cheap. Another reason for their use may be due to the ignorance of the farmer in thinking that the water must soak thru the tile rather than go thru the joints.

Vitrified clay tile would probably be the best tile to use in the end because they are more durable and of course more expensive.

Cement tile have not become a great commercial product although the Consolidated Coal Company of Saginaw make cement tile in all sizes and the tests show them to be among the best in compression and absorption. The compressive strength was higher than any clay tile averaging about eighteen hundred pounds, and the percent of absorption was about the same as vitrified clay tile, from five to eleven percent. A few years more will see concrete tile among the leaders of drain tiles. Large tile from three feet and up in diameter are made almost exclusively of concrete now.

Graphs were made of compression and absorption in an attempt to show that as the compression increased the absorption decreased and vice versa. The graphs in some cases showed this fact very well while in others no comparison could be made, although in no case was the absorption and compression at a maximum or minimum.

The laboratory results and the name and number of the manufacturer are on the last few pages. The factories were numbered to make it easier to follow through the tests, and also to partially keep the manufacturers names unpublished.

The conclusions to draw from these tests on compression and absorption show that Michigan manufacturers make tile suitable for any purpose, all tiles being strong enough in compression and tiles either of high or low percent of

absorption may be obtained, the price usually determining this factor.

Factory Number	Kind of Tile	Diam. of Tile	Approximate Length	Thickness of shell	Breaking Load Per Ft.	Mean Breaking Load Per Foot	Percent Absorption
002	Soft Clay	4"	12"	9/16	1284 1400 1334 1208	1306.5	15.95
002	S.C.	5"	12"	5/8	767 800 997 1145	927	15.53
002	S.C.	6"	12"	5/8	890 634 1150 935	902	16.21
002	S.C.	10"	24"	15/16	1447 1312	1379	16.37
014	S.C.	4"	12"	5/8	959 1060 1094 893 1210	1023	16.91
014	S.C.	6"	12"	3/4	1210 1297 984 1225 1180	1179	16.69
014	S.C.	8"	12"	7/8	1346 1763 1566 1187 1337	1460	
030	S.C.	4"	12"	9/16	696 624 666 825 783	722	17.82

Factory Number	Kind of Tile	Diam. of Tile	Approx- imate Length	Thick- ness or Shell	Break- ing Load Per Ft.	Mean breaking Load Per Ft.	Percent Absorp- tion
030	S.C.	6"	12"	3/4	1313 1031 628 828 339	832	16.35
030	S.C.	8"	12"	7/8	909 1221 907 824	928	17.03
031	S.C.	4"	12"	9/16	894 436 547 1340 1188	881	21.50
031	S.C.	6"	12"	3/4	770 646 785 625 670	699	23.76
031	S.C.	8"	12"		1333 1369 1223 892	1206	21.09
048	S.C.	4"	12"	9/16	423 968 956 940 1485	954	16.98
043	Cement	4"	12"	5/8	1870 1500 1788 1500	1646	8.63

Factory Number	Kind of Tile	Diam. of Tile	Approx- imate Length	Thick- ness of Shell	Break- ing Load Per Ft.	Mean breaking Load Per Ft.	Percent Absorp- tion
043	Cement	4"	12"	5/8	1575		
043	"	6"	12"	11/16	1658 1650 1675 1517 1348	1709	6.96
043	"	8"	12"	3/4	1365 1170 1174 1169	1247	5.20
043	"	10"	18"	7/8	1678 2000 1947 1990 1884	1901	7.37
037	Soft Clay	4"	12"	1/2	939 926 1035	983	20.63
010	Soft Clay	4"	12"	9/16	496 833 820 915 973	807	16.22
010	S.C.	6"	12"	9/16	300 200 695 543	434.5	16.12
010	S.C.	8"	12"	3/4	700 728 611 800 500	684	14.45

Factory Number	Kind of Tile	Diam. of Tile	Approx- imate Length	Thick- ness of Shell	Break- ing Load Per Ft.	Mean breaking Load Per Ft.	Percent Absorp- tion
011	Soft Clay	4"	12"	5/8	1165 1305 1198 1330 1040	1207.6	24.93
011	S.C.	6"	12"	11/16	775 780 1190 810 910	893.0	23.68
011	S.C.	8"	12"	15/16	645 935 1037 706 850	841.2	29.04
024	S.C.	4"	12"	9/16	1923 1463 1356 1179 1367	1457.6	19.63
024	S.C.	6"	12"	3/4	1652 1686 1679 1636 1676	1724	17.83
024	S.C.	8"	12"	3/4	1008 1270 1666 1050 1038	1226.4	18.32

Factory Number	Kind of Tile	Diam. of Tile	Approximate Length	Thickness of Shell	Breaking Load Per Ft.	Mean Breaking Load Per Ft.	Percent Absorption
003	Glazed	6"	18"	9/16	1347 1226 1133 1464 1345	1303	5.52
003	Gl.	8"	24"	11/16	1123 1123 1256 845 1170	1103.4	6.16
003	Gl.	10"	24"	3/4	1210 1175 1426 1253 1243	1261.4	8.82
047	Gl.	4"	12"	1/2	1148 1056 1338 852 1090	1096	11.2
047	Gl.	6"	18"	9/16	1442 1576 1489 1421 1329	1451	7.56
047	Gl.	8"	24"	5/8	852 035 1810 1675 1542	1383	5.53
047	Gl.	10"	24"	11/16	1500 1260 1531 900 900	1181	4.44

MANUFACTURERS AND NUMBERS

American Vitrified Clay Products	Jackson	#003
Grand Ledge Clay Products Co.	Grand Ledge	#047
St. Clair Clay Products Co.	St. Clair	#048
Consolidated Coal Co.	Oaginaw	#043
Zeeland Brick and Tile Co.	Zeeland	#037
Coleman Tile Co.	Coleman	#010
Croswell Clay Product Co.	Croswell	#011
North Star Tile and brick Co.	North Star	#024
Ashley Tile Co.	Ashley	#002
Bunte Bros. Tile Co.	Flat Rock	#014
South Rockwood Tile Co.	South Rockwood	#030
St. Louis Tile Co.	St. Louis	#031

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