TILE DRAINAGE SYSTEM FOR THE FARM OF F. C. BRAINERD

Thesis for the Degree of B. S.

Walton K. Brainerd

1899

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THESIS

BY

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TILE DRAINAGE SYSTEM FOR THE FARM OF F. C. BRAINERD.

Surveyed and designed by W. K. Brainerd.

The farm on which this drainage system is located is owned by F. C. Brainerd, and is described as follows: The E.½ of the S.W. 1/4 of Sec. 15, township of Brady, county of Saginaw, State of Michigan. It is located in a section of the State which is comparatively new, tile drains not being used to any great extent except for large drains. The soil varies from a clay, to a sand loam, and is admirably adapted for farming purposes; but suffers greatly from the effect of water in the wet season.

The system as designed is not intended to thoroughly drain the land, as might be profitable in a very intensive system of farming, but will be effective so far as a consideration of expense will make practicable.

The work of surveying and leveling was done during the spring vacation of the year 1888-9. The first problem attempted was a survey of the plot with the view of computing the area of the plot and obtaining data for a topographical map. From a recent survey of the section by the county surveyor Mr Goodale and from monuments left by him, the corners of the farm were easily located. The survey was begun from the southwest corner of the farm; which is marked by a long stone

extending about two feet below the surface. A like stone marks the southeast corner, while the north-east and north-west corners are marked by white oak posts about 4 or 5 inches square. The south-west corner was designated as station A, the south-east corner as station B, the north-east corner as station C, and the north-west corner as station D. Each boundary line was measured and all cross fences and water way referenced. From the data obtained from this survey the buildings, fences, and the creek crossing the north-east corner of the farm were plat^t^ed on the scale of 1 inch to 128 feet on the accompanying topographical map.

The work of leveling in order to locate contours on this map, comprised the determination of the elevations at 104 points on the farm; chosen with reference to irregularities of the surface. A primary bench mark was chosen on the south-east corner of the east stoop of the house, and was marked by a cross. The work of leveling then proceeded with frequent checks and temporary bench marks. From the data obtained in this way the contours were drawn.

From the position and direction of these contours, and a consideration of the character of the soil of different portions of the farm, the drainage system was designed. It is evident that the creek crossing the north-east corner of the plot must be the outlet. From a study of the contours, it will be seen that the main

drain may be placed in one of two places, and a good even grade obtained in either position. It might be placed on the east side of the farm about 20-30 rods from the line, or in the position chosen. The reasons for the choice are that the soil of the south-west portion of the farm contains a large amount of clay and is more affected by water than is the east portion of the farm, and by placing the main drain in this way it will more directly reach this portion.

The main drain as plated on the topographical map, and of which there is an accompanying profile, was laid out on the ground, using stations 100 feet apart.

The drain designed to drain the north-west part of the farm will not be needed at present, but will be necessary when this portion of the farm comes into cultivation.

In consideration as to what size of tile to use, the following computations were made. On the main line, the area to be drained is about 40 acres, Estimating that 1 inch of water will fall in 24 hours, there will fall an 40 A, in 24 hours 14520 cubic feet of water. As much of this water will be held in the soil it will be necessary that about 1/2 this amount be carried off by the drain in 24 hours, or 7.2600 cubic feet.

In estimating the amount of water that a given size of tile will carry off, by Ponlecet's formula we have as follows:

$$U = 48 \left(\frac{D \times H}{L + 54\ D} \right)^{\frac{1}{2}}$$

$$V = 48 \left(\frac{\frac{10}{12} \times 66}{25004 + (54 \times \frac{10}{12})} \right)^{\frac{1}{2}}$$

(by substitution)

$U = 2.05$ ft. per sec.

$5/12 \times 5/12 \times \frac{22}{7} = \frac{275}{504}$ sq. ft. = Area of cross.sectio

$\frac{275}{504} \times 2.05 = 1.12$ cu. ft. Amount discharged in 1 sec.

$1.12 \times 60 \times 60 \times 24 = 85568$ = Amount discharged by 10" tile in one day. It will be seen that a 10 inch tile will be ample. By a like computation it can be shown that an 8 inch tile will not meet the demand. As there is no intermediate size on the market a 10 inch tile would be used.

Hodgman, in his book on land surveying, gives tables which will verify these results.

The following is an estimation of the cost of tile taken from the price list of Clippert and Spaulding, of Lansing, Michigan.

			No.1	No.2	No.1	No.2
2500	10"	tile per thou.	$80.00	$40.00	$200.00	$100.00
2750	4"	" " "	18.00	10.00	49.50	27.50
563	3"	" " "	15.00	7.50	8.44	4.22
20608	$2\frac{1}{2}$"	" " "	9.00	5.00	185.47	103.04
		Total- - -			$443.41	$234.76

The cost of laying the drain, silt basins and outlets, based upon"Waring's book on Drainage for Profit"will be as follows:

Digging 1601 rds of ditch, @43¢ per rd. =	$688.43
Grading 1601 rds. @ 6¢ per rd. =	96.06
Laying, covering, and filling, 1601 rds. @ 10¢ per rd. =	160.10
	$944.59
For outlets, silt basins, etc.	60.00
	$1004.59

Total cost of system -

Using No. 1 tiles- - - -	$443.51
Labor- - - - - - - - - -	1004.59
Total-	$1448.00
Using No. 2 tiles- - - -	234.76
Labor- - - - - - - - - -	1004.59
Total-	$1239.35