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HOW TO DETERMINE THE GRADE OF A DITCH

Prof. Wm. H. Day, Ontario Agricultural College, Guelph.

Peep-sights for Home-made Drainage Level—Their Use in Getting Accurate Readings—A Simple Method of Determining the Fall—Valuable Information for Farmers.

IN four years of close contact with drainage problemsin all parts of Ontario, the Department of Physics at the Ontario Agricultural College has come to the conclusion that one of the main reasons why the practice of underdrainage has not become more general is that people have neither means nor method of determining whether they have fall enough for tile drains, and they don't want to go ahead till they find out. Very frequently when you go to make a survey for a man he says: "I just want to know if I have fall enough." Some years ago we devised a simple drainage levelling outfit which any man could have, as it would cost only $1.50 to $2.00, and which anyone could use to determine whether he had fall enough, as the method is simple. We now have a valuable improvement to that "home-made drainage level" in the form of peep-sights, that make it much more speedy and accurate, and it is my purpose in this article to call attention to the instrument and its use, and to these new sights, which have not been described heretofore.

HOME-MADE LEVEL AND ITS USE.

Figure I will show the design of the home-made drainage level, and figure II will show its use. When a man wishes to determine the fall in a certain direction he sets up stakes 100 feet apart right across the field, or farm, as the case may be. He is then ready to begin taking levels. He takes the home-made level and places it between stakes O and 100, sinking the upright firmly into the ground as nearly perpendicular as possible about half way between the stakes and in line with them. He next makes the crosspiece horizontal by means of the spirit level and the thumb screws. Two men are required to do the "levelling," A to sight and B to hold the staff (or measuring pole) and place a target (pencil or something similar) across the staff where directed.

The staff is first stood on the ground at stake O and A sights backward along the top of the level and directs B to place the target across the staff and raise or lower it until it is in line with the level, and when correct, B makes a note of the number of feet and inches the target is from the ground. When this is done done B moves forward to stake 100 and stands the staff on the ground there and A, without moving the level, turns around and sights forward to the staff, directing B as before. When the target is just level with the instrument B again notes the reading.

In figure II the back reading was 4 ft. 10 in. and the foresight 4 ft. 1 in. In both cases the target was level with the instrument, consequently the difference in reading must be due to the rise in the ground, and therefore the amount of rise must be nine inches. The height of the instrument is immaterial—the *difference* between the two readings will be the same no matter whether it is on high or on low ground.

When the rise or fall from stake O to stake 100 has been determined, the level is next placed about half way between stakes 100 and 200 and the rise or fall between them determined in the same way. The level is next set between stakes 200 and 300 and the same operation repeated, and so on over the whole course of the ditch.

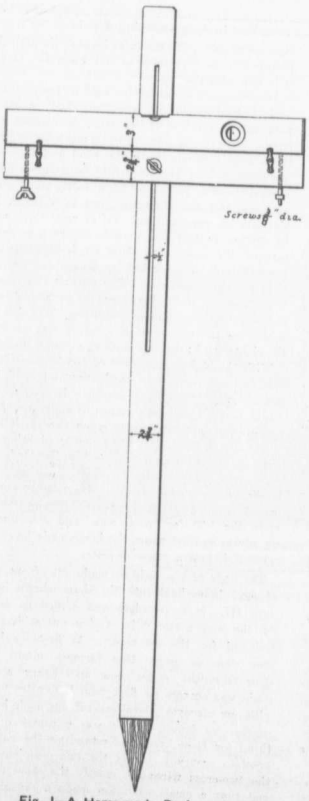

Fig. I—A Home-made Drainage Level

When this is completed, all the rises or falls, as the case may be, may be added together, giving the total rise or fall. If there are both rises and falls along the same ditch, as frequently occurs, where a knoll or a hollow has to be crossed, the difference between the sum of the rises and the sum of the falls will give the net rise or fall. And when the net rise or fall is known and also the length of the drain, it is an easy matter to find the rise or fall per rod or per 100 feet. And when this is known one is in a position to decide whether he has fall enough for underdrainage.

THE REQUIRED GRADE.

Generally speaking about two inches in 100 feet is the slowest grade that should be used with small tiles. Larger ones may be laid on slower grades, for on the same grade water runs swifter in them than in smaller ones and will thus flush out sand more readily. For instance, the water in a 12-inch tile runs *considerably more than twice as fast* as in a three-inch on the same grade. The fall in the ground surface, however, is not always a test of whether a man can underdrain, for he may put his drains deeper at the outlet than at the source and thus have more fall in the ditch bottom than on the surface. This we often find it necessary to do.

As in determining the rise or fall along a proposed ditch, there are numerous readings which a man cannot "carry in his head," it is necessary to have some little book in which to note them. We find it convenient to use the form shown in the following table, which gives the field notes on Drain No. 1 in a certain survey:

NOTES ON DRAIN NO. 1

Stake	Back Sight	Fore Sight	Fall	Rise	Elevation
	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
0	4 10	.....	.....	.....	10 0
100	5 2	4 1	.....	10 9	10 9
200	5 3	3 11	.....	1 3	12 0
300	5 0	3 9	.....	1 6	13 6
400	4 6½	4 0	.....	1 0	14 6
500	4 7	4 3	.....	0 3	14 9
600	4 5	4 5	.....	0 2	14 11
700	4 7	4 8	0 5	.....	14 6
800	.....	5 3	0 8	.....	14 0

Note that in six out of the eight hundred feet sections there were rises, in the other two there were falls. The six rises total 4 feet 11 inches and the two falls total 11 inches, hence on the whole there was a rise from stake O to stake 800 of 4 feet 11 inches minus 11 inches, equalling 4 feet.

THE ELEVATION.

The last column, "Elevation," needs a word of explanation. In comparing the altitude of different towns, for instance, we use the sea-level as a datum plane, i.e., a level of comparison. Toronto Bay is 250 feet, the Agricultural College, 1,150 feet above the sea, from which we learn that the College is 900 feet above the bay. In surveying a ditch we cannot use the sea as a datum, for we do not know how much stake O is above the sea, hence we must choose an arbitrary datum. In the example given we have chosen it ten feet below the ground surface at stake O. Then the elevation of stake O above this chosen datum plane is 10 feet. Since there is a rise of 9 inches to stake 100 its elevation