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tile upright or piling large stones upon the tile to give access to surface water.

An intake properly built answers two purposes: first, it admits air to the drain proper; this is very important, as a matter of fact, is essential for the proper functioning of any tile drain. Many engineers maintain that ample air enters a drain with the water as it percolates through the soil to the drain, but experience has taught me that this is not always true, depending largely upon the nature of the soil, of course, but in all cases to make sure the drain shall operate to its full capacity, especially so immediately after a storm, when a few hours is the farmer's profit or loss, the surface intake feeds the drain to full capacity without interruption due to seeping through three or four feet of earth.

Second, intakes are necessary in various soils. For example in blue clay which firmly cements a floor between the surface and the drain. (Drifting from the subject for a moment, I might say in a case as above, blue clay soil, it is well to fill the trench over the tile with corn cobs, which will decay, but at the same time change the nature of the blue clay to the extent that it will permit water to seep through. Gravel has also been tried by the writer, but unsuccessfully, due to the fact that blue clay runs into the gravel and gradually cemented it shut again.) An intake takes the bulk of the surface water in connection with a seam over the tile as above referred to, this will give sufficient drainage to save the crop.

**Method of Construction**

An intake should not be built over the drain proper but similar to a curb and gutter intake, off to one side. The bottom of the basin should be 18 to 24 inches deeper than the basin outlet. The outlet should be a lateral to the drain. The basin can be constructed of brick approximately 2 feet inside with a grate over the top so as to permit the water, yet keep out all unsuitable material, such as musk rats, rabbits, straw, etc., and they should be placed at low points where the surface water gathers immediately after a rain.

**TILE OR OPEN DITCHES**

Nels Holman, Madison, Wis.

Whether tile or open ditches are preferable in any particular district must be determined in each case by the physical conditions of the territory to be drained. Both systems have their advantages and disadvantages. In most districts both open ditches and tile work out to mutual advantage.

If the territory has steep watersheds and a tight top soil contributing to flooding, a means of quickly removing the water on the surface is desirable. In this case the open ditch commends itself. But the open ditch carries with it many difficulties besides that of leaving a perpetual gash in the land. In the first place the
open ditch must have sufficient fall to enable it to carry off the sediment and to even scour out the weeds that grow in the ditch during low water, otherwise it will fill up. In Dane County we have learned by experience that the maintenance of open ditches is a considerable item of expense. In the Koshkonong-Mud Creek district where we have twelve miles of dredged ditch and fourteen miles of smaller ditch we have levied $500 per year for maintenance practically every year since its construction in 1914 and last year we levied $1000. Simply leaving an opening in the spoil bank and allowing the flood water to pour over the side of the ditch does not work out in practice. Even a very moderate flood running over the side of the ditch very soon erodes the side making a gully which in time extends back into the land considerable distances and proportionately filling the ditch.

In the more recent ditches we have constructed we have anticipated flood conditions and provided culvert pipe of ample size in time to have them dug into the side by the dredge and then making the spoil bank continuous over them. In previously dug ditches where erosion has developed we have sometimes put in pipe and closed the gap in the spoil bank or else built wire flood fences. Either method will produce the desired protection, although in some cases we found it necessary to combine both the pipe and the flood fences.

Another method of preventing erosion which we have discussed but not yet tried out is to spread a couple thicknesses of chicken wire over the flood path and down over the side of the ditch. I am satisfied from my observation of wire flood fences that it would prevent erosion but how durable it would be I have no fixed opinion. The method of fastening down the wire would also have to be worked out. In the use of this method the cattle would have to be fenced out from the wired surface. A ditch we finished last year ended about 20 feet through a highway bridge where we knew a large amount of flood water would enter and cause heavy erosion. At this place we put a 3-foot culvert pipe in the bottom of the ditch under the bridge, lined the sides and bottom of the ditch north of the bridge with concrete, faced the ends of the bridge from abutment to abutment to the ends of the pipe and then floored the entire bridge to a depth of about six inches over the tile. On the south side of the bridge the ditch is also lined, sides and bottom to the highway line. This was done because large quantities of water flow down the highway ditches. The culvert pipe will take the low water running off. In case of flood the excess runs over the concrete floor above.

In addition to the items mentioned above, which may all be charged to maintenance, you are all familiar with the bridges and fences needed in connection with the open ditch and these are perpetual. Securing the acceptance of awards for private bridges is generally accompanied by either actual or pretended dissatisfaction
on the part of the land owner, and if the commissioners succeeded in driving a good bargain it simply means the transference of part of the cost of the bridge from the district as a whole onto the individual land owner, which to my mind is of questionable virtue.

Another most constant source of irritation is that of getting the land owner to keep his cattle away from the ditch. We have had instances where we found it necessary to bring land owners into court to get results, but such methods do not promote good relations between commissioners and land owners. Last year we had circulars printed with the law governing damages to ditches and sent to each land owner, but the usual recalcitrant ones seemed to pay no attention to them.

While I have thus dwelt on the difficulty connected with the maintenance of open ditches it does not follow that tile are free from every difficulty and disappointment. As already stated, they will not handle floods where there are steep watersheds. It may be answered that this matter can be taken care of with surface runs. That is only partially true. It is our observation that if a surface run has good fall, it will scour and gully. If it is flat and grass grows over the bottom, sediment will collect in the grass and fill the ditch. We have had good results from surface intakes set in the tile, but in several instances the heaving of the ground in winter has broken them loose. Laying tile in sandy soil is, of course, a serious business. I believe it would be economy to have one of the commissioners, if he knows his business, oversee the laying of every tile where sand is encountered. In two of our late districts, at the suggestion of Prof. Jones, we wrapped every joint with building paper. So far it seems to have worked out all right. But on the whole, tile has, of course, great advantages over the open ditch. It does not leave a perpetual gash in the ground, it will operate, when carefully laid, with a flatter grade, it will not erode the sides or grow up to weeds; and it eliminates the necessity for bridges and fances.

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**DITCH CLEANING MACHINERY**

**G. M. Hill, Wisconsin Rapids, Wis.**

Our company had a contract with the Brown County Farm Drainage Board to dig a ditch and keep it dug. Man power was too expensive and mother necessity camped on our trail at every turn. Five miles of ditch from 6-10 to 3 feet above grade stared us in the face. We had to get an invention that was capable of taking the material from a ditch grade six to nine feet from the top and 35 feet wide in places, and carrying it to the dump over the berm.

We conceived the idea of building a machine with a very high "A" frame and long, narrow boom. In fact, it is only six feet wide on the bottom by 24 feet long, weighs only 5 tons and is pulled ahead with a wire cable and digs from behind and toward the