Installing a good drainage system

The first, and most important, part of eliminating surplus water on the course is to determine what the cause is. From there, careful work on main and lateral lines, joints, and catch basins will do the job

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Good management of turf means good management of water. Certainly your drainage system will work if you have good soil structure, if you contour the surface to take care of rains and melting snows, and if your underground construction has been properly engineered.

However, because of the extended dry years prior to 1967, we have tended to neglect the important role drainage plays in turf management. We have been more concerned in applying water, than removing it. In reviewing five previous proceedings of the International Turfgrass Conference I could find only one article devoted to drainage, while there were at least eighteen talks devoted to some aspect of irrigation.

This past season, no doubt, many of you experienced "wet areas" that never existed before or were never a real great problem. And this past year was not a real wet summer, more like a normal one. I'll wager that a great many drainage projects were undertaken or in the planning stage this fall than ever before.

Just how does the drainage system work?

To begin with, you must plan the drainage system well, install it properly, and check it regularly.

Since it is the surplus water which causes trouble, it becomes necessary to remove it. Several factors may cause this excessive water:

1. The soil may be water retaining.
2. The area may be landlocked. (See photo 1).
3. The area may be contained upon an impervious layer of shale or compacted clay.
4. Low areas may receive flooded water from high ground. (See photo 2).
5. The areas may have natural dams or dyke-like barriers due to glacial action.

So an important consideration in attacking a drainage problem is to make every effort to ascertain the cause.

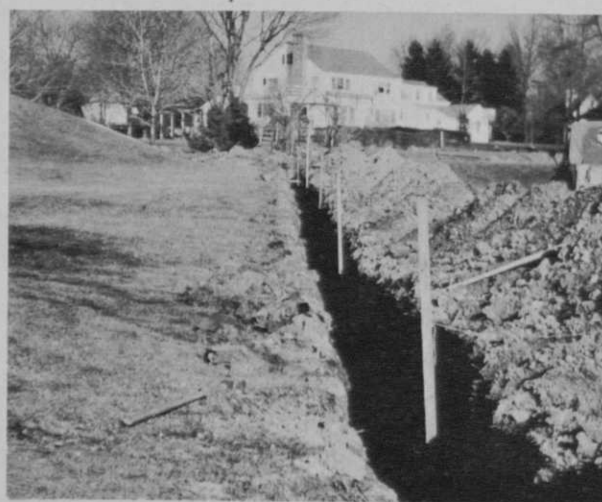
The cause naturally will determine the remedy.

Continued on page 46

1. This area is poor for drainage because it is landlocked and has impervious soil.

2. In this photograph you can see the low area has received flooded water from high ground.

3. Photo at far left is a good example of an open ditch, which is objectionable. 4. Photo beside it shows the same open ditch, graded, with tile installed, and ready for backfill of gravel or bankrun. 5. Picture directly below illustrates an intercepting line on a slope, near a green. 6. Bottom photo is an example of a drain line in clay soil through a wet area.



Drainage system

Continued from page 44

OUTLETS

The key to any drainage system is the outlet. Its selection must be carefully made. A single outlet is highly desirable, even though large tile is necessary to carry the column of water, rather than many small outlets. It is cheaper to construct and care for the single outlet than many small ones.

A good outlet needs protection, and concrete or stone should be used to build proper bulkheads. Should conditions indicate that the outlet is to be very near the ground's surface, a fill of earth mounded over the tile will protect the line from drainage.

If no suitable outlet can be located, the so-called dry wells can be constructed, where excess water is led to drain away in gravel-filled holes or a sump pump can be installed to lift water to a natural outlet.

Once you have found a promising outlet for the source of water to be removed, then the ditch can be dug according to topography of ground, providing sufficient slope is secured. (Open ditches have many disadvantages. They do little towards correcting a general wet condition; will not remove sub-surface water from nearby areas unless deep; they cut up an area removing it from use; make it difficult to operate machinery; necessitate construction of bridges; cause compaction to occur along the edge of the ditch and by bridges; and they need occasional cleaning. See photos 3, 4). Brush and stone ditches have many disadvantages also.

Continued on page 56

Drainage system *Continued from page 46*

Perhaps the most satisfactory drainage device so far developed involves the use of tile—either the agricultural land tile (drain tile); terracotta pipe (sewer tile); poroswall tile (concrete agregates); or the use of perforated lengths of bituminous-asbestos pipe or concrete-asbestos pipe. All of these classes of tiles can be used for drainage purposes.

The four main tile systems are the herring bone, the gridiron, the random, and the intercepting. Naturally, any of these systems can be attached to another if conditions warrant. Therefore, in planning the entire layout attempt to fit the natural conditions to the system best suited for that purpose.

The intercepting line is a very useful method as well as inexpensive in that many times its use will eliminate the necessity of installing a drainage system in a low area below the hill. The cause is corrected before it does the damage.

The judicious use of intercepting lines near hillside greens, tees and traps is rapidly being employed rather than installing drains in these areas. (See photo 5, page 46).

Drains that run down the slope collect water from only a narrow strip on either side of the drain. Lines that run across the slope are much more effective because they intercept both surface and underground water.

MAIN LINES

Grading the base of the drainage ditch is essential in assuring that your tile line functions properly.

In constructing a tile line start at the outlet and work backwards up the ditch. If water is encountered while laying the tile, it must be drawn off through the tile from time to time. Make temporary dams to cut down velocity to eliminate excessive washing. The fact that water may back up in a line a short distance is not serious because the drain water from above will seek its level.

Tile should be set on a firmly prepared, accurate grade, preferably of 3/8'' or 3/4'' stone. This is especially true if the ditch was dug with a machine that left hills and valleys, or if soil is wet and mushy.

It is very seldom that shallow grades are necessary, and for all practical purposes, grades can be kept within the range of five feet per 100 ft. for maximum and to 1/2 ft. per 100 ft. for minimum, although topography of the ground is the determining factor. If necessary, tile can be set on practically level grade, although in such instances larger sized tile should be considered.

Depth should be from 18 inches to six feet, with three feet as an average. Tile placed less than 18 inches is apt to be broken or injured by tractors or heavy machinery passing over the line. Where quick surface water removal is desired, the tile lines should not be over two feet deep.

Continued on page 58

Drainage system

Continued from page 56

Whenever hardpan is encountered at shallow depths, it is recommended that the trench be cut into or through the pan and then the tile placed. Tile put upon hardpan will seldom function properly.

If the trench has been cut through clay or gumbo it is wise to bring the gravel or stone to the upper level of the subsoil; or in case the topsoil is also of impervious material, pockets of stone can be brought to the surface along the tile line.

The inlet end of the tile line must be carefully blocked with a flat stone or piece of steel to prevent soil or animals from entering. It is desirable to put gravel or crushed stone around the tile and above it to create an easier path for the water to enter the tile. Care must be taken in the backfilling so that the tiles are not shifted out of place, broken by stones, or the coverings over joints displaced.

If a backhoe, or other machinery is employed, a 12-inch bucket is ample. A greater width would require more soil than necessary to be removed, and a larger amount of stone needed for grading and backfilling. (See photo 6, page 46).

If the soil should contain clays or gumboes the placement of lines at a two-foot depth is good practice. Greater depths in clay soils have proved satisfactory but the results were not apparent for two or three years after installation.

In lighter soils there is practically no depth limit within reason. Three-foot depths have become rather standard because a title line can then take care of a greater space on either side of itself. (The depths referred to above are to the bottom of the tile).

LATERAL LINES

If the lateral line for any drainage system is 2,000 feet or less, four-inch tile can be used. After 3,000 feet of four-inch tile has emptied into the main, the size should be increased to six-inch tile and after 4,000 feet of four-inch and six-inch have been accumulated, increase the main to eight-inch tile. Increase the size of tile two inches for each 1,000 feet of smaller tile.

Laterals must be connected into the main line by means of catch-basins or by the use of manufactured connections or branches (Y's and T's); or if not available, the junction should be chipped and fitted and the connection sealed with mortar made in proportion to one part of cement to two and a half parts of sand.

Tiles should be kept as straight as the general directions of the trench permits, and bends should be made in smooth curves. Tiles should also be turned in order to fit snugly for joints on curves or in case tiles are slightly warped or have uneven ends. Any broken or cracked tile should not be used for this purpose.

JOINTS

Water enters only at the joints in drain tile and terra cotta tile; through the openings on perforated asbestos tile, and throughout the length of the tile in poroswall.

Continued on page 60

Drainage system

Continued from page 58

Any joints that have openings greater than the above permitted maximum, must be covered with broken tile, flat stones, or strips of heavy tarpaper. This will prevent the soil from dropping in and filling the tile.

Many times it is advisable to use sewer pipe or steel pipe with each joint cemented where there is excessively soft bottom; or when passing by a large tree; or for the last 10 to 20 feet at the outlet end.

Tile lines will improve with age. For once the air can work its way into the soil and consequently induce plant roots to go deeper, quicker drainage will result.

Spacing is important, and soil conditions determine this factor. The spacings can range from 150 feet to 200 feet for sandy soils to not over 30 feet for clay soils. Where funds are liminted and there may be doubt about spacing, it might be advisable to space the lines twice as far apart as it seems wise. If additional lines are needed, these can be installed later.

CATCH BASINS

To guard against lines silting up, catch basins are installed along long lines, every 200 to 250 feet. These should be large enough for easy cleaning and should have bottoms six inches to 18 inches below outlets. Thirty-inch sewer tiles or discarded 50-gallon drums with no bottoms, and holes cut in sides for inlet and outlet, and a cover are all that is needed.

Catch basins can be used for inspection pits. Periodic cleaning is essential, otherwise their purpose is defeated. Catch basins can also be used: where an important lateral connects into the main line; where several tile lines converge on a main line at one point; if the tile line changes direction abruptly; or where there is a sharp drop in grade.

Tile lines can become inoperative by failure to protect outlet; failure to clean the outlet at least annually; failure to check and clean catch basins; poorly made junctions; wide and unprotective joints; poor grading of trench bottom; poor surface inlets; sharp reduction in rate of slope; breakage by traffic of heavy equipment; and by tree roots entering and filling tile lines.

When completed, map your tile line so that you have a *permanent record*. Also, the use of a transit or farm level is of utmost importance. Every professional golf course superintendent should have one and use one.

Yes, your drainage system will work, providing you plan it carefully, install it properly and check it regularly. □

About the author—Sherwood A. Moore has served as director and secretary/treasurer on the Executive Committee of the GCSAA, and he was elected president in 1962.