| Materials | Tons | Carloads—50 Tons or Equivalent |
|---|---|---|
| Dynamite, Powder and Exploders | 20.24 | 2 |
| Manure | 1,204.27 | 24 |
| Fertilizer | 16.00 | 1 |
| Sand | 1,287.13 | 26 |
| Seed | 5.61 | 0 |
| Feed | 208.63 | 12 |
| Cement | 83.46 | 2 |
| Crushed Stone | 330.00 | 7 |
| Building Supplies | 76.00 | 2 |
| | Line. Ft. | |
| Gal. Iron Water Pipe (1" to 6") | 31,765 | 4 |
| 3-Ply Rubber Hose (1") | 11,400 | 0 |
| 4" T. C. Drain Tile | 10,000 | 1 |
| Wire Cable and Conduit | 19,626 | 0 |
| Fencing Wire | 6,435 | 0 |
| | Sq. Ft. | |
| Creeping Bent Stolons | 181,111 | 3 |
| Steel Reinforcing | 23,200 | 1 |
| Lumber | 37,620 | 2 |
| Roofing (all types) | 7,911 | 0 |
| | Gallons | |
| Gasoline and Oils | 12,082 | 1 |
| Paint | 373 | 0 |
| Tools, Equipment and Supplies | ..... | 1 |
| Boilers, Radiators, Engines | ..... | .. |
| Pumps and Fittings | ..... | 1 |

This would make a train nearly three-fourths of a mile long. Compared with the actual material handled, earth, rock, timber, topsoil, etc., however, it is a small item.

The whole job was done with local labor who displayed great interest in the progress of the work from start to finish. Its timely and successful completion, in view of the many hardships of the winter of 1923-24, was a tribute to their efforts.

## Seepage Water, A Menace to Good Turf Maintenance

By O. B. Fitts

One of the important drainage problems which is most frequently neglected in the construction of golf courses is that of properly taking care of seepage water from side hills. The writer has visited seven golf courses during the past season where his attention was called to poor drainage conditions on at least one green of each course, and in one instance a highly unsatisfactory fairway, resulting from seepage. Yet, in spite of the fact that all greens had been maintained in accordance with the same plan, on these courses, those which were not damaged by seepage water being in good condition, it was difficult to convince most of the greenkeepers that their trouble was due to seepage. This indicates that not only the constructor of each of these courses but also those in charge of maintenance had failed to appreciate the importance of intercepting seepage water and preventing its reaching the putting green or fairway.

Seepage problems are most frequently encountered on putting greens located on side hills, where, in order to get the desired grade, it has been necessary to cut into the slope, leaving a bank rising above the surface of the green, or on greens located on low, flat land near the base of slopes or hills. The trouble in both cases is caused by water

which has accumulated in the higher ground finding its way to the green, where it comes to the surface and keeps the soil in a more or less waterlogged condition, eventually resulting in a soil condition more or less toxic to grass. In other cases the soil becomes puddled by the trampling of players and workmen following a rainy period, when the soil finally dries out it is impervious to water applied on the surface. Either of these conditions is very undesirable, since the turf is unhealthy and the green too soft or too hard to provide a good putting surface.

In the case of hillside greens, seepage water may be easily diverted by cutting a ditch between the green and the higher ground. This depression should be cut between the green and all higher ground to a depth below the lowest level of the surface of the green. Care should be taken in the construction of this ditch to give enough fall to carry the surface water away freely.

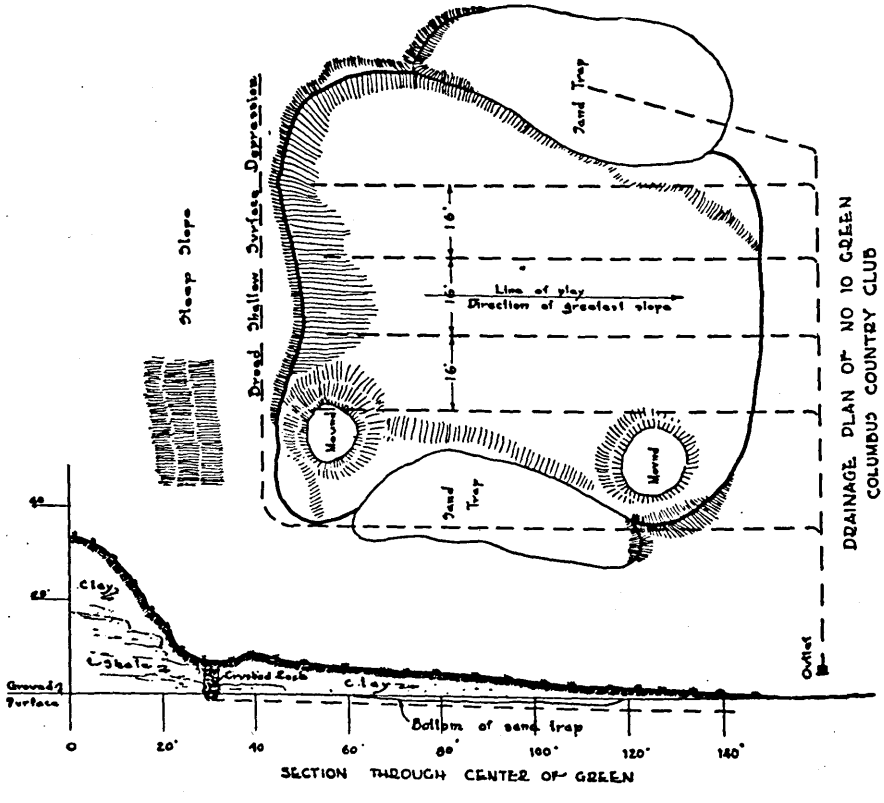
In some cases, where it is not necessary to cut quite deep in order to intercept the seepage water, it is advisable to leave the drain open and utilize it as a shallow sand trap or grassy hollow. In such cases the drain should be constructed to conform with the requirements of a trap, or grassy hollow, best suited to the architecture of the hole, as well as to properly intercept and carry off the seepage water. But if it is necessary to go deeper than is advisable for traps or grassy hollows, a narrow ditch or trench is sufficient. Tile should be laid in the bottom of the ditch and coarse material such as cinders or gravel used to fill it within 4 to 6 inches of the top. The remaining 4 to 6 inches should be filled in with good loam top soil that is sufficiently permeable to permit any water that accumulates on the surface to pass through to the drain. If the area is to be used as a sand trap, the coarse material should be covered with 3 or 4 inches of permeable soil and the sand placed on top of it. The soil in this case serves only to prevent the sand from filtering through the coarse material.

In the case of a green located at the foot of a hill, it may be found necessary to construct a ditch or hollow as described above and in addition install a system of tile under the green, for often the water which passes under the depression cut below the level of the green will rise to the surface, or near enough to the surface, to cause trouble. Where this condition exists it is advisable to install several lines of tile across the green parallel with the greatest slope of the surrounding ground. The tile should be placed 18 inches to 2 feet below the surface and the lines should be 10 to 15 feet apart. Each line should connect with a main leading to the outlet. The depth of the tile and the distance between the lines should be governed by the type of soil. In a clay soil the tile should be nearer the surface and the lines closer together than is necessary where the soil is sandy. In any event after laying the tile it is advisable to fill the trench to within 4 to 6 inches of the surface with coarse material as suggested above and then cover with permeable soil.

The accompanying illustration of the tenth green at the Columbus (Ohio) Country Club, shows a good system for such a green. One view gives an idea of the arrangement of tile in the traps and the green itself, while the other shows how the seepage is intercepted between the slope and the green. Before seepage from the slope was intercepted the green was soggy and the turf poor.

In many instances attempts have been made to intercept surface water by building an embankment between the green and the higher ground. Such attempts not only fail to better conditions so far as seepage is concerned, but make them worse unless care is taken to insure quick run off of surface water, for if drainage from behind the bank is slow the water confined there will seep through onto the green. It is often worth while to check the flow of surface water in this manner, thus preventing the carrying of weed seeds onto the putting surface, but quick run off must be assured, and it must not be forgotten that this is never a solution of the seepage water problem.

Danger of seepage should always be considered by the architect, or drainage engineer, during construction of the course. If this is not done the club may be put to needless expense later, and what is more serious in many cases, may be forced to use miserable greens until the cause of the trouble is recognized and corrected.




Really interesting three-shotters can be made on a straightaway level strip of land in just one way, and that is by placing a very wide bunker or a nest of smaller ones across the fairway in such a position that the second of two good shots will carry clear and the green will be out of reach for the man who plays short of the cross bunker on his second.