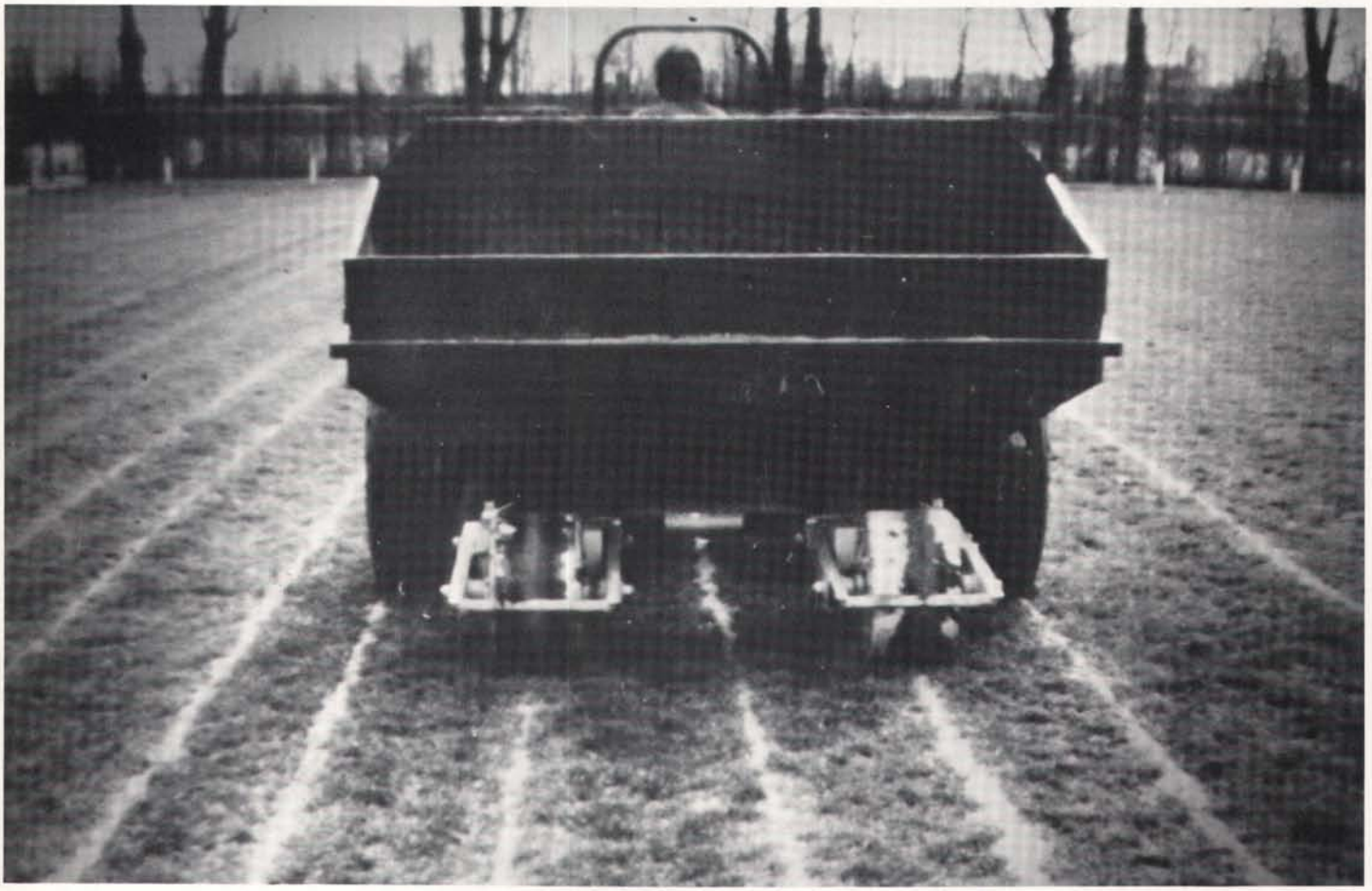
Sports Turf Drainage:

A Battle of Two Forces



Sand is injected into a British soccer field by a machine designed just for sand-slitting sports fields.

By John W. Moreland

When sports turf managers experience problems with insects, diseases, drought or winterkill, they may not realize these are often visible manifestations of poor drainage. The full impact of poor drainage on turf is not well documented, but few would argue that poor drainage is the number one problem of sports turf.

Drainage is a lot more complex than "water runs downhill." In soil, water moves according to two forces which often oppose each other. Gravity is the first force, the one that makes water go downhill. The force gravity exerts on water is dependent on the depth of sample. From this relatively simple concept of gravity we jump to the other, more complicated force called capillary attraction.

If gravity was not opposed by another force, soil would not retain water for plant use. The main factor in capillary attraction is the size of the pore spaces in the soil. Smaller pore spaces have stronger capillary attraction than large ones.

An easy way to illustrate the two forces is with a wash cloth. Water will move in a wash cloth in very much the same way that it does in soil.

First, thoroughly soak a wash cloth and hold it parallel to the floor. It remains wet and drips very little. The capillary attraction of the wash cloth is greater than the force of gravity on such a shallow sample. Now rotate the wash cloth 90 degrees so it's perpendicular to the floor. Water flows freely down the wash cloth. The top edge of the cloth is no longer as wet as the bottom.

Although the wash cloth has the same capillary attraction in both positions, the force of gravity has increased more than tenfold due to the increased depth of the sample. Gravity then exceeds the force of capillary attraction in the large pores of the cloth. The cloth remains wet because the force of gravity is not sufficient to pull the water out of the smaller pores.

These two forces working within the soil sample really determine how much water is removed from the turf. In most cases the permeability of the soil is the limiting factor, not the size of the drain pipe.

In fact, if the soil were absolutely uniform in permeability, water moving downward in the soil profile would not enter the pipe at all, it would be carried around the pipe by the capillary attraction of the soil.

Sports turf drainage is not the same as agricultural drainage. In agriculture, the cultivated surface soil is more permeable than the subsoil. French drains are very effective in these situations. A French drain is

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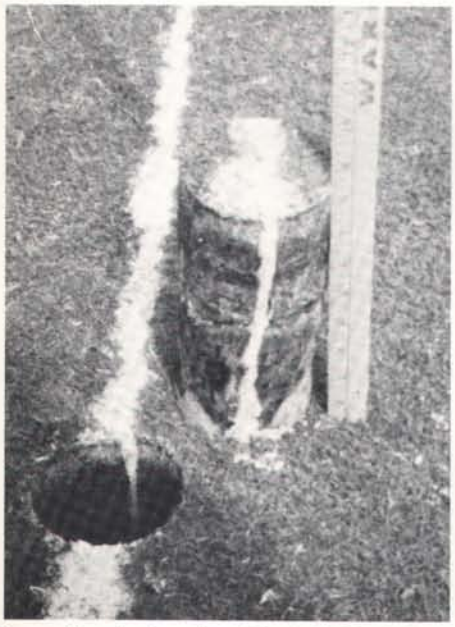
installed by trenching through the permeable topsoil and a foot into the impermeable subsoil (hardpan). A four-inch drain pipe is placed in the trench and backfilled with gravel up to the top of the subsoil. Topsoil is used to fill the trench the rest of the way to the surface.



Narrow bands of sand are injected eight inches deep into the soil in a crossing pattern.

The water moves through the highly permeable topsoil to the water table created by the less permeable subsoil (hardpan). The drains set in the subsoil carry the water away. In other words, the force of gravity is sufficient to move water through the highly permeable topsoil when it is saturated. As the topsoil dries, its capillary attraction increases and the rate of water removal decreases. When the capillary attraction becomes equal to the force of gravity, water stops moving and the drain ceases to function.

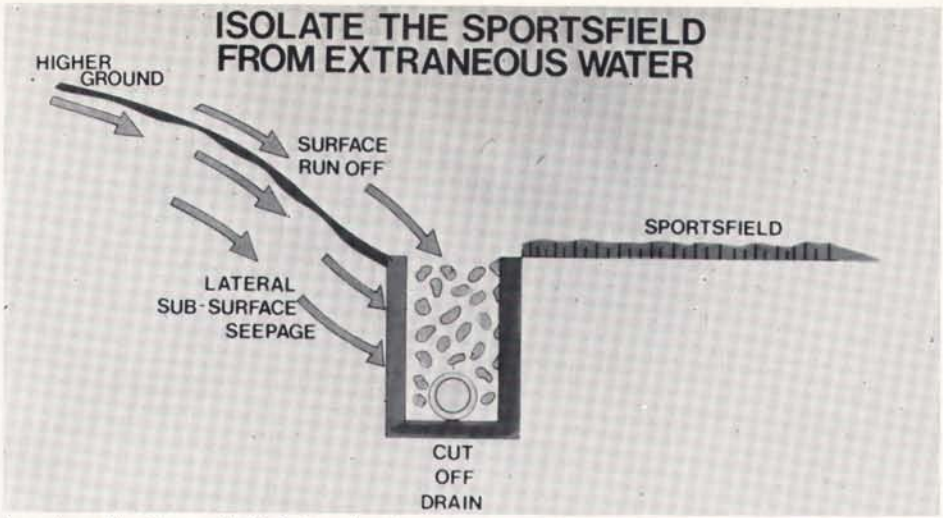
In sports turf the surface soil is usually compacted and less permeable than the subsoil. It is very difficult for water to move through the top few inches of soil to the more permeable subsoil. Player damage to turf is severe when the surface soil is compacted and saturated with water. When the water finally does make it through the topsoil, it moves downward at a faster rate. Under these circumstances, a conventional French drain is ineffective.

Agricultural drainage systems are inadequate for sports fields. Additional control over soil moisture is required to assure a durable surface that resists compaction and damage to turf. This control has been achieved by reconstructing fields to place a sand rootzone over a gravel blanket on top of the subsoil. Properly sized sand will not compact and will remain highly permeable. French drains would then be effective when installed into the top of the subsoil. This provides outstanding results. But, such construction is expensive and requires the use of three to four thousand tons of sand and a large amount of gravel.

Sports turf drainage is not the same as agricultural drainage. Topsoil in agriculture is cultivated and highly permeable. Topsoil in sports turf is often compacted and impermeable.

Unfortunately, such reconstruction is not always practical. The Cambridge system was designed as a solution to poor drainage when total reconstruction is impractical. It avoids much of the expense of reconstruction by utilizing a grid of perforated pipes in narrow sand-filled trenches in conjunction with sand topdressing.

The system puts the forces of gravity and capillary attraction to work in harmony. The



trenches, like the wash cloth hanging down, use gravity to move the water downward in the trench. Sand at the top of the trench becomes drier than the adjacent sand topdressing. The drier sand uses capillary attraction to draw water like a blotter from the topdressing to the trenches. The sand in the trenches also draws water from the surrounding saturated soil.

The area impacted by the blotting action of the sand is proportional to the depth of the trench. Deepening a trench increases the pull of gravity (hydraulic head) increasing the effectiveness of drying the sand in the trench. Therefore the trenches should be as deep as convenient.

The closer together the trenches are, the faster the field will dry and the more uniform surface moisture will be. Experience has taught us the depth of the topdressing depends primarily on the spacing of the trenches. Our standard design uses one inch of sand topdressing.

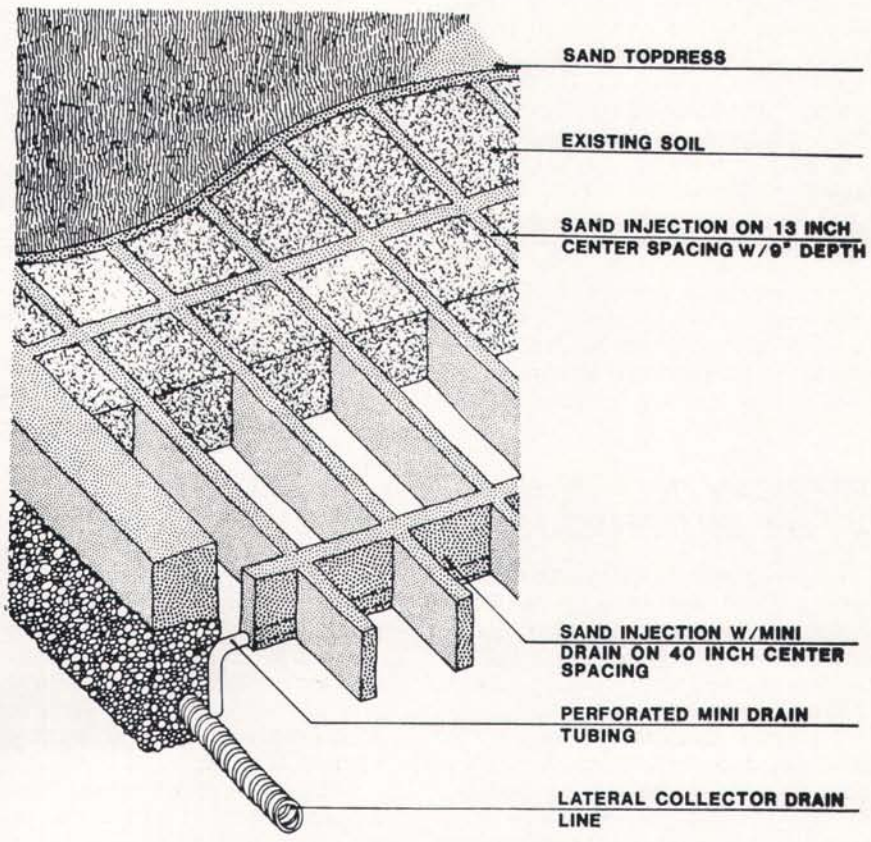
To keep disturbance of existing turf to a minimum, a narrow trench is preferable to a wider, conventional trench. This required development of equipment to cut a narrow trench. At the same time, it was decided to incorporate a pipe installer and automatic sand backfiller with the trencher. With this equipment, our company digs trenches 3/4-inch wide, nine inches deep. A Mini-Drain pipe is installed into the trench perforated-side-up. The narrow trench is simultaneously backfilled to the surface with sand.

Drains are normally placed on 40-inch centers. Crossing sand slits without drain pipe can be added on 13-inch centers to further improve drainage.

The drainage system is completed by topdressing four times with 1/4-inch of sand for a total of one inch. A drop of water falling midway between sand slits has to travel less than seven inches to reach a drainage trench.

Installations of our system can be seen at the Orange Bowl in Miami, FL; the Atlanta Country Club, Atlanta, GA; the Houston Astros spring training center in Kissimmee, FL, and Cominsky Park in Chicago, IL. We are currently installing a system on a golf course in Memphis, TN, with the goal of eighteen holes in eighteen days.

The installation of a Cambridge drainage system has little effect on subsequent maintenance. The only change would be topdressing the field each year with 1/4-inch of the same sand used in the slits.



SAND INJECTION & DRAINLINE CUTAWAY

Gravity and capillary attraction really determine how much water is removed from sports turf, not the size of drain pipe.

During irrigation, the topsoil absorbs water from the sand topdressing and the soil lining the nine-inch-deep trenches. All excess water is removed by the Mini-Drains. Surface runoff and puddling are eliminated so fertilizers and chemicals stay in place.

Soil has greater capillary attraction than sand so the sand in the trenches acts as a reservoir for moisture after irrigation. If the field has been watered recently and the turf over the trenches appears darker than the surrounding turf, an application of fertilizer is needed.

Since wet sand holds together better than dry sand, we recommend irrigating with 1/4-inch of water on game days. This will provide firmer footing and the best playing conditions. ▶

EDITOR'S NOTE: John Moreland is president, Cambridge Soil Services of America, Inc., Glencoe, AL.