A Comparison of Water Drainage and Storage in Putting Greens Built Using Airfield Systems and USGA Methods of Construction

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Objectives:

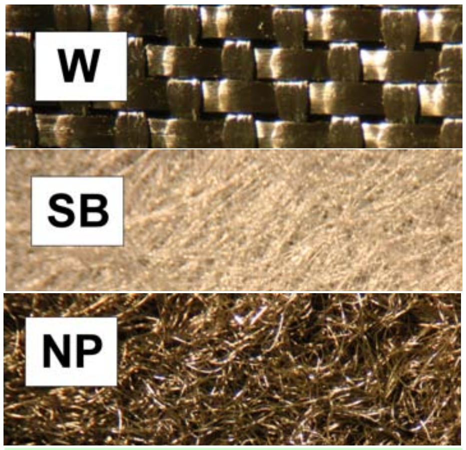
1. Investigate potential for clogging of geotextile pores from fines migrating out of the rootzone mixture
2. Investigate the changes in the temporal distribution of drainage and spatial distribution of water holding capacity of a green constructed with a geotextile compared to a green constructed with gravel.
3. Investigate construction methods designed to reduce down-slope movement of water in sloping greens.
4. Develop criteria for selecting appropriate rootzone mixtures for putting greens constructed with geotextiles.

Start Date: 2007
Project Duration: three years
Total Funding: $90,000

This research investigates the dynamics of water movement through, and storage within, the rootzone of putting greens constructed using a geotextile atop a plastic support acting as the drainage structure (Airfield Systems' design) compared to the same dynamics and storage in a green constructed with a gavel-based drainage structure (standard USGA design). The research is a collaborative effort between Texas A&M University (College Station), Airfield Systems (Edmond, OK), and the USGA.

Sand-based rootzone mixture over gravel drainage is the standard design for putting green construction. Sand-based rootzone mixtures placed over gravel hold water at the rootzone-gravel interface at tensions between 0 and 100 mm water when watered to such a degree that drainage occurs. The Airfield Systems' design replaces the gravel with a geotextile atop a 25-mm deep porous plastic support for drainage. The range of tensions at the rootzone-drainage structure in the Airfield Systems' design is limited to between 0 and 25 mm water after drainage. We have verified these expected differences in tension and water holding capacity when using the same rootzone mixture with the two methods of construction.

Four studies have been initiated to address the objectives. To investigate clogging of geotextiles by rootzone fines, permeameters were constructed from 150-mm inner diameter by 350-mm tall PVC pipe. Each permeameter is being filled with 300-mm deep rootzone mixture over a geotextile supported on a 25-mm deep plastic geogrid (Airfield Systems' AirDrain). Ten geotextiles are being evaluated: two woven, three spunbond, five needle punched. The woven materials are WM104F (Propex) and FW404 (Tencate). The spunbond fabrics are Typar 3301L and 3341G (Fiberweb), and Lutradur 130g (Freudenberg). The needle punched materials are NW351, NW401, and NW1001 (Propex), and NW10 and NW16 (GSE). Apparent opening size (AOS) of the ten geotextiles are 212, 425, 300, 250, 122, 300, 212, 150, 150, 150 micrometers, respectively.



Geotextiles types being investigated: woven (W), spunbond (SB), needle punched (NP). Horizontal scale is approximately 12 mm side-to-side (0.5 inch).

Six rootzone mixtures with differing distributions of fines are being created by blending three materials with differing particle size distributions. Each geotextile will be combined and tested with all six rootzone mixtures. Clogging will be evaluated by observing changes in whole-system permeability. Changes in whole-system permeability will be assessed by measuring the temporal distributions of drainage rates from simulated rainfall events applied at durations and intensities typical of natural storm events. Fines passing through the geotextiles will be collected and analyzed for particle size distribution.

To address Objective 2, 380-mm inner diameter test cells are being fabricated from PVC pipe. Treatments in the test cylinders will include four rootzone mixtures with different particle size distribution combined with three geotextiles (over AirDrain) and two gravels with different particle size distributions. Tensiometers will be placed at the interface of the rootzone mixture and the drainage structure. To monitor rootzone water content, time domain reflectometry (TDR) probes will be inserted into the rootzone through the test cell wall. Drainage rate will be recorded with an electronic balance to determine inflow-outflow characteristics. The test cells will be planted with 'Tifway' bermudagrass and the experiments will run for two years.

For Objective 3, a 3-m long by 0.5-m wide by 34-cm deep box has been fabricated such that the slope may be varied. In the test box, the temporal and spatial distribution of drainage and rootzone water content and tension will be measured with TDR and tensiometers. A mathematical model will be used to optimize the size and spatial distribution of subsurface structures if they prove useful.

Summary Points

- This project will provide data comparing the hydraulic performance of Airfield Systems greens using various combinations of rootzone mixtures and geotextiles with the performance of standard USGA designed greens using various rootzone mixtures and gravels.
- The project will assess the degree of lateral movement of water in sloping greens constructed with the Airfield Systems design compared to the same with the USGA design.
- Data will be collected showing the effectiveness of subsurface structures designed to minimize down-slope movement of water and for choosing appropriate rootzone mixtures for greens constructed with geotextiles compared to established criteria for gravel-based greens.