

Investigating Water Movement in a Sloped Green

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The United States Golf Association (USGA) introduced guidelines for constructing putting greens over thirty years ago and since then the USGA green has become the standard for golf course putting greens. The concept behind the USGA recommendations for putting green construction is to build a green that provides a measure of resistance to compaction in the rooting zone and drains quickly to an optimum soil moisture level. In a world of flat greens there is little doubt that most, if not all, USGA greens would perform well. However with the slopes present on putting greens today, the USGA greens do not always perform ideally. Two problems that have commonly been encountered on greens are “Localized Dry Spot” (LDS) and “Black Layer”. These problems are primarily associated with extremes in soil moisture in the rootzone of the green.

LDS is a problem characterized by irregularly shaped areas of stressed turf that often occur on the high areas of greens. The mechanism behind LDS development is not completely understood but research has shown that hydrophobic, water resistant, coating of sand particles in the rootzone is primarily responsible and that complete drying of the surface inch of the soil profile accelerates the occurrence of these organic coatings. LDS essentially stresses the turf by making water unavailable to the plant.

Black Layer is the black banding of the rootzone in sand based putting greens and is also related to soil moisture. Similar to LDS, the mechanism behind Black Layer development is not completely understood but there are several ideas on the cause. Metal sulfides produced by sulfur reducing bacteria result in the blackening of the soil. Turfgrass decline associated with Black Layer could be the result of competition for water and nutrients or from the production of toxic hydrogen sulfide gas from the organisms in the black layer. Although several possibilities exist for the decline of the turfgrass, one constant in Black Layer development is the presence of excessive soil moisture in the rootzone.

Specifications for the rootzone mix of USGA putting greens require the sand mixture to be placed at a uniform depth of 12” across the entire surface of the green. The 12” depth is designed to increase the amount of water held in the rootzone, while avoiding complete saturation of the rootzone following irrigation. On a flat green this system works well but on a sloped green later water flow can cause the high areas to become dry and the low areas wet, potentially leading to turfgrass decline. In 1998 a sloped USGA putting green was constructed at the Hancock Turfgrass Research Center to examine the effects of different rootzone materials (sand, sand/peat mix, and sand/soil mix) and different rootzone depths on the water movement in sloping and flat areas of the green. Three

plots (one of each rootzone type) were constructed with a uniform rootzone mix of 12" depth and three were constructed with a rootzone mix varying from 8" at higher elevations to 16" at lower elevations. The hypothesis is that altering the rootzone depth, decreasing it in high areas and increasing it in low areas, will increase the water content near the surface in the high areas and decrease the water content near the surface in the low areas. The green has been instrumented with 120 Time Domain Reflectometry (TDR) probes to measure soil moisture throughout the soil profile and tipping buckets have now been installed to measure drainage losses from the green.

This research has the potential to revolutionize the construction methods of sand based putting greens in order to minimize water-related problems such as LDS and Black Layer commonly associated with sloped putting greens.

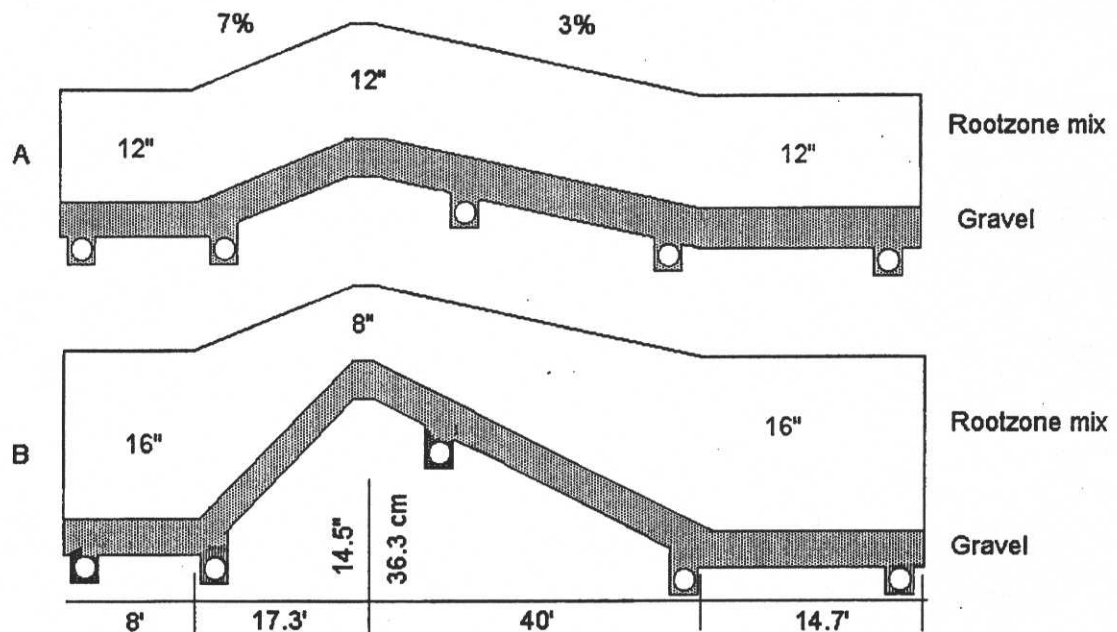


Figure 1. Cross section of the two construction methods (uniform depth [A] vs. variable depth [B])

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