

Capillary Drainage

Luke Cella, MAGCS

Just about every golf course superintendent that I know is either an efficiency freak or has someone on their staff that is always looking for new ways to solve problems, do things better, or use new methods. It is the reason that you can walk into a room of nine superintendents and share a problem at your facility and you'll walk out with nine successful ways to solve the hitch in your giddy-up.

In the past few years, several golf course superintendents have taken a new approach to removing subsurface water from their putting greens and other fine turf areas using a system that pulls water out through capillary action.

Capillary action is important for moving water on earth. It is defined as the movement of water within the spaces of a porous material due to the forces of adhesion, cohesion, and surface tension. (water.usgs.gov)



Capillary action at work – water is drawn from the tubs of water on the counter up and over each tub and eventually ends up in the bucket on the ground because the adhesive properties of water.

Capillary action occurs because water is sticky, thanks to the forces of cohesion (water molecules like to stay close together) and adhesion (water molecules are attracted and stick to other substances). Adhesion of water to the walls of a vessel will cause an upward force on the liquid at the edges and result in a meniscus which turns upward. Surface tension acts to hold top layer intact. Capillary action occurs when the adhesion to the walls is stronger than the cohesive forces between the liquid molecules. The height

to which capillary action will take water in a uniform circular tube is limited by surface tension and, of course, gravity. That's when water is moving upward in a column or if you remember from plant physiology the movement of water and nutrients upward in plant tissue.

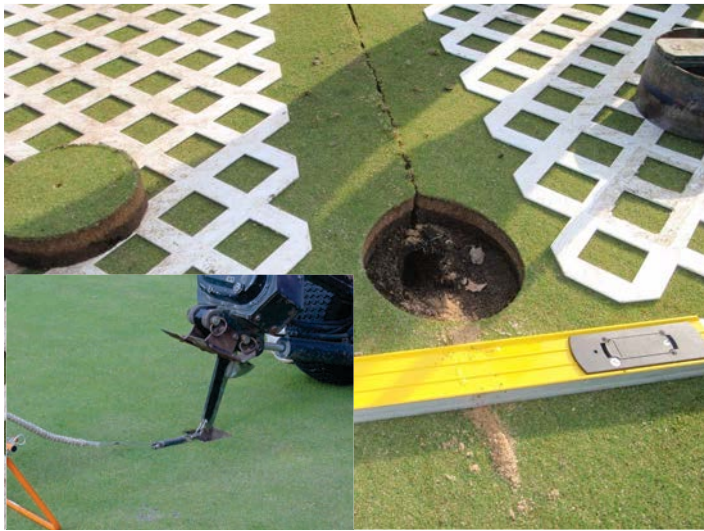


The PC element is a stainless steel mesh tube shrouded by woven fiberglass.

Not only does water tend to stick together in a drop, it sticks to glass, cloth, organic tissues, soil, and, luckily, to the fibers in a paper towel. This sticking action of adhesion is the principle that helps this new product to overcome problems in our putting greens; specifically perched water tables where layering is a problem.

Layering often occurs in our putting greens from topdressing with sandy mixes over finer textured native soils, topdressing with inconsistencies in sand particle size over long periods of time, or even through design (USGA con-

struction method – sandy root zone mix over a gravel bed). When layering occurs between two distinct and differing soil textures a boundary between the two occurs. The boundary is



A plug is pulled when starting with the vibratory plow on the putting surface.

created by the physical differences between the two, and the problem it causes with water movement is from the difference in pore sizes in the overall soil profile. Excess water may sit above the boundary and be perched above the layer interface. If this layer is near the putting green surface, the surface can be considered “wet” – a problem for growth and play.

This new system was designed to pull the water out of that perched table – using some gravity but also using the same cohesion and adhesion forces that keep the water tied to the soil profile in the first place. It does this by decreasing the texture difference between layers by having a very similar texture as the sandy root zone – moving the water off the perch and into an outlet. The process is known as passive capillary drainage or PC Drainage.

The material used to create the capillary action is a woven fiberglass rope, a material that has the permeability similar to fine gravel. The fiberglass creates a continuum of water attracting pores from the perched root zone to the outlet. It is wrapped around a stainless steel mesh core that helps to move greater amounts of water when the soil is at or above field capacity.

A number of area golf course superintendents have had this system installed to alleviate different circumstances where excess water is problematic inhibiting plant growth and impacting playability.

One of the first clubs to install the system was Midlothian Country Club. I recently ran into Dave Behrman, CGCS the Superintendent that decided to give it a try. Dave was very pleased with the system, installing it in most of the greens at the time.

“It definitely pulled water from the root zone of the greens at Midlothian and continues to do so,” Dave said. “We all know how important it is to be able to remove water, especially from our putting surfaces when we are trying to grow healthy turf and dry things down,” he continued.

Luke Strojny, CGCS experimented with the system in 2012 by having it installed in one green at Prairie Bluff Golf Club. He followed that installation with several more greens in 2013 and most recently two more this spring. He really likes how little the putting surface is disrupted and how quickly the greens are ready for play. The trouble greens are 15-year old California sand based that have black layering and poor drainage.

While the most tedious part of the install was connecting it to the existing tile, Luke feels it is all worth it. His “test” green (the one where it was first installed) was his worst green on the course in 2011 and now it is one of his best.

“The front of the green dries out and there is no turf loss,” Strojny said.

Ben Kelnhofner at Mistwood Golf Club too has roughly the same age California greens and put the system in to alleviate problematic areas in a few greens. “We had the system installed in site-specific areas where we were experiencing problems, not the whole green.” For some, this has been the beauty of this procedure: only installing the system in troubled areas.

As long as I’ve known Dan Dinelli, CGCS he’s been trying to get the water out of his native push up greens at North Shore Country Club. Dan has tried the system in a one of his putting greens and a few approaches as well.

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A vibratory plow is used to install the drainage element into the soil with minimal disruption to the surface.

"The ropes do drip water when the soil is wet, helping to dry the root zone," Dan explained.

Dan plans to push the envelope even further this year overlaying the PC system on top of an existing an XGD system (more traditional - gravitational based drainage system) in hopes of enhancing drainage from his pushup green.



The discharge end of the PC Drainage is hooked up into existing or new conventional drain lines.

"I want to test it for myself to see how well it works in other areas because it is very quick and easy to install," Dan went on to say. He's even planning to install the system in a troublesome bunker that is heavily shaded with no air movement to see if it will help to get the sand to dry out.

Jeff VerCautren has been using the system since 2009 in approaches and areas surrounding his greens with his latest install in the fall of 2013.

"The initial install site is still working and meeting my expectations, that is why I keep adding a few areas every year." Speaking of the original area, Jeff explained, "we couldn't even mow that approach in the morning after running a light set of irrigation the prior evening until we installed PC there. Now we mow that area in the mornings as part of our normal rotation and schedule."

What attracted Jeff to the system was the ability of the system to draw water up and out of problematic areas. Jeff wants to keep the sand channels open to the rope and schedules two aerifications and topdressings to those areas each year.

Mark Kosbab of Sportsman's County Club regrassed the native push-up greens with A4 in 2005/6. Two of the greens with low spots struggled for several years after the grass conversion. Mark noticed the grass really seemed to weaken after periods of rainfall and excessive moisture. After the July 23, 2011 storm that dumped 8" of rain overnight, Mark needed to take action on these greens to get rid of the ponding water that was impacting the turf quality. Once Mark was able to

nurse the greens back to health, he had PC Drainage installed in the whole first green and a partial install of the second.

Mark does not worry about surface drainage on those two greens anymore. PC Drainage has alleviated the "bird baths" that used to form after rainfalls. "We are seeing a dramatic difference in the quality of turf due to the ability to remove water more quickly. I have noticed that it works very well removing the surface water from the green. In the past, puddles would form and take at least a day to go down. Now, the puddles drain quickly and I no longer worry about surface drainage on those two greens."

Mark does see a difference in the amount of water these



This is a drawing from North Shore's 13th green that shows the PC element (blue lines) and where it will connect to the existing drainline (red line).

two greens hold after a rainfall event, noting the first green is a little wetter than the second. He attributes this difference in the soil texture between the two, citing much more clay content in the first green.

Each superintendent has found success with this new system. Whether they are using it in newer putting greens, native push-ups or high impact areas, all have expressed positive sentiments about the system. Overall, they've been happy with the installation process, minimizing the impact to play and restoring their putting surfaces quickly. After the areas are selected and mapped for installation, a vibrating plow is used to pull the rope into the green. The channels created by the plow are backfilled with sand during the process, the channels are rolled and the turf begins to heal. The ropes are then connected to a drain tile (usually off the green) and installation is complete. On average, it takes about a day to install the system on an average size putting green with play being restored the next day or as soon as the work is done.

The superintendents polled explained that the most labor intensive part of the process was "hooking up" the system to existing drain tile or installing a new drain line off

the green to complete the system. After having an outside contractor (Hollembeak Construction) install the drainage component in the green or approach most clubs completed the hook up to existing tile in-house.



A little rolling over the slits from the plow and the area is ready for play.

The other question that all seem to ask is how long will the system work? Stainless steel and fiberglass will last hundreds of years in a landfill, so there is little worry about deterioration of the physical components. Sedimentation can compromise any drainage system by fines clogging pore space. It is believed movement of fines in this system is minimal because of the installation method, (little disruption of the soil profile) the low velocity of water flow through the system, and by the product having a similar texture to the sandy rootzone. Time will tell as more courses install this system to help them grow better turf today using an application of an old principle of nature. ©

Images: Dan Dinelli, CGCS, Dave Marquardt, Dr. Ed McCoy

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