Frilford Heath GC

Blinded by science?

If you're rebuilding a putting green to a USGA spec you need to be aware of the various specifications – here Andy Stanger and Stephen Prinn discuss the pros and cons of using the intermediate 'blinding' layer

Despite the USGA's restrictive specifications for putting green construction, golf course managers are presented with a multitude of choices when faced with the task of building new putting surfaces.

The decision to eliminate the coarse sand intermediate layer is often made to reduce construction costs, but the long-term cost of its exclusion must be fully understood before such a decision is made.

The rapid growth in demand for golf after World War II quickly identified a weakness in the construction methods of the time as surfaces were failing under the increased amounts of play.

As a result, the USGA commissioned several research projects in the 1950's to identify the most successful rootzone mixture for putting green construction, which subsequently led to the first putting green specification being published in 1960. (Fig. 1)

The specification required the intermediate layer to be 35-50mm thick and contain sand particles that were at least 1mm in diameter or greater.

A particle size contrast ratio for the sand and gravel was recommended at this stage but it was made purely on the grounds of preventing particle migration, no perched water table or water retention properties were mentioned at this time.

The difficulty of sourcing such material, sieving costs and installation time quickly lead to this layer being recognised as a very costly element of the specification and

A soil modification procedure for greens involving a perched water table

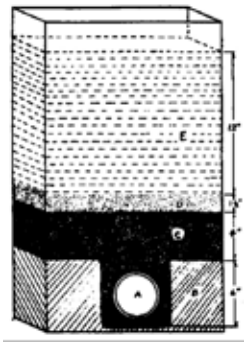

Fig.1, 1960 USGA Construction Specification Profile (USGA Greens Section Staff, 1960)

the necessity of its inclusion was brought into question.

Accepting that the blinding layers had a role in preventing particle migration, the focus of several studies in the 1960's found its ability to increase the water holding capacity of the overlying rootzone material through the creation of a 'perched water table', although the USGA had not listed this as a reason for its inclusion. Humel (1993) cites that and Miller and Bunger, (1963), observed increased water retention in the overlying soil when placed over a either a sand layer or gravel layer and that having any coarse textured layer within the profile will result in a 'perched water table', increasing the soil water retention of the entire profile.

As the USGA had never listed water retention as a feature for its inclusion, the coarse sand layer remained in the second edition of the specification published in 1973, on the original grounds of its role in preventing particle migration and insisted that absence of an intermediate layer meant the green would not qualify as a USGA green.

The focus of study then reverted back to the original claims to ascertain whether the intermediate layer actually did prevent particle migration. Brown and Duble (1975), Johns (1976) and Brown et al. (1980) all found particle migration into the gravel layer to be minimal in the absence of an intermediate layer, (Fig.3).

These studies alluded to the fact that a 'proper sized gravel' must be used in order to prevent particle migration and suggested that pre-

Fig.2: Time consuming installation of a course sand intermediate layer (Hummel, 1993)

vious construction failures in the absence of an intermediate layer may have been due to mistakes being made during the construction process itself.

Brown et al. (1980) also incidentally identify the turfgrass roots as being instrumental in binding rootzone mixture materials and contributing to a lack of particle migration.

Despite the fact that the research conducted over the last two decades dispelled the idea that an intermediate layer was necessary to improve moisture retention and prevent particle migration, albeit with suitable chosen materials, the USGA included it again in their third edition published in 1989. This was the first occasion that the intermediate layer was listed as an integral part of the perched water table concept.

However; by this time it was common knowledge that hundreds, possibly thousands, of putting greens had already been installed without an intermediate layer (Hummel, 1993).

Many of these greens had proved to be successful though in some cases, greens had failed within the first two years of construction due to particle migration and drainage failure. As the exclusion of the intermediate layer from construction was likely to continue, it was suggested that the USGA should provide a specification for greens that did not intend to include one.

The USGA published its fourth edition of the specification in 1993 with the express aim of making putting green construction more affordable.

This was the first specification to offer an option to omit the intermediate layer from the construction process and the first time the term 'bridging' was used to describe the prevention of particle migration in the absence of the intermediate layer.

This alteration was later described by Jim Moore, the USGA's director of construction education as, "The biggest change the USGA had ever made to its guidelines", (Willnerd, 2005).

This change, however, came with a very clear caveat, "Strict adherence to these criteria is imperative; failure to follow these guidelines could result in greens failure."

Following publication of the fourth edition, previous studies, conducted in the 60's and 70's, were replicated using the most modern specifications for rootzone material to allow a true comparison to be made between two and three layer construction methods.

All found that the absence of the intermediate layer significantly increased the moisture content and decreased the air filled porosity levels within the overlying rootzone, Taylor et al. (1994), Snyder and Cisar (1997) and Baker and Binns (2001 a,b). In addition, two studies also tried to quantify and value the additional water held in the rootzone in the absence of an intermediate layer.

Both studies explained how the additional water held would allow the turf manager to delay irrigation by one or two days in temperate climates but suggested that this would probably not be of significant agronomic importance, Taylor et al. (1994), Baker and Binns (2001 a,b).

The USGA's most recent edition published in 2004 has continued with the option to omit the intermediate layer and broadened some of the particle size ranges in all categories of the construction materials as a result of further research funded by the USGA in a bid to make construction more affordable.

The evolution of the USGA putting green construction method has undergone intense scrutiny and rigorous testing since it was introduced in 1960.

The USGA may have revised its specification to allow the absence of an intermediate layer but that in turn has presented the turf manager with two methods of construction and offers no bias toward either method.

Table 1 (Advantages and disadvantages of the intermediate layer) highlights desirable characteristics that would support the decision to select either form of construction method. The presence of a coarse sand intermediate layer would provide the turf manager with a free draining rootzone that if built

Table 1: Advantages and disadvantages of the intermediate layer

USGA Specification	Putting Green
Intermediate Layer	**No Intermediate Layer**
Advantages • Reduced moisture retention • Improved air filled porosity • Insurance against particle migration	• Reduced construction costs • Shorter construction period • Increased moisture retention • Available water held in closer proximity to the roots • Reduced irrigation demands
Disadvantages • Increased construction costs • Higher irrigation demands • Lower water retention around root proximity	• Longer construction period • Reduced air filled porosity • High risk potential for particle migration if improperly constructed

correctly would provide a layer of insurance and safe guard against particle migration and ultimately drainage failure.

The decision to opt for the reduced moisture retention within the profile may appeal to some turf managers in order to reduce the likelihood of fungal disease outbreaks.

However, it could be argued that the evapotranspiration rates (ET) used to equate this water to practical use are theoretical maximums and that under average ET conditions in temperate climates, with appropriate crop coefficients applied, this additional water could potentially provide sufficient water for grass growth for perhaps three or four days.

With increasing water usage restrictions and rising water costs, this attribute of a putting green without an intermediate layer could be an extremely desirable characteristic to the turf manager.

The weight of evidence would suggest that a putting green will cost less to build and cost less to maintain after installation if the intermediate layer is left out of the construction process.

This appears to be a very easy decision to make except for one overriding factor, the cost of getting it wrong.

If mistakes are made when selecting the construction materials or during the construction process, the green will undoubtedly fail and eliminate all the short and long term cost savings made by omitting the intermediate layer.

Whilst cost is an important factor in the decision process it should not be the only one that influences the decision to leave out the intermediate layer.

Fig.3: The absence of an intermediate layer showed minimal particle migration into the gravel carpet (Brown et al, 1980)

Geographical location, availability of materials, irrigation capabilities and contractor experience should all be considered before selecting the most suitable and appropriate method of construction to suit the needs of each individual situation.

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