REBUILDING Golf Greens

By Steve Isaac, Senior Turfgrass Agronomist, STRI Scotland

Why rebuild?

Most courses have a few greens that perform badly compared to the others, usually in relation to drainage and winter playability. With the increasing demand for year-round play and the uncertainty over climate change, though it does seem to be getting wetter, the need to rebuild inferior greens is greater than ever.

The latest weather data from the Climatic Research Unit and the Hadley Centre demonstrates that the climate has changed due to the inevitable effects of global warming. The data shows that total annual rainfall has increased but, more importantly, the amount of precipitation during the winter months has increased hugely (see figure 1).

Further analysis shows autumn rainfall has increased hugely, compared to the total amount of rain during August, in the past ten years. During the period 1961-1991, the percentage difference in September and October rainfall compared to August rainfall was 2% and 12% respectively. In the past ten years the difference has increased to a staggering 23% and 28% respectively, essentially meaning our autumns are much wetter than they ever used to be. This has major implications of year-round playability of golf greens and our ability to work on them to increase winter usage.

There are plenty of options to try before resorting to reconstruction, but when years of Verti-Draining, Drill & Fill or drainage options such as Fin Drains and gravel banding have failed to provide a permanent solution, reconstruction is the final answer. Whenever the subject of rebuilding a green is raised during an advisory visit, we usually get one of five responses:

- The members will not accept the disruption.
- The Club can't afford it.
- A new green will play in a wholly different way to the others on the course.
- We've tried it before and it failed miserably.
- Yeah! Let's go for it!

Whilst the last response is always the one we hope to get, there is a good answer to all of the others.

How much disruption are members prepared to put up with? If a green is a candidate for reconstruction then it probably takes little, if any, winter play and is slow to develop in the spring. It may be one of the better greens through the summer, wet greens usually perform well when it's dry, but 3 months of decent quality on an annual basis is not generally acceptable these days. If a rebuild is planned properly,

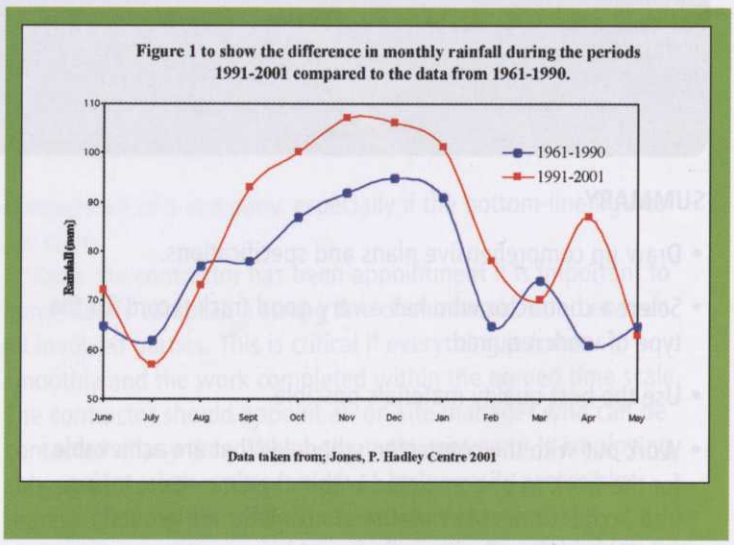


FIGURE 2

the green may be out of commission for 6-7 months for just 1 year, and this assumes that it is going on the same site as the existing surface.

Cost is a factor. If you employ a contractor you could be looking at a figure of £35,000 for a new green and surrounds. However, we have seen in-house builds of quality being produced for as little as £12,000 (materials only).

A new surface can react differently to a mature one. The most frequent comment is that the new green is much firmer and less receptive to an approach shot. In some respects this is exactly what reconstruction is about, producing drier and firmer greens that will take winter play. This potential problem can be overcome by turfing rather than seeding and by relaying the original turf, which restores a surface that is likely to be far more compatible with the others on the course than might be the case if imported turf was used.

If you have a rebuilt green on your course that performs just as badly, perhaps worse, than it's predecessor then it is probably due either to the use of poor construction technique, bad materials or inappropriate grow-in maintenance. To achieve a quality finished product you have to follow accepted guidelines and this includes quality materials and a greenkeeper who appreciates the difference between managing a new green and the mature ones on the golf course.

HOW TO GUARANTEE SUCCESS

There is plenty of science in golf green construction. Indeed, there has been for over 30 years. This is how long the USGA recommendations for golf green construction have been around. The USGA Spec – as it is commonly known – has been much maligned over the years. Many so-called USGA greens have failed but, in my experience, this is because they are **not** USGA greens. Often they do not conform to the basic profile or the materials used do not comply with the stringent laboratory testing required or they are managed in an inappropriate fashion. If you follow USGA guidelines you will produce a green that will drain well and ease grass maintenance, enabling the development of a quality, year-round (frost and snow permitting) putting surface.

The USGA green profile is, basically, layers of free-draining materials built up over a pipe drainage scheme. Figure 2 (page 24) shows this profile for the two variations of the recommendations that are currently available.

The laboratory testing of the gravel, blinding (if used) and rootzone is critical to the success of the construction. All selected materials must conform to specific requirements and, if the blinding is omitted, the gravel and rootzone must be proven to be compatible.

THE GRAVEL CARPET

When the blinding layer is used, the gravel must have the following properties:

- Not more than 10% of its particles in greater than 12 mm diameter.
- At least 65% of particles between 6 mm and 9 mm
- Not more than 10% of its particles less than 2 mm

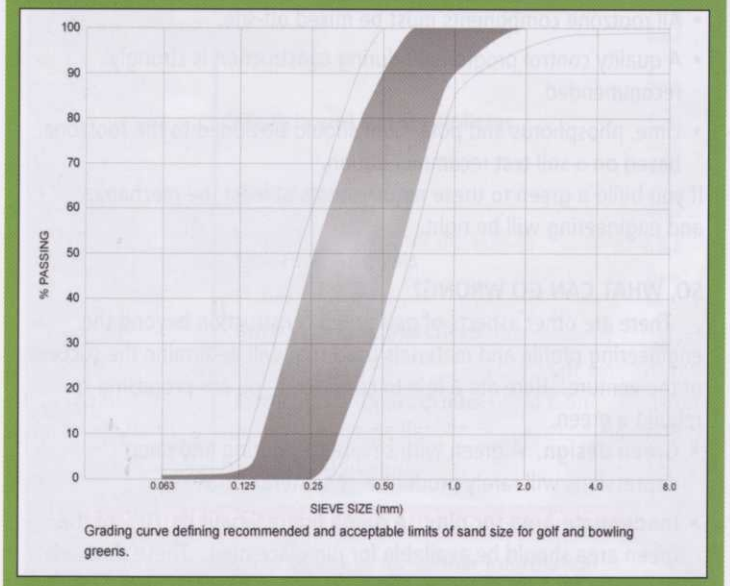
And the blinding material must have at least 90% of particles between 1 mm and 4 mm.

If the blinding is omitted the spec for the gravel is tighter:

- No particles greater than 12 mm.
- Not more than 10% less than 2 mm.
- Not more than 5% less than 1 mm.

In addition, the gravel has to comply with a Uniformity Factor that puts a strict limit on the range of its particle sizes, often eliminating gravels that do not fit a tight 2 mm to 6 mm grade. The gravel is then tested against the rootzone to ensure that there will be no migration, with subsequent contamination, of the rootzone into the gravel (the Bridging Factor) and also to ensure that water will move readily from the upper rootzone into the gravel (the Permeability Factor). These factors are calculated from grading curves of the gravel and rootzone, which show the percentage of particles passing through a series of sieves. Figure 3 shows the grading curve for the sand component of a golf green rootzone. Sands falling within the grey region of the graph would be acceptable in terms of their particle size distribution.

FIGURE 3.



Grading curve defining recommended and acceptable limits of sand size for golf and bowling greens.

SELECTING ROOTZONE

There are quite a few ready-made rootzones on the market that purportedly conform to USGA recommendations. Be careful. Some do and some do for only the particle size parameter. For a rootzone blend to conform to USGA standards it must fall within the following particle size distribution:

Fine gravel including	2.0-3.4 mm	Not more than 10% of total,
Very coarse sand	1.0-2.0 mm	a maximum 3% fine gravel.
Coarse sand	0.5-1.0 mm	Minimum 60% in this range.
Medium sand	0.25-0.5 mm	
Fine sand	0.15-0.25 mm	Not more than 20%
Very fine sand	0.05-0.15 mm	Not more than 5%
Silt	0.002-0.05 mm	Not more than 5%
Clay	<0.002 mm	Not more than 3%

Total fines (very fine sand, silt plus clay) not to exceed 10%.

Having passed this first test, the rootzone must then comply with further analyses that determine the physical properties of the mix. These tests determine the total space between solid particles within the rootzone (Total Porosity), that filled with air (Air-Filled Porosity) and that retaining water around rootzone particles (Capillary Porosity). Drainage rate can also be tested (Hydraulic Conductivity) and the rootzone must also contain a certain amount of organic matter. Table 1 lists the figures that the selected rootzone must comply with if it is to be used (as per the 1993 Revision of the USGA recommendations).

TABLE 1. PHYSICAL PROPERTIES OF THE ROOTZONE MIX

Total Porosity	35-55%
Air-filled Porosity (at 30 cm tension)	15-30%
Capillary Porosity (at 30 cm tension)	15-25%
Hydraulic Conductivity (mm/hr)	150-300 (Normal) 300-600 (Accelerated)
Organic Matter Content (by weight)	1-5% (ideally 2-4%)

The two ranges for hydraulic conductivity reflect the tremendous range of circumstances that the USGA recommendations have to cover; after all it is the means of building greens worldwide. Higher drainage rates are required in tropical and sub-tropical areas and where recycled or highly saline irrigation water is used, where greens have to be flushed out now and again to get rid of contaminants. In the UK the Normal range is the one to aim for.

The USGA recommendations are not right for every situation. A different approach would usually be taken if rebuilding a green on a links course, but this is one of few exceptions.

So, there are very tight guidelines for selection of materials and it is this that helps guarantee success. However, even if you follow all of these parameters things can go wrong.

MORE RECOMMENDATIONS FROM THE USGA?

The USGA Recommendations are more than just a series of laboratory tests. The document produced by the USGA Green Section (the US agronomy service that plays a similar role as STRI) covers many other aspects of green construction. It is not a specification as such but there is more than enough advice in its pages to ensure a quality rebuild.

A selection of important, additional information includes:

- The subgrade, i.e. the soil base beneath the gravel carpet, need not conform to the general slope of the finished grade, but its shaping must reflect its purpose to facilitate water movement to the drainage system.
- The drainage design should ensure that the main line is placed along the line of maximum fall and lateral drains shall be spaced no more than 5 m apart.
- Drain lines shall be laid to ensure a minimum positive slope of 1 in 200.
- The surface of the gravel blanket must conform to the proposed finished grade.
- Materials suspected of lacking mechanical stability or of questionable weathering stability should not be used.
- All rootzone components must be mixed off-site.
- A quality control programme during construction is strongly recommended.
- Lime, phosphorus and potassium should be added to the rootzone, based on a soil test recommendation.

If you build a green to these requirements at least the mechanics and engineering will be right.

SO, WHAT CAN GO WRONG?

There are other aspects of golf green construction beyond the engineering profile and materials used that will determine the success of the venture. Here are a few to consider if you are proposing to rebuild a green.

- **Green design.** A green with severe contouring and deep depressions will rarely produce a consistent surface.
- **Inadequate area for play.** A rough figure would be 70% of the green area should be available for pin placement. These days we, generally, look for greens with an area of at least 500 m2.
- **Capping of the rootzone.** The means of establishing a grass cover to the green will be a major influence on the final outcome. If you cap the sandy, free-draining rootzone with clay or silt brought in with imported turf or a thick layer of dense thatch from the original turf then you immediately compromise the USGA spec. Seeding is the preferred option for establishment but this assumes that you have plenty of time before the green has to come into play and a seeded green will react differently to the mature turfed greens on the golf course.
- Inappropriate grow-in maintenance. Broadly speaking, a new USGA green will require more fertiliser and irrigation than mature greens. The grass will have to be nursed through its first year or two in use, possibly with less aggressive mowing heights and verticutting regimes. Over-zealous top dressing can strangle a new green at birth.

GET ADVICE – DO IT RIGHT

Rebuilding a green can be a nightmare or a sweet dream. There is an awful amount of information to consider and you must have access to laboratory facilities to get it right. STRI have the expertise to help you get it right the first time. From explaining the perceived problems of reconstruction to your members, through the materials selection process and into the grow-in programme, STRI can smooth the path to a successful rebuild.

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