Playing perfo

Dr Steve Baker, Senior Research Officer, reports on the fascinating research he is currently undertaking at the STRI.

Within the golf clubhouse a fairly regular toplc of discussion concerns the playing quality of the greens. Snippets of conversation may include – "the greens were far too slow today", or "...the greens were much harder than those on the course we played last week" or hopefully "...the putting surface was excellent". Unfortunately human nature being what it is, it is more likely that the complaints will be voiced more loudly than the compliments!

Unless we can measure the various components of playing quality it is very difficult to assess whether the complaints can be justified or was it a case of a poor round and a "bad workman blaming his tools"? One of the objectives of our recent research project for the R&A covering a National Survey of Golf Greens (*Greenkeeper International*, January 1996) was to develop test procedures for measurlng the playing performance of golf greens and to assess the range of values that are likely to occur on golf courses.

This had two main objectives – firstly knowledge of playing performance can set clear objectives for the management of greens. Secondly ln research work it is important that we can assess how for example a particular construction technique or maintenance operation will affect the playing quality of greens, so that the measurements we make have direct relevance to the golfer.

THE SURVEY

The work took place over an 18 month period and included visits to 74 golf courses from south-west England to north-east Scotland, although with a concentration in sltes in northern and central England. Several types of course were visited, e.g. parkland, links, heathland etc. and on each course we tested two greens one of which the Head Greenkeeper considered to be one of his best greens, the second heing one of his weaker greens. As well as measurements of soil and grass properties (for example drainage rates, air-filled pore space or grass species composition) we measured the playing quality of the greens.

PLAYING QUALITY MEASUREMENTS

The three main aspects of playing performance of interest to the golfer are the speed of the green. the evenness of the putting surface and hardness, in particular how this will influence the distance taken for a ball to stop when pltched onto the green.

Measurements of green speed are well established through the use of a Stimpmeter. To measure the evenness of the putting surface we used a proflle gauge consisting of ten graduated rods at 50 mm intervals which were free to move vertically if they were displaced by undulations. Measurements of displacement could be combined into an index of evenness.

For the last ten years we have made regular measurements of the hardness of sports surfaces using a Clegg Impact Soil Tester. This consists of a 0.5 kg, 50 mm diameter cylinder which can be released from a variety of heights. An accelerometer attached to the cylinder and the appropriate electronics measures how quickly the cylinder stops when it lands on the turf. If the surface is hard the test mass stops quickly and a high reading is obtained. On the other hand the cylinder will stop much more slowly on a wet, thatchy surface and a low hardness reading will be recorded. In the current study we evaluated the effectiveness of two different drop heights, i.e. 0.3 m and 0.55 m.

Ball impact properties can be assessed by firing a ball at the surface with deflned conditions of velocity, approach angle and back spin so that we can simulate different shots. This was achieved using ball firing apparatus in which the ball was fired between two independently rotating wheels to simulate what can loosely be described as 5-iron and 9-iron impacts. In recording the impact we recorded the distance of the first bounce, the patterns of subsequent movement, in other words whether it continued to travel forwards or whether backspin brought it back. Most importantly from the golfer's point of view we recorded that the total distance travelled from the pitch mark of the initial impact to the final resting position.

mance and how it's defined

PLAYER ASSESSMENT

It is no use making thousands of measurements if we have no means of lnterpreting them. Just what does a hardness value of 1;5 gravities mean compared with a value of 105 gravities and do these differences relate in any way to how a golfer perceives the hardness of a green? One solution was to ask golfers using the greens what they thought about the turf's playing performance, so a questionnaire was prepared covering everything from the golfer's handicap to his perceptions of green speed, hardness, etc. Players are notoriously variable in their attributes to the quality of a green so it was important that a large number of responses were collected. In total we collected questionnaire forms from 787 golfers enabllng us to look at general patterns of response.

GREEN SPEED

In an article of this length lt ls not possible to cover more than a fraction of the results but some of the more interesting findings are discussed here. For example results for green speed are given in Table 1 and are related to the USGA classification for regular membership play. The overall range of values was 1.20 m to 2.97 m but the vast majority of values occurred ln the range 1.52 m to 2.44 m which accord to the USGA classifications of medium-slow to medium-fast.

Table 1: Green speed in relation to USGA classification for regular membership play

Category	Distance rolled (m)	Number of cases April/ Sept	October/ March
Fast	>2.44	6	6
Medium fast	2.15-2.44	31	15
Medium	1.83-2.14	37	28
Medium slow	1.52-1.82	14	5
Slow	<1.52	2	1

Most of the players were happy with the speed of the greens. Only 6% of replies suggested speeds were too slow and only 1% of players thought the greens were too fast. There was some inconsistency in response to green speed but 38% of respondents considered green speeds less than 1.8 m to be slow or too slow but for values greater than 2.40 m 84% of respondents suggested that green speed was good or fast.

HARDNESS AND STOPPING DISTANCE

Hardness measured using a 0.3 m drop height ranged from 50-130 gravities with the maJority of readings being between 60 and 110 gravities. Hardness values tended to be highest on greens with high bulk density (a measure of soil compaction) and a low organic matter content and inevitably firmness decreased as soil moisture content increased. Newer greens also tended to give a harder surface, in part probably reflecting greater sand contents in modern rootzones but probably also because of less thatch build up on these newer greens, thus giving a firmer playing surface.

Ball firing apparatus: part of the research

There was a significant relationship between player response and measured values of hardness. For example 40% of players considered greens with values less than 70 gravities to be soft or too soft while the number of responses that the green was hard increased for greens where measured values exceeded 90 gravities.

Similar results were obtained when stopping distance was considered. Stopping distance was influenced by such factors as soil density and moisture content. For the five iron simulation the average distance between the pitch mark and the landing point of the first bounce was 1.21 m and in general the ball continued to move away from the point of initial impact giving an overall stopping distance ranging from 0.5 m behind the pitch mark to 9.04 m beyond the pitch mark. However for the nine iron simulation, although the initial bounce was similar, roughly half of the balls spun backwards to the point of initial impact because of the greater backspin and the overall stopping distance ranged from –1.36 m (i.e. the ball lay behind the initial point of impact) to 3.56 m.

Again there was a significant association with player response. For example, greens where the ball spun back behind the initial pitch mark following the nine iron simulation (i.e. had negative values of stopping distance) were generally considered to be soft while the proportion of golfers considering the surface to be hard increased as stopping distance became higher. In addition the proportion of golfers complaining that their ball travelled on excessively increased considerably on those greens with high measured values of stopping distance.

SUGGESTED PERFORMANCE REQUIREMENTS

The proposed limits for interpreting the playing quality of golf greens under British conditions are given in Table 2. They have been established as relatively broad bands because one of the joys and challenges of golf is playing a wide variety of courses under a range of weather conditions and it would be criminal to deflne an excessively uniform set of playing conditions. In dry summer conditions it would be expected that for example hardness and stopping distance would be towards the upper part of the range while in wet winter weather the values would fall. However it is believed that the values that have been proposed eliminate the extreme conditions that may be unacceptable to the golfer such as slow, thatchy surfaces that will hold almost any chip however badly struck or badly constructed greens that have set like concrete in dry weather.

The limits have not been determined only by the information on player response as it is important that greens present a challenge to the golfer and reward the skill of the better players. In this respect firm, fast greens should be regarded as ideal, even though questionnaire responses from some players indicated that the greens were too fast and that the ball travelled on excessively after pitching.

Finally it is essential that the limits were set so that they could be achieved using good greenkeeping skills without causing unnecessary stress to the turf as this may have long term effect on the quality of greens. In the United States for example, there have been problems with Stimpmeter readings putting pressure on greenkeeping staff to reduce cutting heights to achieve faster and faster green speeds. By setting both upper and lower limits for each component of playing quality it is hoped that these values can act as a tool to help research work and management decisions without giving unrealistic expectations for the golfers who play the course.

Table 2: Proposed limits for interpreting playing quality of golf greens under British conditions

Parameter range	Test method	Normal range	Acceptable
Green speed (ie. distance rolled, m)	Stimpmeter	1.6 to 2.8	1.5 to 3.0
Hardness gravities	Clegg Impact Soil Tester 0.5kg mass dropped from 0.3m	70 to 100	55 to 120
Stopping distance (m)	"Five iron" simulation (Angle 53°,velocity 22.7m s^{-2}, backspin 750 rad s^{-1})	0.5 to 5.0	–0.5 to 8.0
Stopping distance (m)	"Nine iron" simulation (Angle 53°,velocity 18.8m s^{-1}, backspin 880 rad s^{-1})	0.0 to 2.0	–1.0 to 3.5
Surface evenness (mm)*	Profile gauge	≤1.0	≤1.25

*This index is based on the calculation of standard deviation, which is a statistical measure of the variation of readings.