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The British Golf Greenkeeper

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This month's Front Cover illustrates the preparation of a trial on Soil Moisture Control at St. Ives, the S.T.R.I. Research Station. One of the most important aspects of good turf management is moisture control; maintaining sufficient water in dry weather and getting rid of excess in wet weather. (Photo by courtesy of the S.T.R.I.)

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TURF DRAINAGE

—applying new concepts in drainage design to the Golf Courses

C.J. Head. Chipman Limited. Date: 29th June, 1976

THE subject of sports turf drainage has received a great deal of attention in the past few years with much of the research effort and published work emanating from Dr. V. I. Stewart and Dr. W. A. Adams of the Soil Science Unit, University College of Wales, Aberystwyth. Although attention has been centred on the severe problems of waterlogging in soccer and rugby pitches the principles, problems and solutions apply closely to the golf course situation. The intention of this short paper is to attempt to identify areas where new concepts and techniques could be usefully applied to golf course design or management.

DRAINAGE DESIGN

The objectives of drainage design on a golf course might be defined as follows:

To ensure that:

(a) At no time of the year does waterlogging prevent play, even during periods of prolonged rainfall.

(b) Excess water is removed rapidly so that an optimum moisture state for plant growth can be maintained.

In stating the first objective the question is raised as to what rate of water removal would be required to drain water as quickly as it falls. At what rate would the rain be falling, and for how long? How often would such rainfall be expected to occur? To design a highly intensive drainage scheme to cope with a rainfall intensity which may occur only very infrequently could be considered uneconomic and the slavish interpretation of the first objective regardless of cost considerations would seem unreasonable. None-the-less an attempt to quantify the requirements must be made. In the light of past history of drainage failures it is not stating the obvious to say that if a drainage scheme is to be designed it must be decided what it is intended to achieve. How else can its success be anticipated or satisfactory performance measured?

TARGET DRAINAGE DESIGN RATE

Even in localities where there is no theoretical drainage requirement, i.e. where annual rates of moisture loss from evaporation from the soil surface and transpiration through plants combine to exceed the amount of annual rainfall, there will be occasions when precipitation is heavy for short spells and the drainage needs must therefore be considered. In Britain generally annual rainfall is about twice as much as can be removed by evapo-transpiration and the risks of surface accummulations will be very rea .

In choosing a target rate for drainage a guide can be obtained by studying local rainfall data, from which the probability of a certain level of rainfall occuring can be reasonably predicted from the frequency with which it has occurred in the past.

For example, if rainfall data over the past 50 years indicates that the number of occasions during which the soil is at fie d capacity when rain falls at say ¼inch/hour for one hour is only on average once per year, then unless the course is very important indeed it would seem unnecessarily expensive to fix the drainage design rate to meet this event, i.e. 6 inches/day. If it so happens that an important tournament coincides with that single occasion of the year it would be very unfortunate—clearly it is a matter of probabilities and the important thing is that sensible judgements can be made when the appropriate information is available.

An overall drainage design rate of at least one tenth inch per hour (2.5mm/hour) or between 2-3 inches per day would not be an unreasonable minimum target in Britain. Higher rates may be chosen for priority sites and in practice the cost/benefit ratio for installations greatly improves with higher target design.

PATTISON IN THE WEST

DEREK RUSSELL

Handsome, debonaire, confident—some of the words used by him when we said we want to print something about you—actually he is not a bad looking chap in a rugged old fashioned sort of way, two smashing kids and a very charming wife, fond of the country and enjoys meeting people—in fact he is just the man to promote Pattisons new van sales delivery service.

Calling on Golf Clubs from his local centre in the west country Derek is able to offer immediate delivery from the wide range of our equipment carried by his van.

ACHIEVING SATISFACTORY DRAINAGE

Rain can do two things when it hits the ground: It can infiltrate the soil or, if the rate of precipitation exceeds the rate of infiltration, it will accummulate on the surface or flow towards lower areas. There are two obvious ways therefore of removing excess water, intercepting it at

(a) By allowing it to flow through the soil to drains

(b) By intercepting it at the surface.

Both techniques will be called upon in golf course drainage, and having chosen a drainage rate for a scheme it is essential, to ensure success, that every part of the system is quantified.

If water is required to flow through soil then it is important that the hydraulic conductivity of that soil is known because the rate at which water moves through will determine the spacing required of drains. Natural unassisted drainage can only occur at rates in excess of one inch/day in very sandy soils or in finely textured soils possessing good granular structure to depth. Few inland courses will have sufficiently sandy soils and the maintenance of adequate structure in heavily trafficked fine-texture soils will be unlikely. For example, a well structured soil may have a hydraulic conductivity initially of say 20 inches per hour. This structure can collapsed with tread in the wet to the extent that its hydraulic conductivity reduces in a very short time to as little as a thousandth or even a ten-thousandth of that figure, i.e. 0.002 inches per hour.

DISTINGUISHING BETWEEN AREAS WITH DIFFERENT REQUIREMENTS

A study of the topography of the area will reveal those areas which are, because of their relief, shedding areas for water and those which are low receiving areas. The first essential of course is to cut off the former from the latter. If the course can be divided into self-contained sections in this manner, with each area isolated from the influence of extraneous water from any other area, and each possessing its own outfall. The cut-off drains will be continuously permeable and contain backfill material at the surface of sufficient size to enable water from the entire catchment area it serves (measurable) to be intercepted at the design rate. This cut-off system can form the basic skeleton of main drains and must be of the required size. Manufacturers pipe data charts will show the capacities. For example a final single outfall main carrying the accummulated discharge of 20 acres at 2 inches per day potential will need to be 10 inches in diameter at 1 per cent slope. All situations are calculable and nothing must be left to guesswork.

Having cut the site down to size in this manner the special needs of individual sections can be considered. There will be good and bad areas but in many parts of the course management can be aimed at maintaining good natural structuring by encouraging the soil biology. If necessary chemically and mechanically. Unless the area is underlain by a subsoil of sufficient permeability to function as a natural soakaway there will need to be a full system of drains of continuously permeable construction to the surface, across the slope, so that as well as receiving water through the topsoil they can also act as surface water interceptors. It is only in this way, on most soils that drains may be installed at spacings as wide as 5 or 6 yards, if drainage rates indicated are to be achieved.

The same drain system, possessing as it does, permeable backfill, for example sand, to the surface, built with a view to providing for well structured soil areas can be used as the skeleton for areas where structure is non-existent or will be expected to collapse with tread in the future.

DE-STRUCTURED SOILS

If water cannot be moved through the soil at an acceptable rate then either the soil must be replaced, or amended, or excess water must be removed at the surface. Few fine textured soils can be adequately improved by the simple addition of sand as in most cases so much sand would be required to make an effective improvement that the surface would

be destroyed in the process. If, say, it took 9 inches of sand to suitably amend 1 inch of soil (as is often the case) the cost would be exhorbitant.

Recent techniques of surface water removal by interception include sand slitting, by which means vertical bands of sand are installed in the soil, and intersect the permeable backfill over drains. These are set at spacings adequate to intercept surface flow across slope and the spacings, depth, width, and hydraulic conductivity of sand, all have a bearing on their performance. All are quantifiable. An appropriate system can be chosen to link with a given drain spacing to preserve the target design rate. To function efficiently in the long term sand slits must not be capped at the surface by soil but must be maintained in a sandy condition by top dressing if they are to continue to meet the drainage rate requirement. New techniques of maintenance by "microslitting" to renew the surface link when necessary have been developed.

SPECIAL CONSTRUCTIONS

Where imported material is to be used in construction the opportunity presents itself of quantifying drainage from a knowledge of the characteristics of that material. Drain spacings within greens or tees can be specially suited to the hydraulic conductivity of the entire depth of construction and can be considered separately if higher-than-elsewhere drainage rates are to be selected for these special areas. The hydraulic conductivity of sand/soil mixtures used in construction will reduce considerably with compaction. It is therefore important that drainage designs are based on measured values of compacted material.

Sand slits have been installed in existing greens and subsequently management has secured a perfectly true surface. The time this takes to achieve will depend on the amount of attention given to surface truing afterwards. There is some surface heave following sand injection but as important major surgery which has to be performed once only to cure a waterlogged green the trouble required in reinstatement could be considered insignificant.

The treatment of greens which have developed problems of thatch formation or layering within the profile whether by mismanagement of top dressing practices, irrigation, feeding, soil chemistry or whatever other cause is outside of the scope of this short paper. It is pertinent however to note that in severe situations by-pass systems, such as sand slits, may present the only short-term solution which is conducive to its subsequent improvement by chemical or physical means.

STEP-BY-STEP CONSTRUCTION

Systems such as these described lend themselves to step-by-step construction. Having chosen a design rate work can start with cut-offs for main sections; to these can be added the skeleton of permeable-fill drains within sections; concentration can then focus on adding the flesh—managing the soil structure on the large scale and installing slit or reconstruction systems in areas of intensive use.

In this manner important priorities can be met first and the system added to as the budget allows.

SYSTEMS THAT REALLY WORK

Whether installed at the outset or piecemeal one thing is vital—whatever is done must be done with the complete confidence that it is part of a planned system that can be expected to work in the manner it was designed to. Drainage schemes installed to a traditional pattern without an understanding of soil/water relations, whose working or not working is left in the hands of fate and thought to be outside of the control of the designer should become a thing of the past. All is measurable, all is quantifiable, and the benefits to acrue to the well being of the course, and the game, from informed management of drainage will be considerable.