**A differential slip wear machine is used on a trial of turf reinforcement materials. The areas free from mud are reinforced by a molded plastic mat and a needle-punched polypropylene geotextile.**

# ATHLETIC FIELD DRAINAGE

The Sports Turf Research Institute in Bingley, England is far ahead of the United States in research on field construction, drainage and wear tolerance. During the last decade, researchers at STRI studied what makes a good field.

*by Stephen W. Baker, Ph.D., The Sports Turf Research Institute*

Britain has a problem. Many of the principal sports—notably soccer, rugby football and field hockey—are played through the winter months with the summer as off-season. Rainfall for the period of November through March, the heart of the playing season, averages about 2.2 inches per month in London and four inches per month in wetter areas in the north and west.

With evapotranspiration rates of less than 0.4 inches per month at this time of year, there is a considerable surplus of water. This problem was reflected in a survey of sports field drainage published by the Sports Turf Research Institute in 1983. Of pitches (fields) owned and maintained by local town and city councils, 44 percent had a drainage problem. Twenty percent of the pitches had regular match cancellations between November and February.

The alarming picture of poor drainage indicated by the survey does not, however, reflect a lack of suitable technology to create hard-wearing, well-drained sports turf in Britain. Indeed, since the 1960s, there has been a revolution in the construction methods used for winter games pitches. This is reflected in high quality natural grass sports surfaces at many of the professional soccer grounds in Britain.

## Research techniques

In the last 10 years, the Sports Turf Research Insititute has had a major program of research on the drainage of winter game pitches. This includes work on fundamental drainage theory and on the management of free-draining, sand-dominated, rootzone media.

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**A trial at the Sports Turf Research Institute shows the cost-effectiveness of different construction methods. The same intensity of simulated wear is applied to all plots, but those with pipe drainage are a sea of mud, while the slit-drained and sand rootzones retain a good grass cover.**

The research work consists of two main philosophies. First, any trials should receive a realistic wear treatment. It is meaningless to conduct drainage research for sports turf without considering the interaction with the wear and compaction caused by play.

Mike Canaway of the STRI has developed a differential slip wear machine which is widely used in our experimental work.

For soccer, this can be fitted with studded rotors: the vertical forces are applied by virture of the machine's weight (348-480 lbs. depending on the amount of ballast) while horizontal forces occur because the front and rear rotors are coupled by pulleys of unequal size. The front rotors move faster than the overall forward speed of the machine and rear rotors slower, and this causes a tearing action on the turf.

The second important aspect of research is that the data collection should be meaningful to the sport in question, and in particular that player's needs should be considered. Factors such as ground cover and infiltration rates are monitored in most trials, but there is an increasing emphasis on surface playing quality.

For soccer, for example, tests include ball rebound and ball roll characteristics; the traction or grip properties of the surface; and the hardness for running/falling. These results can be interpreted in relation to recently-developed performance standards.

## Drainage techniques

Research has been conducted on both slit drainage techniques and the effects of different rootzone materials. Slit drainage is primarily a method to by-pass the de-structured and compacted surface layers of a sports field.

If vertical slits of highly permeable


**A differential wear machine is fitted with studded rotors to simulate football-type wear.**

sand and gravel materials are installed on close centers, typically less than two feet to about 3.2 feet and connect into an underlying pipe drainage system, rain water can pass rapidly from the surface to the drains. There are, of course, optimum flow lengths, spacings, widths and depths of the slit drains. This has been studied in relation to design rainfall events.

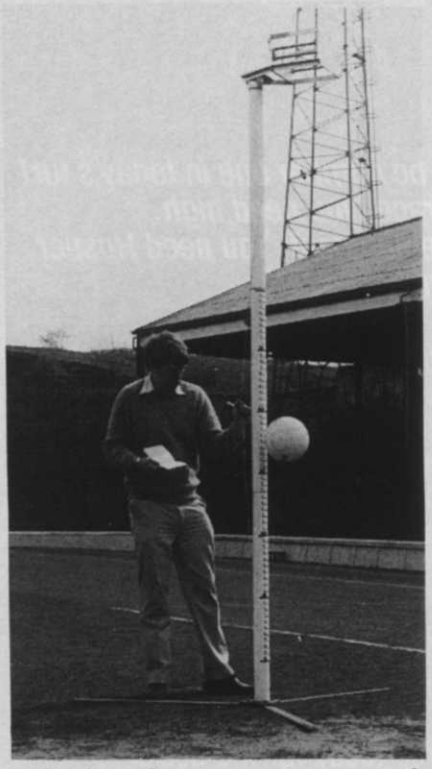
Research on rootzone composition has considered both the effect of sand type and the proportion of sand that should be used. Uniform medium-fine sands of 0.25-0.5 mm (.01-.02 inches) diameter are preferred for winter games. That size satisfies the compromise of high permeability and good aeration against the problem of droughtiness and instability when wear removes much of the grass cover.

For many professional soccer clubs, sand-soil mixes are generally used because of the limited period available for grass establishment (the close season is only three months). Recommended specifications, however, require at least 90 percent sand in the final rootzone mix. When it takes longer for grass to establish, pure sand constructions are used more often.

Two main types are: 1) the suspended water table construction of 10-12 inches of rootzone sand over two inches of a coarse blinding sand and four to six gravel carpet; and 2) a sand carpet construction where the native soil is intensively drained with pipe drains at, almost 23 foot centers and gravel slits at 3.2- to 6.5-foot centers.

A layer of four to six inches of medium-fine sand is then added before the pitch is sown, usually with perennial ryegrass. This provides a free-draining surface layer, yet the grass roots can still penetrate into the soil beneath, which acts as a reserve for moisture and nutrients.

The use of sand-dominated rootzones has many management implications. In consequence, the STRI



**Ball rebound resistance is measured by dropping a soccer ball from 9.8 feet.**

also has a program of research to examine the effects of grass establishment and nutrition on sand rootzones, mechanical treatments, amendments and conditioning materials and use of synthetic reinforcement materials which are intended to increase the wear tolerance of the natural grass surfaces and improve the playing quality.

### Construction techniques

The majority of pitches in Britain either have no drainage at all or just a rudimentary pipe drainage scheme. Slit drainage is widely used for both professional sports grounds and at the local recreational level. Sand-soil mixes have been used by many of the senior professional soccer clubs, but Britain still probably has no more than 50 pure sand rootzone pitches.

Sand-based rootzones have consistently performed well in trial work. Where they have been used, the response has been generally favorable. The construction costs are, however, four to eight times that of a pipe-drained pitch and two to five times that of a pitch with slit drainage.

This addititional cost must be justified in terms of improved playing performance performance and in the number of games that can be held.

**Measuring traction: the force to tear the studs through the grass is measured using a dial-indicating torque wrench.**

Little published data is available on the relative performance of different construction types. But this is currently being investigated by a trial with simulated wear at the STRI and an extension trial using detailed pitch monitoring.

Principles of construction needed to produce high quality surfaces have been established in Britain. These two trials should give justification for much more widespread use of these drainage techniques. **LM**