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AGROSTIS RESEARCH

VOLUMETRIC MOISTURE CONTENT

&

SURFACE HARDNESS

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1 INTRODUCTION

One basis for a high quality football pitch design is a sand carpet of around 50 mm thickness. Another would be no less than 50 mm depth of rootzone blended to form a very sandy seedbed. These designs combine the drainage capabilities of sand with the nutrient and moisture retaining properties of a more conventional growing medium (the native soil) and this has been common practice since perhaps the mid to late 80's if not before. More recent developments include the introduction of Fibresand in the early 90's to further enhance and control playing characteristics such as traction. A very recent development is the use of rubber chip, which has been studied by Agrostis over the past few years.

Five pitches, designed by Agrostis, have been installed at Colchester United's new training ground on an area previously used for arable agriculture. All the pitches were provided with a pipe drainage system but have a range of construction types including a sand carpet, rootzone, Fibresand and rubber chip. We undertook to study the influence that these construction types may have, and in particular the respective benefits of sand and rubber chip, on football pitch performance.

That performance was measured in this preliminary investigation as hardness, an important factor relating to player safety and ball behaviour, and volumetric moisture content (VMC). Wet pitches is almost always the cause of cancellations so a measure of the water content of the soil, at one particular point in time and in relative terms, could indicate the extent to which water retention may influence playing quality.

2 METHOD

2.1 Soil type

The soil type according to the Soil Survey of England and Wales indicates that the northern part of the site is on the Windsor Association. Typical of much of north London and Essex these heavy soils are formed over Tertiary Clay and are described as 'Slowly permeable seasonally waterlogged clayey soils mostly with brown subsoils. Some fine loamy over clayey and fine silty over clayey soils and, locally on slopes, clayey soils with only slight seasonal waterlogging.'

In the southern part the soil is probably of the Efford 2 association. These are formed over glaciofluvial drift and are described as 'Well drained fine loamy soils over gravel at variable depth. Associated with fine loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging. Some fine loamy over gravelly soils affected by groundwater. Some slowly permeable seasonally waterlogged fine loamy over clayey soils.'

2.2 Drainage and construction

The pitches were constructed with a pipe drainage system spaced at 5 metre centres. This drainage system discharged into a soakaway chamber located in the south east of the site. The layout of the pipe drainage system and soakaway chamber is indicated in Figure 3-3. The drains were constructed as shown in Figure 2-1

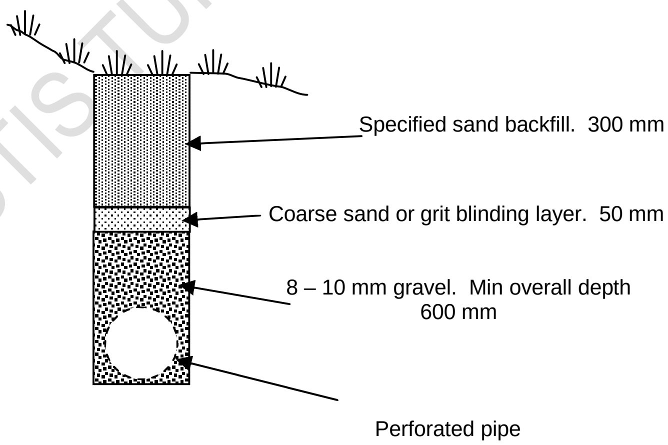

Figure 2-1 Schematic cross section through a drain

Levels within the site needed little adjustment. Only one pitch (pitch D) had to be levelled by cut and fill work within the subsoil. The remainder achieved a satisfactory level by laser grading within the topsoil.

The various construction types are summarised in Table 2-1 and are situated within the site as shown in Figure 2-2.

Pitch	*Fibre sand*	*Rubber Crumb*	*Rootzone*	*Sand Carpet*
A (Match)	25 mm	10 kg m^{-2}	100 mm	
B (Practice)	25 mm	10 kg m^{-2}	50 mm	
C (Practice)		10 kg m^{-2}		
D (Practice)		10 kg m^{-2}		50 mm
E (Community)				

Table 2-1 Pitch construction methods

Figure 2-2 Site plan

Following installation of the drainage, rubber chip was spread and cultivated into pitches A to D. A pre-mixed 50 : 50 sand : soil rootzone sufficient to cover pitch A to a firmed depth of 100 mm and pitch B to a firmed depth of 50 mm was imported and spread. Pure sand, sufficient to cover pitch D to a depth of 50 mm was imported, spread and lightly harrowed into the levelled topsoil. Fibresand was harrowed into the surface of pitches A and B. The site was then sown with a blend of perennial ryegrass, smooth stalked meadow grass and fescues.

2.3 Survey design

Directly following the construction and establishment of the pitches, and just before they came into use, a survey of the volumetric water content (VMC) over the whole site and surface hardness over the pitches were undertaken.

VMC was measured using a Spectrum TDR 300 with samples located using a Garmin Oregon 550t GPS. Measurements were taken at 10 metre intervals forming a grid over the entire site.

Surface hardness was measured using a 0.5 kg Clegg hammer over each pitch at four locations, two in each half of the pitch. The test was laid out as shown in Figure 2-3.

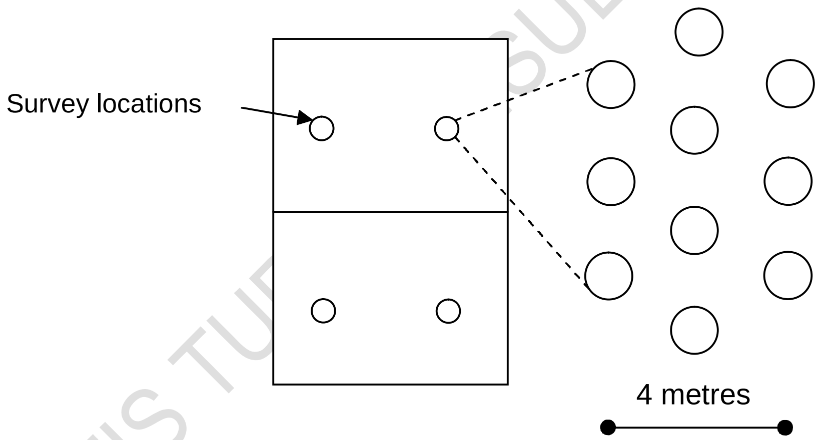

Figure 2-3 Clegg sampling method

2.4 Analysis

ANOVA was performed on both datasets and the least significant difference (LSD) was calculated to act as error estimation (p = 0.05). Subsequently the sample means were graphed with LSD error bars.

The null hypothesis adopted for this research project is: ‘There is no difference between pitch construction methods in terms of surface hardness and VMC.’

Finally VMC results were mapped onto the site plan.

3 RESULTS

3.1 Surface hardness

From Figure 3-1 it would appear that all construction materials have a positive effect on reducing hardness. Pitches A, B and D are significantly different from C and E. Pitches C and E do not contain sand in any form, whereas A, B and D do. This suggests that sand is tending to reduce surface hardness.

Rubber chip alone has a small effect on surface hardness, as can be seen by the difference between pitch C and E.

The addition of Fibresand firms the surface while increasing depths of rootzone appears to reduce surface hardness within the range examined in this study.

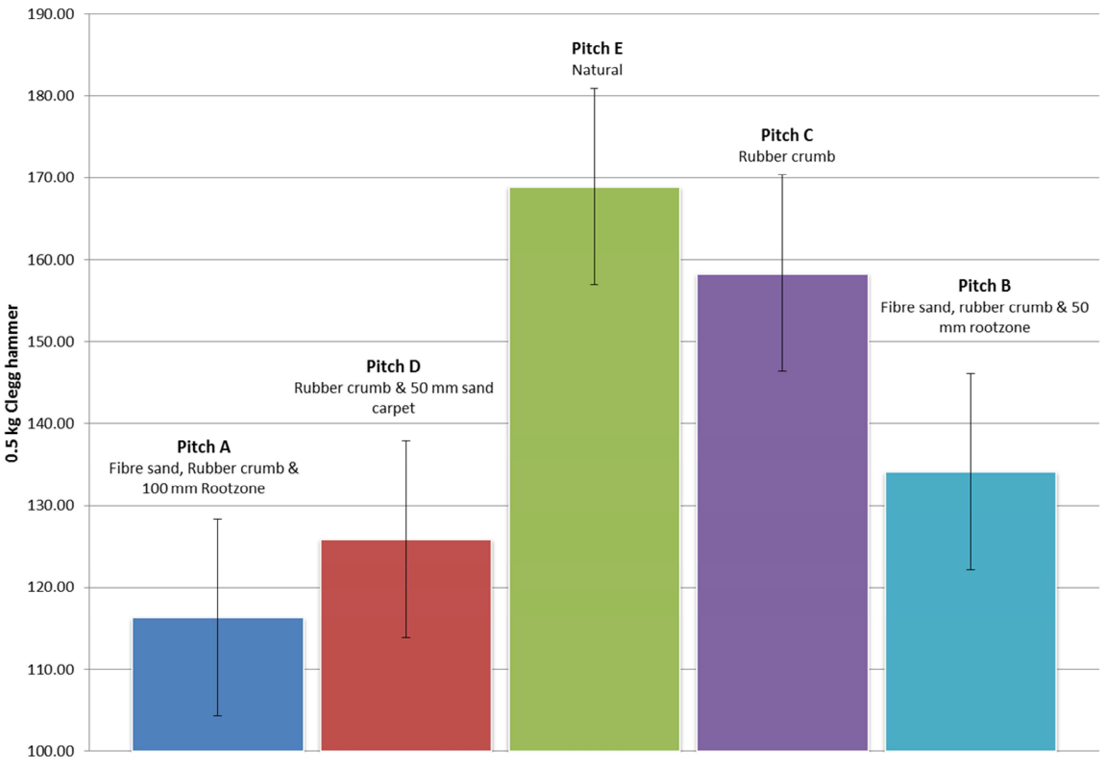

Figure 3-1 Mean surface hardness of pitches

3.2 Volumetric water content

3.2.1 Comparison of means

The inclusion of rubber chip produced a very significant reduction in VMC in all the constructed pitches. This can be seen in the data presented in Figure 3-2, pitch E was constructed without chip.

The inclusion of sand in the construction, either as a carpet or in a blended rootzone, further reduced VMC. Pitch C, without an amended surface, was significantly more moist (greater VMC) than all three of the amended pitches.

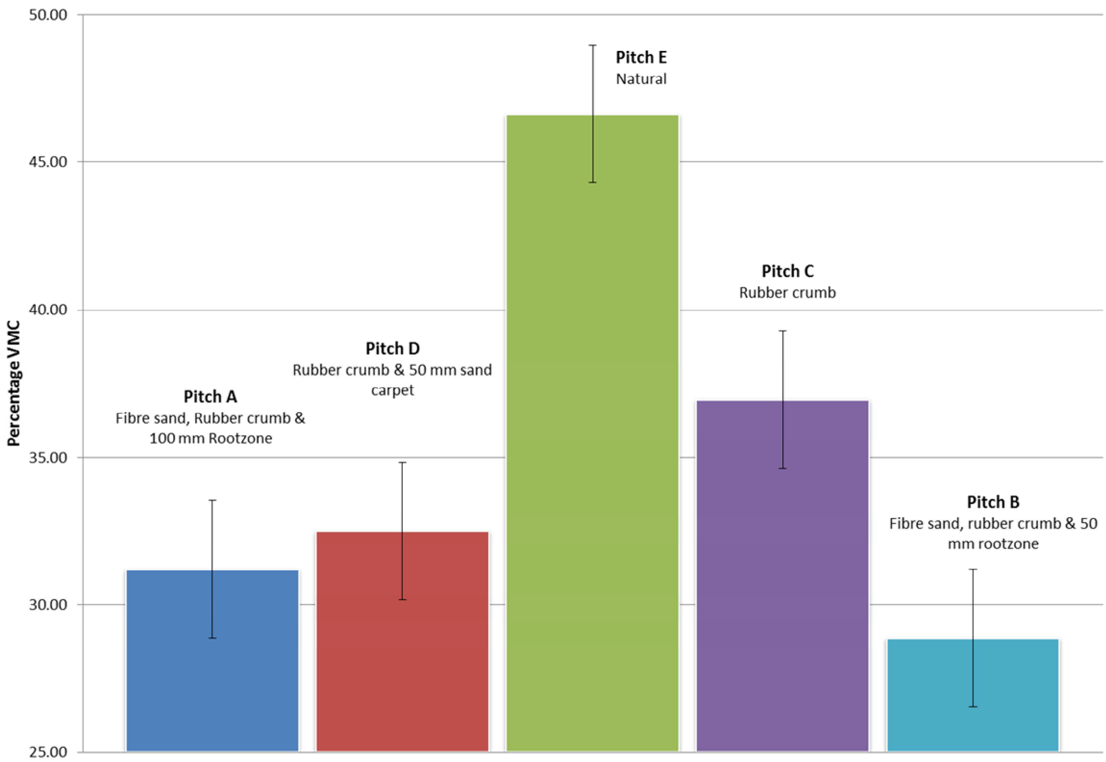

Figure 3-2 Mean VMC of pitches with least significant difference error bars

3.2.2 Map

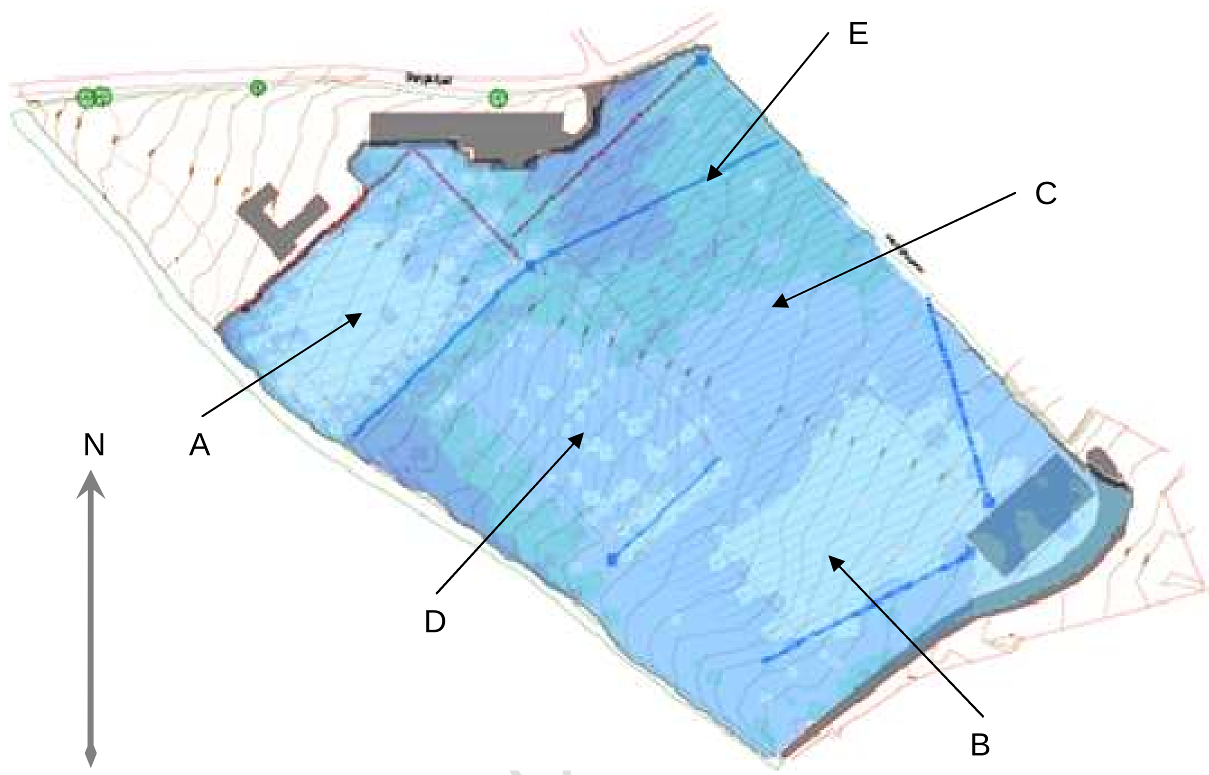

Figure 3-3 Map of site showing VMC & pitch locations

From the mapping of VMC over the entire site the individual pitches are clearly identifiable although some residual natural influence is also evident. Pitch A showed what appears to be a wetter area at the north eastern end and all pitches demonstrated an ‘edge effect’ at their margins. Pitch E, topsoil only, showed a large amount of residual natural influence and was similar to the surrounds of the pitches which shared the same construction type.

4 CONCLUSIONS

This investigation highlights the advantages of more intensive pitch construction. By applying one or more of the construction elements studied here, it is possible to achieve significant improvements in pitch performance.

- The incorporation of rubber chip into the topsoil reduces hardness in a manner likely to be experienced by players but not by a very large amount
- The incorporation of rubber chip into the topsoil produces a significant reduction in VMC
- Sand, incorporated into the surface either as rootzone or as a carpet, reduces surface hardness and this effect is likely to be maintained consistently throughout the year
- Sand incorporated into the pitch surface, either as rootzone or as a sand carpet, reduces VMC

And, slightly more tenuously…

- Greater than a depth of 50 mm, the capacity for rootzone material to reduce VMC diminishes but its effect on hardness may be enhanced with greater rootzone depth
- Fibresand produces harder pitches and may reduce VMC slightly beyond the effect that would be achieved with sand alone.

It is likely that the reduced VMC associated with the inclusion of rubber chip is related to its effects on soil structure and texture. Agrostis continue to investigate these aspects of pitch construction and the use of rubber chip in particular.