XVII[th] World Congress of the International Commission of Agricultural and Biosystems Engineering (CIGR)

Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB)
Québec City, Canada June 13-17, 2010

ADVANCES IN SPORTSTURF DRAINAGE

DAVID B. SHELTON[1]

1 D.B. SHELTON, T.D., F.I.Ag E., Shelton Sportsturf Drainage Solutions LLP, Baumber House, Baumber, Horncastle,Lincolnshire. LN9 5NF. United Kingdom, d.b.s@hotmail.co.uk.

CSBE100162 – Presented at ASABE's 9th International Drainage Symposium (IDS)

ABSTRACT Sportsmen and sportswomen the world over enjoy playing on well-drained turf. Almost all soils drain naturally but in the majority of cases natural drainage is insufficient to meet today's sporting requirements. Sportsturf drainage differs markedly from agricultural drainage; sportsturf is a permanent “crop” and relatively delicate and needs to be treated as such. Other differences are highlighted. The latest techniques of sportsturf drainage are explored and a comparison of cost and effectiveness of three approaches to intensive drainage systems made. The latest machinery to undertake this drainage is considered with examples of costings and the productivity improvements resulting. The approaches to research and development of both drainage systems and machinery are outlined together with the role that universities can play in commercial developments. Manufacturing techniques will be considered.

Keywords: Sportsturf, Intensive land drainage, Drain today and play tomorrow, Agricultural drainage, Gravel band drainage, Sand slitting, System 25™, Lightening-drain™, Grassland tyres, Sward, Secondary systems, Primary land drainage, Contamination of the sward, Backfilling.

INTRODUCTION Advances in sportsturf drainage - let the starting date be 1978, at the famous Ascot Racecourse. 20 men, three tractors achieved 800 metres in a day - 40 metres per man/day. Comparative output 30 years later will be revealed in due course.
Sportsmen and sportswomen the world over enjoy playing on well-drained turf. Almost all soils drain naturally but in the majority of cases natural drainage is insufficient to meet today's sporting requirements. Hence matches have to be postponed or cancelled, facilities are closed, and revenue is lost. The sward suffers, too.

Gone are the days when draining a sportsfield meant the facility was out of use for weeks, sometimes months. New techniques and the latest equipment cause minimum surface disturbance such that 'drain today and play tomorrow' is a reality.

The Shelton business has led the way on many of these new developments. Its research and development programme is perhaps the biggest of any organisation or commercial business anywhere. It has resulted in sportsturf drainage techniques in use worldwide, including cricket and football world cup venues.

Today, water is a precious commodity. If it can be recycled then this should be built into the drainage proposals. On numerous golf courses the water from drainage schemes is being harvested and used to irrigate the courses.

In this presentation I plan to answer five questions:
1. What do we categorise as sportsturf?
2. Why, and how, does sportsturf drainage differ from agricultural drainage?
3. What are we trying to achieve?
4. How do we achieve it?
5. How are the research and development programmes undertaken?

I am confining my remarks to established sportsturf.

WHAT DO WE CATEGORISE AS SPORTSTURF? Any permanent grass sward used for sport or amenity purposes; golf courses, football, rugby and hockey pitches, polo fields, stadia, racecourses, airfields, caravan sites and public parks. At one end of the spectrum we have the fine grasses of golf greens; at the other the coarser grasses of the horseracing courses.

WHY, AND HOW, DOES SPORTSTURF DRAINAGE DIFFER FROM AGRICULTURAL DRAINAGE? Usually, in agriculture there is a cropping rotation and the land is cultivated by plough, disc or harrow. The roots of many farm crops go deep. Agricultural land drains are often installed at depths in excess of one metre and at spacings of up to 40 metres. A small depth of gravel may be placed over the pipes. To hasten excess soil water to these drains subsoiling or mole ploughing at one to two metre intervals is often undertaken every second or third year. Surface disturbance is not of concern for subsequent cultivations level the ground.

With sportsturf the sward is permanent. During the growing season these swards are mown frequently. The roots of the finer grasses are predominately in the top 500mm of the ground. In the case of the coarser grasses perhaps 100-200mm deeper. Permanently-sited irrigation is frequently used to keep the swards growing in the drier periods. For these reasons sportsturf drainage operations have to minimise disruption to the grass surfaces. They are shallower that in agricultural drainage, and they have to be much more intensive. If a sports facility is out of use whilst land drainage operations are being undertaken then considerable loss of income may result.

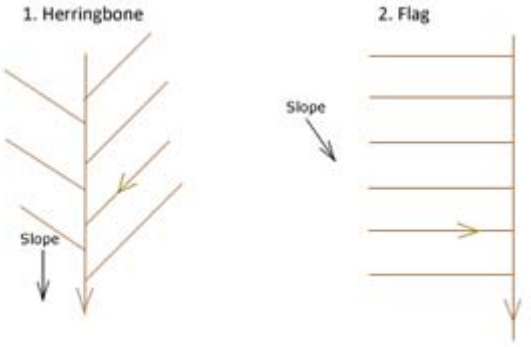
WHAT ARE WE TRYING TO ACHIEVE? To enable use of the facility however hard it rains! Grass roots drown if they are waterlogged for even a matter of days resulting in unsightly bare patches of soil. More frequently slow drainage of the soil causes yellowing of the sward. The aim of the man-made land drainage system must be to keep the top 500mm of the soil from becoming waterlogged. The required speed of drainage of the site will depend on the use to which it is being put. A premier division football club may seek to remove 25mm of precipitation from its pitch in 30 minutes; on the other hand an infant school pitch would be pleased to see this amount drained in 24 hours! In the main, sportsturf drainage operations are undertaken on high-quality grass surfaces. Contamination of the sward by soil spillage or by the placing of backfilling aggregates is not acceptable.

The drainage machinery and the ancillary equipment must cause no indentation of the sward. The facility must be out of commission for a short period - measured in days, not weeks or months.

HOW DO WE ACHIEVE IT? We need equipment to dig trenches for land drainage pipes. The primary system usually has main drains of 100-150mm diameter. Into these drain the laterals usually of 60-80mm diameter. Trenching machines used to install these piped systems are either self-propelled trenchers with conveyors on tracks, or pto driven machines, mounted on the 3-point linkage of a wheeled tractor.

These, too, have conveyors and numerically are much more popular. Why? They cost but a fraction of the self-propelled machine and when the tractor is fitted with appropriate low ground pressure grassland tyres they do negligible damage to the sward.

The digging mechanism may be chain or high-speed wheel. The wheel trencher enables accurate and clean trenches to be dug at speed. We aim to dig 78mm wide trenches for 60mm pipes, 98mm wide trenches for 80mm pipes. We like the drainage pipes to fit snugly in the trench for backfilling aggregates are expensive and large quantities are required; it makes for a cost-effective installation. Virtually all the trenching machines being used for sportsturf drainage are capable of laser grading - either manual or automatic. The use of GPS is still in its infancy.



The herringbone layout of land drainage pipes is now a thing of the past. The flag layout minimises damage to the sward in that the main drain is sited off the main playing area to one side and the junctions of the laterals connecting to it are off the main playing area also.

Backfilling Backfilling these relatively narrow trenches at speed without any spillage whatsoever is not easy! It is usual to backfill with a clean gravel of 8-10mm diameter to within 50-75mm of the surface. (Marine sourced gravels are best for they are round and consequently drain more quickly than crushed gravels.) On top of this may be a free-draining sand or a sand/soil mix.

Until recently the backfilling operations have been slower than the trenching operations and almost as labour intensive. The Shelton company introduced their Fast-Flow range in 2005 which has resulted in backfilling becoming a one-person operation with materials being placed at forward speeds of 5000-6000 metres per hour.
Repairing these scars on the playing surface is usually done by generous sowings of a matching grass seed mixture. Where the sward is growing vigorously it may simply be left to grow over the scar. There are cases where instant renovation is required in which case narrow strips of turf are laid in the trench.

Secondary systems Piped systems on their own rarely move water off the site fast enough. It is necessary to superimpose a secondary system over them at 90°.
Sand slitting (a misnomer!) consists of 50mm wide trenches dug 250-300mm deep and spaced one to two metres apart. They are backfilled with 'pea' gravel to within 50mm of the surface and then topped with a free-draining sand.

They are effective but they have serious drawbacks. 50mm wide scars at close intervals across the turf take time to grow over. The aggregates in them frequently sink necessitating topping up with more free-draining sand. It is not unusual on heavy clay soils for two, sometimes three, topping-up operations; this entails more expense and a longer sward recovery time. For this reason, Sheltons introduced Gravel Band Drainage.

It is a trenchless system and no soil is removed. Bands of 4-6mm gravel are installed by using a vibrating stainless steel channel opener and the integral gravel box feeds in the gravel in a one-pass operation. Bands are usually 25mm wide and 250-300mm deep, spaced at 400-1000mm. If undertaken when the soil is moist there is negligible surface disturbance and the facility may be returned to use immediately. It is low cost yet highly effective. It cannot be undertaken in dry, hard soil.

To overcome this problem, we brought out 'System 25 ™'. A small trenching machine capable of digging trenches 25mm wide to a maximum depth of 450mm. The excavated soil is carried to a dumper or trailer as with the bigger trenchers. Simultaneously, gravel is inserted in the trench and brought as close to the surface as required. This has become very popular.

On some sites very fast secondary drainage is required. Another challenge! Lightening-drain™ is the answer. Close-spaced 30mm wide trenches are dug with our System 25 ™ equipment into which we feed a 25mm diameter land drainage pipe. These are topped with gravel virtually to the surface.

HOW ARE THE RESEARCH AND DEVELOPMENT PROGRAMMES UNDERTAKEN? These break down into two divisions - techniques, and machinery development. We sell equipment in over twenty countries worldwide. The bulk of this equipment is sold direct to the end user. This is an important point for we are in touch with those who have the drainage problems at the sharp end.

Techniques In this presentation let me give you one example of a problem facing many of those who manage golf courses. It demonstrates how our R&D programme operates. The majority of golf courses built more than thirty years ago had pushed-up greens. The topsoil in the vicinity was pushed into a mound to form an elevated platform. Drainage was rarely installed for golf was a sport for the warmer weather. In recent years golf is being played year-round and in the wet weather these greens become unplayable. Where finance allows clubs have rebuilt their greens to USGA specification, at a cost of around £25,000 each green. This takes weeks and causes serve disruption to the course. We were asked for alternatives that had to be cheaper and immediate! Initially we used the gravel banding technique at 400mm centres carrying excess soil water to a 60mm drain sited just off the green. It worked remarkably well.

With the introduction of System 25™ we used this technique also. It moved water considerably faster than gravel banding and could be undertaken in the warmer summer months when the scars quickly grow over.

The third technique is 'Lightening-drain™' using 25mm land drainage pipes.
It has proved to be a winner for it drains greens as fast, or even faster, than those built to USGA specification.

As to average costs and effectiveness:

Gravel Band Drainage per green	circa £750	speed of drainage X
System 25 ™ per green	circa £1,500	speed of drainage 2X
Lightening-drain™ per green	circa £3,000	speed of drainage 4X

How do we monitor the results? We have a contracting department and an equipment-hire department. We contract throughout Great Britain on a wide range of soil types. We do not get paid if the drainage system does not work! It is the best incentive to ensure success. Over the past thirty years we have accumulated an unrivalled fund of knowledge solving drainage problems both at home and overseas.

Productivity Improvements
Reminder: 1978 Output per man/day 40 metres

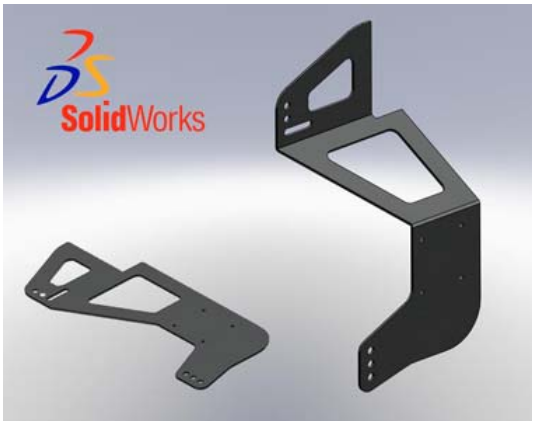
In 2008 - comparative drainage works

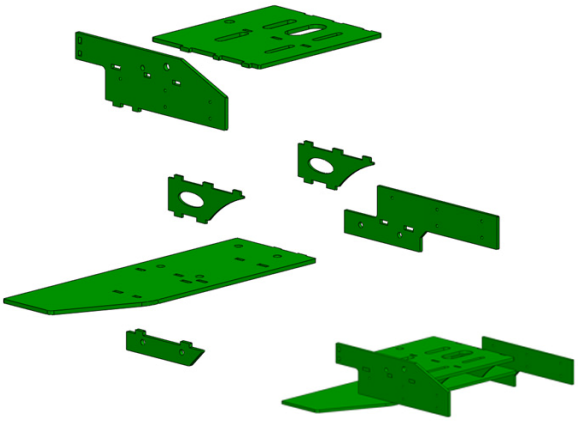
1200 metres of 60mm pipe drainage installed by Shelton Supertrencher, by 3 men, three tractors and one backfilling hopper, output per man/day 400 metres

A ten-fold increase in productivity!

Machinery Development Having identified a sportsturf drainage problem we need to develop machinery to fix it. We employ several graduates who work closely with the skilled agricultural engineers. As a team they are encouraged to think outside the box! We have received a number of substantial financial awards from the Government's Department of Trade and Industry for this innovation work.
Once a prototype machine has been built it spends a minimum of twelve months being operated by our own staff in the contracting department. Here it undergoes refinement. More machines are built which are then available for hire. They get rough treatment and virtually no maintenance in the hands of most hirers. Weaknesses are speedily revealed, and rectified.

Only then does the new machine go into production. We use SolidWorks as our CAD programme, laser profiling in the manufacturing programme, and build mainly in stainless steel to enhance flow of materials, stop rusting, give greater strength without extra weight and because it looks good!





This approach to manufacturing has won us numerous national and international awards.

As a result of the financial turmoil worldwide we have changed our approach to production of new machines. Whereas previously one engineer built one machine which might take two or three weeks, we now build only to order and organise our resources in such a way we can build one in five days. This enables us to be a bespoke manufacturer and improve cash flow position at the same time.

CONCLUSIONS Major upheaval of established sportsfields as a result of land drainage operations need no longer occur. Using the latest techniques and layouts when installing

primary (piped) systems does little damage to the sward. Secondary drainage systems superimposed over the piped systems speed excess soil water off site.
Dedicated sportsturf drainage equipment minimises damage to fine turf and has dramatically reduced drainage costs.

'Drain today and play tomorrow is a reality'

LET ME FINISH BY LOOKING AHEAD.

The future is electric!

Within 10 years we are likely to see our farm tractors powered by electricity and hydrogen fuel cells. On the farms we shall be generating our own electricity using biogas and other clean methods.

As agricultural engineers we have the skills to develop these exciting new systems. We must grasp these wonderful opportunities.

Are you going to play your part?

DBS ©

revised 19/04/10