Drainage

Barry F Cooper, son of the nationally acknowledged drainage expert, the late Turner Cooper, inventor of the first trenchless drainage machine in 1954 and author of the seminal work 'Practical Land Drainage', has spent a lifetime in solving drainage problems. This feature is edited from a paper prepared by Barry Cooper for the BIGGA Education Conference at Cirencester. It offers timeless words of wisdom

In my opinion, the drainage of golf courses is no different from that of ordinary agricultural land. In most cases one is dealing with virgin land, and the principles of land drainage remain the same. This applies to both existing courses and courses under construction, with exceptions being those that have been constructed by Americans or Japanese, where wholesale earth moving is the norm.

I must be appreciated that it takes a very long time for a reasonable sub-soil structure to build up in land that has been subjected to massive earth moving, and no matter how many drains are installed the drainage will not work to full capacity until this sub-soil structure is restored. This fact is of paramount importance to the successful drainage of any course.

When I am asked to assess the drainage requirements of land that is to become a golf course, I approach it in the following way. Normally I am provided with a plan showing the proposed layout, but it will not be of much use in the initial stages of drainage design. My first requirement is a 1/2500 OS map of the area showing all the old field boundaries. If it is possible to obtain an OS map dating back to the early l900s so much the better, because there are likely to be many more field boundaries shown than on later series, showing the original boundaries before farmers and the Ministry of Agriculture vandalised the area concerned in order to produce more food and facilitate the ever increasing size of farm machinery.

Having obtained the relevant OS maps, I can visualise how each original field was drained, and I have a starting point for designing my scheme. In the old days the hedgerows usually depicted differing sub-soil types, so that farmers knew exactly which field could be worked during which time. All of this skill vanished when farm machinery improved, but I still feel this knowledge is important to me, because my plan may call for different drainage designs dependent upon the nature of the sub-soil. I try also to obtain a copy of the Geological Survey map for the area, which denotes sub-soil changes fairly accurately. Thus equipped I can be on my guard when designing a drainage scheme in an area of ever changing sub-soil.

Having ascertained where old field boundaries were I check on the relevant outfall ditches. This will also give me an answer as to whether any more modern grant-aided drainage schemes have been installed over the last 40 years or so. My next task is to seek out the man who has been farming the land in previous years. Such information is invaluable, for he will be able to tell me almost to the metre where the wet areas are, or where an old main drain runs. This is particularly important in instances where the land is flat, main drains travelling some distance to find a satisfactory outfall.

As drainage is a very costly operation, I often come under pressure from constructors to cut drainage specifications to a bare minimum, this to encourage the client to proceed with the contract. I resist this vigorously, not only because it is false economy, but also it is like building a house without foundations. If the drainage is right, some of the surface requirements, eg. trees and bunkers, can be postponed until the following year to ease the cost, without any long term damage being done.

Having made my enquiries, I start my own field work: soil samples, level surveys etc. It is at this point that I turn to the proposed layout plan, because I can allow for larger diameter pipes to accommodate greens, tees and bunker drainage, whilst designing my drainage scheme around any proposed tree planting.

I am often asked whether the drainage or irrigation should be installed first. Usually I would plump for drainage first. Drainage is purely hydraulic and has to rely on being laid to the correct falls, and as an advocate of deep drainage I like to operate without the restriction of irrigation pipes and cables.

On courses with a fairly uniform clay sub-soil, my usual design would be for a series of laterals laid at 15m centres and approximately 800mm deep, with porous fill to within 150mm of the surface, with the last operation taking place before seeding: a good sub-soil at 450mm deep. This sub-soiling is of prime importance, because during the construction work considerable compaction occurs, which must be overcome before seeding takes place. I like to bring the porous fill to within 150mm of the surface, so that lighter machinery can successfully carry out secondary treatment.

During 1989 I was asked to design and supervise a system for the Strathtyrum at St Andrews. The sub-soil was pure sand and most of the area was below the high water mark. I instituted a comprehensive level survey and ascertained that a pumping situation would be required. I am no expert on pumping schemes, so I set out to find the contractor who had worked on neighbouring land three years previously. I found him and learned more in talking to him for an hour than if I had toiled on my own for a month. He told me what water volume to expect, what pump sizes would be necessary and to make provisions for dealing with the dreaded 'red ochre'.

A series of very deep and large size concrete mains had been laid by the first contractor some seven years prior to our starting the new scheme, and upon inspection they were already beginning to block with 'red ochre'. We successfully jetted them all, and installed extra man-holes to facilitate future jetting work. A system of laterals was installed some 1.2m deep at 15m centres, which produced a staggering amount of water. The plastic pipes were all filter wrapped and I am keeping my fingers crossed that the wrapping does not become blocked. The end of every lateral was brought up to surface level and covered with a cap – also to facilitate jetting – which I calculate will be needed every five years.

In the past I believe that drainage was considered to be of little importance on existing courses, with green chairmen just shrugging their shoulders if any fairway was unplayable, with little concern to either take the affected fairway out of play or close the course until it was dry. Thank goodness these attitudes are changing now, as the realisation that if a course, or any part of it, is too wet for play a considerable amount of revenue may be lost. Many courses remain wet because people in power think they are impossible to drain. This usually comes about because 'the greenkeeper had a go at draining the fairway down by the stream and it did not work, therefore it is impossible to drain'. They do not stop to think that the drains hadn't been laid either deep enough (the usual problem) or in the correct location to achieve the best results. It amazes me that people who should know better still advocate shallow drains when draining fairways. I would rarely, if ever, recommend to a club that they lay any drains less than 750mm deep, and I shudder when I hear a supposed drainage contractor refer to a golf course as a ➡

'sports turf situation'. This usually is an excuse to lay drains at 450mm deep, at about 5 or 6m centres. Not only is this very expensive, but it is not as effective as it should be, giving little or no room for secondary treatment.

When I am called to visit an existing course, I follow a similar procedure as when visiting a greenfield site, particularly as far as the old OS sheets are concerned, obviously with a course some 80 or 90 years old, there are unlikely to be any workers left who know anything about the land. If it is possible to obtain these old maps, at least then I have the old field boundaries to hand and can start my investigations accordingly. Some times construction work has been carried out during a dry time and ditches have been assumed to be dry, when in reality they were not what we know as dry ditches, and we all know the result of burying drain outfalls.

At St Andrews, apart from the greenfield site I mentioned earlier I had to design a pumping scheme in order to drain a 1200m landstrip that comprised the 2nd, 3rd and 4th holes of the Jubilee Course, which was also below the high water mark. Well, I thought I had seen an awful amount of water making out of the sand on the Strathtyrum Course, but it was nothing compared to what we hit on the Jubilee. The contractor installed the pump site and we started with the pipe reservoir at 3.5m deep at the pump site and 1m deep 1200m away at the 4th Green. Two laterals were installed, average depth 1m, parallel to the main and connected into it at intervals. We were suddenly removing in excess of 1 million gallons of pure clean water per day. I thought the water would be salty, but it was beautifully fresh and clear.

There are five courses at St Andrews and they have a 400,000 gallon reservoir that was kept going by pumped water from the Swilken Burn. This water was sparse and not as clean as it might have been and although all the courses at St Andrews have automatic sprinklers on greens, tees and fairways, water was so scarce that only the Old Course received the amount required to keep it fairly green.

'Many links courses could be sitting on a goldmine of untapped pure water...'

Now with the water we had found, we connected it to the reservoir through a series of gate valves again and they had to install a 150mm overflow pipe to cope with the quantity of water. I was concerned that the water was forming an underground block against the encroachment of salt water, and with drawing so many million gallons of it away I felt the salt water may eventually become predominant. However, chemical tests are carried out regularly and during the last two years this hasn't happened and the quantity of water has only decreased slightly.

What was very interesting at St Andrews was that there were two main drains (stone drains) with manholes at every 150 yards that must have been at least 100 years old, laid by hand. They were around 300mm in diameter and, apart from their upper reaches, were working perfectly. I should mention that where our new main drain was at its deepest, we were drawing water from the sand over 150 yards away.

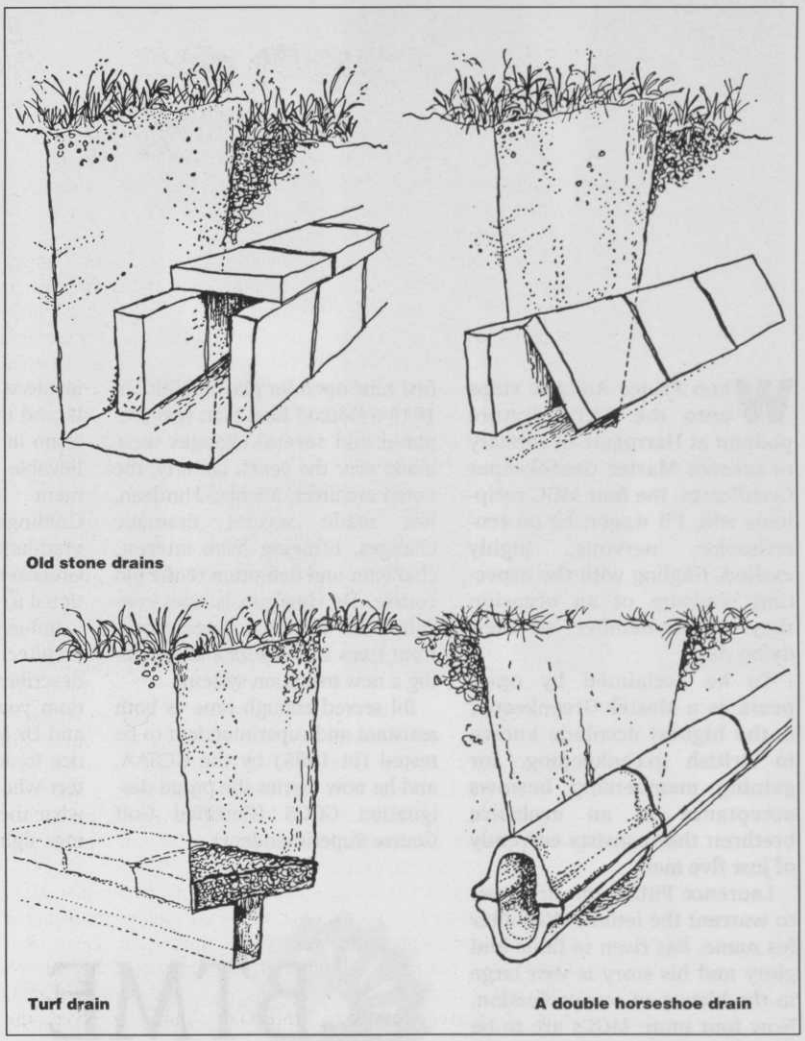
Having had these experiences at St Andrews, I can't help feeling that many other links courses could be 'sitting on a gold mine' of untapped pure water, which could save untold cost if harnessed properly. The same could be said for some inland courses, where there is a particularly sandy sub-soil and the topography of the area creates the correct circumstances.

I would just like to mention the drainage of greens and tees. These days greens are constructed on a 'stone carpet', with pipe drains laid under the carpet at approx. 300mm deep. The carpet

is usually 40mm clean stone laid to a thickness of around 225mm. Newly constructed tees are drained in an identical manner. The only thing I fall out over regarding this is that if there is no general drainage scheme required or afforded, green and tee drains are usually led to a 'soakaway'. The use of soakaways always make me smile, because I believe that if water is expected to soak away just a few feet from the drained area, it is reasonable to expect it to soak away anyway and not require draining! Greens that were constructed many years ago have no stone carpets and present a variety of different problems, particularly the obvious ones arising from sunken greens or those carved out of the side of a hill. The only way to drain virgin greens is to install pipe drains to lower the water table therein. Sometimes with careful thought this object can be achieved without actually laying drains in the putting surface.

As with agriculture, drains alone do not keep a green dry. Good greenkeeping is essential, and things such as thatch and compaction must be kept under control at all times. Bunkers on clay based courses are also a potential trouble spot, and I usually recommend that drains be laid along the length of the bunker some 300mm below the level of the sand. I usually specify filter wrapped pipe, with a 6mm to 10mm backfill over, with a geo-textile membrane strip over the backfill or turves. I prefer this method to a sump in the bunker, because the sump tends to be like taking the plug out of a sink full of water and drains the sand into the porous fill and the pipe.

Another thing I feel strongly about is the timing of drainage work. Most clubs will try to insist that their drainage scheme is carried out at the end of the season so as not to interfere with tournaments, but what they don't realise is that not only are they taking a much bigger risk weather wise, in extreme conditions they could lose a further season's play on the affected areas. I always try to persuade clubs to allow the work to take place in mid summer, when disturbance to both club and soil is minimal.



Old stone drains

Turf drain

A double horseshoe drain