THE CONSTRUCTION OF ARTIFICIAL WATER HAZARDS

By: Howard Swan, M.Sc.

Why use artificial water on a golf course at all? Or I would prefer to put the question, Why not?

Firstly and most important, take the requirement of water conservation for use elsewhere on the course. We are all familiar now with the automatic watering systems for greens and tees, and in some cases for fairways also. Such a system obviously requires a source of water, which could be from elsewhere on the course or else via a mains supply. If one considers that it takes approximately 10,000 gallons of water for a six minute irrigation of a course each day and a mains supply would cost about 40p per 1000 gals (besides any connection charge) so a summer's watering might cost in the region of £700 per year. Quite a sum for supply alone! Obviously, many golf clubs may not have sufficient natural water inflow to maintain such an irrigation system, but many have, and there could be a considerable saving if a 'natural' system is adopted.

Secondly, the creation of artificial lakes does provide an alternative type of hazard to the sand trap, and is, if correctly positioned, a particularly attractive and pleasing part of any course. Many golfers may think that they have perfected their bunker play; it will take them considerably longer to play from water with any satisfaction! Additionally, and somewhat lightheartedly, it does provide the greenkeeping staff with an excellent source of balls for their own game. Seriously, artificial lakes really can add a new dimension to a wide variety of holes on a course and present a great challenge to the player. The positioning of an artificial water hazard is vital to the course, and there are many aspects which must be considered before a choice of site can be made and construction can begin.

The architect must look first at the location of natural water courses on the proposed site, be they small or large ditches or streams; second at the inflow and outflow capacities of the ditches throughout the site; third their relation to the existing drainage system (if any) on the surrounding land.

Along with this consideration, he must visualise how one or more water hazards will fit in with his initial plans for the overall course layout. A suitable site for a lake may dictate the incorporation of a particular hole at that particular point on the course, and therefore will inevitably contribute towards the overall design.

Then he must look at the proposals for land drainage and irrigation for the total golf course development. Is the lake to be positioned in such a place as to be a good outfall for fairway drains or will it impede their discharge? It is obviously essential that any surface water is drained adequately from the site, and a well-positioned lake can help in this respect and also be maintained in water level by this outfall. Also, it may be possible to use the lake as a reservoir for irrigation should the location be such that the economics of pumping are not too restrictive. It is unlikely that one could find such an ideal lake position to fulfil all these considerations on every site, but careful consideration of a location is obviously important.

Turning towards the practical side of these hazards, we find essentially three types of construction.

The first is the simplest and cheapest and this is the unlined lake. This type of construction would be related to an existing water course, which is able to maintain a permanent inflow or water in sufficient proportions to fulfil any irrigation requirements, and also an impermeable subsoil. It is a simple method of enlarging a section of stream or ditch to a pleasing irregular shape of a size between 1000—4000 sq. yds., and to a depth of no more than 4-5 feet. Just deep enough to deter the avid golfer from wading in to retrieve his ball ! ! We were fortunate enough to be able to construct two lakes of this type recently at Ely City Golf Club in nearby Cambridgeshire. The position chosen for the lakes was in an area where the water table was high, and with a combination of a large inflow of water from existing ditches and an impervious subsoil, no lining membrane was necessary. In fact, we found that we were able to maintain a capacity of 200,000 gals. throughout a summer, and a full daily programme of greens irrigation only lowered the water level by 2″ and this was quickly replenished.

The second type of lake construction includes the installation of a Butyl or ruberoid lining on the base and walls of the lake to form a water tight seal. The lining is thick and elastic to some degree. It is essentially tailored to a particular size of lake and is laid as one sheet, being held in a trench at the perimeter which is backfilled with soil. Butyl lining is particularly suitable for lakes in which a high quality preparation of the base is not possible, either because of underwater springs or particularly wet underfoot conditions. It is an immensely strong fabrication and the makers claim a long life span under even the most extreme conditions.

An alternative lining to Butyl is polythene sheeting. This is the type with which I have had most experience and I should like to go into the methods involved in its use. The polythene membrane which we normally use is of a 1000 gauge and combines a fairly strong character with a certain degree of pliability whichever is preferred.

The initial step in construction is the excavation of the lake to the desired contours by bulk earth moving machinery. The subsoil removed here can be utilised elsewhere in the construction of greens and tees etc. (a saving here). After the lake has been roughly contoured to the desired shape, it is necessary to trim and carry out the final shaping with a smaller machine to leave the base and walls in a smooth formation. Before the lining is laid, a small amount of handwork is required to rake over the surface to remove any small flints, stones etc., which could damage the lining. In addition, it is often good practice to blind the raked surface with a little sand to prevent any possible puncturing.

A narrow trench is then excavated around the perimeter of the lake, 12″ wide and 12″ deep, some 24″ from the edge of the lake. This will act as an anchoring trench for the polythene itself.

The lake is now ready to receive the polythene sheeting. This comes from the manufacturer in rolls and is therefore laid in strips from trench to trench. The laying is quite a sophisticated process and we employ a specialist firm to carry this out for us. Each lining strip is joined to the next with double-sided bitumastic tape with a considerable overlap as a safety measure. The sheeting is left quite slack on the base of the lake to allow for the weight of backfill and water to take its effect.

Now it is generally accepted that the type of sheeting is not everlasting if left open to sunlight and spiked golfing shoes. Therefore, we recommend that an overlay of between 4"-9" of soil, or sand, is run on top of the polythene as a protective layer. This can be done by manual or mechanical means, the latter being obviously quicker, so long as sufficient care is taken to ensure that the lining is not damaged by either human feet or machine wheels or tracks. Generally however, this can easily be done. This overlay will not only provide protection for the polythene, but will also prevent the rare occurence of water getting beneath the sheet and forcing it up to the surface.

The sides of the lake above the projected water line can then be soiled and seeded to marry in with the surrounding fairways and rough. All that is then necessary is to fill the lake with water if a natural source is not available, and this is quickly done from a hydrant point in the irrigation system. Such a point should be included in a watering system where artificial lakes are to be built as periodic topping-up may be necessary.

One or two more additional points which may be of interest to you:—

1. There is a danger that outfall drains from fairway schemes may come into the lake and possibly flow under the polythene. This is easily remedied by introducing short lengths of alkathene pipe onto the end of the tile drain and bringing it through the polythene. A thermal weld is produced at the point where the pipe breaks the sheet and so perfects the seal.
2. We have found that a blinding layer of shingle on top of the soil or sand backfill prevents any debris floating in the water and so clouding it. A useful fact especially for lakes around the clubhouse which can be planted and stocked with fish.

Now to the economics of all these operations:—

Let us take construction first—say a proposed lake of some 2000 square yards and 5 feet deep. The bulk excavation of this lake would cost about £300 but as already described, such an expenditure can be offset against the earth movement costs of building a green or tee. General trimming and final preparation would run out at £50. Now using Butyl lining, the supply and laying process would cost about 80p—to £1 per square yard, whereas polythene sheeting would be between 25p and 40p per sq. yd. The cost of the backfilling with sand at a depth of 3"-4" would be around £250 and then the water filling is just an incidental.

So using polythene sheeting one could have a fairly large lake or reservoir for about £1,500 or 75p per square yard. Now compare this with a bunker of say 60 square yards. At least £10—£15 to construct, and with good quality sand £50—£60 could be expended in all. Thus £1 per square yard to compare with 75p for a lake.

On the question of maintenance of these hazards, there is a minimal outlay. The occasional topping-up and removal of surface weeds, and perhaps a spray with a selective herbicide, should it be found necessary. But a bunker—a high labour content in maintenance. Raking, cutting the banks and surrounds, and weeding—as regular items and also the replacement of sand probably each season. Obviously, all these can work out at quite a sum taken over a year.

Of course, I am not saying that we should replace bunkers with water hazards, but I feel that there is a strong case on economic grounds alone to include some water hazards on a new or existing course during constructional activities.

An artificial water hazard brings a new dimension to the design and construction of a golf course. It brings a new dimension to the problems which the golfer faces and can add a beautifying feature to a particular part of the course. In all, they have an enormous potential in becoming much more important components of many more courses. I certainly hope we shall see many more of them.

Questions on

ARTIFICIAL WATER HAZARDS

Q. Could Mr. Swan develop the commercial aspects that the water would cost the club several thousand pounds a year and with the nationalisation of water with the Water Resources Act, what is that going to mean to the average Golf Club.

A. When we investigated the economics of the supply alone from the Water Board, they gave us that figure of 40p a thousand gallons, and on the calculations of the average amount that you would use in the summer, then it would work out about that figure. I have really no idea what it might come to following the reorganisation.

Q. We have just finished constructing a course and introduced a small reservoir around one of the tees and are using this to take water off for an automatic system, and we went through the usual channel of finding liners, touched on a rubberised one which was going to cost around £2,000. So we went for the polythene in the end, but since then I've heard of another product and wondered whether you had had anything to do with it, this bitumastic solution which is pumped in by tanker as the water is filled up, because we are on chalk which does not hold any water anyway naturally.

A. It is something we have not used. I think on some of the courses in Spain they have sprayed a type of latex onto the surface of the walls at the base of the lake to hold the water. It is something we have not at present used in this country, we have, in fact, only used the two types of lining and we have found, in fact, polythene to be very successful indeed.

Q. Could you enlarge on the thickness of the polythene ?

A. It is a 1000 gauge. I think on the little brochure I gave out it will give the actual thickness (Q. about 4-5 millimetre ?). It is not as thick as that. I have some samples so we can look, if the questioner would like to see me afterwards.

Q. Surely in the long term, an artificial base is bound to suffer from the effects of trees and their roots ?

A. Yes, I would agree, if you have a lot of large trees about, then obviously the roots may go into it. I mean we have not had any evidence of this at all because we have never put a lake in, close to a tremendous amount of very mature trees. We have never had any experience of the polythene being punctured or the butyl being punctured from the outside at all, but I mean theoretically, certainly it is possible; but it is something we have not had any experience of at all.

Q. In constructing lakes, I always find it a problem to decide how deep to make one's artificial lake, but obviously you don't to make it too deep from the cost consideration. At the same time I am quite sure one must not make it too shallow, because if it is too shallow, you do greatly accentuate the week problem, and what sort of happy medium have you found in your experience.

A. Well, we have found that we have built one or two fairly shallow and we have found that one or two people have gone in, with the polythene lining, and punctured it with their spikes. It has got to be deep enough to deter the golfer from going in after his ball, obviously it has got to be shallow enough not to present too much of a danger problem. The golfers may stay out of it, but there may be children who play around unnoticed by the greenkeeper, who could easily go in and the deeper it is the worse it is from the danger point of view. You have to have a compromise between the amount of water you require to, say, irrigate the course, the capacity required within the lake and some compromise between the surface area and the depth. It all has to tie in with the overall design. Down at Foxhills we have got about 5 foot and we have never built one shallower than about 3′6″.

Q. I have been to a golf course which has been recently constructed and they made a lake there, and the banks on the lake were very high. Now when it was completed, it was done with polythene, and when the banks were completed and the banks started to grow, it looked very nice, but after 2 years of the banks being there, they started to slide down the polythene into the lake. This is what has happened and the polythene has been left open. Do you have a solution ?

A. The banks must not be constructed more than 1 in 3 because in order to get the soil to stay on there, you have to have gentle banks. Polythene is a smooth surface itself and therefore it is easy for sand or soil to slip down. Now either you build gentle banks, or if you are in a position not to be able to have gentle banks, as you are, you would be better either not putting soil on the banks which is obviously a bit dicey with polythene, or else using some other type of surface to put on the banks. You can get types of concrete blocks which you can put soil or sand in and seed over the top, which are specially designed for surfaces where soil won't stay on because the angle is so great. This is a possibility. Having used polythene and now you have it exposed, you can either try and put the soil back and make sure it holds, or you have to cover up in some way, so have to use some other form of seeding.

(Mr. Swan Senior)

If the banks are rather acute or severe then you could fill the bottom of the lake with a greater depth of soil. If the banks are sheer, then you raise the level of your fill inside, so that, in fact, that will hold any slip of soil down the surface of the polythene. Obviously if there is a 45° angle, you can raise the amount of fill on top of the lining by 1′ or 1′6″ therefore making the water slightly shallower. This then alters the angle of your bank and holds the material from slipping.