Syringing — another degree of system diversity.

Irrigation – The Hidden Story

by **CHARLES B. WHITE**
Agronomist, Southeastern Region, USGA Green Section

IF YOU WERE TO evaluate all the factors responsible for quality turf, a well-designed irrigation system would surely top your list. Without water, there can be no grass. Many believe irrigation is the single most important practice in turfgrass management today.

What a wonder, then, how few realize that the irrigation system is a management tool. Golf course operators strive to buy the best machinery for their money, so why shouldn't golf course irrigation be given the same consideration?

The hiring of a qualified irrigation design engineer is the initial step to a quality system. It is always best to hire a reputable irrigation engineer who is known in the field, one who has installed systems that can be observed while in operation and discussed with their owners. Experienced engineers may be more expensive, but the quality of work and service from the system will more than justify the additional cost. A competent engineer is the key to the success of a well-designed system and pump station. Engineering is not a place to cut corners.

A knowledgeable superintendent can be of tremendous help to the irrigation engineer. He has the local knowledge; he is the person who must work with and depend upon that irrigation system once it is installed.

What type of turf to be grown should be considered early. This involves two basic concerns: first, the water requirements of that specific turfgrass, and secondly, the environmental conditions of the area in regard to annual rainfall, temperatures, severity and duration of stress periods. These environmental factors determine the irrigation frequency that must be designed into the system.

Such requirements will determine the delivery needs the system must meet in terms of water capacities and frequencies of cycle, because the irrigation system is designed to supplement the annual rainfall and to replenish losses from evaporation. Note the phrase "supplement the annual rainfall"; that is an important part of system design. A system is not designed to furnish the needs of a specific turfgrass completely.

THE NEXT consideration of design is the source of water. Water is now being scrutinized very carefully for recreational use in many areas of the country, and quality of water as well as quantity is becoming a critical issue. Often, golf courses in some sections of the United States irrigate with water exceeding 2,000 ppm salt. This can create turfgrass problems, especially when improperly used.

Recreational areas, such as golf courses, will be the first to be cut off when potable water becomes limited. Thereafter, other sources, such as effluent water, must receive primary consideration for future use. This fact requires special planning for the irrigation system. Special filtering systems for pump stations as well as more frequent filter checks for the individual sprinkler heads will be needed. Anticipating future water problems will hopefully encourage irrigation design for maximum efficiency with all kinds of water sources.

Once all the variables have been studied, it is time to decide exactly the type of system needed. Major considerations for determining the overall plan include the coverage desired, soil infiltration rate, frequency of application and type of irrigation control. Uniform coverage is essential. Wet spots and dry spots can easily be introduced by poor design or improper installation.

One important aspect of uniformity of coverage is the need for specialized heads. Many times, specific coverage patterns must be applied in areas to cope with high winds, steep slopes or non-target areas. Low-angle nozzles in windy areas will help minimize wind-caused distortion and improve coverage of that head. Low-pressure and low-precipitation heads help on steep slopes when large water volume could cause severe runoff and erosion problems.

Other areas that require specialized water control, such as residential perimeters and clubhouse grounds, are in and around golf courses. Here the

Quick couplers should be readily accessible and easy to locate.

Swing joints of all PVC construction act as shock absorbers for the piping system. This one is ready to install.

engineer will utilize part-circle heads to control water applications.

Quick coupler valves are frequently neglected in automatic systems and systems of total pop-up, irrigation-type heads. A quick coupler can be one of the handiest components in a golf course irrigation system; one should be located at every green and tee, and several should be in every fairway. Ideally, par-4 and par-5 holes should have a quick coupler every 200 feet to provide readily accessible water for all types of supplemental needs, such as filling sprayers, watering ornamentals, or operating set sprinklers in specific areas. Quick couplers should be installed immediately adjacent to an irrigation head so they can be located easily.

It is also important to design the irrigation system to insure that its delivery rate does not exceed the infiltration rate of the soil. A prime example of this is the high-silt clay soils that require light, frequent applications of water not to exceed infiltration rates. The converse examples are the high-sand soils of Florida and other areas where infiltration rates almost cannot be exceeded by the irrigation system.

FREQUENCY OF application required is important. It will determine how elaborate a system will have to be. For example, if the entire golf course must be watered every night, the system must be much more elaborate and much more expensive than a golf course requiring only once-a-week irrigation. This goes back to the demands of the system for delivery rates. The elaboration and expense come from increased pipe size to meet higher demands, the increased requirement of the pump station to deliver water and the greater precipitation rate of heads needed to meet the requirements of irrigation frequency.

The type of system actuation is the last basic factor in determining the irrigation needs of a course. The best approach to control is individual head control or as few heads per station as possible. That is, to be able to control each head independently wherever possible and as few heads as possible where individual head control is not feasible.

The closer one can approach individual head control, the better the handle on controlling water rates and watering to the particular needs of the golf course. Greens and tees should certainly have individual head controls.

Fairways should be sectioned into blocks as small as affordable. It would not be feasible to water the entire fairway for one specific dry spot which commonly occurs in landing areas or approach areas to the greens. This is why stationing is so critical. Station requirements should be designed to provide maximum control of water distribution and placement. A maximum of four heads controlled by one station is frequently suggested for fairway application.

The degree of control is also important for specialized functions, such as syringe cycles. Courses with creeping bentgrass greens may require syringe capabilities for the hot summer months, while courses with bermudagrass greens will require light, frequent applications in the fall when establishing the overseeding cover of cool-season grasses.

The type of control mechanism forces another decision. Hydraulic versus electric is always a controversial subject, but both do have advantages and disadvantages that the design engineer will

Pipe misalignment need not be a headache.

point out. The hydraulic control system is used in many cases because its operation is somewhat simpler to understand. However, it cannot be used as effectively on courses that have significant elevation changes, because pressure losses in the control tubing can prevent accurate operations. Further, water supply for the control lines must also have a clean source, preferably from a potable water system. Even a small amount of debris can quickly cause clogging and failure of the hydraulic system.

Electric controllers, on the other hand, are often avoided in areas of frequent thunder and lightning storms. This is a common problem in south Florida, where the level terrain is conducive to hydraulic controllers.

AFTER MAKING the above considerations, the next step is to determine the type of pump station needed to deliver the demands of the designed system. The irrigation engineer will undoubtedly design the pump station to handle the system adequately, but the superintendent should also know some of the basis of design so that he can contribute his views on station selection and function.

Electric motors supply the power for the pumps and should be studied to determine function characteristics. For example, turbine-type motors and pumps are much more efficient than centrifugal or submersible pumps. Also, one large pump is more efficient to operate than two smaller pumps, but a golf course irrigation system cannot afford to be at the mercy of a single pump. If there is a breakdown, a tremendous amount of grass may be lost before the pump is repaired. This is why it is essential to have two or more smaller pumps to meet the demands of the irrigation system.

A jockey pump is usually the second power source. It is normally 20-25 hp in size and set to cycle no more than five times per hour to maintain pressure in the system. It also supplies small demands for water, such as syringe cycles or specific area watering for two to three heads.

One important consideration to remember in evaluating the feasibility of a jockey pump is the function that it serves. Starting an electric motor requires 150 percent of its electrical demand. Any time larger motors are used to maintain pressure for small delivery demands, a tremendous amount of electrical power is used.

To better understand the electrical requirements of a jockey pump, if you wish to irrigate at the rate of 10 gallons per minute and the main pump delivers 100 gallons per minute, this is 10 percent of its electrical power. This means that 30 percent of the electrical requirement of that pump is being wasted to meet the small demand. Over a period of time, this can significantly add to electricity costs. Moreover, this low demand causes frequent cycling of the pump, thereby creating severe surging in the lines, which in turn may lead to pump and pipe damage. The importance of the pumping station cannot be overly stressed. It is the heartbeat of the entire irrigation system.

After the system's design and pump station have been established, the next step is to plan the actual installation.

The pump station site is a natural beginning point since it is from here the pipe runs to the extremities of the course. The type of pipe to be used is very important. This will be established by the irrigation engineer. Usually, 160 psi PVC pipe is used for most large turf irrigation systems.

As the pipe installation progresses, it is vitally important to make sure swing joints are installed properly for each irrigation head. The best swing joint material is schedule 80 PVC. PVC has proved to be much better for swing joints than galvanized pipe because there is no corrosive breakdown and it is cheaper. Schedule 80 PVC is needed because it is much stronger than schedule 40 or 160 psi and withstands shock from traffic and surface abuse to which irrigation heads are normally subjected.

Swing joints must be constructed and installed in the proper manner. They may very well be the most important component of the piping system, and they should never be omitted from large turf irrigation systems.

GATE VALVE sectioning is another very important step that must be accurately accomplished to prevent system failure in the event of a line break. Gate valve locations will be arranged by the design engineer to section off the piping system. This enables the operator to isolate a line break, and the entire system will not have to be shut down to repair it. Gate valves should be boxed for ease in location and accessibility. All valve boxes should be well removed from play areas such as greens, tees and fairways. Plastic or concrete valve boxes are more feasible and durable than metal. Gate valve sectioning will increase costs because of the need for additional pipe, valves and valve boxes, but these costs are insignificant compared to the benefits received.

As the pipe, swing joints, heads and valves are being installed, the control lines are simultaneously being laid down. Whether electrical wires or hydraulic tubing is used, their placement is critical to prevent damage and insure positive relocation. The best position for control lines is to place them on the left-hand side of the piping with the swing joints on the right side. This procedure will help insure against damage when repairs to lines are made. The pipe serves as a protection for these lines and insures that their exact location is always known. Position there insures that they will not interfere with the action of the swing joint, which could pinch or sever the lines. All splices in control lines should be well-made and located in a valve box. This allows for easy accessibility to splices and makes for easy tracing of electrical breaks or hydraulic tubing clogs.

After all components have been installed, thrust-block construction and backfilling follow. Thrust blocks should never be omitted from an irrigation system. They prevent pipe separation and blowouts due to water hammer. Often, bricks or rocks are used as thrust blocks, but these materials can severely wear the pipe as it vibrates and moves as water under pressure flows through. Thrust blocks must be composed of five parts sand, two parts gravel and one part cement. This mixture allows for adequate rigidity but does not form too hard a surface, one that is abrasive to pipes and eventually causes a puncture at the surface.

The positioning of a thrust block is as critical as its composition. Ordinarily, this cement mixture is used as a wedge between the pipe and the trench wall. In heavy clay or gumbo soils, the wall of the trench can be used as a thrust support, providing the joint is secured tightly against the wall and the cement mixture is poured to keep the joint stationary.

If a joint occurs where there is no trench wall to pour the thrust block against, other arrangements must be made. Concrete reinforcing rods do a very effective job of anchoring thrust blocks when driven in the ground at the joint to be secured. They are aligned in double rows about two inches apart, four rows deep, and driven level with the top of the pipe. The cement is then

Bundled control tubing makes for easy repair.

poured around the joint and reinforcing rods, which should hold the pipe securely in place.

Once all thrust blocks have been constructed, the backfilling of trenches should be completed as quickly as possible to secure the system in the trenches and prevent float-outs from rainstorms. Make sure clean soil is always used for backfilling over the pipes to prevent direct contact with rocks or other foreign matter. As mentioned previously, the pipe movement against such material can cause severe damage to pipe surfaces.

Initial backfilling is done between joints, leaving all joints exposed. Once this backfilling and tamping is finished between joints, the system can be pressurized and checked for leakages. It is best to let the irrigation system function for approximately two weeks so that all joints, valves and heads can be observed for leaks and performance. This is also a perfect opportunity to observe coverage patterns, because dry spots can easily be located on bare soil.

After the pressure check is completed and proper coverages are established, the "as built" can be verified as to the exact location of all heads, valves, control lines and splices, and control boxes. The "as built" is simply a readjusted irrigation plan which provides a complete and thorough system analysis of exactly how that system was installed. It will be invaluable for future reference when repairs are needed or component locations are needed to prevent damage from excavation projects. Needless to say, this can save tremendously on money and man-hours in the future.

ONCE THESE operations are completed, the next step is to backfill trenches and tamp the soil firmly in place. Tamping is essential to prevent future settling and depressions over each irrigation line.

Once backfilling and tamping are completed, the final grading can be set without future settling of the irrigation line. After the turfgrasses are established, it will be necessary to make the final height adjustment on heads and valve boxes. This is a very tedious job, but proper swing joint installation makes it as easy as possible. All heads should then be made absolutely flush with the surface. Low heads will cause depressions and high heads are subject to mower damage.

Quick couplers are probably more important for leveling than pop-up heads because dirt can easily infiltrate into the quick coupler and cause clogging. Some pop-up heads do have somewhat of a self-flushing system as they are activated and inactivated to keep some of the soil out during the establishment phase. In either case, it is important to stress that eventual head and valve leveling to the grade of the existing turf is a necessity.

Now that the installations have been completed, the grass establishment phase is begun. If all the steps outlined above have been followed, the golf course superintendent can establish his turf with confidence. The irrigation system will deliver when and where necessary. It is the single most important management tool he has at his command.

(Special thanks to William Fuller, Augusta National Golf Club, and Mark Hampton, Wyndemere Country Club, for their help in preparing this article.)