Golf Course Irrigation

• The engineer's role in helping to set up a system at your course

• Practical facts you should know about costs, measurements, efficiency

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(Third of three articles)

IF AN irrigation engineer is retained so that a club can obtain competitive bids from responsible contractors for the installation of a course watering system, the engineer should furnish the following service:

1. Consult with the supt. on maximum water requirements. It must always be borne in mind that club members will expect greatly improved turf from the new irrigation system and will hold the supt. responsible. Consequently, both he and the design engineer must be in complete agreement.

2. Stake out on fairways, tees and greens the exact locations of all sprinkler valves, drain valves, control valves and piping routes.

Prepare Plane Survey

3. Prepare a complete plane survey of the course showing all fairways, tees, greens, traps, roads, buildings, etc., which will help to give a clear and understandable picture of the layout. On this drawing should be shown the complete irrigation system drawn to scale. (A common scale is 1 in. to 100 lineal ft.). Fairway, tee, green and lawn areas to be watered, along with sprinkler coverages, should be shown on the drawing. A meeting should then be arranged with the supt., green chmn. and his committee so that the entire irrigation design can be thoroughly examined. If any changes, additions or deductions are requested they can be made by the engineer who then proceeds to prepare the final plans and specifications covering every phase of the work.

Outlines Contractor's Obligations

4. In addition to the specifications giving the complete list of pipe footage, pipe fittings, type of pipe, method of trenching, laying pipe and backfilling of trenches, the engineer must prepare the necessary proposal and contract forms in order to obtain bids. He also must make sure that the club is protected in every way by seeing to it that the contractor who is selected carries workmen's compensation insurance plus fire, tornado and theft insurance on his equipment and material going into the construction. Further, the contractor should furnish the club a performance bond guaranteeing the performance of the irrigation system as dsigned by the engineer. This bond should remain in full force for one year after the system is installed and accepted as a guarantee that the piping will drain free of water. To further guarantee this clause it should be the contractor's duty to drain the system in the fall, following its installation, and turn on the water into the system the following spring. If any leaks or defective material shows up the contractor must repair them and replace all defective material at his own expense and to the satisfaction of the supt. A performance bond for 100 per cent of the value of the contract usually costs 1¼ per cent of the contract amount.

Arranges for Payment

5. The engineer in his specifications should inform the contractor of the time and the basis upon which payments will be made. Payment on the 15th and 30th of each month for work done usually is acceptable to a contractor. The engineer is able to appraise the value of the work done by having the contractor, when he is submitting his bid, give a lump sum price based on furnishing and installing all materials listed by the engineer in the specifications and then breaking this price down into unit costs (i.e., furnishing the price for each foot of pipe in various sizes, each sprinkler valve, drain valve and control valve, all in place.) It then becomes an easy matter for the engineer to measure the amount of pipe installed plus all other

items every two weeks and by multiplying by the contractor's unit costs, he can correctly arrive at the cost of the work completed. It is usual to retain 15 per cent of these partial payments for work done until the entire project is completed.

If, during construction, the club wishes to add to the irrigation system the engineer can quickly, from the unit price submitted by the contractor, arrive at the exact cost of any addition.

6. When the irrigation system is completed, tested and accepted, the engineer should prepare a final drawing showing any deviations from original plans and submit to the club at least three blueprints of the corrected drawing.

Some Handy Formulas

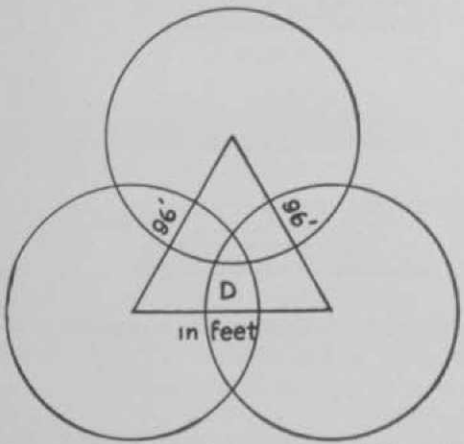
Formula for finding precipitation in ins. per hour from any sprinkler when the discharge in gpm and the dia. of coverage in ft. is known:

$$\text{Precipitation in inches per hour} = \frac{122 \times \text{GPM}}{\text{Dia. squared}}$$

Example: If a sprinkler discharges 25 gpm and covers a circular area, 120 ft. in dia., precipitation per hour is:

$$\frac{122 \times 25}{120 \times 120} = 0.21 \text{ inches per hour.}$$

Formula for finding precipitation in ins. per hour from sprinklers located in an equilateral spacing when the sprinkler discharge in gpm and distance between sprinklers in ft. is known:



The precipitation in ins. per hour of the water falling within triangle is:

$$\frac{111 \times \text{gpm}}{\text{D in ft. squared}}$$

Example: If each of above sprinklers discharge 25 gpm and they are spaced 96 ft. apart in an equilateral position the precipitation in ins. per hour of the water falling within trianglar area is:

$$\frac{111 \times 25}{96 \times 96} = 0.30 \text{ ins. per hour}$$

Practical Precipitation Method

It often is the desire of the supt. to obtain a cheap, easy, and accurate method of determining the exact precipitation of water in ins. per hour obtained from his sprinklers. The following suggested method can be used:

Materials required

1. A number of No. 2 cans, or any similar type of container, which has a diameter of 3¼ ins. No. 2 cans are commonly used for canning peas, beans, tomatoes, etc.

2. One glass or plastic cubic centimeter tube. A graduated cc tube is inexpensive and may be purchased at most drugstores.

Method to Employ

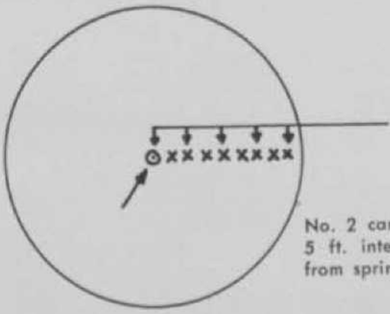
1. Place sprinkler in desired position.

2. Use as many of the above No. 2 cans as are required to extend them in a straight line at 5 ft. intervals from the sprinkler to the outer edge of coverage.

3. Set the sprinkler in operation. Run it for exactly 44 minutes.

4. Shut-off sprinkler and pour the contents of each can separately into the cc tube. A reading in cu. centimeters will be obtained but each cu. cm. will equal exactly 0.01 inches (1/100 inch) of sprinkler precipitation per hour.

Example: If a reading of 37 cu. cm. is obtained from the contents of any No. 2 can during the 44 minute run, the sprinkler will have precipitated exactly 0.37 inches (37/100) of water per hour on that particular area. By plotting the precipitation from each can on graph paper a true picture of the sprinkler precipitation can be obtained. The above test must, of course, be conducted when there is no distortion of water coverage by wind velocity.



No. 2 cans at 5 ft. intervals from sprinkler.

Method of Computing Economical Pipe Sizes

Selection of the correct size of pipe for a course water distribution system should be based on costs (i.e. the cost of the pipe, pipe fittings, labor to install and cost of power to operate the pump.)

A small pipe costs less than a larger pipe. But friction or power loss is greater in the small pipe and this increases the bill for pumping water. A larger pipe will, in many instances, save more in power bills than the additional cost of the large pipe over the small pipe. Furthermore, the larger pipe may so reduce the total head, or pressure, at the pump that a smaller and lower priced pump may be used.

One example of how to arrive at the "best" or most economical size, once the flow and yearly operating time is known, is given below:

A pump is to supply water at 100 gpm through a pipe 1,000 ft. in length and which, we will presume, is laid on level ground. While the size and kind of pump will not be considered here, we'll assume its efficiency is 70 per cent.

Size of pipe	cost of pipe installed	10% of pipe cost	Pipe friction in h/ft	KWH per year in pipe friction	Cost of power per year @ 4¢ per KWH	Total cost per year
2 in.	$1150.00	$115.00	358	7715	$308.60	$423.60
2½ in.	$1310.00	$131.00	120	2586	$103.44	$234.44
3 in.	$1630.00	$163.00	49.60	1067	$ 42.68	$205.68
4 in.	$2550.00	$255.00	12.20	263	$ 10.52	$265.52

Explanation: The figure in column 2, the cost of the pipe, pipe fittings, trenching, installation and backfilling, is based on current costs for this type of work in the Chicago area. The interest rate on the initial investment is 5 per cent. The life of the pipe is estimated at 25 years, so that 4 per cent of the initial investment must be laid away each year to take care of depreciation.

Thus a total of 10 per cent as shown in column 3, must be paid out or put aside each year to pay for the use of the pipe.

The pipe friction in column 4 is computed in the usual way and is based on a friction of C 100.

The horsepower required to drive the pump against the head in column 4 is then computed. In column 5 this is changed to kilowatt hours (KWH) by multiplying by 0.746 times the number of hours the pump is in operation each year. In this case the yearly irrigation season is construed to be 100 days at 8 hours per day, or a total of 800 hours. Thus the figures in column 5 come from the formula:

$$\text{KWH} = \frac{\text{gpm} \times \text{head in feet}}{3960} \times \frac{1}{0.70 \text{ efficiency}} \times 0.746 \times 800$$

which in reduced form is:

$$\frac{\text{gpm} \times \text{head in feet}}{4.64}$$

With power costs at 4¢ per KWH the figures in column 6 result. The total cost per year for the pipe and the power is the sum of columns 3 and 6, as shown in column 7. In this case 3-in. pipe is the most economical to use.

For a complete picture of all the costs a pump and motor should be selected and about 15 per cent of their cost added to the totals in column 7 for the yearly use of the pumping equipment.

Taking issue with C. E. (Scotty) Stewart's observation that cement-asbestos pipe absorbs water to the extent of 10 per cent by weight, and in time may become flaked (Golfdom, Sept. p 28), C. R. Hutchcroft, research mgr. of Keasbey & Mattison Co., Ambler, Pa., has this to say: Water absorption, it is conceded, may amount to 10 per cent, but exhaustive testing by K & M shows that cement-asbestos pipe remains essentially unchanged in spite of this adverse condition.

The lowest costs of these new totals give the correct size of pipe and pump equipment to use.

All too often cost influences the purchase of pipe. We frequently end up with pipe of too small diameter. This is false economy when we realize that when we double the diameter of a pipe we increase its water delivery by 5.70 times. Under the same pressure, velocity of water flowing in the small pipe is less than it is in the larger pipe and the volume of water delivered varies in about the square root of the 5th power of the pipe dia. The table below is calculated on this basis.

The figures opposite the intersection of any two pipe sizes is the number of smaller pipes required to equal one of the larger pipes; thus one 4 in. pipe equals 5.70 two inch pipes.

Dia. (ins.)	½ in.	¾ in.	1 in.	2 in.	3 in.	4 in.	5 in.	6 in.
2	32.0	11.7	5.7	1.0				
3	88.2	32.0	15.6	2.8	1.0			
4	181.0	65.7	32.0	5.7	2.1	1.0		
5	316.0	115.0	59.9	9.9	3.6	1.7	1.0	
6	499.0	181.0	88.2	15.6	5.7	2.8	1.6	1.0

NOTE: A 1-in. hose will, at equal pressures, deliver slightly more than twice the amount of water delivered by a ¾ in. hose of equal length.

Dawson Now Equipment Sales Engineer

Thomas W. Dawson, jr. has resigned as supt., CC of Virginia, Richmond, to join the Richmond Power Equipment Co. as sales engineer. He is establishing a golf course equipment and supply division for the company. Widely known as a practical authority on golf course maintenance, Dawson was brought up in course maintenance. His father was supt., Fenway CC (NY Met dist.), and now is supt. at Palm Beach (Fla.) CC. Tom attended N.Y. State Agricultural College then went into golf course management work. He was supt. at clubs in the NY Met. district before coming to CC of Virginia in 1951. He is succeeded at the CC of Virginia by Harry McSloy, previously supt., Elizabeth Manor CC, Portsmouth, Va.