Solving Drainage Problems at El Macero

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After several greens at El Macero Country Club deteriorated badly in 1966 and large areas of grass died, several possible causes were investigated. Also, some different procedures for drainage were tried and evaluated. Possibly our experiences may be of value to others with problem greens.

Salinity

The water from one of two irrigation wells proved quite saline, with electrical conductivity of 3.7 mmho/cm. Although salinity of greens soils was generally below levels expected to injure Seaside bent, the well was immediately taken out of service.

Soil Conditions

Excessively wet greens had been noted frequently, and to find why drainage was so slow, the soil beneath the greens was sampled. The top 3 to 5 inches is fine sand underlain by loam to clay loam soil. Under 12 of the poorer greens, the soil is dense (total pore space typically 35 to 45%) and anaerobic as indicated by blue-black color and foul odor. Layers of such compacted soil extend to depths of 3 to 5 feet, with native soil beneath the greens mounds open and permeable, suggesting compaction by equipment during construction.

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Irrigation

The distribution of water from manually-operated greens sprinklers proved exceedingly uneven. Both range and spreader nozzles were ¼-inch, and spreader nozzles caused rapid flooding close to the sprinklers while little water reached inner areas of greens. Smaller, single-nozzle sprinklers, purchased in 1968, gave a more uniform pattern, minimized flooding, and generally permitted irrigating on alternate days. Less excess water was applied, and there was a longer period for drainage between irrigations.

Drainage Test

For evaluation of drainage on various greens and the effect of drain systems installed, a procedure was evolved to obtain quantitative data. Basically, it consisted of making several holes to six-inch depth in the green with a ¾-inch diameter, push-type soil sampling tube. Free water in the upper soil (especially the sand layer) seeps into the open hole and its depth is measured one to two hours after the holes are formed. Since sprinkling gave uneven saturation of greens, most comparisons were made 18 to 24 hours after heavy rain with 12 holes for each green or portion tested. For evaluating drainage conditions with sprinkling, more holes are needed to obtain a more complete pattern.

Drainage Installations

Several inexpensive means of greens drainage were attempted over a two-year period. Since the native subsoil under a few greens was nearly pure sand, there was a possibility that dry wells would be effective. A portion of No. 2 green was treated by making holes of 1¼-inch diameter reaching into the subsand and back-filling with pea gravel. The holes, on 3-foot-square spacing, were made with a hammer-driven soil sampling tube. Drainage was improved (see Table 1) and subsequently all of No. 17 green was similarly treated, using holes of 2-inch diameter at 4-foot triangular spacing. The upper two feet of each hole was made with an auger powered with a generator-driven slow-speed electric drill, and the remainder by water jetting. The jetter consisted of thin-walled conduit tubing of 1½-inch diameter with a ¼-inch-diameter nozzle at the bottom, and utilized water under pressure from sprinkler coupler valves.

Other drain systems installed were as follows:

No. 13 Green — Perforated plastic pipe (1¼-inch nominal-size) in 2-inch-wide by 8-inch-deep trenches on 6-foot spacing. The perforated pipe was surrounded with pea gravel top-dressed with sand.

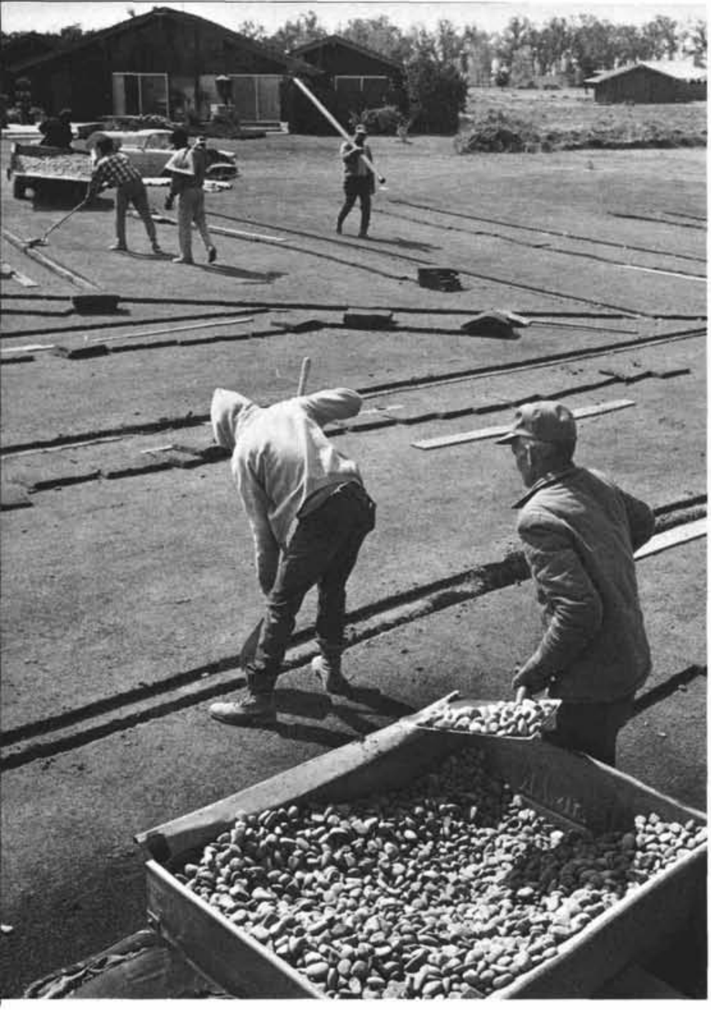
No. 14 Green — Slots (8-inch deep by ¾-inch wide) made with a modified commercial trencher on 6-foot spacing, backfilled with gravel and top-dressed with sand. Individual slots were drained by 1¼-inch diameter dry wells extending into sandy subsoil at a depth of 4 to 5 feet at intervals of 12 to 15 feet. The sod was not stripped over the trenches, but the cuts essentially healed within two weeks, and the green was never taken out of play. Two attempts to cut slots with a chain saw failed because it became dull after cutting a few feet.

Nos. 1, 3, 4, 9, 10, and 18 Greens — Three-inch perforated plastic pipe main line with 1-inch perforated laterals in herringbone pattern at 18-foot maximum spacing. All pipe was placed in 4-inch wide by 20-inch deep trenches, surrounded by rock averaging over ½-inch diameter, covered with a filter of graded gravel and top-dressed with sand.

TABLE 1. Water depths in shallow test holes on three dates.

1-68		1-69		12-69	
*Green**	*Water Depth*	*Green**	*Water Depth*	*Green**	*Water Depth*
—	—	1U	2.9″	1P	0.0″
2U	2.5″	—	—	2U	2.5
2W	0.0	—	—	2W	0.0
3U	1.5	—	—	3P	0.0
—	—	9U	1.9	9P	0.0
—	—	14TW	0.1	14TW	1.7
17W	0.1	17W	0.2	17W	0.0
18U	3.8	18U	3.8	18P	0.1

*Letters following Green number indicate treatment at the time of measurement. U—undrained; W—dry wells; P—perforated pipe; TW—gravel-filled slots plus dry wells.



If the architect had only built the greens properly at the outset, the drainage project would not have been necessary. This is a sample of the "soil" underlying the original greens.

Extensive tile installation was accomplished on the worst greens. Note the neatness of the operation.

The main drain was 3-inch perforated plastic pipe on a gravel base. One-inch perforated lateral lines feed into it in a herringbone pattern.

Putting green slots being cut with a modified commercial trencher. This was more effective than the chain saw method.

Superintendent Jack Jagur perforating the 1-inch plastic lateral lines.

Backfilling the drain lines with graded gravel to be followed with sand. The original sod (with a sand base) will then finish the job.

Pipe drain systems near lakes were constructed with outlets into the lakes, while others were drained into long, gravel-filled trenches, permitting seepage into the subsoil. The native subsoil below the zone compacted by traffic is quite permeable.

Drainage Costs

Material costs were essentially negligible for the dry well system and slots plus dry wells, and labor requirements were approximately 12 man-hours per 1,000 square feet. For pipe spaced at 18 feet in large trenches, material costs were roughly $50 per 1,000 square feet, and labor requirements were about 24 man-hours. Material costs for pipe in small trenches on 6-foot spacing were approximately $60 per 1,000 square feet. No labor records were kept, but the time required was considerably higher because of the greater footage, and the small trenches needed considerable cleaning by hand.

Drainage Results

Tests showed that all types of drainage were quite effective (see Table 1). The gravel-filled slots plus dry wells on No. 14, however, failed in the second winter after installation. The failure probably was caused by plugging of the relatively few dry wells.

The tests show that all the systems can remove excess water from the greens by 18 to 24 hours after waterlogging. From both theory and rough observation, the dry wells have the least surface for water intake and drain most slowly, widely-spaced pipes or trenches are intermediate, and closely-spaced drains are most rapid. We are installing pipe systems at 18-foot spacing in all our poor greens and plan to supplement them with narrow gravel-filled slots on 6 foot spacing if more rapid drainage is necessary.

"Dry Spot" Treatment

On several greens, small areas of poor summer turf persisted after drainage and better irrigation were provided. Soil observations showed that in these spots the sand layer was very shallow or missing entirely, or that the sand was intermixed with silt and clay. Roots penetrated no more than two inches, with many dead by late summer.

To provide better rooting, more water entry into the soil, and better drainage, some spots were treated by removing ¾-inch diameter cores to a depth of nine inches on 3-inch centers with an open-sided push-type tube soil sampler. Each core pushes the preceding core from the tube, so the process is rapid. After

Dr. Henderson at work with a hammer-driven soil sampling tube on No. 2 green.

cores were removed from the green surface, a ⅜-inch tube was used to water-jet an opening at the bottom of about one hole per square foot down to permeable soil, 3 or 4 feet below. The jetted material on the green surface was allowed to dry and was removed, and the holes were filled with top-dressing mix.

Three treated spots slowly improved (as compared with nearby untreated spots) and did not recur the following summer.

Conclusions

The soil under several greens is marginal for growing good turf, even with drainage. Probably only the shallow sand layer can be drained effectively because the soil below is too tight. Few roots penetrate below the sand layer, and those found in soil are often weak or dead. Nevertheless, the program described (involving salinity control, careful irrigation, drainage, and spot renovation) has generally improved the greens markedly in the past three seasons. We avoided a crisis with very moderate expenditure, and we have sufficient time to proceed with future greens reconstruction on an orderly basis. Under very careful management our greens could, if necessary, last indefinitely.