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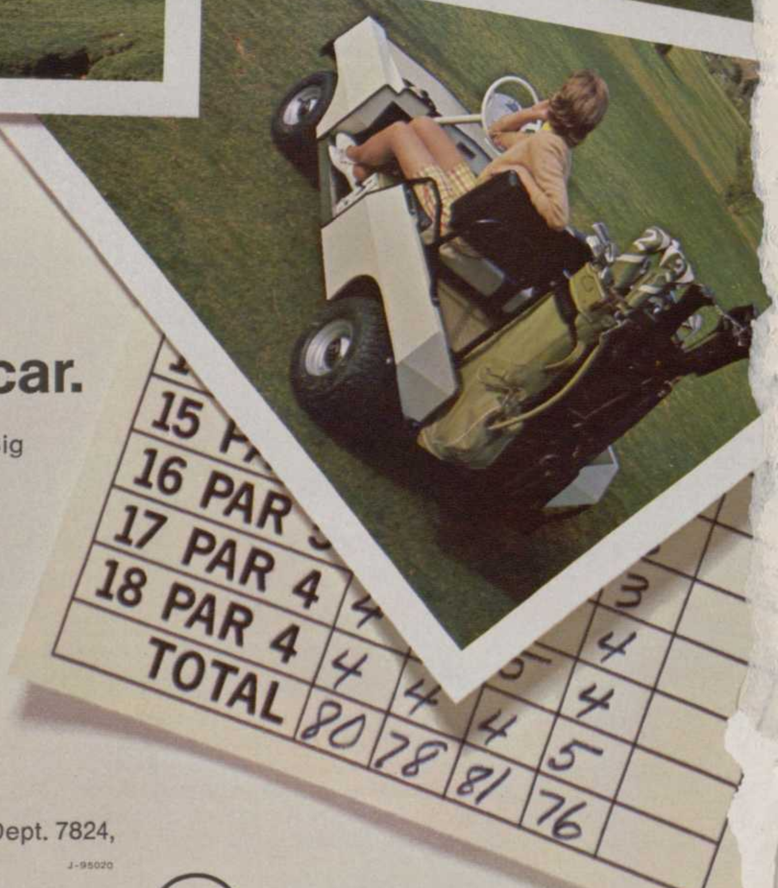

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Turfgrass research review

By Dr. James B. Beard

Investigations into the nature of thatch and methods of its decomposition.

F.B. Ledeboer and C.R. Skogley. 1967. Agronomy Journal. 59(4):320-323 (from the Department of Agronomy and Mechanized Agriculture, University of Rhode Island, Kingston, Rhode Island 92881).

The physical composition of thatch from a twenty year old velvet bentgrass turf which had not been topdressed was examined. The thatch was two inches thick. Leaf remnants were found only in the surface layers which indicates that the soft tissue was rapidly decomposed. The lower three-fourths of the thatch layer was composed of vascular strands and the nodes of bentgrass stolons, especially if the nodes had rooted and formed new crown tissue. When a similar thatched turf which had received topdressing was examined, the degree of decomposition of thatch in the lower layers was more advanced. Live bentgrass roots were concentrated in the upper portion of the thatch with only a few extending through the two inches of thatch and into the soil.

Field experiments were conducted to evaluate methods of biologically stimulating thatch decay. The experiments were conducted on a 15 year-old velvet bentgrass putting green turf.

Three treatments: (a) a June application of calcium in the form of dolomitic limestone, (b) three fertilization programs and (c) weekly applications of a sucrose solution, were made in all possible combinations. After four months, the calcium, sucrose, and fertilization treatments in all combinations showed no effect on rate of thatch breakdown. Sucrose decreased visual turfgrass quality ratings, fertilization increased quality, and calcium treatments had no visible effect on quality. Fertilization decreased the incidence of dollar spot disease, whereas sucrose caused an increase in the disease.

Comments—Thatch is defined as accumulation of undecomposed organic matter which builds up between the soil surface and the turf or green vegetation. Thatch is undesirable because it (a) enhances disease activity, (b) restricts rooting, (c) decreases tolerance to adversities such as drought, heat, cold, or disease, (d) causes scalping on greens and (e) restricts water movement when dry, causing localized dry spots. Turfmen who switch from weak, low management bentgrasses to the newer more vigorous varieties should be on the look-out for potential thatch problems. The more vigorous bentgrass varieties such as Toronto and Penncross will thatch if management practices are not adjusted to minimize this potential problem.

Thatch is a problem which develops over an extended period of time and is best controlled by a long-term, preventative program. As yet, there is no easy short-term solution available for achieving control of an existing thatch problem. Mechanical control by vertical renovation and removal can be used but is costly, time consuming, and, most important of all, disrupts play, especially if extensive thatch accumulation has occured.

Long-term management factors which enhance microorganism activity and the resulting thatch decay include: (1) Adequate oxygen levels for decomposition of the organic matter. This is achieved by a well structured or coarse textured, well drained soil as well as by mechanical aeration as it is needed. (2) A near neutral or slightly acid pH level in the thatch and adjacent soil. A pH level near 7.0 is the most favorable for decay of organic matter by microorganisms. (3) Topdressing which enhances decomposition by providing a more favorable microenvironment. The topdressing can also serve as a supplemental source of microorganisms and should be similar to the existing soil. Any significant variations in particle size will create layers which can impair the proper water and air movement needed for good rooting. (4) Avoiding overstimulation of vegetative growth.

Physiological and color aspects of turfgrasses with fall and winter nitrogen.

A.J. Powell, R.E. Blaser and R.E. Schmidt. 1967. Agronomy Journal. 59:303-307. (From the Department of Agronomy, Virginia Polytechnic Institute, Blacksburg, Virginia, 24061).

The effects of fall and winter nitrogen fertilization on turfgrass color, shoot growth, carbohydrate level and net photosynthesis were investigated. Various nitrogen rates and times of application were made during the winter of 1965-66 to an established Cohancey creeping bentgrass putting green, a Kentucky 31 tall fescue sod and a newly established Penncross creeping bentgrass putting green. The latter was located at Martinsville, Virginia, and the other two at Blacksburg, Virginia.

The monthly nitrogen treatments

Continued on next page

Beard

Continued from preceding page

involved one pound of actual nitrogen per 1,000 square feet as ammonium nitrate applied in (a) October only, (b) Oct. and Dec., (c) Oct., Dec., and Feb., (d) Oct., Nov., Dec., Jan. and Feb. and two pounds of actual nitrogen applied in (e) January only and (f) in Oct., Nov., Dec., Jan., Feb.

The results showed that turfgrass color increased as the nitrogen fertility level was increased. However, no measurable growth occurred from December to March. Quantitative carbohydrate measurements indicated that the level increased slowly until January and then decreased until late spring. Carbohydrate accumulation was generally higher with low than with high nitrogen fertilization rates. Determinations of the net photosynthetic rate showed that photosynthesis is operative under certain winter conditions including (a) an unfrozen soil the night before and (b) a relatively high daytime temperature. Nitrogen fertilization increased the photosynthetic and respiration rates.

Based on these results, the authors concluded that liberal late fall and winter nitrogen fertilization does not seriously reduce the soluble carbohydrate level of creeping bentgrass and tall fescue. This was attributed to low temperatures impairing top growth much more than photosynthesis. Thus, desirable turfgrass color was achieved in winter in Virginia without adverse physiological changes.

Comments—These results indicate that late fall and winter nitrogen fertilization can be effective in maintaining a desirable green turfgrass color during the winter period in Virginia. However, how widely this practice can be utilized in other winter climates is yet to be determined. Research in Michigan and Ohio indicates that heavy, late fall nitrogen fertilization causes a decrease in the low temperature hardiness of turfgrasses, especially annual bluegrass, tall fescue, red fescue and the ryegrasses. These regions are more prone to direct low temperature kill because of the occurrence of (a) greater crown tissue hydration and (b) lower surface soil temperatures. □

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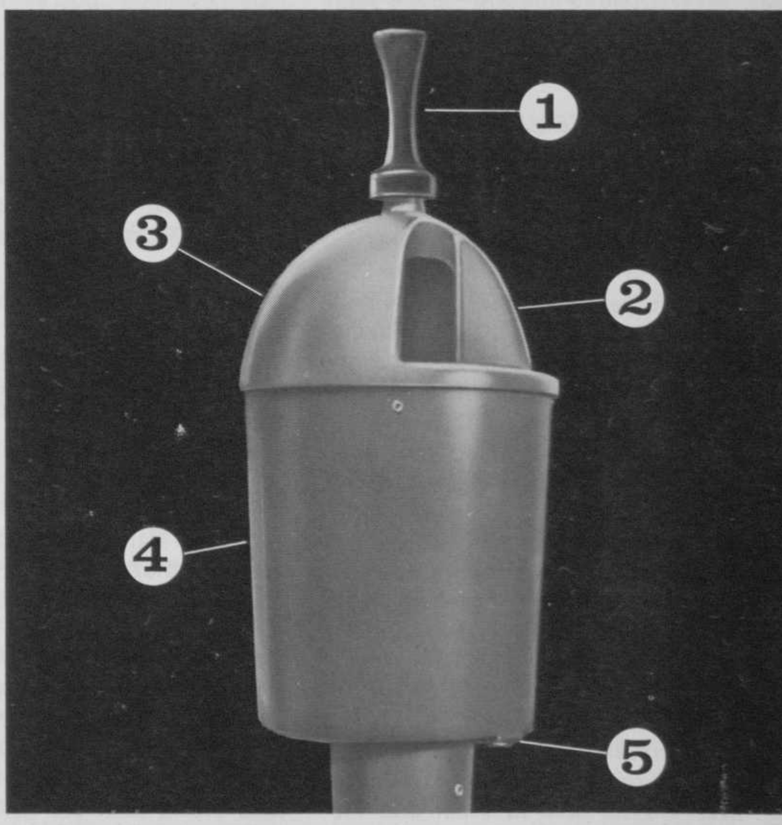

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A superintendent's challenge

North Jersey CC (Wayne, N.J.) presents Dick Williams with a unique problem—a front nine that has a rock-shale base and a back nine that has a clay base

by Frank Leber

North Jersey Country Club in Wayne, N.J., lays claim to being one of the few courses in the country where the front nine and back nine are completely different as to the types of base. The front nine (and the greens superintendent, Richard W. Williams, can prove it) has a rock-shale base, with the outcropping producing drainage problems that cannot be relieved by ordinary methods. The back nine has a clay base, and again drainage problems arise, but these are being handled in an ordinary manner.

Chartered in 1895 in Paterson, N.J., North Jersey CC came into the Wayne area in 1922, and the course was opened for play in July, 1923. It was designed and built by the famous Walter J. Travis, who took advantage of the rolling, hilly land to carve 18 scenic holes. While North Jersey is only ten minutes from Paterson and less than 45 minutes from New York City, a visitor to the club is struck by the complete absence of any roads, houses or general city impressions once inside its gates.

A half mile of gently winding road leads to a large French (Normandy) chateau-type clubhouse complete with blue slate roof and high swept gables. Ablaze with color during the season and early fall, it is also a wild life refuge. Deer are prevalent, as are woodchucks, ground hogs, squirrels, chipmunks, skunks, raccoons, snakes, and, occasionally during the late summer, a few bears will wander down from the mountain. Water fowl use the large pond in front of the 18th tee as a home site, and a family of beavers can be found at the reservoir.

From a superintendent's point of view, however, its scenic beauty is a mask to cover its maintenance problems. At the time of its construction, U.S.G.A. specifications as to the building of greens were not as precise as they are today, nor were they universally followed. The greens, small and heavily-contoured, were built over rock bases (mostly), crushed and screened to a degree; but no tile was provided, nor were drainage culverts or run-offs put in. (When one of the original greens was re-built several years ago, they found it to be layers of dirt piled on each other for the base).

Compound this problem by having one nine located on rock shale base and the other nine on a clay base and the superintendent must be blessed with not only a green thumb, but a wealth of experience, the patience of Job, a willingness to experiment, and when necessary, to improvise.

Dick Williams came into these problems five years ago, after at-

tending Deerfield Academy, the University of Massachusetts, and then working on the construction of golf courses for more than seven years.

Dick found that heavy play (the play at the course had increased almost ten fold in the last decade) and several years of unseasonable weather had worked havoc with the course. The original planting on the greens had been South German strain with Kentucky Blue and Fescue on the fairways. The heavy play, and too much water, had brought on a heavy growth of Poa Annua. It was impossible to obtain the German strain that was wearing out, so Dick decided to substitute Penncross bent mixed with top dressing on the greens and to bring in Seaside bent for the fairways.

THE FRONT NINE

While the course has a center line watering system, it is all under manual control. To compensate for the rock-shale base on the front nine Dick turned to frequent, light watering to avoid break-outs on outcropping ledges, and to prevent flooding in the low area. To protect the contours of the greens on the front nine, the same hand watering method was adopted.

To bring back the fairways he decided on continual aerifying in the fall months and the addition of 40 lbs. per acre of Seaside bent. To eliminate the drainage and seepage problem in the low areas he put in stone drains and culverts.

Three of the greens on the front nine were torn out and replaced with Penncross sod. The other six greens were over-seeded, spiked, and top dressed with the Penncross bent.

As Dick spoke about his first months at the club, he still looked at the front nine in a distressed fashion. "There is no way, absolutely no way that you can eliminate the problems brought on by the rock-shale outcropping, short of tearing out the whole course and blasting the rock-shale out. We have tried to control the amount of water by hand-watering frequently, rather than for extended periods. But a heavy rain storm can cause damage. The water sinks into the soil rapidly, then races along the outcroppings and ledges looking for a place to break through. If we're lucky it will work its way downhill to a low spot where we have placed several culverts and drains. Here we can control it to a degree.

"If we're not lucky, the water will break through the side of a hill and you suddenly have a small stream down the fairway with all the silt and sand that accompanies it. It's a funny thing, but the amount of the rain makes the difference. A light, gentle rain is great and keeps the course in condition. The water makes its way underground without any problem at all. But a heavy down-pour, that's trouble! And you can only imagine what's happening. It just goes along the outcroppings, then boom—out she comes. Never the same route twice."

THE BACK NINE

Turning to the problems of the back nine, he listed the clay base as number one and then the grass mixtures as number two.

"With the clay base," he explained, "you have a 'sponging' problem. The water gets through the soil reluctantly and into the clay which sops it up like a sponge. There is no run off, unless of course you have a cloud-burst. In general it is just a continuous sopping operation. This is good, up to a point. Then you get too much of a good thing. Once it gets too soft, you just have to work out the individual holes, each with its own problem."

Two greens on the back nine which were a perennial problem have been completely re-built according to U.S.G.A. specs. They are set on a gravel base, average of two feet, with 14 inches of screened topsoil, followed by sand and humus to a mixture of 60% coarse sand, 20% topsoil and 20% humus. Here again Dick has used Penncross sod. The other seven greens still have the South German bent, which he is replac-

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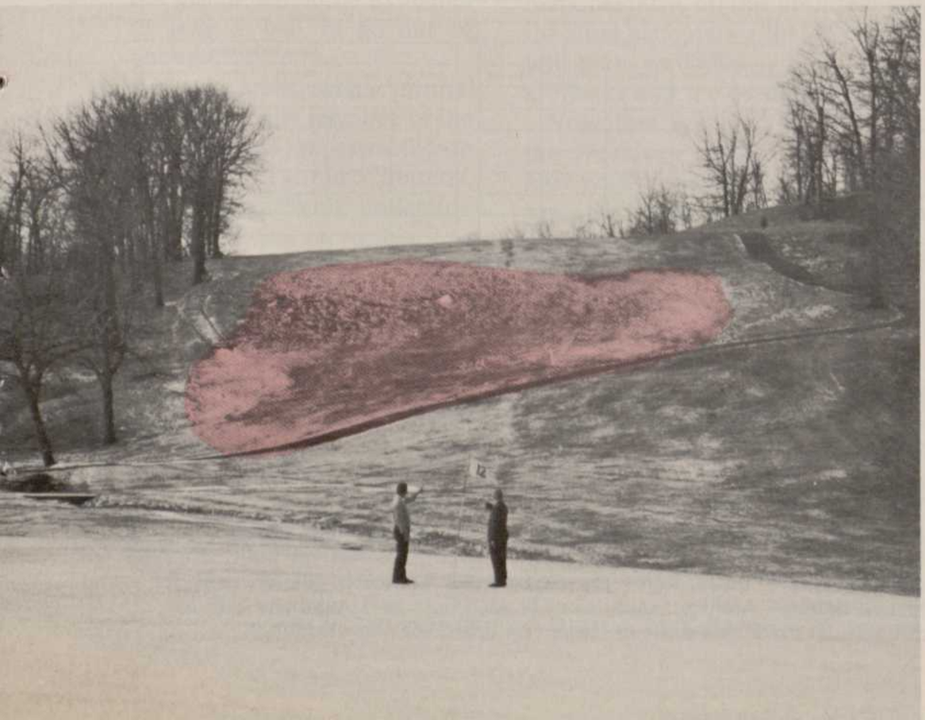


Photo at far left shows view from behind 6th green looking back up the fairway. Though the gently sloping hills look innocuous, the rock-shale base has created many drainage problems. In the center picture, you are looking down from the 14th tee to the green just in front of the pond. The center area, about 80 feet below the tee, provides a natural cup (tinted area) which, with the clay base, holds the runoff water and creates "sponging problems." To solve this, greens superintendent Dick Williams has put in drainage ditches on both sides of the fairway, feeding into pond in background. The fairway part has been sodded over. In photo at right, head pro Ray Ferguson and Dick Williams stand on 12th green, look back up fairway. Area in left center of picture (tinted area) is a trouble spot where breakthroughs can occur during heavy rains.

You can cut on-course waiting time

A computer program can now provide alternatives, without eliminating any holes, to speed up play on existing or unconstructed courses

by Donald B. Cook

Is your course one of those that's beautiful to look at but frustrating to play because of excessive on-course waiting time?

If so, there is something that can be done about it!

With almost every business today finding some sort of use from a computer, golf now finds itself no exception. Although it's realized that several characteristics such as aesthetic beauty, golfing challenge, construction and operation costs, and safety must also be considered in golf course design, smoothness of play (waiting time) cannot be underrated. A program called GCS (Golf Course Simulator) has been designed to provide assistance in areas of complex waiting situations.

In computer terminology, a golf course is considered to be a "complex feedback network." In layman's terms this simply means that what happens on the 17th hole to the 20th foursome of the day may well affect what will happen on the 2nd hole to the 30th foursome. Through the use of feedback network analysis, the GCS computer program was specifically designed to predict waiting time characteristics for any golf course either *prior to actual construction or for alteration of existing courses.*

It should be noted that similar to most complex scientific analyses, certain assumptions are required to stay within economically feasible costs of solution. Two of the more important assumptions of the GCS program are:

(1) *The standard playing group is a foursome*—This is a realistic assumption since a foursome is the normal playing group required during peak periods on the course.

(2) *The course is being played under maximum utilization*—Assuming of peak conditions is quite logical since in any waiting time problem the most critical period, naturally, is when a facility is under maximum capacity.

By now you may be wondering just what kind of information must be supplied to the computer, and how the computer can possibly account for the great variation in the playing speeds of different golfers. First of all, times have been collected for the various golfer playing elements. Over two hundred times were obtained by actual stopwatch studies on various courses for elements such as hitting the ball from the tee, walking, putting, etc. Ranges of time, rather than any one specific figure, were calculated for elements such as putting, where there is a high degree of variation among different golfers. This time data is given to the computer and the computer is programmed to randomly select specific times that fall within the given ranges. Using a random selection from a range of values, rather than one specific figure, permits the computer to simulate the time variability caused by different golfer playing speeds.

To complete the data required by the computer, the architect must supply certain key characteristics for each specific course design. The major areas of information are readily accessible to the architect and center around hole sequence and layout, playing distance and unusual features, and distance between each green and the following tee. The actual architectural data sheet is shown in Exhibit I (below).

Only one item in the chart calls

GCS ARCHITECTURAL DATA SHEET

Architect: ______________ Course: ______________ Alternative: ________ Date: ________

Hole Design						
Hole No.	Par	Dist.-Yds.	Difficulty	Upgrade	Conveyance	Office Use
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

Walking Between Holes					
From-To	Dist.-Yds.	Stopover	Upgrade	Conveyance	Office Use
First Tee	XXX	XXX	XXX	XXX	XXX
1-2					
2-3					
3-4					
4-5					
5-6					
6-7					
7-8					
8-9					
9-10					
10-11					
11-12					
12-13					
13-14					
14-15					
15-16					
16-17					
17-18					

Additional Remarks:

Stopover column is to identify rest rooms, refreshment stands, etc., located between a green and the following tee. In courses not yet built, the GCS will indicate where these items should be built. Difficulty column calls for a subjective opinion. Architect must classify each hole as 1) normally difficult, 2) very difficult, 3) extremely difficult, based on time, not par. (Exhibit I).

for an opinion. Everything else is factual. The difficulty of each hole must be classified by the architect as: (1) normally difficult, (2) very difficult, (3) extremely or unusually difficult. The term difficulty is to be taken to mean *difficulty in completing a hole within the normal playing time, rather than difficulty in scoring par.* Since searching for lost balls is one of the most time-consuming elements on the golf course, a rough guideline for the difficulty classification is as follows:

(Assume a foursome who members play to a 20-25 handicap:)

(1) normally difficult: under normal conditions *no* member of the group would be expected to lose a ball or go out of bounds,

(2) very difficult: under normal conditions *one* member of the group would be expected to lose a ball or go out of bounds,

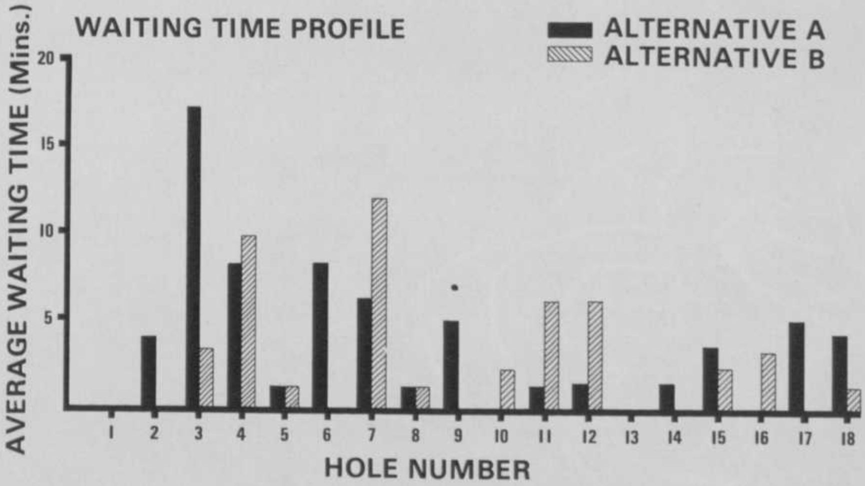
(3) extremely difficult: under normal conditions *more than one* member of the group could be expected to lose a ball or go out of bounds.

Most courses will only consist of number (1) and (2) holes. In a very unusual situation a type (3) may be encountered.

Through the use of the predetermined golfing time ranges and the information provided by the architect, GCS simulates five days of actual golf play under maximum course utilization for any normal golf course design. The results are tabulated and summarized in layman's terms in the form of a report complete with graphic exhibits. Using this information, the architect can compare smoothness of play for various alternative layouts of the same course and in time, after he has accumulated a library of reports, he can make cross comparisons between his new design and those he has already had constructed.

It should be emphasized that the program *does not* redesign the course or explain why the course will have the reported waiting time characteristics. The redesign is the responsibility of the architect and the final acceptance that the course will play smoothly is between the architect and the owner.

Now that we have gone through the workings of GCS, perhaps the best way to further explain the program is to show the partial results of a sample application. In this example, an existing course was used in order that the simulation results could be verified by referring back to the actual course. (However, the input information required by the computer would have been available even if the course were still on the drawing board). Using the actual course data for Alternative A and the same holes played in a different order for Alternative B, the GCS program developed the following information:



In this bar graph (Exhibit II) Alternatives A and B represent waiting times for the same course. In the latter case, the holes were played in a different order. Wherever there is no bar for a hole, there was no waiting time.

	Alt. A	Alt. B
Average waiting time per foursome	65 mins.	47 mins.
Maximum waiting time (hole-time)	3-44 mins.	7-33 mins.
Average course time per foursome	305 mins.	287 mins.
Completion time for 50 groups to complete 18 holes	728 mins.	712 mins.
12 Hr. course capacity (assume all groups play 18 holes)	49 Grps.	51 Grps.

In the case above it is quite simple to come to the conclusion that Alternative (B) is a smoother playing course design than Alternative (A), since it is superior in all of the above characteristics. Several other samples, however, have proven to be more complex than the above example.

It is quite possible, for instance, to have less waiting time per foursome and yet a lower course capacity. This is particularly true where the first hole slows down the entry of foursomes on the course; thus spreading the groups so far apart that the course is being under-utilized. It is also feasible to have a higher maximum waiting in one location and yet less average waiting for the entire course if most of the waiting is being consolidated at a single hole.

In addition to the summary data shown above, three graphs are included in each GCS report. These graphs include the following information:

(1) Course time per foursome for 50 foursomes,

(2) Group finishing times for 1 through 50 foursomes,

(3) The location and duration of waiting times.

The accompanying graph, called the Waiting Time Profile (Exhibit II), shows each hole for Alternatives A and B of our sample project. This type of graph can be extremely helpful to the clever architect as he improves his course design or attempts to improve an

Continued on page 78