



Better Turf for Better Golf

# TURF MANAGEMENT

from the USGA Green Section

## *Specifications for A Method of Putting Green Construction*

BY THE USGA GREEN SECTION STAFF

Golf course construction is presently enjoying its most accelerated pace since the introduction of the game of golf into the United States. Not only are new courses being built but old ones are being "modernized."

The cost of maintenance has influenced some clubs in their decisions to undertake a rebuilding program. There is a need to do away with features such as sharp contours and abrupt tee slopes which create maintenance problems.

Golf course design and golf course construction have been considered an art rather than a science. The individuality and the character of golf courses in this country have resulted from the artistic talents of some of the great architects in whose minds they were conceived.

Likewise, construction methods have been developed as a result of individual experiences and individual preferences. It is a tribute to those whose efforts have gone into golf course building as well as to those who maintain them that so many courses have stood up well over the years.

The pace of golf activity and the traffic on golf courses is presently at a peak, however, which has never been equaled in our country. Many of the construction methods that were satisfactory in an earlier day, will no longer produce greens

which will withstand the wear that is now imposed upon them.

Because of these considerations, the Green Section has for the last decade interested itself in construction methods and in a study of the physical problems of soils used in putting greens. Research in these matters has been sponsored by the Green Section at Beltsville; at Oklahoma State University; at UCLA; and during the past six years an intensive program of study has been supported at Texas A. & M. College.

It has been found that the problems of construction procedures and methods and those of physical behavior of soils cannot be separated. The two matters are related and must be considered together if a desired result is to be produced.

The findings of the Green Section sponsored research are such that a sufficient amount of information is now available to warrant the publication of a suggested method of construction. The procedures which are outlined here may well be used as the basis for specifications which a club may present to the prospective golf course builder.

Such specifications will place no limitations upon the individuality nor the artistry of any architect. They will, however, provide a guide for the builder and

for the club which wants to be assured that the greens they build will continue to provide good playing conditions for many years.

The basic considerations underlying the specifications and methods presented are those of good drainage and resistance to compaction. These ends cannot be achieved without some compromise. A highly permeable soil which drains readily offers some problems in the establishment of turf. It is loose and sometimes may create difficulty in the changing of cups. These are minor problems, however, when weighed against the advantages of rapid drainage, good aeration, deep rooting, protection against diseases, protection against over-watering, protection against salt problems, a putting surface which holds a shot without being overly wet and one which resists pitting by golf balls.

The methods and specifications outlined in the following pages represent the best thoughts of the Green Section staff and of numerous soil scientists who have given serious attention to the problem. It is hoped that they will result in more satisfactory and less troublesome putting greens throughout the nation.

#### 1. Subgrade

The contours of the subgrade should conform to those of the proposed finished grade, with a tolerance of plus or minus 1". The subgrade should be constructed at an elevation 14 inches below the proposed finished grade. The subgrade should be compacted sufficiently to prevent future settling which might create water-holding depressions in the subgrade surface and corresponding depressions in the putting surface.

Where terrain permits, it is possible to build the subgrade into the existing grade or to cut it into the subsoil. It is not necessary to elevate or "build up" the green unless design considerations dictate the desirability of doing so.

It will be noted that courses of materials above the subgrade consist of 4 inches of gravel, 1½ to 2 inches of coarse sand, and 12 inches of topsoil. Thus the total depth will be 17½ to 18 inches. However, this fill material will settle appreciably,

## **Bermudagrass**

**Question: How do you keep bermudagrass from seeding on the putting green?**

**Answer: Usually the tendency to produce seedheads indicates a need for heavier nitrogen feeding. Bermudagrass putting green turf can make use of as much as 2 lbs. of nitrogen per 1000 square feet per month during the growing season.**

**Some strains of bermudagrass give more trouble from the standpoint of seedhead production than others. Choose a selection that behaves well in this respect, then fertilize generously.**

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and experience indicates that 14 inches will be the approximate depth of these combined materials after settling.

#### 2. Drainage

Tile lines of at least 4-inch diameter should be so spaced that water will not have to travel more than 10 feet to reach a tile drain. Any suitable pattern or tile line arrangement may be used, but the herringbone or the gridiron arrangements will fit most situations.

Cut ditches or trenches into the subgrade so tile slopes uniformly. Do not place tile deeper than is necessary to obtain the desired amount of slope. Tile lines should have a minimum fall of .5%. Steeper grades can be used but there will seldom be a need for tile line grades steeper than 3% to 4% on a putting green.

Tile may be agricultural clay tile, concrete, plastic, or perforated asphalt-paper composition. Agricultural tile joints should be butted together with no more than ¼" of space between joints. The tops of tile should be covered with asphalt paper, fibreglass composition, or with plastic spacers and covers designed for this purpose. The covering prevents gravel from falling into the tile.

Tile should be laid on a firm bed of ½" to 1" of gravel to reduce possible wash of subgrade soil up into tile line by fast water flow. If the subgrade consists of undisturbed soil, so that washing is unlikely, it

is permissible to lay tile directly on the bottom of the trench.

After the tile is laid, the trenches should be backfilled with gravel, being careful not to displace the covering over the joints.

### 3. Gravel and Sand Base

a. The entire subgrade should be covered with a course of clean washed gravel or crushed stone placed to a minimum thickness of 4 inches.

The preferred material for this purpose is washed pea gravel of about  $\frac{1}{4}$ " diameter particle size. Larger gravel or stone may be used, but it is important that changes in size between this course of material and the succeeding one overlying it not be too great. Otherwise, smaller particles from overlying material will wash into the gravel, clog the pores or drainage ways and thereby reduce the effectiveness of the gravel.

The maximum allowable discrepancy appears to be 5 to 7 diameters. In other words, if  $\frac{1}{4}$ " pea gravel (about 6 mm.) is used, then the particles of the overlying course of sand should not be less than 1 mm. in diameter. If stone of 1 inch diameter were used, it would be necessary to include a course of pea gravel to prevent the movement of smaller soil aggregates into the stone.

b. When the gravel is in place, assuming that pea gravel has been used, a  $1\frac{1}{2}$ " layer of coarse washed sand (commercial concrete sand is satisfactory) should be placed to a uniform thickness over the gravel.

The tolerance for error in the thickness of gravel and sand courses should be limited to plus or minus .5 inch.

A profile of a properly constructed putting green is illustrated in Figure 1.

### 4. "Ringing" the Green

When the courses of gravel and sand are in place and outlets have been established for subsurface water (through tile lines), the green should be "ringed" with the soil which is to be used for aprons and collars. This soil should be placed

around the green and any contours established in such a way that they will blend into the putting surface.

The next step is to fill the depression, which represents the putting surface, with the prepared topsoil mixture described in the following paragraphs.

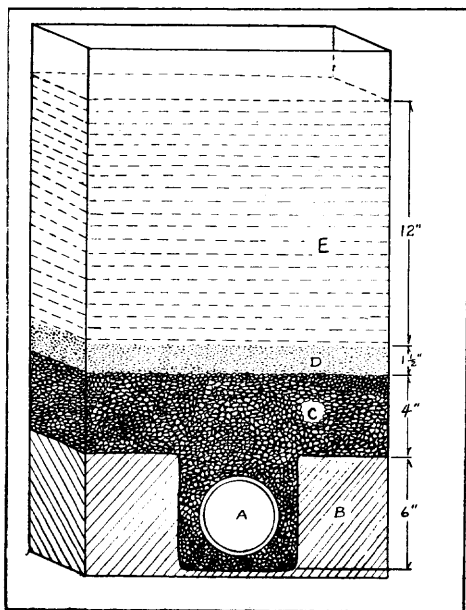
### 5. Soil Mixture

A covering of topsoil mixture at least 12 inches in thickness should be placed over the sand and gravel layers.

The soil mixture should meet certain physical requirements.

Permeability—After compaction at a moisture content approximately

Figure 1  
CROSS SECTION OF A PUTTING GREEN PROFILE SHOWING A TRENCH AND TILE LINE



- A. 4-inch diameter tile.
- B. Subgrade of native soil or fill material.
- C. Gravel—preferably pea gravel of approximately  $\frac{1}{4}$ " diameter. Minimum thickness 4 inches.
- D. Coarse sand—this sand should be of a size of 1 mm. or greater. One and one-half to 2 inches in thickness.
- E. Topsoil mixture. Minimum thickness of 12 inches.

field capacity as described by Ferguson, Howard and Bloodworth (8), a core of the soil mixture should permit the passage of not less than  $\frac{1}{2}$  inch of water per hour nor more than  $1\frac{1}{2}$  inches per hour when subjected to a hydraulic head of .25 inches.

**Porosity**—After compaction, a sample of the soil mixture should have a minimum total pore space of 33%. Of this pore space, the large (non-capillary) pores should comprise from 12 to 18% and capillary pore space from 15 to 21%.

Information with respect to bulk density, moisture retention capacity, mechanical analysis, and degree of aggregation in the hands of a soil physicist may be helpful in further evaluating the potential behavior of a putting green soil.

Few natural soils meet the requirements stated above. It will be necessary to use mixtures of sand, soil, and organic matter. Because of differences in behavior induced by such factors as sand particle size and gradation, the mineral derivation and degree of aggregation of the clay component, the degree of decomposition of the organic matter, and the silt content of the soil, it is impossible to make satisfactory recommendations for soil mixtures without appropriate laboratory analyses.

The success of the method of construction herein described is dependent upon the proper physical characteristics of the soil and the relationship of that soil to the drainage bed underlying the green. Therefore a physical analysis of soil should be made before the soil components are procured. When the proper proportions of the soil components have been determined, it becomes extremely important that they be mixed in the proportions indicated. A small error in percentages in the case of a plastic clay soil can lead to serious consequences. To insure thorough mixing and the accurate measurement of the soil components, "off site" mixing is advocated.

Any soil physics laboratory which is equipped with the facilities to

carry out the measurement described by Ferguson, et al (8) can prescribe a soil mixture for putting green use. Green Section offices can provide names of laboratories so equipped upon request.

#### 6. Soil Covering, Placement, Smoothing and Firming

When soil has been thoroughly mixed off site it should be transported to the green site and dumped at the edge of the green. Padding the edge of the green with boards may be necessary to prevent disturbance by wheeled vehicles of the soil previously placed around the outside of the putting surface. A small crawler-type tractor suitably equipped with a blade is useful for pushing the soil mixture out onto the prepared base. If the tractor is always operated with its weight on the soil mixture that has been hauled onto the site, the base will not be disturbed.

Grade stakes spaced at frequent intervals on the putting surface will be helpful in indicating the depth of the soil mixture. Finishing the grade will likely require the use of a level or transit.

When the soil has been spread uniformly over the surface of the putting green it should be compacted or firmed uniformly. A roller usually is not satisfactory because it "bridges" the soft spots.

"Footing" or trampling the surface will tend to eliminate the soft spots. Raking the surface and repeating the footing operation will result in having the seed or stolon bed uniformly firm. It should be emphasized that the raking and footing should be repeated until uniform firmness is obtained.

Whenever possible after construction saturation of the soil by extensive irrigation is suggested. Water is useful in settling and firming the surface. This practice will also reveal any water-holding depressions which might interfere with surface drainage.

#### 7. Sterilization of Soil and Establishment of Turf

These steps may be accomplished

by following well-known conventional procedures.

The foregoing steps in construction have been used successfully in many greens in various parts of the nation. It should be emphasized that each step in construction is dependent upon all the others. It is inadvisable to use a blanket of gravel unless the proper soil mixture is used above. It is inadvisable to use the gravel and the proper soil mixture unless the intermediate layer of sand is used to separate them. The courses of gravel and sand may result in saturation of the lower portions of the topsoil mixture unless the proper soil mixture is used.

In short, **do not** attempt to incorporate some of these steps into green construction unless they are all used in exact accordance with these recommendations.

The foregoing specifications tell the club how to proceed with the job of building a putting green but they do not tell why one should follow these procedures. There is ample evidence in the body of published literature to support the methods herein advocated. For those who are interested in a study of the principles which are involved and which are used as a basis for the recommendations set forth, a list of references is appended.

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