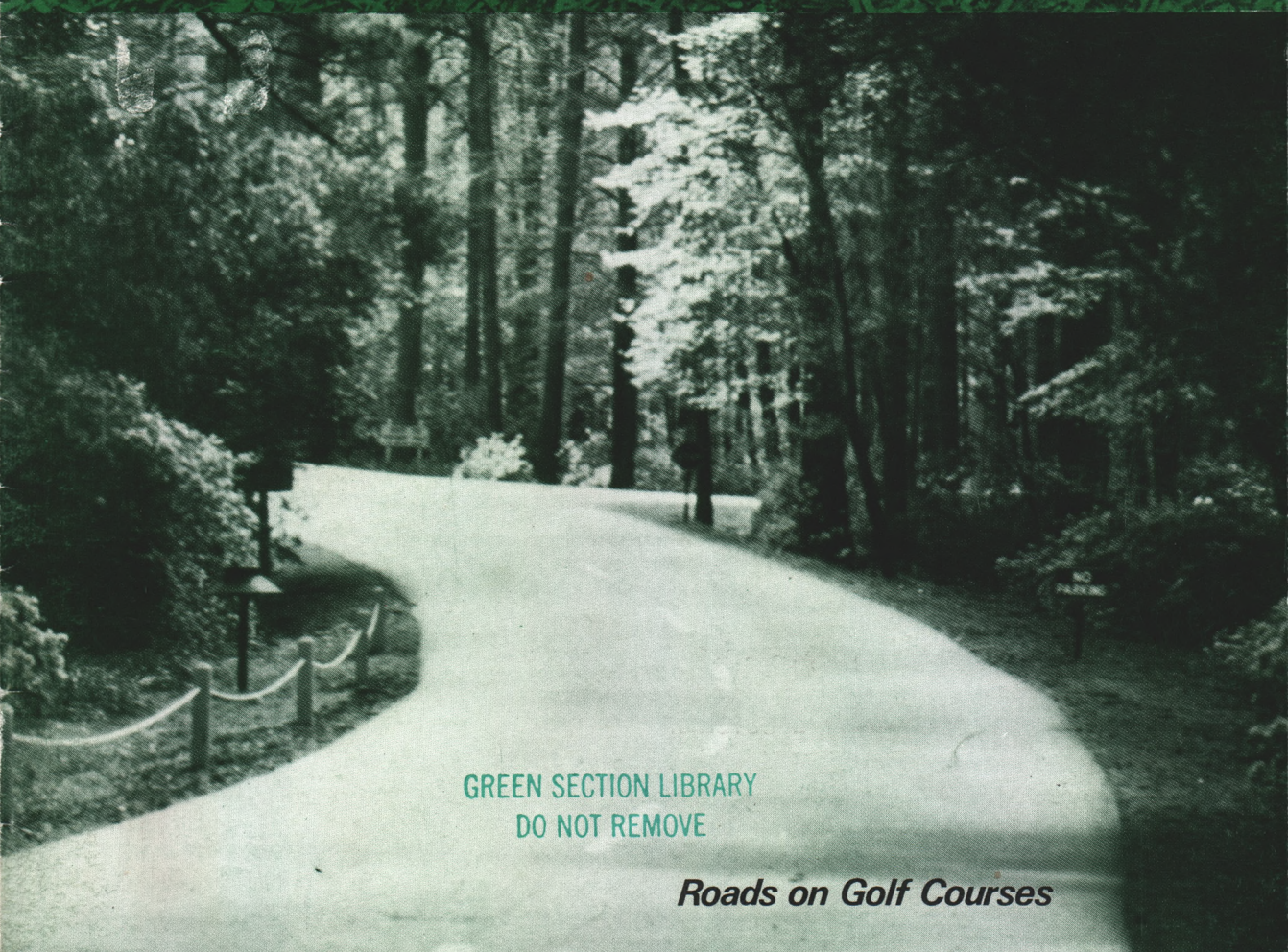
NOVEMBER 1977

USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association



Roads on Golf Courses

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COVER PHOTO: Well-landscaped road leading to maintenance building and golf courses at Calloway Gardens, Pine Mountain, Georgia.

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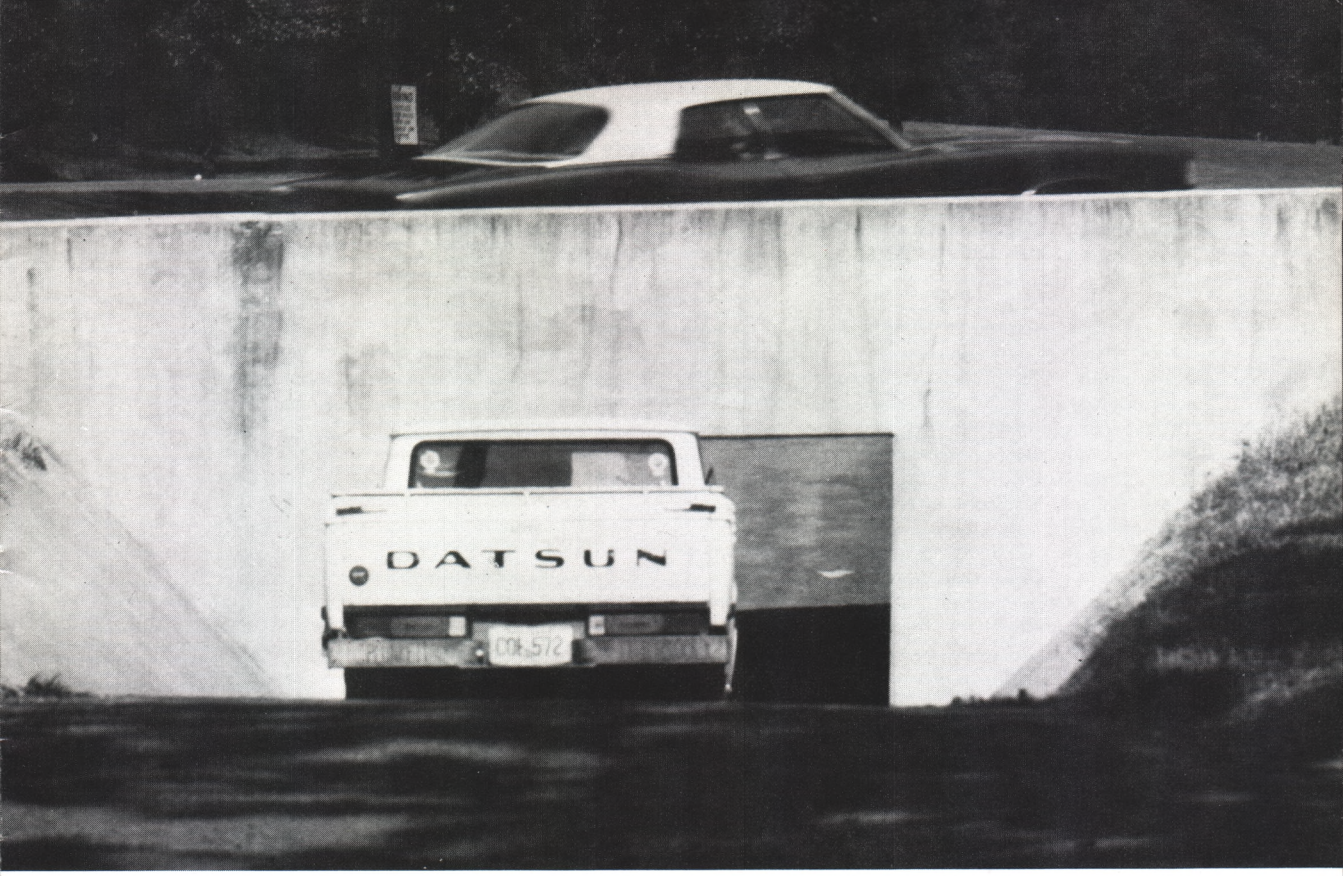


Pleasant Valley Country Club, Little Rock, Arkansas, has excellent underpasses for protection of the golfer.

Roads Extend the Life of Turf and the Golf Car

by JAMES B. MONCRIEF, Director, Southern Region USGA Green Section

THERE ARE MANY REASONS why golf and country clubs continue to build roads through their property, and so whether we fear an asphalt jungle or not, golf cars and golf roads are here to stay. The popularity of the cars assures the survival of the roads.

There are other reasons why the use of golf cars is promoted. Revenue derived from their use is one. Some courses require all golfers to ride in cars, and no one can play the course without renting one. Management believes it speeds play. Because of this, caddies have all but been eliminated in some areas. In others, clubs still insist that a caddie accompany a group whether or not they take a car. By doing this, some clubs preserve and protect the traditional role of the caddie.

The increase in the number of rounds of golf at resort areas, municipal fee courses and clubs is causing roads to be built not only to preserve the grass, but also to get more mileage from each golf car. Maintenance is reduced and the cars last longer. To the turfgrass manager, at least part of the income from golf car rental should be returned to course maintenance. It is a cost item in this budget.

Roads are the best solution to the problem of playing golf under adverse weather conditions. Because of the extremely cold weather across the South last winter, a number of clubs have stepped up road construction. The continuous use of golf cars on dormant bermudagrass caused thin, bare areas, if not outright bermudagrass kill. The winter traffic pattern on many courses was still evident by late summer of 1977.

As car fleets increase, worn, thin, bare turfgrass areas expand. This calls for increased maintenance programs, extended roads and, hopefully, a stronger strain of grass for the future. Many

golf courses today require golf cars to stay on the roads at all times.

The simplest means of illustrating the effect of keeping traffic off turf is to select a par-3 hole and restrict cars to the rough, or construct a road and confine all traffic to it. The grass will recover from excess golf car and maintenance equipment traffic wear in a short time.

Courses with very steep terrain also call for a road system. It will reduce hazards on steep hills, spinning wheels and excessive wear of grass. Holes with unusually steep grades require road construction to minimize hairpin turns and allow golf cars to proceed safely from tee to green. This unusual condition exists on the 12th hole at Gatlinburg Country Club, Gatlinburg, Tenn. There is a drop of perhaps 150 feet to 200 feet from tee to green.

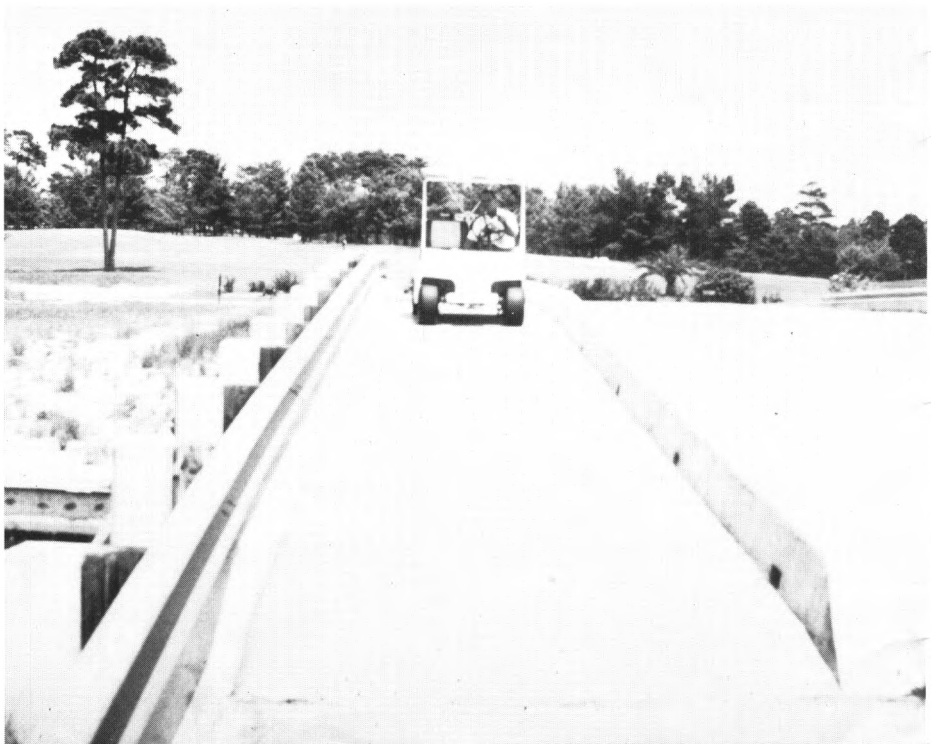
Practically all members will comment when the club decides to build roads. Some members believe their golf course will be turned into a super highway and roads will run in all directions. They fear the destruction of the beauty of the course and interference with the game. Most members think only of the width of the golf cars and fail to realize maintenance equipment may also have to use the roads. If this is the case, the roads should be wide enough to accommodate tractors and other equipment as well. There are many narrow roads where both golf cars and maintenance equipment run off the edge, kill the grass and cause erosion and hazardous conditions.

Many roads built 10 years ago are now being renovated, widened and reinforced with concrete or thicker asphalt. The first roads on any course are usually developed in areas of obvious need. Discussions about roads usually begin two or three years before actual construction. The discussions may continue endlessly, but someone eventually must make a decision, and it is doubtful if that decision will please every member.

The size of tires on golf cars as well as tires in maintenance equipment has a great influence on the wear. Research at the Coastal Plains Experiment Station, Tifton, Ga., in 1966 showed that 300 repeated golf car passes over a selected area of bermudagrass compacted the soil to the extent that a measurement made one year later showed as much as 33 per cent water runoff from the compacted area. Different tire sizes were used and research indicated a 9½- x 8-inch tire size was best. Five different selections of bermudagrass were tested. Tiflawn was the most wear resistant and Tifway was second. Tiflawn is not in use on golf courses today, but Tifway, Tifgreen, and common bermudagrasses are. Research at Texas A&M University by Dr. James B. Beard and his staff has indicated that Tifway is one of the most wear-resistant bermudagrasses used on golf courses today.

Roads should be constructed so that they do not distract from the course or the clubhouse. If they are carefully planned they may even add to the beauty, or at least blend into the landscape. From green to the following tee, they may be attractively landscaped with flowering shrubs and annuals. This type of scenery is quite often found at resort areas. In some instances, roads may also be used to divert water away from the playing areas of the course and clubhouse grounds.

Roads should generally follow the direction of the fairways wherever possible rather than follow a straight line from tee to green. Roads at the Countryside Country Club, in Clearwater, Fla., go from the first tee through the 18th green, but they were constructed to be as inconspicuous as possible. Landscaping plays an important role in designing roads; the use of flower gardens, flowering or evergreen shrubs and selected trees help break up the monotony of any road system. Roads should be designed for each hole so that the game will



Yacht and Country Club, Stuart, Florida, has high curbs to keep automobiles and golf cars separated.

Safety is important to Green Island Country Club, Columbus, Georgia.

have the least interference and at the same time the golf ball be accessible with minimum loss of time and play. Some roads are designed to curve around bunkers and mounds and at the same time place the golfer near the landing area or in proximity to the ball. An island can divide roads so that golf cars will not be too close if they should meet in a congested area. Small shrubs and rock gardens have been planted to improve the appearance of roads at the Las Colinas Country Club, in Irving, Texas.

Control of traffic on busy golf courses is becoming more of a problem. Sometimes patrols are needed to keep play moving with minimum disturbance to other golfers. Many people play only one to three rounds of golf a year. They usually drive their golf car wherever they please because they may be paying $100 a day or more for their stay.

The golfer usually goes to the course to relieve business pressure and for recreation. In many instances, he does not pay much attention to directional indicators to minimize traffic wear or to alert him to possible danger. Accidents are becoming more numerous and insurance coverage has become increasingly necessary. Miniature replicas of highway signs have been used for directing golfers and to indicate hills, danger areas and uneven terrain in an effort to reduce accidents. Unfortunately, they are too often ignored.

Some quite elaborate bridges across drainage ditches, creeks, rivers and highways are now being built on golf courses. Some of them compare quite favorably with bridges on public highways. To prevent golf cars from accidentally running off bridges, railings are of particular importance and are usually required by insurance companies.

Tunnels or bridges have been constructed under or over public highways to permit the golfer to cross such thoroughfares without danger of collision. An excellent arrangement of bridges can be found at Pleasant Valley Country Club, in Little Rock, Ark. The bridges were built at the same time the golf course was developed, and there is adequate clearance for pick-up trucks as well as for golf cars.

Metal culverts are often used for tunnels under a road. The underpasses should be built to insure adequate drainage without requiring pumping. Of course, a minimum clearance to permit golf cars with tops to pass through the culvert is essential.

Increasing attention must be given to those golf courses where the golfer must cross a public highway or street. Some authorities predict that sooner or later, golf cars will have to have license plates or tags to cross public ways.

Since it is difficult to move a road after it has been installed, there should be a complete drawing and understanding of the road system throughout the course before construction begins. Roads should be wide enough for all vehicles that are expected to travel over them, including maintenance and delivery trucks. Developing roads with a concave design or curbing will help in diverting water and causing the least interference to play.

The cost of petroleum directly affects the cost of asphalt. In some areas today, asphalt is almost as expensive as concrete. Where asphalt roads cross water drainways, concrete slabs should be installed since asphalt deteriorates in standing water. Concrete requires minimum maintenance and lasts longer than asphalt installations.

The cost of road construction varies from one community to another, and, therefore, estimates from state to state cannot be quoted. Local paving companies will provide estimates for roads based on foundation preparation, width of road and depth of asphalt. Hot or cold, asphalt is sold by the ton.

Reinforced concrete requires little repair, but the original cost can be many times that of asphalt. One cubic yard of concrete will cover an area 80 square feet at 4-inch depth or 65 square feet at 5-inch depth. From these approximate figures, one can estimate the cost of a concrete installation based on its local price per cubic yard.

The tendency to take shortcuts leads to worn turf in certain cart path locations. The installation of a low curbing (3 to 4 inches high) will not damage a golf car if it runs over it, but it will be a reminder to stay on the path and thereby preserve the turf. Curbing can be made from almost any material. Asphalt, concrete, cocoanut trees, pine trees, old railroad cross ties, and any other product that can be used to discourage the "shortcut" will

John Biddy at Lakeside Country Club, Houston, Texas, placed concrete in low drainage areas for minimum repair.

prove valuable. For easier maintenance, fill in behind the curb with soil and turfgrass to the level of the curbing. This will permit easier mowing.

There will be some light reflection from white concrete. To reduce glare, dye can be added when the concrete is being smoothed or when the finishing touches are made to the road surface. Lamp black or green dye can be used quite satisfactorily. A portion of concrete that has been dyed and a portion that has been left in its natural state can be compared for contrast.

Most golfers who use pull carts do not believe they are damaging the turf when they park their pull cart on the turf. There is no research showing wear of the pull cart compared with the golf car.

Most members pull up to a tee, pull off the road and park. This is a natural reaction after driving on public highways.

Roads are seldom constructed by land labor today unless they are of limited length. Forms can be built and cold mixes used and then rolled with a 300- to 500-pound roller. This will form a very satisfactory road. When properly constructed, it will last at least 15 to 20 years with minimum repair.

The type of car and turning circle required will determine the width and turning circles of a road. Many have to be widened in the circle area when the model of golf car is changed. The turning circle at the end of the road should be large enough to make the turn comfortably without backing or jockeying. A 4-inch curb will confine the cart to the road.

Many types of soil swell and shrink under varying weather conditions. These soils will affect the road surface even if it is made of reinforced concrete. Repair of concrete roads is much more difficult if swelling and shrinkage of clay causes the road to buckle or break.

The type of traffic using a road is important in determining construction and thickness of the material used. Delivery trucks of all sorts will be using roads around the maintenance building. A reinforced surface will not break under a 20- or 30-ton truck delivering sand, fertilizers, or other products to the golf course. Handling of delivery trucks should be taken into consideration when developing drive throughs. Ample backing space should be provided.

There should be a detailed drawing of the road system available so that everyone involved will have access to the system plans. The plans should be in great detail and careful thought should be given to efficient movement of both golf cars and maintenance equipment.

There should be at least a minimum of ¾- t 1-inch compacted asphalt for road building. A ¼- to ½-inch thickness breaks up easily under heavy traffic, and pot holes soon develop. These damage golf cars as well as maintenance equipment. Water also causes asphalt deterioration; bare areas develop and erosion sets in.

Tree and grass roots will damage a road if growth inhibitors are not placed on the soil before laying asphalt or concrete. Bermudagrass and weeds deteriorate thin asphalt rapidly. It also absorbs heat, and bermudagrass and other warm season grasses grow extremely well under these conditions.

Drainage is very important when constructing an asphalt road, and, therefore, the foundation under the asphalt is equally important. The amount of substrata or foundation depends very much upon the type of vehicles that will be used. Construction does not have to be of reinforced material if only golf cars are involved. Asphalt could be three to four inches thick and countersunk in the soil to be flush with the surface if there is a good sand base. Sealing the asphalt will slow deterioration and prolong the life of the road.

Everything imaginable has been used for golf roads, from pecan hulls to cypress bark. These are very attractive materials and they make excellent roadways, but heavy rains and excess traffic eventually break them down and distort their appearance. They require constant attention, and even then very dusty conditions may develop. Eventually, they are replaced with asphalt or concrete.

To provide the best possible playing conditions and to enjoy golf to the fullest, healthy turf plays an important role. Many factors are involved in developing and maintaining good golfing turf. One of them is the problem from ever increasing golf car traffic. Roads on the golf course extend the life of turfgrasses and the golf car.

TOPDRESSING MIXTURES

The Green Section's Position

by THE USGA GREEN SECTION STAFF

MUCH INTEREST has been generated in recent years concerning the use of sand for topdressing greens. This interest was given renewed impetus by the work of Madison, Paul, and Davis, as reported in the May, 1974, issue of the USGA *Green Section Record* article entitled "Consider a New Management Program for Greens." Topdressing with sand alone is not new, it was common practice years ago when the Scottish influence was strong on the U.S. golf course scene, a practice carried over from the Scots' native land. Since that time we seemed to have turned a complete circle from straight sand to mixtures containing as much as one-third sand, one-third soil and one-third organic matter, and now we are back again to mixtures containing a high percentage, if not 100 per cent sand.

The Green Section's firm position is that materials applied as topdressing must be as carefully prepared as soil mixtures for putting green construction. This can be done only after extensive laboratory tests by trained soil scientists. These facilities and services are available at nominal cost through universities and state experiment stations. Why not take full advantage of the scientific approach? It is the safest way to insure progress in converting a problem green into one that performs satisfactorily. If a putting green is

Results of lab tests on four individual sand samples. Could you have determined these important qualities by observation or feel? Note especially the striking differences in water infiltration rates.

Texas Agricultural Experiment Station, USGA Physical Soil Test Laboratory. Shipment & correspondence: Soil Physics Section, Soil & Crop Sciences Dept., Texas A&M University, College Station, Texas 77843. Phone: R. L. Duble (713) 845-4826; K. W. Brown (713) 845-5251.

TABLE 1

Particle Size Analysis

Soil Mix Materials	Gravel >2mm (>9 mesh) %	Total Sand (9-300) mesh %	Silt .002-.05mm (<300 mesh) %	Clay <.002mm %	SAND FRACTIONS					Organic Matter %
					Very Coarse 1-2mm (9-16 mesh) %	Coarse 0.5-1mm (16-32 mesh) %	Medium 0.25-.5mm (32-60 mesh) %	Fine 0.1-.25mm (60-140 mesh) %	Very Fine 0.05-.1mm (140-300 mesh) %	
Sand A	0.0	94.7	1.8	3.5	0.0	0.3	15.2	75.7	8.8	
Sand B	1.2	89.4	7.2	2.2	0.2	0.8	20.4	63.8	14.8	
Sand C	0.4	98.0	0.6	1.0	0.5	7.4	68.3	23.1	0.7	
Sand D	0.0	98.3	1.7	0.0	2.3	58.8	31.6	6.1	1.2	

Physical Measurements

Mixes Examined (% by Volume)			Bulk Density g/cm³	% Pore Space		Infiltration Rate — Inches of H_2O/Hour	Percent Moisture Retention at Pressure Indicated				pH of Mixture	Lime Needs[1] lbs/1000 sq. ft.
Sand	Soil	Amendment		Capillary	Non-Capillary		40 cm of H_2O	1/3 atm.	2/3 atm.	1 atm.		
Sand A			1.39	17.5	30.0	14.3	12.6					
Sand B			1.45	20.2	25.1	3.9	13.9					
Sand C			1.37	7.0	41.5	52.1	5.1					
Sand D			1.28	5.5	46.5	120.8	4.3					

[1] Lime values indicate rates of pure calcium carbonate (100% neutralizing value) uniformly incorporated to a six-inch soil depth. Adjust rate of application according to neutralizing value of material used and depth of soil to which it is applied.

poor because of its soil, a good program of topdressing can greatly improve it. One rule of thumb handed down through the years is that a topdressing mixture similar to the soil presently under the green must be used to maintain a uniform profile. Although this is a good general rule, it is not without exception. If the original soil is unsatisfactory, there is no advantage in perpetuating its use. If it is too heavy and drains poorly to begin with, there is little chance that permanent improvement can be made by adding a topdressing mixture of the same quality.

Selecting a commercial topdressing or mixing your own is not easy. It is a decision that cannot be taken lightly. Many of the commercial topdressing mixtures contain too much silt and/or clay to be acceptable for use on greens. Usually the purveyor provides a statement indicating the per cent of sand, soil and organic matter contained in the mixture he offers; however, no details are given as to *the kind of sand, the kind of soil, the kind of organic matter* involved. Sands are not all alike **(Table 1)**, nor are all soils and organic materials **(Table 2)**, and well suited for use in topdressing mixtures. These are vitally important characteristics to know about when selecting materials for use on greens. They have a great bearing on the make-up of a topdressing mixture and on the eventual long-term behavior of a putting green. As an example, **Table 3** provides information on top mix variability using different ratios of a sand and soil. It bears careful study.

Economy dictates that the source of supply for each ingredient should be available locally, otherwise transportation charges will be high for materials of this weight. Before sand, soil and organic material is purchased it is advisable to:

(1) Prepare individual and representative samples of each material. This requires taking random samples from various areas of the stockpile, mixing them to make one representative sample and placing each composite sample into separate strong containers to insure they will reach the testing laboratory intact.

(2) If soil is taken from a field, core samples should not exceed six inches in depth. When the contractor moves in with his equipment, be sure to insist that he does not take soil from below the 6-inch depth at mixing time.

TABLE 2

Variability Encountered in Organic Amendments for Topsoil Mixtures

Organic Material and Source	pH	Titratable Acidity to pH 6.5 meq./100 grams	% Ash
Sewage Waste (Calif.)	7.3	0.0	67.3
Muck — Peat (Ind.)	5.8	5.0	25.8
Muck — Peat (N.C.)	3.8	5.6	73.2
Moss Peat (Ore.)	4.0	30.7	3.9
Sedge Peat (Wis.)	6.0	1.4	12.8
Moss Peat (Ga.)	6.2	2.8	19.4
Lignified Wood (Calif.)	5.6	1.5	1.0
Rice Hulls (Tex.)	6.4	0.0	24.3
Cotton Gin Trash (Tex.)	8.3	0.0	43.3

Editor's Note: The percent ash shown represents inorganic residue including sand, silt and clay.

TABLE 3

The Influence of Native Soil on Various Properties of a Sand-Soil Mixture

Ratio of Components		Silt Plus Clay %	Bulk Density	Pore Space		Water Infiltration Rate (inches/hour)
Sand[1]	Soil[2]		g/cc	Capillary	Non-Capillary	
10	0	2.1	1.36	13	36	10.4
9	1	3.0	1.30	14	37	8.8
8	2	3.9	1.39	17	30	4.0
7	3	4.8	1.41	25	22	2.2
5	5	6.6	1.47	39	6	0.1

[1] Sand contained 22.7, 36.3, 30.0, 7.3, 1.6, 0.0, and 2.1 percent of very coarse, coarse, medium, fine, very fine, silt and clay, respectively.

[2] The soil contained 88.8% sand, 6.3% silt and 4.9% clay.

Editor's Note: Note almost zero water infiltration when equal parts sand and soil are mixed.

(3) Have a laboratory test made — one that provides information on the physical properties of the ingredients separately and in mixture. It is important to know the moisture retention qualities of the mixture, what the water infiltration rate is, what measure of resiliency (bulk density) is to be expected, whether the mixture will permeate established turf quickly and not interfere with the roll of the ball nor dull the mower, the particle size distribution of sand, etc.

(4) Be assured that adequate quantities of the exact same materials are available after laboratory recommendations are received. It is sheer folly to send one material to the lab and then use another in the mixing process. It is also wrong to alter the mixture to your specifications, i.e., to "improve" on the lab recommendations. It just won't work!

The question now arises, "What do I do when the prepared topdressing is all used up?" There is no assurance that you will be able to purchase the exact same sand, soil and organic matter endlessly; therefore, it is imperative that a lab test be run each time you purchase new materials. If the exact materials are not available, you want to be assured that the important qualities of the final mix are relatively close, and this can only be done by laboratory test. A recommendation based on scientific soil laboratory procedure will insure that the physical qualities will be as close to the original mixture as possible. Also, the ideal material is not always obtainable in every part of the country, and so it is sometimes necessary to settle for an "acceptable alternative." It is advisable to purchase and stockpile quantities of each material for mixing as time and labor permit. It is also good practice to allow a mixture to age by composting it for two months or more with occasional turning before it is applied to the turf. Its qualities then are better preserved when spread over the putting surface. If the topdressing is to be applied soon after mixing, the organic matter should be left out of the mixture.

Sands need not be white bunker sand. An off-white, tan, grey, or brown sand is suitable and, in fact, preferable to a bright-white sand for topdressing. It is decidedly advantageous if the sand contains some silt and clay. Up to 5 per cent silt and 3 per cent clay maximum is permissible in mixtures that meet the Green Section specifications

TABLE 4

Sand Particle Size Classification Table

	Tyler Scale (ASTM)* (Mesh)	U.S. (Sieve) No. (NBS)**	Sieve Opening mm.	Textural Name	
	4	4	4.76		
	5	5	4.00		
	6	6	3.36	Gravel	
	7	7	2.83		
	8	8	2.38		
	9	10	2.00		
	10	12	1.68		
	12	14	1.41	Very Coarse Sand	
	14	16	1.19		
	16	18	1.00		
Range	20	20	.84	Coarse Sand	Range For
For	24	25	.71		Soil Mixes
Bunker	28	30	.59		And Top-
Use					Dressing
	32	35	.50		
	35	40	.42	Medium Sand	
	42	45	.35		
	48	50	.30		
	60	60	.25		
	65	70	.21		
	80	80	.18		
	100	100	.15	Fine Sand	
	115	120	.13		
	150	140	.11		
	170	170	.09		
	200	200	.07	Very Fine Sand	
	250	230	.06		
	270	270	.05		
	325	325	.04		

*American Standard Testing Materials

**National Bureau of Standards

Editor's Note: A high percentage of sand should be in the range of .25 to 1.0 mm.

for putting greens. These sands are less costly and they blend well with soils beneath greens.

Sand particles should preferably be smooth or round in shape. Particle sizes should fall between .11 and 1 mm with a high percentage falling in the range of .25 to 1 mm (see **Table 4**). If round-shaped particles are not available, sharp sands are suitable and acceptable. Be sure to stay away from sands of soft origin, such as limestone and other calcareous materials. Only sands formed from silica, quartz and other hard rock materials are recommended.

Why should topsoil and topdressing material contain a high percentage of sand? To answer this question we refer you to the article "Principles of Soil Improvement For Drained Putting Greens" by L. Art Spomer in the USGA *Green Section Record*, July 1977. This article illustrates that 75 per cent to 90 per cent sand is required in a sand-soil mixture before physical improvement is realized. The other lesson illustrated is that adding a small amount of sand to a soil decreases pore space, thereby worsening soil quality. This strongly supports our position that without scientific assistance it is impossible to precisely determine the optimum soil mixture regardless of how good the sand, soil and organic matter appear to the naked eye. A soils test by scientists specifically trained in testing mixtures for greens is good insurance that your topdressing mixture will be the best available using materials you are able to obtain locally and economically.

As a general summary, an excellent topdressing mixture in our view must meet the following specifications:

Infiltration rate — 4 to 6 inches per hour (compacted) is ideal with a maximum of 10 inches per hour being acceptable. It is important to know that after grass is established, roots can reduce this rate by up to 80 per cent. Therefore, infiltration rates slightly higher than 10 inches per hour are more acceptable than rates below 4 inches per hour if an alternate choice has to be made because of limitations set by available sand.

Bulk density generally should range between 1.25 and 1.45 g/cm^3. Above 1.45 g/cm^3 the putting surface will be more compact and therefore less resilient, while below 1.25 g/cm^3 the turf will be softer and less enjoyable for maintenance and play. Bulk density limits are 1.20 g/cm^3 to 1.60 g/cm^3.

Water retention for plant use should range between 12 per cent or a minimum of .10 inch and a maximum of 25 per cent or .20 inch water held per inch of soil.

We are often asked our opinion on topdressing with 100 per cent sand. While we have observed good results to date, we are somewhat apprehensive about the long-range impact of a mix without some soil. However, if it is a question of not topdressing at all, or using an inferior product because of the unavailability of quality soil and/or organic matter, then in our view topdressing with straight (100 per cent) sand is acceptable as long as the sand is laboratory tested to insure that it meets the particle size specifications in **Table 4** and conforms with other requirements as prescribed in our specifications for putting green construction.

Coarse Sand	Medium Sand	Fine Sand	Silt and Clay	Organic Matter
.5 to 1 mm	.25 to .5 mm	.11 to .25 mm	Max. 5% silt Max. 3% clay	Quality product should be approximately 70% organic
75% Minimum		Preferred Range 10% Maximum Range 25%		Generally between 10% and 20%. Not required if used after mixing. Include if composted and turned at minimum 2 months before use.

This article was prepared by the Green Section Staff — **William H. Bengeyfield, William S. Brewer, Jr., William G. Buchanan, James B. Moncrief, Carl Schwartzkopf, James T. Snow, Stanley J. Zontek and Alexander M. Radko, Editor.**

Tables 2 and **3** were furnished by **Dr. Rollin C. Glenn** when he was in charge of the USGA Soils Lab at Mississippi State University. We also wish to acknowledge the assistance of **Dr. Kirk W. Brown** and **Dr. Richard L. Duble**, who are involved in the operation of the USGA Soils Lab at Texas A&M University, for review of this article.

Prepare Your Own Topdressing

by BRAHM P. VERMA

TOPDRESSING used for greens is a mixture of two or more particulate materials. A machine is described by which topdressing for golf course greens can be prepared. The machine can also be used for preparing all soil mixes used in the construction of greens.

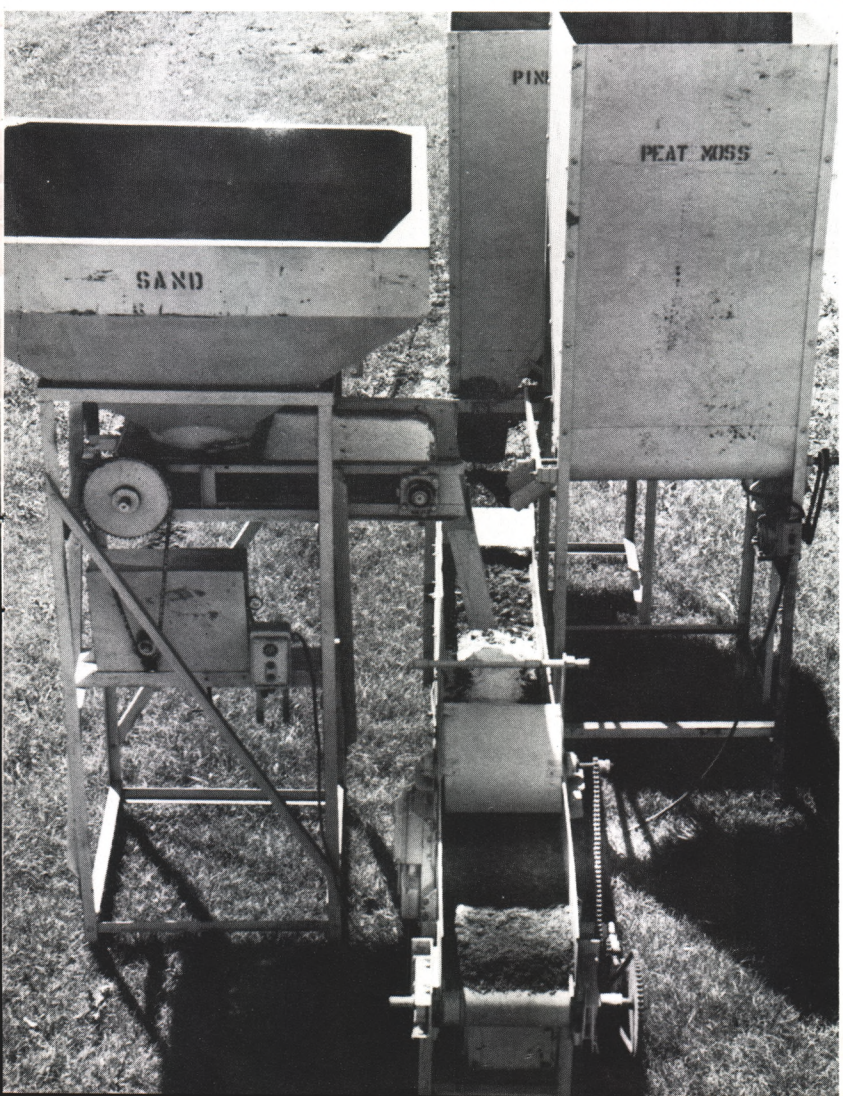
The operating principle of the machine is shown by a schematic diagram in the figure. The principal components of the machine are hoppers for each material, a conveyer belt on which mixing is performed, and a rotary mixer. The materials are metered through the hoppers onto the belt to form a traveling ribbon of materials to be mixed by the rotary mixer. The rotary mixer intercepts the ribboned materials and makes it airborne resulting in uniform mixing. The mixed material is discharged on the other side of the rotary mixer and deposited on the belt. The belt conveys the mixed material to a desired location.

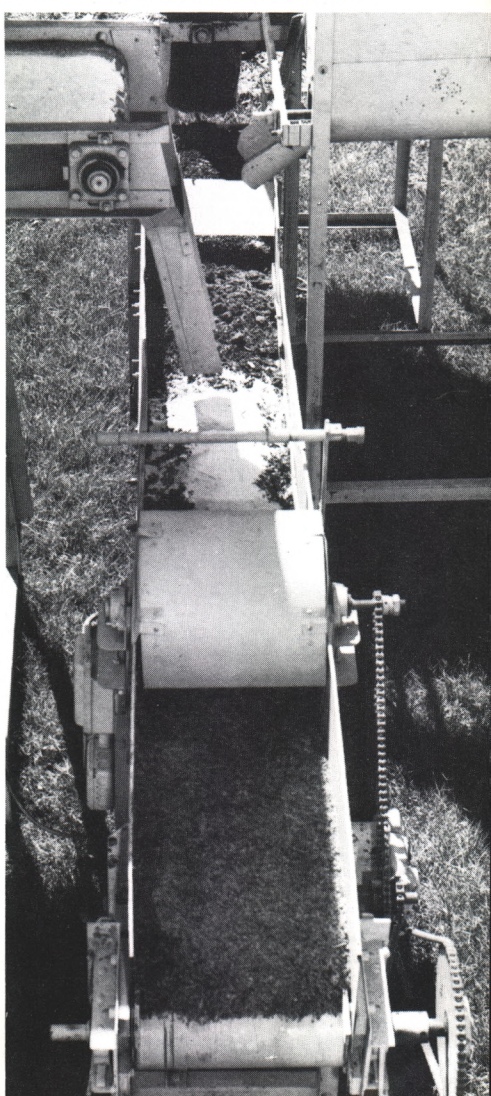
CONSTRUCTION

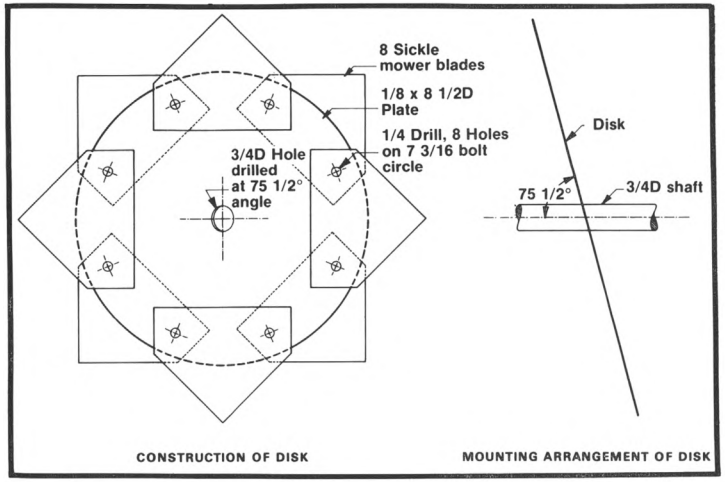
Construct a sheet metal trough, 12½ inches wide, 15 feet long and 8 inches deep. Mount a wing pulley at each end for the belt in a manner so that the belt is supported by the bottom of the trough. Use a 12-inch-wide belt of appropriate length and mount it over the pulleys. Support the entire assembly on legs at desired height.

Starting from one end of the trough, mount the hoppers so that the discharged material from each

The mixing machine with a closeup view on the right of the conveyor belt.







SCHEMATIC DIAGRAM SHOWING OPERATING PRINCIPLE

Brahm P. Verma, Georgia Experiment Station, Experiment, Ga. 30212

ROTARY MIXER ASSEMBLY

is distributed evenly over the width of the belt. The coarsest material should be deposited first. The number of hoppers used will depend upon the number of materials to be mixed. Use the first hopper (discharging material to form the bottom layer) for the coarse material.

The hopper design should be such that the slope of the walls does not exceed more than 30 degrees from the vertical. Most of the materials flow well when they are not wet. In general, sloped-wall bottom-unloading hoppers will provide an uninterrupted flow of materials. A hopper design is shown in the figure which can be used for metering materials. The metering rate can be changed by changing the gate opening and/or by changing the metering belt speed. A vibrator on each side wall may be used if one anticipates using wet materials, especially sand. A perforated pipe may be mounted over the belt to add water to the materials if needed for good mixing.

The main component of the machine is the rotary mixer. The mixer is constructed by mounting four 11¾-inch-diameter discs, three inches apart, on a ¾-inch-diameter shaft at 75½ degrees from the axis of the shaft. The disc mounting should be phased over a 90-degree turn of the shaft for balanced loading. The mixer assembly should be positioned so that the tips of the blades have an ⅛-inch clearance over the conveying belt. The construction of the disc is shown in the figure. A metal shield should be constructed to cover the mixer and to direct the airborne material on the belt.

Two electric motors will be needed to drive the metering belts, the mixing belt and the rotary mixer. One motor will be needed to drive the mixing belt and the mixer. The belt speed should be approximately 30 feet per minute for a mixer speed of 350 rpm. The hopper belt speed will depend upon the type of mix desired. A drive train should be constructed to interconnect all the hoppers so that a single electric motor can drive the metering belts.

For safety, place appropriate shields around all moving parts. Construct a control panel and mount all the motor switches at a convenient location.

The mixer blends materials to form a very uniform soil mix. The capacity of the mixer can be easily changed by increasing the metering rates and increasing the speeds of the mixing belt and the rotary mixer. At the speeds recommended above, one should expect a mixing rate of approximately 12 cubic yards per hour.

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POA ANNUA Bulletin Now Available

We are pleased to announce that the new bulletin *Annual Bluegrass (Poa annua L.) — Description, Adaptation, Culture and Control* will be released in December, 1977. This bulletin was prepared by James B. Beard, Professor, Texas A&M University (Editor); Paul E. Rieke, Professor, Michigan State University; Alfred J. Turgeon, Associate Professor, University of Illinois; and Joseph M. Vargas, Associate Professor, Michigan State University.

A major portion of this work is the result of a seven-year study supported by the USGA Green Section Research and Education Fund, Inc. This is the first comprehensive research study on annual bluegrass since 1937 and is another example of the USGA's interest on behalf of golf and its Member Clubs, through its agronomic arm, the Green Section. *Poa annua* is the most controversial of all grasses found on golf courses. Many superintendents promote and encourage it while others loathe and attempt to eradicate it. *Poa annua* is found on golf courses in all parts of the nation.

Included in this work is a section prepared by the Green Section agronomists that deals with cultural programs designed to maintain *Poa annua.* There is also a section devoted to *Poa annua* control measures for those who work towards its eradication.

Two copies of this important bulletin are being mailed to every USGA Member Club; one addressed c/o of the Chairman, Green Committee, and one addressed to the Golf Course Superintendent, with the recommendation that one of these copies be made a permanent part of the Green Committee file at the club.

We are pleased to have this opportunity to participate in this extraordinary research bulletin as an example of how your USGA research money is being spent in the interest of better golf through the Green Section's golf-related research program.

Index to the GREEN SECTION RECORD for 1977

The appropriate article is listed and followed with the name of the author, year, volume, number and page.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

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B. Paid Circulation		
1. Sales through Dealers and Carriers, Street Vendors and Counter Sales	none	none
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C. Total Paid Circulation	5,984	6,294
D. Free Distribution (including samples) by Mail, Carrier or other means	310	309
E. Total Distribution (Sum of C and D)	6,294	6,603
F. Office Use, Left Over, Unaccounted, Spoiled after Printing	310	198
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I certify that the statements made by me are correct and complete.
Robert Sommers, Managing Editor

TURF TWISTERS

BIOLOGICAL THATCH REDUCERS

Question: What's the latest on products marketed as biological thatch reducers? (Connecticut)

Answer: The idea seems logical, i.e., the introduction of thatch decomposing organisms to speed the decay rate. However, research data in most areas has been disappointing thus far. Better try on a small scale first.

SAND SIZE FOR BUNKERS

Question: Do you have any guidelines for selecting sand that is suitable for use in bunkers? (Missouri)

Answer: Sand particle sizes ranging between .25 mm and 1.0 mm have been satisfactory for use in bunkers. Particles larger than one millimeter (1 mm) have the tendency to remain on the putting surface; whereas, those less than 1.0 mm permeate the turf, causing little problems in mowing and keeping players from picking up pebbles from their line before putting. The sand should pass through a 16 mesh screen and be retained in a 60 mesh screen.

WHAT'S ALLELOPATHY?

Question: There are wars among nations, wars on the sports fields, wars among insects, animals, birds and all living creatures. Is there also war between plants? (New Jersey)

Answer: Yes indeed, there is warfare among plants and the term for it is allelopathy. In fact, VPI's *Plant Protection Newsletter* reports that just recently the Agricultural Research Service, U.S.D.A., sponsored a research planning conference on allelopathy at Starksville, Miss. Plants interact with one another by releasing chemicals which have a detrimental effect on each other. Such chemicals are released by leaching from foliage in rain water, decomposition of plant residues, or exudation from roots. This may explain the unexplainable weak spots often visible under trees.

As other examples, researchers and turfmen have observed the absence of *Poa annua* where ryegrasses predominate; and who can forget a takeover of good grasses by weeds; the constant battle between bentgrass and *Poa annua*; etc.