HOW TO BUILD AND THEN MAINTAIN A DURABLE, NATURAL ATHLETIC FIELD

By John Kerr, Associate Editor

Natural turf has become the preferred playing surface on athletic fields for many athletes and field managers. Yet both grow nervous when rain and extreme weather conditions cause sloppy footing and an unkept appearance. The proper construction and maintenance of an athletic field will produce a dense, tightly-knit, wear-resistant turf. Such a condition depends on good soil drainage and preparation, adequate fertility, the right kinds of grasses, proper design, and a sound maintenance program.

Drainage

The first step in the establishment of a new turfgrass area or improving established turf is drainage. Drainage must be considered in three different ways. These are: surface drainage, internal drainage, and subsurface drainage.

A field or any turfgrass area should be designed so that excess water moves quickly to open drains to flow into non-use areas or storm drains. On athletic fields this can be accomplished with a so-called "crown" so that the soil is higher in the center of the field. A one percent slope should be the minimum.

Internal drainage means that the soil used in the field or any specialized turfgrass area should be open and porous. In order for water to move internally, a soil mixture with a very high sand content is necessary. Sand content can be as high as 85 to 95 percent. This means that in new construction it is necessary to start with sand and add the necessary amount of soil.

Sub-surface drainage will remove excess soil water from periods of heavy rainfall and prevent waterlogging of the field. In order to provide adequate subsurface drainage, the subgrade should be contoured the same as the finished grade. A 3- to 5-inch layer of mixed gravel or cinders should be placed 12 to 24 inches below the soil surface to facilitate removal of excess moisture from the field.

"If internal soil conditions are poor, a little tile drainage (or slit plastic tubing) is very important," says

Improved football field looks professional, is easier to maintain, and provides players with safer, more attractive conditions. A good example is memorial field in State College PA.

Dr. John Harper, extension turf specialist at Penn State University. "For the high school low on funds, it is fairly inexpensive to dig an area and lay drain tiles." Many field managers are also laying a stone gravel blanket 4 to 6 inches deep over the tile lines. A fine pea gravel or coarse sand about an inch deep over the gravel blanket prevents the soil mix from washing into the gravel bed.

Irrigation

After the problem of what to do with water within the soil has been solved, it must be decided how to regulate the amount of water applied to the soil. Barring nature's own allowance, an irrigation system can be installed that will provide the proper amount of moisture. The right system is one which will distribute enough water uniformly to meet the maximum needs of turf. An irrigation consultant should be sought to make the proper analysis and specifications for any site.

Many variables exist for choosing the right system. According to Dave Pagano, irrigation consultant of D D Pagano Inc., Tustin, CA, each area of the world differs in its demands for an irrigation system. Windy country necessitates setting up sprinklers in the same direction of the wind to maintain a regular diameter for the throw of water. Pagano doesn't think spacing should exceed 60 feet. "It should never exceed 60 percent of the diameter for spacing," he says. In desert or windy conditions, 50 feet is the maximum spacing with the reminder that the closer the spacing the more the system costs.

Under severe drought conditions turf will lose a quarter to a third of an inch of water per day. This is equal to about 200 gallons per 1,000 square feet. A good-quality loam soil will hold about 1,000 gallons of available water per 1,000 square feet to a 6-inch depth. Therefore, an adequate irrigation installation should be capable of supplying the turf with a minimum of 1½ inches of water about every 4 to 5 days in periods of extreme drought.

Other factors to consider are soil temperature — hot soil will corrode a steel pipe; type of water — some will necessitate using plastic over brass or steel; freezing temperatures — sprinkler design must be such that water drains out of heads; water scarcity — in areas like Southern California you need anti-drain valves; and soil type — clay or sandy conditions require varied application rates. Also, Pagano says, in the Midwest and East lightning rods may have to be installed.

Irrigation systems vary from padded pop-up types of sprinklers, spaced uniformly over the entire playing area, to occasional outlets on the perimeters. Traveling sprinklers with hose connections to perimeter outlets provide very satisfactory and efficient irrigation for athletic fields. These apply water uniformly over rectangular areas and can be adjusted readily to conform with wind direction and velocity. Lower initial costs of perimeter outlets may prove more expensive in the end, considering efficiency, additional labor, and equipment.

Cost cutting on an irrigation system may be hazardous. Pagano says that the only way is to use less expensive equipment, not space a system farther apart. Sometimes, thinner, lighter parts can substitute for heavier, industrial-built parts. But "If you skimp in design, you are defeating your purpose," says Pagano. "Nothing is worse than a poor sprinkler system."

Types of grasses

Wear tolerance is the vital feature for turfgrasses used on athletic fields. The improved grass varieties provide the greatest resistance to wear. Both ryegrass and tall fescue have a high fiber content, which provides increased wearability. Wear tolerance also increases when the amount of green vegetation per inch increases. Moderate amounts of thatch provide an extra cushion and improve wear tolerance.

Research done by turf agronomists at Michigan State University ranked the wear tolerance of the following turfgrasses when grown in their respective region of adaptations:

Ranking	*Warm Season*	*Cool Season*
Excellent	zoysia bermuda bahia	
Good		perennial ryegrass tall fescue Kentucky bluegrass
Medium	St. Augustine	red fescue
Poor	carpetgrass centipede	creeping bentgrass colonial bentgrass *Poa annua* *Poa trivialis*

From *Turf Manager's Handbook*, Dr. W H Daniels, turf specialist and Dr. R P Freeborg, professional turf technician. Purdue University.

Fertilizers, Lime, and Other Materials

Building a good athletic field deeply depends upon the kind and quantity of materials to be used, how and when they are applied, and the manner in which the work is done, according to Dr. Harper. All of these things must be adjusted to the specific conditions of the individual job. The basic principles affecting the use of fertilizers, lime, and other materials, and the relationship of the kind and condition of the soil to methods of its preparation are vital factors in producing good turf at the lowest possible cost.

Soils vary widely in the quantities of available plant nutrient materials which they contain. Nutrients most likely to be deficient are nitrogen, phosphate, and potash. Soil tests, available through each state's agricultural extension service, will provide adequate information on the need for phosphate and potash. When tests show low levels of these materials, liberal applications should be made in preparing the seedbed for turf. Adequate quantities of phosphate and potash can be supplied by applications of 50 to 75 pounds per 1,000 square feet of 0-20-20 fertilizer or equivalent. The material should be applied prior to tillage and worked into the soil as deeply as possible.

Soil tests are not totally reliable for determining the quantity of nitrogen that should be used. They show only the quantity of soluble nitrate nitrogen present, which is utilized or lost very rapidly. Three basic guides exist for the use of nitrogen in turfgrass establishment: the needs of the grass itself, the kind of nitrogen applied, and the depth to which it is mixed into the soil.

To meet the needs of young grass seedlings, it is seldom necessary to apply a total of more than 1 pound of quickly available nitrogen per 1,000 square feet. This nitrogen may be exhausted quickly, requiring a reapplication within three to four weeks. The necessity for a second application in such a short time may be avoided by supplementing the initial application with an additional three to five pounds of nitrogen per 1,000 square feet derived from materials such as natural organics or compounds, which release nitrogen slowly.

It is best to apply fertilizers containing nitrogen just prior to seeding. These should also carry phosphate and potash, even though previous applications of these elements have been made. This will insure that liberal quantities of the nutrient materials will be available to developing seedlings. The starter fertilizer should be worked into the soil to a depth of not more than one inch. If a material containing nitrogen in soluble form is used, the nutrient ratio should be 1-1-1. If fertilizer containing 35 percent or more water insoluble nitrogen is used, the ratio of nitrogen to the other nutrients can be increased to 2-1-1 or 3-1-1. The material should be applied at a rate to supply three to five pounds of nitrogen per 1,000 square feet and proportionate amounts of the other elements.

The degree of acidity or alkalinity affects the activity of soil microorganisms, the availablity of plant nutrients, and the activity of disease-causing fungi. Without good microbial activity, high acidic conditions prevail, which encourage fungi growth.

Lime is the most economical and readily obtainable material for correcting soil acidity. Application rates should fulfill the total lime requirement. Lime should be applied prior to preliminary tillage and worked into the soil to a minimum depth of five to six inches.

Soil compaction — one of the most common causes of poor turf on athletic fields — reduces the rate of movement of air and water through the soil. These effects can be reduced by adding conditioning materials when the field is built. Sand and some form of organic matter are useful materials.

The quantity and quality of sand use will depend on the character of the soil to be treated. Heavy clays and silts may require as much as 50 to 60 percent sand by volume, mixed to a 5-inch depth, to improve their resistance to compaction while retaining the firmness necessary for good playing conditions. Graded sands with the fines removed are best adapted for use as physical conditioners.

Various types of organic materials, such as raw or cultivated reedsedge peats, effectively reduce soil compaction. They absorb much moisture and improve aeration of the soil. Where peats are used, it is seldom necessary to apply them at rates of over 10 percent by volume. Other types of organics which reduce compaction include raw sewage sludge, tannery wastes, seed hulls, and well-rotted sawdust. Because of their faster rate of decomposition, they work for a shorter period of time.

To gain the highest value from soil conditioners, they must be uniformly mixed into the soil to a specified depth. Tools, such as rotary hoes, rotovators, or disks, can be used. When both peat and sand are being used, the peat should be spread first and the sand following to work the lighter peat into the soil.

Bed Preparation and Seeding Establishment

Seedbed preparation is the single most critical operation in constructing an athletic area, according to Dr. Harper. Improper seedbed preparation or preparation under adverse weather or soil moisture conditions may result in complete seeding failure. Working soils containing excessive moisture, especially with heavy equipment, will destroy the physical condition of the soil. Destruction of the soil's physical condition increases compaction.

"You need to get a good, firm seedbed," says Eugene Meyer, turf specialist at O.M. Scott & Sons, Marysville, OH. "If you don't prepare enough and large clogs are in the soil, you inhibit growth, whereas overworking the soil leaves you with a powdery, fine composition that is just as bad." Meyer prefers to get the soil between the size of a marble to a golf ball, leaving enough fines and open areas for seedbed germination.

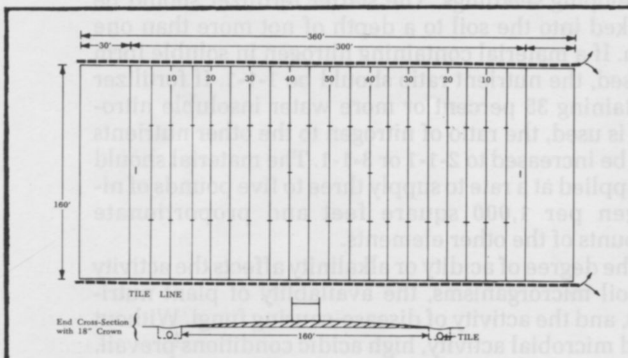

Figure 1 Field plan of football gridiron showing end section and tile lines.

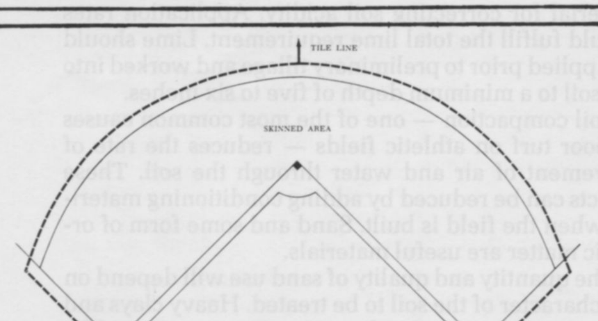

Figure 3 Field plan of regulation baseball diamond showing design of tile system.

Harper thinks that over tillage can also destroy the soil's physical condition. This is especially true with a rapidly revolving tine-type rotary tiller. Rotovators, on the other hand, are equipped with shovel-like cultivators which revolve relatively slowly. Plowing provides an acceptable method of tillage, provided care is taken to work out by disking and floating the uneveness caused by the furrows. Disking alone may be satisfactory for some soils.

The final seedbed should be a homogenous mixture of the original soil, physical amendments (sand and organic matter), lime, and fertilizer. When mixing sand and organic matter into the soil, the organic matter should be laid down first with the sand on top. Tillage tends to float the light organic material upwards while the heavy sand moves downward. Layers of any given material must be avoided.

Once the bed is prepared, a uniform application of seed is essential for proper density and coverage. This is best accomplished by using an accurate spreader that has been properly calibrated. Make certain that the spreader is set at the recommended rate. When seeding athletic fields, it's a good idea to seed in two directions — lengthwise at 1/2 the rate and widthwise at 1/2 rate. This will give much more uniform coverage and density. After the seed has been applied, it should be lightly mixed into the top quarter inch of soil. Pulling a short section of chain-link fence or flexible door mat over the seed area will accomplish this.

After seeding, apply a thin, uniform, weed-free mulch. Mulching will help conserve moisture and reduce seed loss due to wind and soil erosion. Manure, clean straw, salt hay, shredded bark, burlap bags, wood shavings, or peat can also be used as mulches. This material should be spread lightly across the seeded area so that the soil surface is visible at all times. If applied correctly, mulch need not be removed because it is easily chopped up with mowing equipment and decays rapidly.

Even though mulches are helpful, a full watering program should be followed. Water is extremely important to the new germinating seedlings. From the time of germination, the seedling is vulnerable to drying and must receive sufficient moisture until it is a well-rooted, established plant. Water twice and preferably three times a day and even more frequently on hot days with drying winds. A gently spray will prevent seed dislodgement and puddling but keeps the soil surface constantly moist.

Once the grass has been established, it should not be mowed until it has reached a height of 1½ to 2 inches. If mowed too early, the new seedling may be pulled from the soil leaving bare spots or ruts. Light equipment should be used on the first mowing, also according to O.M. Scott recommendations.

MAINTENANCE

A good maintenance program is just as necessary to insure athletic field turf of satisfactory quality as sound establisment methods. Without good maintenance practices, quality turf on athletic fields is impossible.

"Steady maintenance is the key to our field — everything it needs we do," says Don Bryan, field manager of Memorial Field in State College, PA. Under the direction of Merrill Sweitzer, director of grounds, the field has drawn applause from people throughout Pennsylvania. It is because of this acclaim that funds for operation of the field have not been cut back.

There's no magic that creates this model football-soccer field. Bryan aerates, plants grass seed, and fertilizes with a starter fertilizer every spring. When the ground becomes dry, he uses a traveling sprinkler with a 1½-inch hose that extends across the field. In three passes it covers the field. "It's important to water," he says, "probably the most important thing."

Bryan's crew cuts the field every fourth or fifth day. If it grows very rapidly and they can't keep up with the mowing, his workers sweep up the clippings.

When dandelions start growing, the crew applies a 30-5-3 fertilizer and dicot weed control which kills the roots immediately. In July and August they spread a 31-3-10 high-density fairway fertilizer. A little over-seeding is done in September, but it is not necessary to do anything else in the fall, according to Bryan.

Bryan and Sweitzer are now preparing a new field, which they have been building for two years and will make ready for play next fall. They have followed many of the construction procedures outlined previously: laid a rock bed underneath the soil for drainage through the clay soil; leveled, rowed and packed the land both years to get a firm, contoured slope; had the university do a soil test; and with those results, prepared the proper amounts of lime and conditioners.

They expect the new field to be as attractive and functional as Memorial Field. Yet now Memorial is the showpiece and their close maintenance has made it that way. "The biggest thing is steady watching," says Bryan. "You've got to get on the problems right away. It makes the job a lot easier."

Although Bryan's remarks may seem to simplify a rather precise operation, his and his boss's years of experience enter into the day-to-day work that is not verbally expressed. Research and results from Penn State University and O.M. Scott can add the fine points to the maintenance of an athletic field.

Mowing

Grass should be cut often and at a height adjusted to the predominating grass in the mixture. Kentucky bluegrass, fescue, and ryegrass or a mixture of these should be cut regularly at a height of 1½ to 2 inches. Prior to play, the height can be reduced to 1¼ inches. It should be taken down gradually and never more than one quarter inch at a time. Frequency of mowing is governed by the growth rate of the grass.

Cutting should be done whenever grass makes a growth of ¾ to 1 inch above the cutting height. If this practice is followed, it is not necessary or desirable to change the mowing height at any time. Bermudagrass should be kept ½ to ¾ of an inch by frequent mowing during the playing season and 1 inch during periods of limited use. When cut higher it becomes spongy and loose and does not provide a good footing or a dense turf. Zoysia should be cut at ¾ of an inch.

Watering

When dealing with mature turf, it is only necessary to irrigate when the grass shows signs of water stress, such as discoloration or wilting. When these signs appear, it becomes necessary to water the field to a depth of 4 to 6 inches, which is about 1½ inches applied in two or three applications a week. The sprinklers should be adjusted to apply water only as fast as the soil can absorb it. Since the type of soil dictates the amounts of water it can absorb, caution should be

Exceptional systems give extended life for turf

For the athletic field manager with the funds and support to construct a new field, a few modern options exist beyond the basic principles of construction and maintenance. These fields cost more but they also last much longer than superficial renovations. In the long run, the best system could also be the least expensive.

Dr. William Daniel, turf specialist at Purdue University, and Melvin Robey, who at the time was superintendent of athletic facilities at Purdue, coinvented the Prescription Athletic Turf or PAT system first installed in 1972. It is a replacement system which improves the playability of the field and extends its usage by countering the wet, dry, cold, and hot extremes of climate.

Briefly, it works like this: first, whenever it rains during a game, the suction pumps (below the surface), which are attached to the terminals of drain tubes, are turned on and they pull the moisture through the compacted sand, topmix, and turf; second, the flat subgrade is covered by a strong continuous plastic film which forms a waterproof barrier that conserves the overflow rainfall; and third, automatic subirrigation is achieved by back-watering through the drain tubes. Moisture sensors in the rootzone sand signal the need for rewatering whenever necessary. (For more information, write **901** on reader service card.)

Robey has since developed his own system and company for athletic fields, Sportsturf Systems, Inc. Basically, there are two types of fields which Robey's crew build and have built in various parts of the world: the Sportsturf All-Weather Field, which contains a 100 percent sand rootzone of 18 inches, and the Sportsturf Touchdown Field, with a 12- to 14-inch sand rootzone. Both types involve a plastic liner, which aids in the conservation of water and plant nutrients and also prevents contamination of the all-sand rootzone from external water in the surrounding subsoil; and a network of drain lines and sub-surface irrigation which controls the amount of moisture in the sand.

Robey points out that although the sand is the vital ingredient, his system involves a soil analysis to determine the right type of sand, amendments, and drainage. He also has a system called Sportsturf Mod Field, a modified version of the other two. (For more information, write **902** on reader service card.)

Another system of benefit to athletic fields is Enkamat, a turf reinforcement installed in the Rose Bowl, Orange Bowl, and other prestigious playing fields. This three-dimensional webbing made of nylon monofilament fused at the intersection is sold by Tom Mascaro of Turfibre Products in Miami.

Enkamat comes in 87-pound rolls that are 38 inches wide and 328 feet long. It rolls like a rug over an already-prepared soil mix and drain tile system. Once it has been laid, you can either sow seed or stolinize into it. Enkamat helps scarred turfgrass heal itself while protecting against compaction and wear, promoting a strong root system that will give resilient footing and may help reduce players' injuries. It also holds turf together, minimizing the damage from tearing and divots as athletes make their cuts and pivots. (For more information, write **903** on reader service card.)

taken not to over-water. When run-off occurs, the water should be shut off. The soil should be checked with a soil probe to determine the depth of the water penetration.

Traveling types of sprinklers can provide more uniform water distribution than stationary kinds, unless the latter are checked often. Periodic aeration will speed up water penetration and usually results in more efficient water use.

Aeration

Constant trampling often produces a compact, impermeable surface layer of soil. Mowing, rolling, and use of other heavy equipment when soils are wet can aggravate this condition. When compaction develops, grass roots are injured because they can't receive sufficient moisture or air.

Various types of aerating tools have been devised to break through the compacted soil layer mechanically and remove a soil core. Size of openings made by these machines varies with the diameter of the hollow tines or spoons used. For athletic field use, such openings should be about ¾ to 1 inch diameter. Aerating equipment should be used over solid tine spikers, which do not remove a soil core.

Penn State recommends aerating heavily in the spring (six to eight times over the area) and lightly in late summer or early fall (one to three times). Scotts recommends heavy aerification during the fall. It should always be done before fertilization and overseeding. Aeration in the spring or late summer should be followed by dragging with a chain or chain link fence to break up the soil cores. Fields should not be dragged after aerification later in the season because freezing and thawing of moisture will help relieve compaction and improve soil structure with open holes.

Fertilization

The maintenance fertilizer program should be based on complete soil test results. Most athletic areas will require two complete fertilizer applications per year although some fields may require only one complete fertilizer application supplemented with one or more nitrogen application. Occasionally, fields having very high phosphate and potash levels will require only nitrogen applications.

The ideal fertilizer program provides uniform growth over the entire growing season. The type of nitrogen-carrying materials—quickly available or slowly available — in a fertilizer determine how such a program can be obtained.

In general, cool season grasses require a rate of 4 to 6 pounds of nitrogen, 1 pound of phosphorus, and 1 pound of potassium per thousand square feet each season. Southern grasses require 5 to 10 pounds of nitrogen with approximately the same amount of phosphorus and potassium per thousand square feet each season. These amounts should be evenly distributed in four to five separate applications. This will supply the necessary nutrients throughout the growing season.

Overseeding

An overseeding program to regenerate worn turf should be an integral part of any athletic field maintenance program. The same quality seed should be used in overseeding as used in original establishment. An

Continues on page 24

HoneyLocust *from page 23*

'Skyline' Honeylocust (*Gleditsia t.i.* 'Sunburst') has a somewhat ascending to upright oval crown, reaching 45 to 50 feet in height. Staking is not required in the nursery. It does develop a good straight central leader. The leaves are a rich, dark green during the summer and develop an attractive yellow each fall. It is a good specimen for large areas or home landscape sites. It certainly ranks with 'Moraine' Honeylocust as one of the outstanding cultivars.

'Sunburst' Honeylocust (*Gleditsia t.i.* 'Sunburst') has an upright habit, reaching 40 feet at maturity. 'Sunburst's' foliage is unique. It has rich, dark green leaves on year-old wood, contrasted with outstanding yellow foliage on the current season's growth. To develop this color, one must encourage vigor. This means annual pruning after 10 to 15 years in the landscape to stimulate new growth. This annual pruning should be vigorous, almost attacking the tree with a "machete." 'Sunburst' does seem to attract more than its share of insect problems, specifically Honeylocust Pod Gall and mites, but if used sparingly in the landscape, it can be a unique addition.

Honeylocust is an outstanding urban tree. It has been overused, leading to increased reports of insect and disease problems. If not overused (diversity — no more than 5 percent of the same tree specimen in the community), insect and disease problems will not be significant. If overused, borers and many other problems will crop up. This did happen with 'Moraine' Honeylocust in the '60's, but with a shift of emphasis and more knowledgeable urban foresters, landscape architects, and horticulturists, this plant is again becoming a desirable tree for city streets, large area landscapes, parks, and home landscapes. Its ability to compete with turf, providing open shade and the fine texture make it outstanding. Its rapid rate of growth is certainly another desirable characteristic. In fact, it is not uncommon to see this vigorous tree grow 2 to 3 feet annually the first 10 years planted in the landscape. There have been some pest problems, but if our rule of diversity in any landscape is maintained, this tree has a place in difficult sites for most urban landscapes. **WTT**

Athletic Field *from page 22*

acceptable program for overseeding permanent grasses might follow these steps:

1. Aerify heavily in late fall (four to six times) leaving holes open
2. Break up and drag in plugs next spring
3. Mow area close (¾ to 1 inch) and remove all debris
4. Scarify
5. Apply starter fertilizer at recommended rate
6. Seed at recommended rate
7. Apply light topdressing if possible
8. Drag lightly
9. Keep newly seeded area moist

These are general considerations. The methods should be adjusted to suit the level of maintenance desired, equipment available, and the present condition of the field. Program modifications for southern turf should include increases in fertilizer rates from 4 to 8 to 10 pounds of nitrogen per thousand square feet each growing season. Timing of the aerification and overseeding operations should be adjusted to the longer growing season. **WTT**