Denver's Mile High Stadium suffers (and survived) the ravages of a rock concert. Photo courtesy: Steve Wightman.

Constructing Fields for Peak Performance

The heavy native-soil fields of many facilities were designed for limited, seasonal use in a single sport. Today, with more participation in sports in general and the huge increase in soccer play, these fields are being put to the test.

In this article, three sports turf specialists — Michael DePew, Steve Guise and Steve Wightman — share their experiences on what it takes for fields to survive the test of miltiple use.

Laying the Groundwork

By Michael W. DePew

Multi-use sports fields are defined as those devoted for a variety of functions, including two or more sports activities. Non-sports uses may include fairs, car shows, concerts and more. Some of these fields also may be used for parking or camping.

The type of root-zone construction system that fits a particular facility's requirements can be specified and constructed. To do this successfully, all things must be considered in determining the objectives for the field, the subsequent expectations, and the anticipated level of use and maintenance. An experienced and qualified sports turf agronomist, with these factors in mind, can help evaluate and meet the athletic field requirements of the facility by specifying the component mixtures to be used.

Tackling Compaction

The largest management concern for these types of fields is compaction — because of their varied uses, frequency of use and high intensity of use. "Frequency" refers to the number of times a field is used; "intensity" to the level of force or stress per use. For instance, a high school football field and a college football field may have the same frequency of use, say five times a week, but the college field has the higher intensity because of the more competitive nature of the play.

Controlling the detrimental effects of compaction is achieved in two ways: (1) management techniques, including careful scheduling and timely cultivation (aeration) and (2) construction with compaction resistant materials.

Improvement with construction often is attempted by new construction or complete reconstruction or by differing levels of renovation practices and procedures. Unfortunately, the decision whether to renovate or to reconstruct multi-use sports turf areas is too often based upon emotional issues or on incomplete information. This information is many times perceived as "free," because it is supplied by a contractor or salesperson who hopes to obtain the contract for the project.

Planning a multi-use field is too important to be approached haphazardly. To avoid costly mistakes, all decisions should be made with the best advice possible. This usually means consulting with a non-biased, experienced sports turf agronomist or a landscape architect working with a sports turf agronomist.

The key to creating a successful multi-use field is to start by answering a series of questions, which tend to fall into three groups.

Levels of Use?

How and how often will the field be used? In other words, what are the expectation levels for use and performance? Are those expectations realistic in terms of the budget available for the project and the subsequent maintenance level? Is the sports turf manager's level of expertise adequate to manage the type of field specified? Is the necessary maintenance equipment available or budgeted for? Is an objective of the project to improve the field performance for the current frequency and intensity of use, or will frequency and intensity increase following completion of the project?

Field renovation or construction projects may be perceived as total or partial failures when the improved field conditions bring on ever-increasing frequency or intensities of use. Even if the field has the potential to tolerate the increased use, the necessary management intensity levels may not rise correspondingly.

A monster truck pounds Mile High Stadium's field. Photo courtesy: Steve Wightman.

Safety & Playability?

Is one of the objectives of the proposed project to increase the playability and safety of the field? If so, primary considerations for real improvements include:

- reduced field hardness and increased traffic tolerance, through compaction-reduction techniques;
- increased footing or traction, through dense, uniform, strongly knit turf;
- increased drainage and aeration rates;
- a reduction in drastic micro-topography changes (such as undulations or holes from settlement of irrigation components and erosion around sprinkler heads, etc.);
- a higher degree of uniformity in the above types of characteristics across the playing surface, making the surface more predictable and playable.

Improved aesthetics can also be considered but should be secondary.

Management Alone?

Can the level of use and objectives for the field be achieved by a combination of cultural management techniques alone — such as increasing aeration, altering the fertility program, managing root-zone moisture differently, or changing wear patterns? Can management intensity levels be increased to achieve the desired results? Is there a policy in place to limit or cancel play upon the occurrence of field conditions not conducive to use, such as excessive soil moisture? That is, will using the field in this condition be severely damaging to the turf's root-zone system and can the field manager take the necessary steps to avert the damage?

Amending the Root Zone

The type of root zone specified for multi-use sports turf areas varies widely. These range from (1) simple installation of drainage systems to (2) recontouring of existing fields using the existing root-zone material to (3) construction or reconstruction with amended root-zone components. Deciding which of those is called for depends upon the answers to the questions above, and in making the best decision, the advice of a sports turf agronomist can be invaluable.

This is especially true for amended root-zone constructions because of the many types of materials available: organic amendments, sand, diatomaceous earth, calcined clay, synthetic fabrics, synthetic fibers, rubber or other granules, native soil, and industrial earthy material waste products such as slag, ash and others.

Many of the materials used as mixture components in root-zone construction can have certain limitations or drawbacks:

- For instance, industrial earthy materials are often high in salts or toxic elements.
- Organics can be tricky because they encompass so many types of materials (manures, food wastes, sawdust, grain hulls, various kinds of peat and others) and are therefore highly variable in their fiber content, carbon-nitrogen ratio and other characteristics.
- Diatomaceous earth and calcined clay raise questions because they have not been thoroughly researched in all contexts. It may be true that those materials do enhance the soil's water-holding ability; or it may be that the process of working them into the soil simply increases the soil's tilth, which enhances water retention. Nor has it been determined how easily they release water or how stable they are (there's some indication they may break down under freezing and thawing).
- The effectiveness of fibers and rubber depends upon whether the pieces touch or interact, the types of soils around them, the depth at which they're incorporated, and other factors. The effectiveness of synthetic fabrics and fibers is sometimes limited because they may create shear planes within the soil that may "give" under stress.

If any of the root-zone amendments are used incorrectly or in improper proportions or if the construction is poorly done, the results achieved from the project may be much less than expected. Even worse, the field quality may actually decline from the pre-project performance level.

For a better understanding of the complications involved, let's take a look at the more common types of field constructions.

Native Soil

Many multi-use field constructions include a significant proportion of native-type soils and may have certain beneficial properties. For instance, native soil-based systems generally require a lower management expertise level and may have a lower maintenance budgetary requirement. They may also have a higher frequency use level than, say, a sand-based system. One reason is that turfgrass plants are more firmly anchored because of the native soil's greater internal strength characteristics.

But native soil systems also have definite limitations. Because they are more prone to compaction, they generally have a much lower intensity use level, particularly under adverse climatic conditions.

Mixing Sand

A common root-zone modification system is to mix various proportions of sand with the existing native soil and then reinstall the modified soil mixture. An organic component may or may not be included in the mix.

One problem with this type of modification is the mixing of two contrasting types of soil. While the sand is a granular or "non-plastic" soil component, the native soils are commonly high in "plastic" soil components.

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Murrayfield withstands the stresses of heavy use. Photo courtesy: Steve Guise.

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(Note: Physics defines "plastic" components as those capable of continuous and permanent change of shape in any direction without breaking apart.) Plastic soil components are many of the soil minerals (montmorillinite, kaolinite, illite and others) that commonly make up a large proportion of the clay and silt size fraction.

Small additions of sand or other granular materials to a plastic soil will not significantly alter the *physical* (aeration and drainage) performance characteristics of the soil. It's like sticking a few marbles into a jar of flour — the marbles simply "float" within the finer textured material and do not increase the porosity and other physical performance properties of the mix. These small additions of granular materials, however, can improve some aspects of soil *mechanics*. For instance, small additions often increase the internal friction of the mix and can thus slow the rate of compaction somewhat.

Significant changes in soil *physical* properties with the addition of granular sand will not occur until a large proportion of sand is achieved. Until large volumes of sand are added, the sand particles simply "float" within the finer textured soil.

The amount of sand that is required before significant alterations in soil physical properties are achieved is referred to as the "threshold proportion."

At the absolute threshold proportion, the mixture volume will be 100 percent occupied by sand with the spaces or packing voids between the sand grains in the mixture occupied 100 percent by the finer textured native-type soil component. Using the analogy above, it's like having a jar that is 100 percent full of marbles with the spaces between the marbles occupied by a finer material, such as flour. At this threshold proportion in a soil mix, the drainage and aeration characteristics of the mixture will be dominated by the drainage and aeration characteristics of the finer textured component, while the mechanical characteristic (compaction resistance) of the mixture will be dominated by the sand component.

Depending upon the soil texture and sand particle size distribution, the amount of sand required to reach the threshold proportion is typically somewhere between 70 and 80 percent sand, on a volume basis. The percentage varies because the greater the amount of sand already in the soil and the coarser that sand is, the less sand you need to add to reach the threshold. Also, the coarser the added sand, the less you need to add. Significant changes in drainage and aeration characteristics typically require enough additional sand so the final mix is 85 percent sand or more.

Highest use intensities are normally achieved with strictly "specified" sand-based systems — those where the sizes of sand and other mixture components are carefully specified. As noted above, however, sand-based systems do not necessarily have the highest frequency use levels: they can be prone to greater wear (divoting) and therefore may need more recovery time. Further, sand-based fields generally require a much higher management expertise level and often a higher maintenance budget. This is due in part to the inherently lower buffering capacity of sand (quartz). Characteristics of a low buffering system or material include such things as a lower nutrient and water holding capacity; a greater tendency for disease problems; and wider, more rapid changes in pH.

Sand-based root-zone constructions are typically composed of 80 to 100 percent of a specified sand with the remaining proportions of the mixture being composed of an organic component or a soil-organic mixture component. A soil component in these sand-based root zones will often have a detrimental impact (mainly a clogging effect) on the internal drainage characteristics of the root zone and is commonly deleted as a mixture component due to those effects.

Although complicated, it is possible to build a field that meets the requirements of a multi-use facility. But, remember, that's only half the job. The other half is maintaining the field. If a field is "pushed" beyond its limitations or if other aspects of maintenance are not provided for and adhered to, even the best constructions may fail.

Two Successful Fields

By Steve Guise

Even the best designed and constructed multi-use fields must be properly maintained to withstand the stresses of heavy use. Maintenance procedures must be fine-tuned to the specific needs of the turf and its root zone both during existing conditions and to meet anticipated conditions. It's essential for the proper management of multi-use fields to understand thoroughly both the science and the art of sports turf maintenance. Even then, it takes hours of planning and 110 percent dedication to juggle the demands placed on premium fields.

Over the past four years, I've watched two fields in particular that have performed up to — and exceeded — all expectations.

Melbourne Cricket Ground

According to the Melbourne Cricket Club newsletter of November 1993, The Melbourne Cricket Ground field construction was completed in November of 1992, with the new arena used for its first cricket match six weeks later, followed by a test match on December 26.

The field was used for Australian rules football immediately following the cricket season. Ninety-seven matches were played over a 50-day season, with two games played on 42 of those days. Several major rock concerts also were held during that 1992-1993 season, providing a major source of revenue for the club.

During the 1993-1994 season, the field accommodated 36 days of cricket, compared to 22 days in previous seasons. This was followed by 115 Australian rules football games. During this period, the field hosted two major concerts and numerous other promotional activities.

Murrayfield Stadium

The Scottish Rugby Union reconstructed two of the pitches at Murrayfield Stadium, the world renowned home of Scottish rugby. These two pitches have been used for overflow car parking associated with major matches at the main stadium in addition to handling the training and matches involving local teams.

The reconstruction has allowed the pitches to be used for overflow parking even during rainy periods without damage to the playing surface.

Planning for Multiple Use — Not Abuse

By Steve Wightman

Facility revenues are based on multiple usage. That frequently means converting fields and accomplishing it within a tight timetable.

For example, on September 21, the San Diego Padres had a 1:00 p.m. game at Jack Murphy Stadium. At 8:00 that evening, a San Diego State University Aztecs football game was held. That allowed three hours to convert the baseball field to football.

Just a few of the factors included removing one-inch thick, 13-foot diameter steel plates holding the pitchers and bullpen mounds; resetting 35 sections of seating units holding 2,500 seats; removing the backstop and netting behind home plate and setting the goal posts; laying out all football lines, numbers and hashmarks; and removing the three-level TV and photo bay structures positioned for first and third base coverage.

NCAA rules require that players have access to the field for one hour prior to kickoff. So precise timing is a necessity.

Two months of planning developed the exact work assignments down to the second for all 35 people who were involved in the conversion. This was essential with two ten-ton forklifts, a smaller forklift and other self-propelled equipment, including a large winch, all on the move. Two precisely staged walk-throughs during that two-month period ensured no details were overlooked and that each step could be accomplished in the allotted time in its pre-planned sequence.

On September 21, the conversion began at 4:06 p.m., following the last "out." It was completed at 6:56 p.m.

Three and one-half hours later, those same people were converting the field again for the Padres baseball game scheduled for the next afternoon. Some of the crew members who had arrived at 7 on Saturday morning headed home at 5 p.m. on Sunday.

The key to such extensive conversions is working precisely, quickly — and safely — with a group who not only respect each other and their capabilities but also respect the integrity of the field.

Whether it's for multiple sports events, rock concerts, or the mud bog of monster trucks, it's important that all stadium users understand the importance of the field. Ultimately, no matter what the level of play, the sports turf manager's responsibility is to provide a safe, playable surface that gives all athletes an equal opportunity to perform to the best of their abilities. Field construction, field maintenance, and even field conversions revolve around that responsibility. ❑

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