Winter conditions, however, have hampered field construction. Emanuel's crews were on the baseball field the third week of November working on the subgrade. There were a few good working days in December and January. At the end of January, weather forced the contractors to pull off the field for four straight weeks.

March 1 was my target date for sodding the baseball field. At that point, crews were still working on the subgrade, trying to get machinery on the field with the freeze thaw cycle. The first goal is to get the subgrade to grade and certified and they've been forced to do it in sections. The site earthmover is in charge of getting the field subgrade to grade. This is checked for a variance of plus or minus 1/2 inch on 25-foot centers and then certified by an outside engineer. Once a section is certified, the playing field contractor takes over and begins digging the drainage laterals into the subgrade. By the end of February they'd certified the left and center fields as one section and part of the infield. They were working on the right field last. The lateral lines were set in left field and part of center field. Once all the laterals are in, the drainage lines laid and the gravel in place, they'll have a supportive base to work on to spread the rest of the materials.

Doing the work in sections means the drainage lines, subsurface air handling system and irrigation system also will be installed in sections. Extra care is needed to insure the pieces all come together properly and that consistency is maintained throughout the entire sand profile.

The baseball field profile varies somewhat from the standard USGA sand field with a higher degree of coarseness in the coarse gravel level. The 9-1/2 inches of sand root zone mix is USGA spec with a 90/10 sand/Dakota peat ratio. The sand is from a local source, Western Sand and Gravel of Ashland, Neb.

The baseball field infield skin specs call for a 60 percent sand, 20 percent silt, and 20 percent clay mix. We'll condition that with both vitrified and calcined clay, and work with the mix to get the right feel. Both of the coaches are requesting a firm, fast surface. The 60 percent sand may be a little high for that, but may be needed to help the field dry in the cool early spring temperatures during the Husker season.

The current UNL Buck Beltzer baseball stadium has an artificial turf infield and a natural bluegrass outfield. This spring has been fairly typical in that the college playing season has begun with the men's team having only a few days outside practice time; the women's team none. Part of the driving force behind construction of the new facilities is to allow earlier field access in the spring. Both fields will have an in-ground heating system as well as the subsurface air handling system so we can extend the growing seasons in the spring and fall.

The baseball stadium faces southeast with the grandstand providing protection from northern winter winds. The softball stadium faces northeast and will be exposed to winter conditions. The baseball field is on a flood plain; its stadium technically is not. The two fields will have different climates throughout the year that my maintenance program will need to accommodate.

The sod is a four-way blend of Kentucky bluegrasses (NuGlade, Freedom II, Arcadia and Award) coming from Graff Turf Farms in Fort Morgan, Colo. The sod contains at least 85 percent sand in the soil for fewer interface problems. If the sod is installed by April 1 for an opening day of June 1, we'll have a 60-day grow in. We're planning an extremely aggressive maintenance program with starter fertilizer, biostimulants and micronutrients mixed into the sand before we lay the sod, and a similar plan on the sod. We'll use soil and tissue testing at least twice a week to monitor the sand profile and turf nutrient levels so we can fine-tune the fertilization program. We'll begin aerification as soon as the sod is knit to begin eliminating any layering issues. Mowing also will be on an aggressive schedule.

Working with the project from the early stages gives me a definite advantage in developing and operating the maintenance program. I've had the opportunity to help eliminate some problems through design modifications. I have a better handle on the intricacies of the various systems and how they interact so I can use them to best advantage. I'm looking forward to getting this triple play facility in the game.

Dan Bergstrom is athletic turf manager for Lincoln Pro Baseball, Lincoln, Neb.

Engineered Soils for Sports Field Constructions

by Michael DePew and Stephen Guise

Many types of root zone constructions exist for all levels of play on sports turf areas from recreational fields to professional stadiums to thoroughbred racetracks. The expected level of use and subsequent maintenance resources and management requirements should drive the decision as to the type of root zone system constructed at a given site. Levels of use can be categorized into two types: frequency of use and intensity of use. These levels of use and the performance expectations of the installation determine to a large extent the soil engineering principals that are most applicable to the field's design.

Levels of use

Frequency of use (use-frequency) can be evaluated as either total hours of play in a given cycle or by the hours of plays clustered at certain time intervals within a cycle. For example, two fields can each have 20 hours of use in a seven-day cycle, but if the one field has a high proportion of its usage time (say 14 of the 20 hours) clustered around day 6 and 7 of the cycle, it will have a different type of wear than if the field is used in equal time increments spread across each day of the cycle.

Intensity of use (use-intensity) factors include the level of competitiveness and number of hours per event and therefore total stress level per event on the field. Larger, more competitive athletes apply higher stress loads on a playing surface. However, lower competitive levels will tend to have wear patterns clustered around the center of the field while higher competitive levels will have wear stresses more widely distributed across the field. The relative importance to a facility of use-frequency versus use- intensity is an extremely important factor in root zone system design.

Soil Design Types

Sports turf root zone constructions may be placed into four basic categories: soil-based, sand-modified, sand-amended or sand-based fields. Each type of field design has its own particular strengths and subsequent limitations.

SOIL-BASED DESIGNS

Soil-based fields primarily refer to field constructions from native-type soil material. This type of native soil material can refer to either on-site top soil or imported soil. Generally speaking, we think of soil-based fields as loamy textures and finer. Sands and loamy sands, while they may be natural native soils, are generally thought of as sand-based or sand-amended fields.

> "Soil root zones will deteriorate rapidly if played on in conditions of excessive soil moisture levels."

In general, soil-based fields may have certain advantages over other types of constructions. Soil-based fields have higher water and nutrient holding capacity and generally have higher use-frequency capacities. Soil-based fields generally provide a better growth media than other field design types. However, the effect of compaction can rapidly rank these field designs inferior to the other field design types.

Soil-based fields have the greatest potential for high soil shear strength characteristics if maintained in a non-compacted, well drained and well aerated state. In an uncompacted state, these fields will provide for excellent traction and playability. They are, however, the type of root zone system most prone to compaction, especially when their use capacity is exceeded in terms of either frequency or intensity. Soil-based constructions also have the greatest limitations to play over wide ranging moisture and environmental conditions. Soil root zones will deteriorate rapidly if played on in conditions of excessive soil moisture levels.

At high soil moisture contents the plasticity characteristics of the soil can be nullified as the soil behaves more like a liquid. When this occurs, soil material often is "pumped" to the surface and the entire field is prone to surface rutting and tracking. Under these conditions, the natural soil structural integrity is rapidly lost and cannot easily be restored. In most cases, it can never be restored without taking the field out of play and performing extensive renovation.

SAND-MODIFIED AND SAND-AMENDED DESIGNS

Sand-modified root zones are those native soil-based fields that have been modified on-site by additions of sand. Sand is normally added through topdressing programs alone or in combination with aeration practices. As sand is added to many native or plastic-type soil materials, the sand will increase the internal friction of the soil somewhat (decrease deformability). As more sand is added, the compaction resistance of the root zone will increase due to increasing internal friction. However, sand additions also decrease the plasticity of soil materials. If a soil does not contain a high enough sand proportion, the resulting rootzone will neither exhibit significant compaction resistance nor desireable plasticity characteristics. Caution must be exercised with the use of a sand modification program as the end result could make a problem worse rather than better. Of course, sand selection greatly impacts the resulting soil properties as well.

Enhancement of soil aeration and drainage would not be expected as a direct effect of sand additions. The enhanced aeration and drainage characteristics of a sand-modified system would be due to a longer period of time that the soil remains non-compacted. Actual increases in aeration and drainage characteristics would not be expected until sand proportions exceed a threshold proportion. Threshold proportions of sand and soil mixtures typically require 60 percent or more sand on a volume basis. Significant increases in drainage and aeration properties are not typically observed until sand volume proportions exceed 80 percent or more depending upon the particle size distribution of the sand and soil components.

Sand-amended root zones are those that have native soils mixed with sand during complete renovation or new field construction. To ensure proper and thorough mixing of the sand and soil components, off-site mixing and blending with a screw or drum type self-contained blender should be practiced over an on-site blending process that utilizes rototilling or rotary cultivation. New blending equipment such as the Netavator blender (distributed by Multi-Use Designs, Inc.) has slow speed reverse-tine tilling and shows good promise as a method for acceptable on-site blending of soils.

The performance of these types of constructions vary widely depending upon the various proportions of sand and soil as well as the relative particle size distribution of each of the components. The ratio of silt to clay and the mineralogy of the silt and clay fractions is an important design consideration. Organic components are sometime included as part of the mixture. Adequate performance of these constructions require considerable soil science expertise to ensure long-term success. An experienced and qualified sports turf agronomist should be consulted when considering these design specifications.

SAND-BASED DESIGNS

Sand-based root zone constructions can be expensive but may provide a greater performance potential. As such, they often receive the most recognition as a "desirable" athletic field construction. Sand-based root zones do generally have a much higher use-intensity than do other types of root zone constructions. Sand-based systems however, because of their granular make-up and lack of plasticity, do not necessarily have the highest use-frequency. While a soil-based root zone system can have dramatically higher use-frequency over sand-based systems, a sand-based system will perform over widely ranging and highly variable weather conditions. This includes live play even under severe and intense rainfall events. A soil-based system would deteriorate rapidly under the same severe conditions.

A well designed and constructed sand-based field will provide a root zone that has high aeration and drainage rates. The higher rates of aeration and drainage in sands is due to a greater proportion of macroporosity. This high macroporosity also results in reduced microporosity and likewise these root zones have reduced moisture retention and therefore if not managed correctly, can be droughty.

Sand-base root zones are commonly composed of low reactivity silicate minerals such as quartz. This inherent low reactivity results in a material that has a low buffering capacity. This low buffering capacity is exhibited both as low cation exchange capacity (CEC) and a soil system that is subject to vast and rapid soil chemical changes. To counter these effects, an organic amendment is often added. It should be noted however, that organic constituents vary widely as to their physical and chemical characteristics and therefore the performance characteristics of the resulting blend can vary widely.

To counter the effects of inherent droughtiness in sands, sand-based systems with an underlying layer of gravel have been employed. The ŒUSGA' specifications for putting green construction is the most widely recognized gravel underdrain design. A gravel (coarser) layer underlying a sand (finer) layer will impede drainage under non-ponded (unsaturated) conditions. This impedance of water movement effectively increases the water holding capacity of the root zone. The larger the contrast in pore-sizes between the coarser layer and the overlying finer textured layer, the more water that the root zone will retain. The danger then is having too large of particle size contrast or too shallow of root zone depth such that much or nearly all of the root zone stays excessively wet.

Excessive wetness within the rootzone profile may result in the inducement of anaerobic and reduced conditions in the profile and create an environment inconducive to turf growth, health and development. One signal of excessively wet conditions in a sand-based system is the production of excessive thatch in sod-forming grasses or elevated crowns in bunch-type grasses. While extensive and often drastic cultural techniques are employed to reduce thatch under these conditions, proper aeration and drainage in the root zone would eliminate the production of the excessive thatch. Black layer is another phenomana that can occur in a sand-based rootzone design due to excessive moisture. The excessive moisture leading to black layer formation can be due to either an over saturated gravel underdrain design or from layer features that can develop over time in poorly constructed/designed and or poorly maintained sand-based fields.

To ensure that excessively wet and reduced sand-based root zones are not constructed, careful design and construction methodologies must be employed. While many root zone construction specification methods have been used and promoted, a new generation of sand-based root zone design specifications are now available for not only sand-based, but also sand-amended, sand-modified and soil-based constructions. Even the best sand-based constructions of the past have experienced poor performance following a period of relatively high superior performance. This period of good performance following construction is often termed the honeymoon period. Following this honeymoon period, the performance can rapidly and drastically deteriorate. The length of these honeymoon periods is highly variable but often last three to five years but may be less. Remedial efforts on these facilities often results in extensive renovation or complete reconstruction. To avoid these excessive costs and practices, proper root zone design along with testing and QC management during construction should be employed by a qualified sports turf agronomist.

"To ensure that excessively wet and reduced sand-based root zones are not constructed, careful design and construction must be employed."

ROOT ZONE AMENDMENTS FOR SAND-BASED CONSTRUSTIONS

Many amendments have been used and marketed to improve the performance of the different types of root zone constructions. These amendments vary from natural and synthetic organics to mined inorganic minerals and various other synthetic materials. In the past seven to eight years, many new synthetic materials have been introduced to improve the physical and mechanical performance of sports turf root zones.

A sand-based field offers the greatest flexibility in terms of providing an all weather playing surface. The down side to these systems is that poor soil plasticity characteristics may create situations where these constructions cannot meet overall performance expectations. The use of synthetic fiber reinforcement may significantly increase the mechanical stability of sand-based constructions. Fibers, grids, meshes and fabrics have all been utilized as an aid in increasing the stability of sand-based constructions. While many of these materials do provide for greater stability, they may also serve simply to stabilize the sand once it becomes compacted. Fabric layers may also increase stability somewhat but also create a potential problem by introducing a Œshear plane'. A shear plane can be detrimental because while overall stability is increased, when failure of shear does occur the failure event can be sudden and severe. In other words, the field may be more stable overall but when playing forces exceed the stability limits, the field can give way rapidly with severe divoting. The greatest potential benefit with synthetic materials for root zone stabilization has been derived from those synthetic products that provide a dynamic interlock system. Dynamic interlock spreads the applied forces over a larger volume of the soil profile. Dynamic interlock (as opposed to static interlock) also provides a characteristic Œrebound' effect in that the interlocked soil complex attmepts to resume its original (less compacted) state following removal of the loading force.

Other amendments are promoted for their effects at modifying soil moisture and soil chemical properties. Various internally porous amendments have been utilized to improve moisture relations within sand-based rootzones. These internally porous materials include such things as diatomaceous earth and calcined/vitrified clay minerals. Amendments utilized to modify chemical characteristics of sand-based constructions include small additions of soil and/or organic matter (such as peat or various composts). Of course, these materials also affect the soil retention properties of the soil profile as well. Zeolitic minerals have also been used to improve the nutrient retention properties of sand-based rootzones. The mechanical stability of amending materials should be considered before employing them in a sand-based root zone construction. Many materials have the potential of fracturing into finer sizes within the profile under traffic stress. Once fractured into smaller particles, these materials can be prone to migration and subsequent detrimental layering effects.

CONCLUSION

Whatever root zone design specification method is employed in root zone construction and establishment, a qualified sports turf agronomist can increase the likelihood of a successful and satisfactory sports turf installation. The design and type of sports turf root zone construction should be determined by the type of competition that is expected on the field, the frequency of use, the maintenance expertise and maintenance budget expected, and the turf quality and playability expectations of the owner and user(s).

Stephen Guise is a Past President of the Sports Turf Managers Association, director of business development for Marina Landscape, President of Guise and Associates (a sports turf consulting company) and the Vice-Chairman of the ASTM F08-64 subcommittee for Natural Turf Playing Fields.

Michael DePew is an agronomist / soil scientist working for Environmental Turf Solutions, Inc. of Pineland, Florida. Michael works extensively with sports field design and also specializes in salt water irrigated golf, sports, and landscape developments. Michael is Chair of the Sports Turf Managers Association Technical Standards Committee and also serves on the ASTM F08-64 subcommittee for Natural Turf Playing Fields.

On the level

Introduced at the 2001 GCSAA Show in Dallas, the Ground Zero LevelerTM is the common sense solution to installing sprinkler heads & valve boxes properly the first time. All models of heads and boxes are easily clamped into place and held in a level position during installation. This allows both hands of the installer to be free for proper back-filling and tamping. All models are built from durable, all-aluminum construction.

Miltona Turf Products
Glenn White
P O Box 164
Miltona MN 56354
Tel: 218-943-2900
gwhite@miltona.com
For more information circle 055.

Even infields

The RAHN GL650 Infield Groomer levels uneven playing surfaces, fills small holes and prevents ridge buildup. That helps create a safer, more consistent infield and eliminates areas where water accumulates from irrigation or rain. Rahn Industries manufactures a full line of Infield Groomers compatible with TORO and TEXTRON utility vehicles. The GL650 also is available in a pull type and 3-point hitch model.

RAHN Industries
Jeff Curtis
9409 McColl Dr.
Savage, MN 55378
Tel: 612-554-6250
For more information circle 056.

Ferris introduces Compact 1000Z

The Ferris 1000Z tackles tight places in cutting widths of 48 and 52 inches. The mower has fans mounted directly to the hydrostatic pumps, allowing the pumps to run cooler and extending the life of the hydraulic system. High capacity oil lines and filter extend the life of the hydraulic system. A unique foot-operated deck lift allows for convenient and safe hands-free operation. A single pin adjusts the cutter deck in 1/4-inch increments from 1 1/2 to 4 3/4 inches. Other features include a low center of gravity, spacious operator compartment, adjustable steering control levers and 9.5 mph groundspeed.

Ferris Industries
Anne Weinberg
Director of Marketing
5375 N. Main St.
Munnsville, NY 13409
Tel: 800-933-6175 ext. 255
Fax: 315-495-0101
For more information circle 057.

Precision mowing on any turf

The Groundsmaster 3500-D incorporates Contour Plus floating decks and the Sidewinder cutting system to deliver a precision cut for many applications. The rotary mower is suited for golf trim mowing, precision patterns on sports fields and general mowing. It has independent, full-floating 27-inch decks that provide excellent cutting performance with a 68-inch width of cut and optional 72-inch cut for less undulating turf. The Sidewinder Cutting System slides decks 12 inches left or right of center for excellent trimming ability and varied tire tracking. The mower is powered by a Kubota 35 horsepower turbo-charged, liquid-cooled, three-cylinder diesel engine. Toro-patented Series/Parallel 3-wheel drive traction system provides unequalled traction by supplying power to two of the three wheels at all times.

Toro
Shelley Benedict
8111 Lyndale Ave. South
Bloomington, MN 55420-1196
Tel: 952-887-8930
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104	111	118	125	132	139	146	153	160	167	174	181	188	195	202
105	112	119	126	133	140	147	154	161	168	175	182	189	196	203
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Pest warfare

A water-based, advanced-generation pyrethroid, Tempo SC Ultra provides quick knockdown and control of more than 60 indoor and outdoor pests. Fast acting and long lasting, the insecticide contains the powerful active ingredient beta-cyfluthrin that packs twice the punch of cyfluthrin. The breakthrough formula combines the power of a powder with the convenience of a liquid and compares very favorably with microencapsulated products for ant management. It is a suspension concentrate, which allows for more even disbursement during application and keeps the active ingredient on top of porous surfaces. As a result, insects get more exposure than with many other liquid formulations, making the product highly effective for ant management.

Bayer Corp.
Sara Buck
8400 Hawthorn Rd.
P.O. Box 4913
Kansas City, MO 64120-0013
Tel: 800-767-5021 ext. 1299
For more information circle 060.

Affordable new topdresser

Earth & Turf announced a new hydraulically-driven topdresser, the MultiSpread 300. The unit spreads a variety of materials such as topdressing for athletic fields, golf greens, infield mix for baseball fields, chips on pathways and salt/sand or grit on sidewalks and driveways. Capacity is 22 cubic feet, and a brush or beater spreading system can be chosen with spread patterns from 36 to 72 inches, making the unit highly versatile. All spreading adjustments can be made easily without the use of tools.

Earth & Turf
John Bentley
General Mgr.
112 S. Railroad Ave.
New Holland, PA 17557
Tel: 888-693-2638
Fax: 717-355-2879
For more information circle 061.

System maximizes comfort, safety

Exmark has introduced the ECS, an Enhanced Control System designed to provide optimum comfort and ease when operating the Turf Tracer HP. The system's natural positioning of hands, arms and back ensures greater comfort and productivity over the course of a typical workday. Cushioned handles and drive levers optimize comfort and reduce fatigue from mower vibration. Operational pressure points are greatly reduced since the energy required for the steering controls is more evenly distributed throughout the entire hand. Innovative topside and inward positioning of the controls keeps the operator's hands further away from

obstacles, creating a safety zone that helps to protect hands from injury. The unique neutral lock system disengages and locks with ease.

Exmark
Industrial Park NW
P.O. Box 808
Beatrice, NE 68310-0808
Tel: 402-223-6300
Fax: 402-223-6384
For more information circle 062.

Seven Steps To Hiring—And Keeping—A Great Grounds Crew

by Louis Rovner, Ph.D.

Hiring grounds crew employees can be a tricky business. Keeping your best employees can be even trickier. But finding and retaining a top-notch crew is crucially important to a smooth-running operation.

Too many grounds crews have a record of high employee turnover, low morale and hardly any loyalty, and too many superintendents accept this state of affairs as part of the cost of doing business. Fortunately, this does not have to be the case. With a little planning, and just a little effort, you can hire ideal employees who will be with you for years to come.

The grounds crew at Riviera Country Club in Los Angeles is made up of 30 people, some who have worked there for as long as 25 years. I had the pleasure of spending part of an afternoon with Paul Ramina, the golf course superintendent at Riviera. Paul is justifiably proud of his crew, and he is certain that their loyalty, professionalism and longevity on the job are the rewards of careful selection of employees and ongoing programs which recognize his people on almost a daily basis.

The seven steps to hiring and keeping a great grounds crew are a combination of the advice I give to companies in every sector of the economy, as well as some industry-specific tips from Paul Ramina. If you follow these steps faithfully, most of your employee problems will vanish.

1. Look in the right places for new job candidates.

Before you can hire someone, you have to find them. There are several proven ways of finding and attracting new members to your team:

Referrals from other employees: Everyone now working for you has friends and relatives. When you are in need of a new crewmember, put the word out to your current employees. One or more of them will certainly know someone who they can refer to you. Although not all of these referrals will be appropriate for your crew, one of them might.

Put ads in your local papers: This is a tried-and-true method of finding job applicants. You will save money if you advertise in small neighborhood papers that are relatively close to your facility. Their ad rates are typically much lower than citywide newspapers.

Make up some inexpensive flyers and hand them out to people at locations like unemployment office: For less than a penny a flyer, this is a truly inexpensive way to get the word out.

If all else fails, contact an employment agency: This is your most expensive option, but the right agency may be able to find applicants when you can't. Just be sure that they give you a good guarantee on the people they place with you.

Spend plenty of time on your job interviews

There is nothing that can take the place of a good interview. It gives you the opportunity to determine whether the applicant is the kind of person that you're looking for. Before you begin the interview, it is important that you're clear about the specific qualities you're looking for in an applicant and how to determine if any of your applicants have those qualities. Be certain that you are well-prepared, and use most of the interviewing time to see if your applicant fits your needs and qualifications, rather than spending time less effectively in "getting a feel for him or her." Most managers want to know if a new person will fit in with the existing crewmembers, whether he or she has a good work ethic, and whether he or she has the type and amount of experience necessary to do the job well. Good questions will lead to plenty of information about the applicant.

Your questions should be developed and written long before an interview begins. Be sure that most questions are open-ended; that is, questions that can't be answered in one or two words. For example, instead of asking an applicant, "Did you like your last job," use an open-ended question, such as, "Please tell me what you liked best about your last job." In this way, the applicant will be doing most of the talking during the interview.

Take some time to make applicants feel comfortable before you get into the meat of the interview. Offer them some coffee or a soft drink. Spend a few minutes making small talk; they will almost certainly be nervous about the interview, and these small things will serve to calm them down a bit. Only then can you truly begin to know them.

It's important to be able to communicate with your people. Be certain that your applicants understand you completely, and that you can easily speak with one another. You will obviously learn this during the interview. This is important since no one can do a good job for you unless he fully understands what you want him to do.

Check your applicants' references

You should personally talk to all of an applicant's supervisors from previous jobs. Ask them about the things that are important to you. For exam-