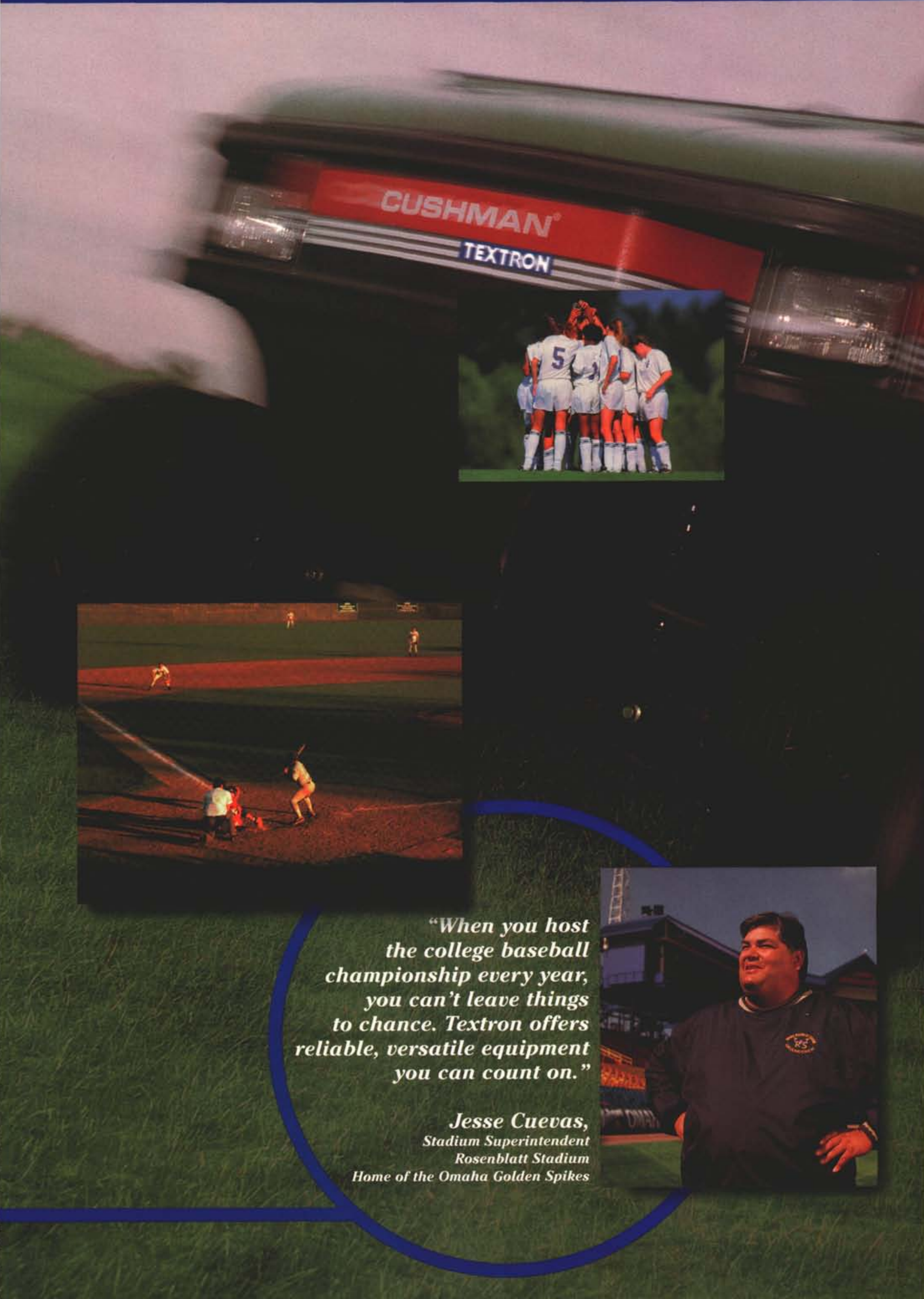
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Continued from pg. 24

turf. The players' cleats would rip right through the canopy into the growing medium underneath.

Despite these limitations, USGA specs represent a good starting point for a successful amended-sand field. When properly designed and installed, these fields offer dramatically greater playability than typical native-soil fields.

Sand-based sports fields

USGA specifications were first published in 1960. Within a few years, planners began developing related methods to build fields for other sports.

Prescription Athletic Turf (PAT) specifications adapted from USGA specs were patented in 1969. Initial installations encountered a variety of problems, which have caused a lingering suspicion of sand sports fields in the minds of many field managers.

In many of these cases, it could be argued that designers followed USGA specs too closely. They failed to incorporate sufficient fines to provide stability for football.

This was less of a problem in the South. Dense mats of roots and stolons in the turfgrass canopy of bermudagrass fields allow them to resist divoting. Without these characteristics, northern varieties tended to blow out more easily.

As the financial stakes in professional and major college games increased, further development of sand-based fields continued to promise greater dependability.

Amended-sand fields provide excellent drainage, allowing play to continue at the desired level of performance. This capability proves most beneficial in a worst-case scenario of heavy downpours (three to five inches per hour) just prior to or during a game, or when heavy rain continues for several days prior to competition.

It's important to note that a sand-based root zone is not the answer for all fields. Appropriate circumstances include high-profile use, substantial funds for both construction and maintenance, and high player and owner expectations. In other cases, a properly designed and installed native-soil field is still the most practical choice.

USGA methods

USGA specs call for 12 inches of

USDA System of Classification		Sieve No.	Sieve Opening, (Millimeters)	Appro. Opening, (inches)	USGA Recommendations
gravel >2mm		6	3.36	1/8"	3% max.
		7	2.83		
		8	2.38		
SAND	very coarse 1-2mm	10	2.00	1/16"	7% max.
		12	1.68		
		14	1.41		
		16	1.19		
	coarse .5-1mm	18	1.00	1/32"	60% min
		20	0.84		
		25	0.71		
		30	0.59		
	medium .25-.5mm	35	0.50	1/64"	
		40	0.42		
		45	0.35		
		50	0.30		
	fine .1-.25mm	60	0.25	1/128"	20% max.
		70	0.21		
		80	0.177		
		100	0.149		
		120	0.125	1/256"	5% max.*
		140	0.105		
	very fine .05-.1mm	170	0.088	1/512"	
		200	0.074		
		230	0.062		
		270	0.053		
silt .002-.05mm		325	0.044		5% max.*
clay <.002mm					3% max.*

*Total particles in these ranges shall not exceed 10%

Figure 1. Particle size distribution of USGA root zone mix

amended-sand root zone mix over a two- to four-inch intermediate layer of very coarse sand and fine gravel (between one and four millimeters). Under the intermediate layer, the specs call for a four-inch layer of 1/4- to 3/8-inch (six- to nine-millimeter) pea gravel, with an installed system of pipe drains. The intermediate layer can be eliminated if a finer grade of pea gravel (two to six millimeters) is used for the bottom layer.

The different textures (coarse on the bottom and fine on the top) create a perched water table. Water will not move through the root zone mix until it's nearly saturated. At this point, gravity overcomes surface tension, and water begins to drain through the root zone mix, into the gravel, and finally to the pipe drains.

A perched water table is desirable for sand fields. It holds moisture in the root zone, where it can be used by the turf plants.

Figure 2 (page 36) shows a typical profile that uses USGA specifications with an intermediate layer.

Sand fields operate primarily by internal-gravity drainage, which makes an installed drain system necessary. The system recommended by the USGA consists of pipe drains that are at least four inches in diameter. The drains are placed at 15-foot intervals, in trenches no more than six inches wide and eight inches deep.

Corrugated or plastic pipe works best. A geotextile filter cloth can be used to line the sides and bottom of the trench, but it should not be placed around the pipe or on top of the trench.

A filter cloth layer can also be helpful between the subsoil and the gravel layer, where the subsoil is comprised of expanding clay, sand, or muck soil. These subsoils can become unstable under some climatic conditions.

A four-inch gravel layer covers the drain pipe and the entire subbase. Selection of gravel size is critical, since proper particle size keeps the root zone mix from infiltrating the gravel.

Proper-sized particles create a bridging effect to maintain vertical channels in the gravel so that the drainage system works as intended. According to the USGA, the best way to encourage bridging is to keep particle size in each layer a maximum of five-times larger than the layer above it.

The root zone mix should posses the following physical properties: 35 to 55 percent total porosity, 15 to 30 percent air-filled porosity, and 15 to 25 percent capillary porosity.

Water permeability should be six to 12 inches per hour in the normal range, and 12 to 24 inches per hour in the accelerated range. Organic matter should be one to five percent by weight.

If soil is used in the root zone mix, the mix must contain a minimum of 60 percent sand and a maximum of five to 20 percent clay. Final particle size distribution of the sand/soil/peat mix must meet the specifications shown in **Figure 1** (page 35).

Modifications

Perhaps the most widely accepted modification has been the amount of silt and clay in the root zone mix. Levels can vary from three to 15 percent.

The wide range results from differences in geography and climate. A sand-based field in Oregon, where local rainfall is high, will need greater permeability than a field in Nebraska, where local rainfall is lower.

Different mixes are also required for different sports. A field designed with a sloped or crowned center will typically require less permeability than a flat, level field. Since surfaces for football require enhanced surface strength, more fines are desirable.

Field use schedules can also prompt modifications to USGA specs. Sand used to build a lightly used field can have more fines, while the same percentage of fines on a heavily used field would create compaction problems.

New Pennsylvania Design

Sports field managers in the Northeast have used another design for amended-sand fields. This method was drafted into a set of specifications by Penn State University faculty member Andrew McNitt.

This New Pennsylvania Design has many points in common with the USGA specifications, but it differs in one important respect. USGA specifies a maximum of 10 percent fines in the root zone mix, and the Pennsylvania Design allows up to 25 percent fines.

The New Pennsylvania Design requires a testing laboratory to ensure that the root zone mix has the following: 35 to 55 percent porosity; 15 to 30 percent air-filled porosity, and the same amount of capillary porosity; five to 10 inches per hour of water permeability; and one to four percent organic matter content by weight. The air-filled and capillary porosity should vary by no more that eight percent.

Maintenance

Maintenance techniques for sand fields are difficult, and they may require the expertise of a trained professional. A maintenance supervisor needs to be on the field every day to check for mowing and fertilization requirements, moisture, compaction, pests, and other stresses.

Mowing a sand field almost always requires a reel mower and cutting every day, or every other day. Remember that golf greens are usually cut every day.

Fertilization should use the spoon-feeding method, which applies small amounts of fertilizer at frequent intervals. Sandy soils have low nutrient-holding capacity and they need nutrients faster. Frequent soil testing is also recommended for these fields.

For most native soils, one inch of water per week during the growing season is adequate to support turf growth. This amount will frequently prove insufficient for sand fields, which may need light watering daily during dry weather.

Remember that exposed dry sand has poor soil strength and provides very poor traction and sod stability. When moist, the same sand performs much better.

Aeration equipment that works on native-soil fields may not work on sand-based fields. In some field trials, typical hollow-core aerators have proven to be too surface disruptive, tearing the turf canopy instead of pulling clean cores. Aerators with narrower, widely spaced tines can provide better results.

In terms of pests, nematodes can be a particular problem in sand fields. They prefer well-aerated, light-textured soil.

Amended-sand fields, such as those based on USGA specs, can be exceptional facilities when they're carefully built with appropriate materials. However, because of the special maintenance and construction demands of these fields, field planners would be wise to seek advice from qualified designers who are experienced in this method.

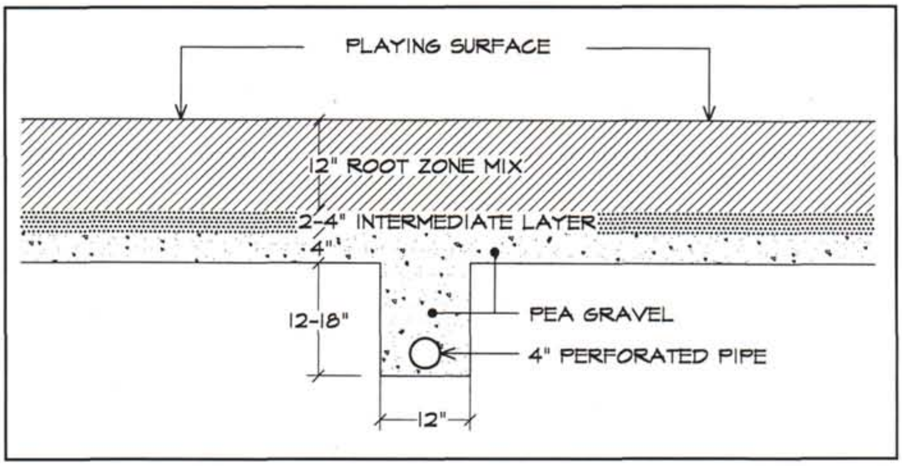

Figure 2. Typical profile of a USGA putting green

Jim Puhalla is president of Sportscape International, Inc., of Boardman, OH, and Dallas, TX. He is author, with Mississippi State University professors Jeff Krans and Mike Goatley, of Sports Fields — a Manual for Design, Construction and Maintenance. *Material in this article was adapted from that book.*

For more details on USGA specifications, call or write the organization and ask for their publication: "USGA Recommendations for Putting Green Construction." USGA, PO Box 708, Far Hills, NJ 07931; (908) 234-2300.

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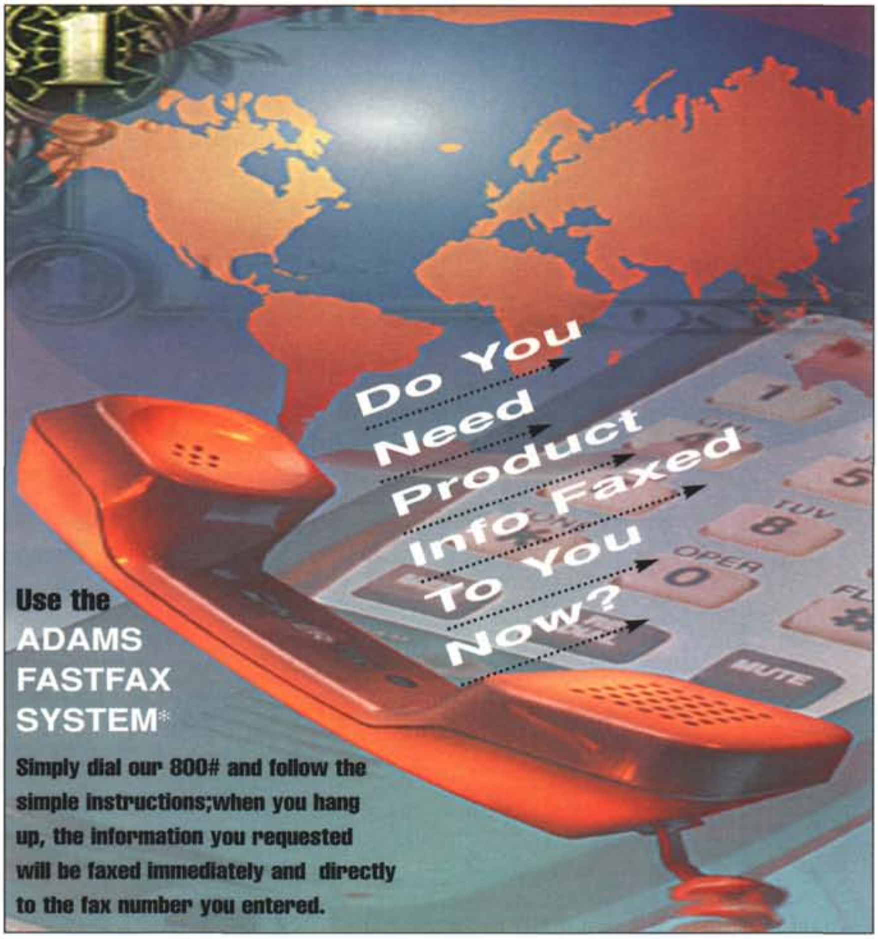

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Tip of the Month

Continued from pg. 6

distributes weight away from the front goal posts, and allows the back of the equipment to carry more of the burden.

Another design option uses lightweight materials for the goal's front posts and crossbar, while using much heavier materials for the rear ground bar and frame members. This type of goal can be designed to fold down when not in use.

All of these options decrease the chance that the goals will fall forward. However, regardless of a goal's construction, all movable soccer goals should be firmly anchored at all times.

Anchoring guidelines

A properly anchored and counterweighted movable soccer goal is unlikely to tip over. It's best to secure goals to the ground at the rear ground bar. Keep all of your anchors flush with the ground and clearly visible.

The number and type of anchors you choose will depend on factors such as soil type, soil moisture content, and total goal weight. The following lists several anchoring options.

• Auger style

This style anchor is helical shaped, and is screwed into the ground. Flanges positioned over the side and rear ground bars secure them to the ground. Recommendations suggest a minimum of two auger-style anchors be used to secure a goal. Depending on manufacturer specifications, unit weight, and soil conditions, more may be required.

• Semipermanent

Two or more functional components make up this anchor type. The main support requires a permanently secured base that is buried underground. In one type of semipermanent anchor, two tethers connect the underground base to the soccer goal. Another design uses a buried anchor tube with a threaded opening at ground level. Bolts passed through the goal's side and rear ground bars secure the apparatus to the buried anchor tubes.

• Peg or stake style

Two or four pegs or stakes can also be used to anchor soccer goals; more units should be used for heavy goals. Anchoring pegs/stakes normally measure approximately 10 inches (250 millimeters).

Drive pegs/stakes as far as possible into the ground with a sledge hammer, and angle them whenever possible. Pass the supports through available holes in the side and rear ground bars.

If a peg or stake is not flush with the ground, it should be clearly visible to persons playing near the soccer goal. Stakes with large diameters or textured surfaces provide extra holding capacity.

• J-hook stake style

Use J-shaped hooks to anchor goals when no pre-drilled holes are available in the ground bars. This support system uses techniques similar to peg/stake-style anchors.

Hammer J-hooks into the ground at angles when possible. The curved portion of the anchors should wrap over the goal bars. Two to four J-hooks per goal are typically recommended. The number of hooks will depend on stake structure, manufacturer specifications, goal weight, and soil conditions. Stakes with large diameters or textured surfaces provide extra holding capacity.

• Sandbags/counterweights

Sandbags or other counterweights can provide effective anchoring on hard surfaces, such as artificial turf, that can't be penetrated by conventional anchors. The number of support bags or weights necessary varies according to goal size and weight.

• Net pegs

Tapered, metal net pegs should only be used to secure nets to the ground. They should NOT be used to anchor entire movable soccer goals.

Goal storage

Most recorded soccer goal injuries do not occur during matches. Most involve unat-