Bearing Capacity of Soils

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Athletic fields and golf courses receive intensive traffic (both machine and foot) under all kinds of climatic conditions during all times of the year on soils that vary widely in their properties. To have a healthy, high quality turfgrass stand it is important to have soils that drain effectively, hold adequate quantities of plant available water, and can retain and release plant nutrients to the soil solution.

Many believe the relationship with soil water (drainage and retention) is the most critical factor contributing to turfgrass quality. With this in mind, soils are most susceptible to compaction when moisture contents are high because of the reduced frictional components in the soil mass. But the turfgrass manager has little control on the scheduling of events on the fields or courses and even less control on the weather. Because of this soil compaction can be a real problem on athletic fields, golf courses, and many other turfgrass areas.

The negative effects of compaction are a decrease in the amount of macropores (large pores that are air-filled at field-capacity) and an increase in the amount of micropores (smaller pores that are water-filled at field-capacity). Decreasing macroporosity decreases soil hydraulic conductivity and the amount of air-filled porosity at field-capacity. During wet periods of the year anaerobic conditions can persist inducing stress and possible death to the turfgrass.

High sand content soils can retain macroporosity even under adverse conditions and retain relatively high hydraulic conductivity's and soil oxygen contents under high moisture conditions. For this reason turfgrass managers will amend native soils with high sand content materials(such as topdressing with 100 % sand) or will use high sand content soils or mixtures in rootzones during construction. An example of a national organization that specifies the use of high sand content rootzone materials is the United States Golf Association (USGA).

The stability of a soil, or in engineering terms its *bearing capacity*, is the ability of a soil to carry a load without failure. When a load is applied, the soil may either resist the load, deform under the load, or fail in shear. Bearing capacity is dependent upon the magnitude of the applied pressure, the size and shape of the loaded area, and the soil's strength. For sand, strength is expressed as the angle of internal friction which is defined as the stress-dependent component of the soil's shear-resistance. The angle of internal friction is governed by properties both inherent to and independent of the sand type. These include angularity, which is type dependent, and relative density, porewater pressure (or tension), porosity, and grain size distribution, all of which can, to some extent, be controlled by material specifications and construction methods.

The bearing capacity of a sand is highly sensitive to friction angle, and can vary as much as 400% over the range of feasible friction angles. Hence, stability under loads such as cleats or tires can depend greatly on soil properties even though USGA specifications are met.

What we are demonstrating today is one of our long-term objectives of performing a series of loading tests on existing putting green and athletic field surfaces. This will provide information and data pertaining to how an established turfgrass and rootzone system will influence the in place stability and shear resistance of the sand mix. These tests will also provide information pertaining to the failure of putting or athletic surfaces, and the influence that poor sand mixes have on the rootzone system. The testing will primarily be carried out using a bearing test field device designed specifically to fail the playing surface in shear.

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