UNDERSTANDING TURF MANAGEMENT

BUILDING THE SPORTS FIELD

The 15th in a series by
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Municipal governments, school boards and service clubs are prone to allocating money for the construction of a new sports fields with minimal investigation of field requirements. Often the questions which are asked by the authorities are "What type of construction should we use?", "What should we be specifying in the tender?"

The cart is now before the horse! The questions which should have been asked first are: "What is the *level of expectation* of the field?", "What are the management requirements for maintaining the field - labour, equipment, irrigation, on-going funding?" Then the funding should be allocated.

Any funding organization contemplating the construction of a new sports field should begin their discussion with the first of the above questions because the level of funding for both construction and maintenance depends on the 'level of expectation of the field', not the sport which will use the field - soccer, football, field hockey, etc.

The 'level of expectation' of the field may be divided into three categories. The highest category - Category I fields - are the most expensive to construct and maintain. They are the fields where professional or semi-professional league and tournament play will take place. An infrastructure of stands, change rooms, lights, etc., are included in the budget, and often cost more than the actual field. A further criteria for this category is that pre-game seat sales will occur, thus a cancellation of a game is not an acceptable alternative. This category calls for the construction to follow the United States Golf Association Greens Committee (USGA) specifications for greens construction. Category I fields should never be attempted without a guaranteed, uninterrupted water supply.

The lowest category - Category III fields - are the local neighbourhood facilities for minor league play and unscheduled play by the general public. No change rooms, stands or other facilities are available and minimum security fencing is provided to insure the play does not spill over into adjacent streets. The quality of the turf should be such that good ground cover is maintained to insure the safety of the user.

The middle category - Category II fields - are the most difficult to define, and also to design. They may be considered as fields where play is generally scheduled, but may be cancelled due to field or weather conditions and where limited infrastructure in the form of change rooms and stands are provided. Even so, the quality of turf should be high and the construction such that heavy use may be entertained.

The Drainage System

The first requirement of a field in any of the three categories should be to assure that adequate surface drainage is available. While mandatory for Category I and II fields which, during construction, will be graded to a defined slope or crown, Category III fields often accept the natural grade or slope of the site. Such acceptance in turn leads to future problems where low areas pond water, increasing the potential damage to the turf. Extra funding to insure a proper surface grade prior to seeding the field will result in lower maintenance costs in the future.

The design of all sports fields of Category I and II must begin with an adequate subsurface drainage system in addition to surface drainage. The first step in designing the drainage system should be a satisfactory outlet for any drainage water. The outlet most probably will be the storm water drainage system.

Drains are 4-inch, perforated, plastic tube spaced at least every 40 feet apart, but in impervious clay soils or sand based rooting zones they should not be more than 20 feet apart. Due to the low cost relative to other items in the construction of a field it is often advisable to space the lines 20 feet apart, or less, under all soil conditions.

Some installers prefer to use a herringbone design. The design adds nothing to the efficiency of the system and may contribute slightly to the cost. The simplest and most efficient system from the installers viewpoint are lines running the length of the field: commencing at mid-field, with a falling grade, to extend at least 20 feet beyond the playing surface at the end of the field. An additional line outside the playing surface for the players bench area is often advisable.

Tile lines should be installed at a minimum depth of 18 inches below finished surface grade. A mid-field depth of 18 inches will result in a depth of 24 to 30 inches at the point where the line enters the main line to the outlet. The drain lines are installed at a 0.5 to 1.0% grade (0.5 feet fall/100 feet of run). Remember there is a 0.33% grade in 100 ft of a 4-inch tube itself if it were installed perfectly level.

It is not necessary to place stone below the tile line, unless the stone is used to obtain a uniform grade on the line when installed with a backhoe. Likewise it is not necessary to enclose the line in geotechnic material unless the native soil is a very fine sandy loam or a silt. Many installations are made with a backhoe which does not provide the grade control obtainable with the laser- controlled excavating wheel or chain used on commercial tile laying machines. The use of a laser-controlled tile laying machine is not only more accurate, but faster, and worthy of serious consideration by the contractor.

The tile lines should be installed *after* the subgrade has been graded to the desired slope of the surface of the field. Installing the lines under wet conditions can destroy the smooth subgrade by leaving ruts, thus preventing the free movement of water laterally to the tile lines in the future. Regrading of a disturbed surface may be difficult as the graded material cannot be spilled onto the tile lines. Crushing of the lines can occur if heavy machinery is used over freshly laid lines, therefore care must be exercised in movement of the remaining materials into place by restricting truck movement and plank bridging over the lines.

Category I fields require the placement of a 6-inch depth of stone above the tile and over the entire subgrade surface (Fig 1). The selection of the size of the stone is critical because the migration of the finer materials used in the rooting zone into the stone blanket must be avoided if the drainage system is to function properly for decades.

USGA specifications call for a stone layer having 65% of the stone in the range of 1/4 to 3/8 inch, with not more than 10% greater than 1/2 inch, and not more than 10% below 1/10 inch. The stone layer is then covered with a 3-inch layer of course sand (choker layer) to provide the necessary bridging over the large pores in the stone. Installa-

Fig. 1: A cross section of a sand-based rooting zone for turf.

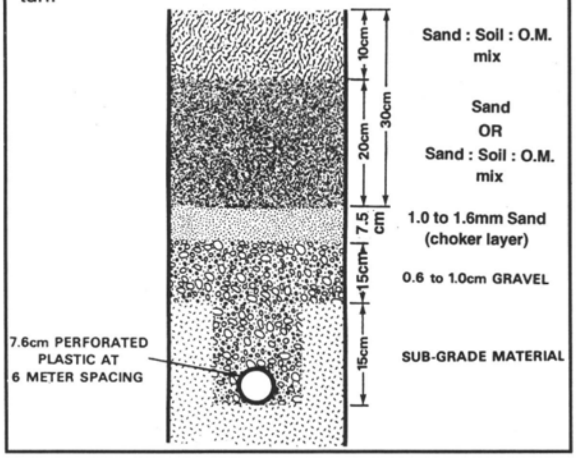
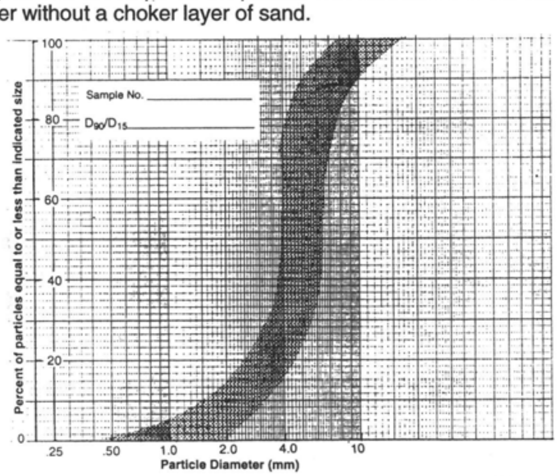


Fig. 2: The envelope for the particle size distribution of the stone layer without a choker layer of sand.



tion of the choker layer is a slow, labour intensive operation.

An alternative now accepted by USGA is to use a smaller stone without the choker layer. For bridging of the root zone particles over the pores in the stone layer to occur the D_{15} (diam. below which 15% of the stone particles lie) of the stone must be less than or equal to five times the D_{85} (diam. below which 85% of the sand particles lie) of the root zone mix. Likewise for adequate permeability of water to occur the D_{15} of the stone must be greater than or equal to five time the D_{15} of the root zone mix. Finally the stone should have a gradation index (D_{90}/D_{15}) less than or equal to 2.5. It is preferable that the stone be an angular shape, suggesting well-screened, crushed aggregate. An example of the size envelope of a satisfactory material is provided in Figure 2.

The Rooting Zone

The next step in the process of construction of Category I and II fields is the selection of the rooting zone mix. Whatever material is used, the rooting zone should be a minimum of 12 inches in depth (Fig 1). The same care must be exercised in placing the root zone material over the stone as was used in putting the stone in place, otherwise rutting and intermixing with the stone will occur.

Many Category II fields are constructed using the native soil for the rooting zone. Prior to approving a native soil for use it should be subjected to particle size analysis and moisture transmission analysis. The textural class of the soil should be a course sandy loam or loamy sand and should have less than a total of 10% silt plus clay. Silt loams and clays should be avoided. It should have the ability to transmit a minimum of six inches of water per hour.

The heavier textured soils may be modified by the addition of sand using the monogram in Figure 3 to select the amount of sand to add. A well-aggregated, screened, surface soil should be selected and thoroughly mixed off site with the sand. Careful costing of the sand modification alternative, relative to other options, should be done because if an incorrect blend of sand and soil is selected this procedure may resulted in a very poorly draining, compacted systems.

The rooting zone of all Category I fields should be based on the principles of USGA greens construction. The principles involve the construction of a tile and stone blanket drainage system on which is placed a special root zone mix. The mix comprises a selected sand to which a relatively small amount of soil and/or organic material is added. The resulting mixture will not be subject to future compaction and will have water transmission values which will permit play under all weather conditions while minimizing the damage to the grass.

The selection of the sand for the root zone is critical. The procedures to follow are outlined below.

Several potential suppliers of sand should be selected and asked to submit a two kilogram sample for particle size analysis. The suppliers should be asked to supply a brick sand or topdressing sand, because these are the trade names for materials which will most probably fit the USGA requirements. The samples should be sent to a laboratory capable of performing sieve analysis of sand and characterizing the moisture relationships of the final mix.

Suitable sands should be selected on the basis of a particle size distribution which falls within the envelope illustrated in Figure 4. Care should be taken to select a sand that is very low in silt and clay size particles (less than or equal to 0.05 mm) because upon the addition of the soil material the final mix must not exceed a total of 8% silt plus clay. Having two or more samples which meet these criteria the contractor is in a position to negotiate price, supply, delivery, etc., with the suppliers.

The next or concurrent step is the selection of a suitable top soil to add to the sand. The preferred soil should be a screened material containing no stones or other debris, weed free, herbicide free, have a high organic matter content and have a sandy loam texture. Samples from potential sources should be subjected to particle size analysis for percent sand, silt and clay by hydrometer analysis, percent organic matter and percent total carbonates. Samples containing less than two percent organic matter and/or more than 10% carbonates will suggest contamination with significant amounts of subsoil.

In many areas a sandy loam soil does not exist. In these cases the local loam or clay loam soils may be used, but the amount which may be added to satisfy the 8% total silt plus clay limitation will be sharply reduced.

Based on the silt and clay analysis of the soil material a calculation is made of the amount of soil which may be added on a volume basis to the sand. A small sample mix is prepared. Organic materials such as peat moss, compost or other organic wastes may then be added. These organic materials should not exceed 10% by volume of the mix. The organic material chosen should also have a loss-on-ignition value in excess of 85% because some organic sources can contribute significant silt and clay to the final mix.

Having prepared the sample root zone mix it is again subjected to screen analysis to confirm the mix still fits within the particle size envelope (Fig. 4). It is recommended that the soil material be very finely ground or physically dispersed in Calgon solution, dried and ground again before adding to the sample mix for sieve analysis. This step is necessary where well-aggregated, high clay content soils are used because the small aggregates of soil will sieve out as sand.

Having satisfied the criteria of particle size by relatively inexpensive sieve analysis the final selection step is to conduct the relatively expensive porosity and moisture characterization of the sample mix. The accepted range of values are listed in Table 1.

In most circumstances if the selection based on particle size analysis has been performed correctly and the criteria for particle size adhered to, the physical properties will fall within the accepted range. If, however, the sample mix fails to pass the one or more of these physical properties it is advisable to re-examine the mix selected.

Installing the Rooting Zone

Pre-mixing the sand, soil and organic material off-site is an absolute necessity to insure proper blending of the ingredients. It is not necessary to screen the top soil below one inch as the larger aggregates act as islands of soil in the sand matrix. Mixing may be adequately performed by front end loaders; adding the materials in the desired ratio by volume of the bucket. Mixing is accomplished by repiling the mix several times. Peat should be moist during the mixing stage to ensure uniform mixing and to minimize peat and sand separation.

It is also a good practice to add 1.5 pounds of phosphate fertilizer (0-46-0) and 0.3 pounds of potassium fertilizer (0-0-60) per cubic yard of mix.

Depending on the economics of the particular site the sand:soil mix may be used throughout the entire 12 inches of rooting zone or restricted to the upper four inches. The shallower depth of sand:soil mix, however, may be more expensive due to the need to install two lifts of material. Of course the bottom lift would be the same sand as was used in making the sand:soil mix. It would not be necessary to add organic material to the lower layer.

Sand which is dry has a very low bearing capacity for equipment whereas sand which is wet will carry substantial loads. It is therefore an essential practice to have an irrigation system installed or a portable system working so that the sand is kept wet at all times. It also aids in preventing wind drift of the sand.

The sand-soil mix is dumped at the edge of the field and bladed into rough position with a small bulldozer. Final surface grading may be accomplished with a motor grader. Moving loaded trucks onto the field can result in rutting the gravel layer and intermixing, particularly by unloaded trucks starting up to move off the field after dumping their load.

It is a good practice to have a vertical division between the adjacent soil material at the edge of the field and the sand root zone mix. The sharp break between the two types of material avoids moisture related growth problems in the future. Strips of plywood or heavy plastic may be used, and moved as the installation progresses.

Sodding, hydro seeding or standard seeding methods may be used to establish the turf. *It is essential that the irrigation system be functional before turf establishment is attempted.* A standard fertilizer program for turf establishment should be followed.

A quality control program during construction is strongly recommended. Periodic, on-site sieve analysis of the sand as it is delivered will insure that the sand conforms to that used in the laboratory analysis and that the field will perform as desired.

Finally, it must be emphasized that Category I fields require a high level of management skills. Some people have regarded these fields as a large hydroponics system. This may be an exaggeration, nevertheless, the field manager must be very conversant with plant nutrition and water use because the normal buffering - ability to resist change - of soils is missing. A delay of two days in irrigation or postponing a fertilizer application for a week can result in an inferior playing surface.

Table 1: The physical properties of a suitable root zone mix.

Criteria	Recommended Range
Total Porosity	35% - 55%
Air-filled Porosity (@ 40 cm tension)	20% - 30%
Capillary Porosity (@ 40 cm tension)	15% - 25%
Saturated Hydraulic Conductivity	15 - 30 cm/hr
Moisture Retention (@ 30 cm tension)	2.5+ cm/30 cm depth

Fig. 3: A monogram for estimating the volume of sand to add to a soil:organic matter mix to provide a suitable rooting zone material.

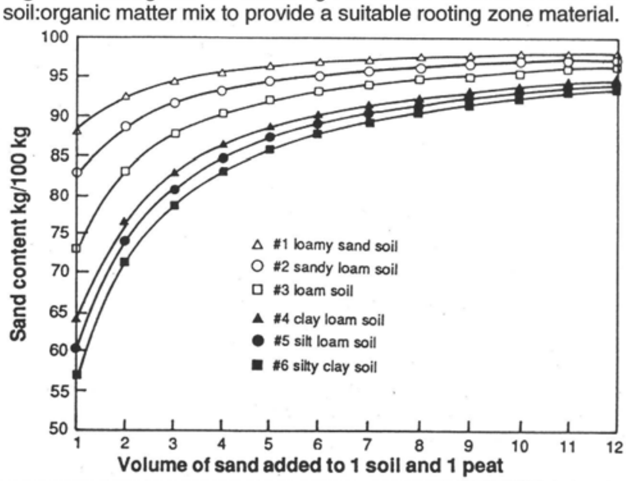
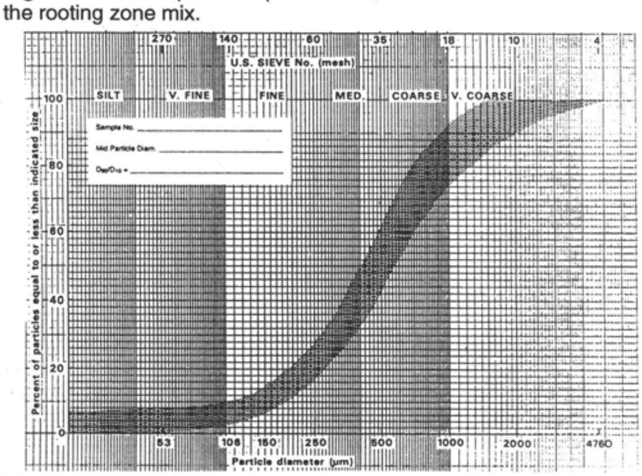


Fig. 4: The envelope of the particle size distribution of the sand for the rooting zone mix.



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