As a sports turf professional once put it, the field is a sport game's foundation. If it is unsafe, the entire franchise and its men who make their living in pounding each other against the turf are at risk. As fans know best, football, soccer and rugby are meant to be played on natural grass. It also comes as no surprise that this notion is seconded by an overwhelming percentage of the players on the field. A recent survey by the National Football League Players Association found that 97% of its members prefer playing on real turf. What gives real turf an advantage is that players have the best surface going (softer and less abrasive), and falling on real grass does not hurt as much as on artificial turf. Unfortunately, real grass morphs into frozen tundra in bitter cold weather and hardly recovers from damage in cold temperature (below 50 °F) when it goes dormant.

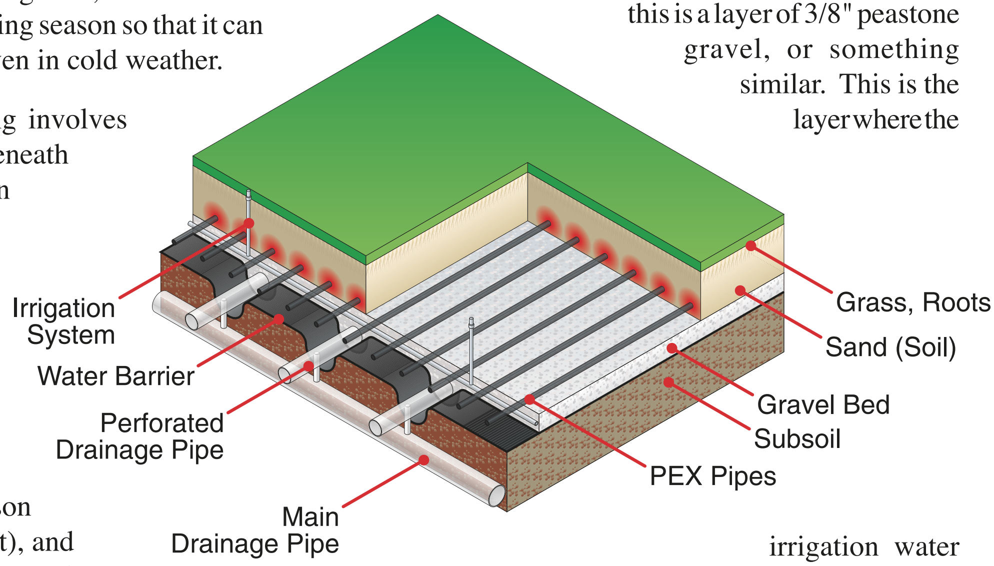
In order to use real turf, natural grass needs help to recover quicker and grow longer in cold weather. This is where field heating comes into play. Since grass grows from the bottom instead of the top, warming the root zone in the soil is key. The objective is to maintain the root zone (about 6-10" down) anywhere between 50°F and 60°F dependent on grass type, soil condition and local climate. This warm temperature prevents the roots from going dormant, promotes root propagation, and allows the grass to grow throughout the playing season so that it can quickly recover from damage, even in cold weather.

Grass root zone heating/warming involves installing a hydronic system beneath the field. Hidden in the soil is an array of PEX pipes that transfer heat to its surroundings from the heated water (treated with glycol—an antifreeze) running through the pipes. This radiant heating system is crucial to the maintenance of the sport field. It helps the growth of the grass root system, extends the growing season (because roots do not go dormant), and keeps the sports field warm, pliable and player friendly when air temperature begins to drop. All costly and time consuming sodding, seeding and patching are eliminated—and player injuries are reduced, as the turf quickly recovers from use and damage.

It is easy to confuse undersoil heating with a snowmelt application because of their functional similarity. Though it is not designed to do it, there will be times that a grass heating system does melt snow. However, one should distinguish the real objective of these systems. In a snowmelt system, surface temperatures greater than 32°F are maintained so that snow is melted at the surface. In an undersoil heating system, the grass root zone (an area 6-10" down) is instead targeted for heat. The system has been designed to maintain temperatures between 50°F and 60°F in this area. Typically, the radiant system in the field is turned off a few days before a game. This allows the turf to stabilize. If it did snow, and the system was on, there is a chance that slush would form thus posing a real problem to endangering both players and field. Snow, in its natural and drier state, is more stable and thus safer.

Radiant Field Heating System Design Considerations

Most professional fields are multi-layered, and understanding how each of these layers is constructed is important. The layers begin with a solid base of compacted earth. The solid base layer typically contains the main drain lines that will pull excess moisture from the field. A covering of 1/2" washed stone typically supports everything in this layer. Above this is a layer of 3/8" peastone gravel, or something similar. This is the layer where the irrigation water lines are contained and radiant heating pipes sit on top. The next layer is the root mix layer; it contains a wide range of soil and sand mixtures. Each field will require a different root mix mixture dependent on how the field is to be used, the level of abuse, the grass condition and the type of grass used.



In addition to the physical properties of the stone, the cut of the stone is also important. Rough-cut stones tend to capture more air pockets than smooth ones. The captured air pockets tend to decrease the layer's ability to conduct energy. Most stone layers contain between 20-40% air, leading to a considerable amount of heat insulation.

The root mix layer is where all of the root growth takes place. It is constantly fertilized, watered, and aerated. Water is an important factor; most root mix layers are maintained with anywhere between 30-50% moisture at any given time, dependent on the type of grass used. Water helps to increase this layer's conductive ability, creating a much more even temperature distribution.

How deep the radiant piping is buried depends largely on the layer construction and how the field is to be maintained. Since aeration is a key component in field maintenance, the radiant tubing needs to be deep enough so as not to be damaged, or interfere with any aeration process. In general, the radiant heating pipes are located at the bottom of the root mix layer, somewhere between 8-10" below the surface. Grass root heating systems generally consist of 3/4" PEX pipes installed at a spacing of 6-12" on centre.

System zoning plays a critical role in maximizing system efficiency. It is greatly influenced by mechanical constraints, such as how the supply and return lines are accessed, which areas of the field are mostly abused (i.e. areas that need faster grass recovery) and solar exposure. The shape of the stadium, and the shadow it casts, chiefly determine the amount of solar exposure each section of the field receives. The areas that are warmed by the sun need less undersoil heating that the shaded areas. Zoning also reduces long pipe runs that induce high head pressure, both of which are unneccessary.

Another critical part of the system's performance is the maintenance of the fluid temperature in the pipes. Temperatures up to 130-140°F would be very hard on grass roots. Roots would gradually die, root pathogens would proliferate and moisture would be pushed up to the surface if exposed to those high temperatures. Generally, temperature (slab) sensors are deployed and placed at different levels in each of the divided zones so that consistent root zone temperature can be maintained by changing the fluid temperature in response to varying weather conditions.

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