

“Synthetic Surface Heat Studies”
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Synthetic turf surfaces have long been regarded as a lower maintenance alternative to natural turf. However, synthetic surfaces like natural turf have their shortcomings. In the spring of 2002 a Field Turf synthetic surface was installed on one half of Brigham Young University’s Football Practice Field. The other half of the installation is a sand-based natural turf field. Shortly after the Field Turf was installed football camps were started. The coaches noticed the surface of the synthetic turf was very hot. One of the coaches got blisters on the bottom of his feet through his tennis shoes. An investigation was launched to determine the range of the temperatures, the effect water for cooling of the surfaces, and how the temperatures compared to other surfaces.

On June of 2002 preliminary temperatures were taken at five feet and six inches above the surface and at the surface with an infrared thermometer of the synthetic turf, natural turf, bare soil, asphalt and concrete. A soil thermometer was used to measure the temperature at two inches below the surface of the synthetic turf. Also, water was used to cool the surface of the natural and artificial turf. It was determined that the natural turf did not heat up very quickly after the irrigation so only the artificial turf was tracked at five and twenty minutes after wetting. The results of the preliminary study are shocking. The surface temperature of the synthetic turf was 37° F higher than asphalt and 86.5° F hotter than natural turf. Two inches below the synthetic turf surface was 28.5° F hotter than natural turf at the surface. Irrigation of the synthetic turf had a significant result cooling the surface from 174° F to 85° F but after five minutes the temperature rebounded to 120° F. The temperature rebuilt to 164° F after only twenty minutes. These preliminary findings led to a more comprehensive look at the factors involved in heating of the artificial turf.

Three aspects of light were measured along with relative humidity. The synthetic surface was treated as two areas, the soccer field and the football field and the natural turf was one area. Four randomly selected sampling spots were marked with a measuring tape from reference points on the fields so it could be accessed for subsequent data collection. Bare soil, concrete, and asphalt sampling areas were selected and marked in a similar manner. The results are shown in table form below:

Table 1.

Surface	Average Surface Temperature between 7:00 AM and 7:00 PM	
Soccer	117.38° F	high 157° F
Football	117.04° F	high 156° F
Natural Turf	78.19° F	high 88.5° F
Concrete	94.08° F	
Asphalt	109.62° F	
Bare Soil	98.23° F	

Table 2.

Two inch depth	Average Soil Temperature between 7:00 AM and 7:00 PM	
Soccer	95.33° F	high 116° F
Football	96.48° F	high 116.75° F
Natural Turf	80.42° F	high 90.75° F
Bare Soil	90.08° F	

Table 3.

Shade	Average Temperature between 9:00 AM and 2:00 PM	
Surface Temperature of Natural Turf	66.35° F	high 75° F
Surface Temperature of Artificial Turf	75.89° F	high 99° F
Average Air Temperature	81.42° F	

Surface Temperature of A.T. (Artificial Turf) is significantly higher than air or soil temperature of A.T. The amount of light (electromagnetic radiation) has a greater impact on temperature of A.T. than air temperature. The hottest surface temperature recorded was 200° F on a 98° F day. Even in October the surface temperature reached 112.4° F. This is 32.4° F higher than the air temperature. White lines and shaded areas are less affected because of reflection and intensity of light. Natural grass areas have the lowest surface and subsurface temperatures than other surfaces measured. Cooling with water could be a good strategy but the volume of water needed to dissipate the heat is greatly lessened by poor engineering (infiltration and percolation).

Average air temperature over natural turf in the late afternoon is lower than other surfaces. Soil temperature of A.T. is greater than bare soil and natural turf. Humidity appears to be inversely related to surface and soil temperature. It is likely that energy is absorbed from the sunlight by the water vapor.

The heating characteristics of the A.T. make cooling during events a priority. The Safety Office at B.Y.U. set 120° F as the maximum temperature that the surface could reach. When temperature reaches 122° F it takes less than 10 minutes to cause injury to skin. At this temperature the surface had to be cooled before play was allowed to continue on the surface. The surface is monitored constantly and watered when temperatures reach the maximum. The heat control adds many maintenance dollars to the maintenance budget.

A budget comparison was made using actual dollars spent and for every dollar spent on the A.T. maintenance one dollar and thirty cents was spent on the natural turf (N.T.) practice field. While construction costs are very unbalanced, for every dollar spent on the N.T. eleven dollars and seventy-seven dollars were spent on the A.T.

The area under the carpet of BYU's installation is designed to move water from the surface and into an extensive drain mat system. This part of the installation is two thirds of the overall cost of the A.T. Thus, for a 2.5 million dollars installation approximately 1.7 million dollars go for the subsurface and drainage. The most interesting thing about this is that the drain mat probably sees little or no water. The surface is hydrophobic and the undersurface is poorly engineered to favor water retention rather than drainage. That seems like a high price to pay for something that does not work!

Artificial turf surfaces have their place in the turf industry. They can work in environments where grass will not grow and are marginal. However, they are costly and not maintenance free. It is important to take all the factors in to consideration before making a large investment. Don't take the manufacture's word for the factors of concern i.e. don't let the fox guard the hen house. The propaganda on BYU's installation is charts with surface temperatures less than the air temperature and claims for drainage of 60 inches per hour. The question still remains is A.T. 11.47 times better than natural turf?