

# USING SOLAR DATA TO SOLVE SHADE PROBLEMS ON GOLF COURSES

By

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Solving shade problems on golf courses can be done simply and effectively by utilizing the known path of the sun across the sky during anytime of the year. Although the calculations to determine the sun's path across the sky are lengthy and complicated, it is possible to acquire that data for any location on earth.

The first step in this process is to determine the longitude and latitude of the subject site. There are a multitude of software programs and internet sites that can provide the longitude and latitude of a site. Using that information and other software, the path of the sun can be calculated for any hour or any day of the year as seen in Figure 1.

The azimuth and altitude of the sun's path across the sky are calculated for various days of the year and the True North azimuth is adjusted for the magnetic variation (declination) of the site. This is done because a compass is used in place of expensive surveying equipment. It must be noted that the sun's location from day to day and season to season is constantly changing based on the earth's rotation around the sun. I like to use the winter solstice (usually December 21<sup>st</sup>) as the starting month and calculate the sun's path on the 21<sup>st</sup> day of every month. The azimuth angle for True North and Magnetic North is the horizontal angle in degrees increasing clockwise with North being zero degrees, East is 90 degrees, etc. The Altitude angle is the vertical angle in degrees with the horizon at zero degrees.

Dec. 21st.	True North	Magnetic North	Altitude
EST			
06:00 AM			
07:00 AM			
08:00 AM	123.0	129.3	6.7
09:00 AM	132.6	138.9	16.6
10:00 AM	144.3	150.6	25.0
11:00 AM	158.3	164.6	31.1
12:00 PM	174.2	180.5	34.2
01:00 PM	190.8	197.1	33.6
02:00 PM	206.2	212.5	29.6
03:00 PM	219.5	225.8	22.7
04:00 PM	230.5	236.8	13.7
05:00 PM	239.6	245.9	3.5
06:00 PM			
07:00 PM			
08:00 PM			
09:00 PM			
Sunrise		07:20 AM EST	
Sunset		05:22 PM EST	

Figure 1

When I have the solar data calculated, I can visit the site and begin the evaluation process. Using a compass and clinometer (measures the vertical angle), each area of concern is evaluated with respect to the sun angles at the appropriate times of year relative to the type of grass. Some grasses such as the ultra-dwarf Bermuda grasses require more direct sunlight. Basically I start on the east side of the area (green) and first use the compass to turn the horizontal angle. I then use the clinometer to measure the vertical angle. For example, if I want to know where the sun is on December 21<sup>st</sup> at 10:00 AM, I use the chart in Figure 1 to look up the magnetic north angle and altitude angle which are 150.6 degrees and 25.0 degrees respectively. I use the compass to turn to 150.6 degrees, then the clinometer to turn to the vertical angle of 25 degrees. At that point, I note whether the sun's location is in clear sky or behind a tree. I repeat the process for the rest of the hours on December 21<sup>st</sup> noting if the sun is in clear sky or behind particular trees. This process is repeated for the other months of the year until I have a clear understanding which trees and/or branches are causing the shade problem(s). I then move to other places around the green and repeat the process.

At each location around the green, I can accurately calculate the number of direct sunlight hours for each month of the year and which trees need to be removed in order to achieve more hours of sunlight. I can graphically illustrate this with a plan of the green using isogonic lines to represent different hours of sunlight across the green in a before and after scenario.

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When it comes down to actually selecting trees that must be removed, it is done so with respect to the type of tree, it's health and even it's relationship to the design of the golf hole. The weaker or less desirable trees (diseased, damaged, fast growing/weak) are selected first then Pines, then deciduous hardwoods and last on the list are Live Oaks.

The bottom line to all of this is that trees selected for removal is based on scientific data of the sun's path across the sky. There is no guess work involved.