Chief engineer explains the method behind the Memorial

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After special events such as the recent Veterans Day ceremony, the Anthem Veterans Memorial Support Team is often asked to explain the engineering process involved with the Memorial's design. Jim Martin, AVM chief engineer, explains the process.

Question: *Given the earth's rotation and considering variations like leap year, how did you calculate for the sun's rays to pass through the ellipses at 11:11 on every Nov. 11?*

Martin: "The answer really relates to the celestial motion of the sun along with time corrections that were internationally adopted in 1972 when International Atomic Time became the world standard for measuring time. International Atomic Time implements leap second corrections to the clock to compensate for pole wandering, slowing of the earth's rotation and the UT1 correction for seasonal variations. This is the time that we see on our computers and cellphones; it automatically adjusts and is really not observable without very accurate timepiece comparisons.

With that said, the variation of the sun's position on any day and time is extremely close – even on a leap year. The leap calendar, along with the other corrections to the Atomic Clock, was a brilliant astronomical feat to allow the ephemeral location of the sun to be so precise relative to time.

When planning the geometry of the Anthem Veterans Memorial, it was clear that the static nature of the structure would require a fixed azimuth (the horizontal angle from astronomical north to the center of the sun on Nov. 11 at 11:11 a.m. that creates the horizontal illumination of the Great Seal) and a fixed altitude angle (the vertical angle for zenith, or horizon, to the center of the sun on Nov. 11 at 11:11 a.m. that creates the vertical illumination of the G Seal).

Each year, the center of the sun is slightly offset from other years by just a few horizontal or vertical arc-seconds relative to the timing of the required azimuth/altitude position of the sun. This does create a time correction that is very minor; it cannot be perfectly aligned at precisely aligned at 11:11:11 a every year due to the static alignment of the memorial. To deal with this adjustment, we calculated the perfect solar position every year from 2011 to 211 and at what time (International Atomic Time plus corrections) perfect illumination would occur. The time variance over 100 years was calculated to be a cyclical range of perfect illumination sometime between 11:10:58 AM and 11:11:22 AM, a difference of 24 time seconds.

Using the statistical mean of the 100-year data, the altitude and azimuth angles for the structure were adjusted to provide time/error fluctuation of plus o minus 12 time seconds from the International Atomic Time mark of 11:11:11 a.m. That small time difference allows for additional compensation of the variations that you mention. We also checked the variance 500 years out, and if the structure is still standing, it will work.

In complete truth, it is not perfect; the only way to do that would be to move the ellipses very slightly each year which is really not a recommended optio would say that it is perfect if you recognize the plus or minus 12 time second difference for 11:11:11 a.m."