

Interpretation of Sunlight on the Faces of the Pyramids

Paul Thompson 6/28/2025

Many of the pyramids in Egypt were clad in white limestone and could be seen for miles around. We have been told this was to show the magnificence of the king but there may be a more practical use. As the sun crosses the southern sky, the faces of the pyramid are illuminated in sequence, east, south and west. Then they darken in the same sequence. A considerable amount of information can be gleaned from this lighting.

Google Earth Pro has a function that simulates the sun moving across the sky and the shadows that are cast. A time slider shows the faces changing from dark to light and dark again. The date can be changed as desired. Using this tool, the time of day was recorded as each face was fully illuminated and, again, the time each face began to darken. This was done on the 20th of each month for the year 2025. The time zone is East Africa Time and no change for daylight savings.

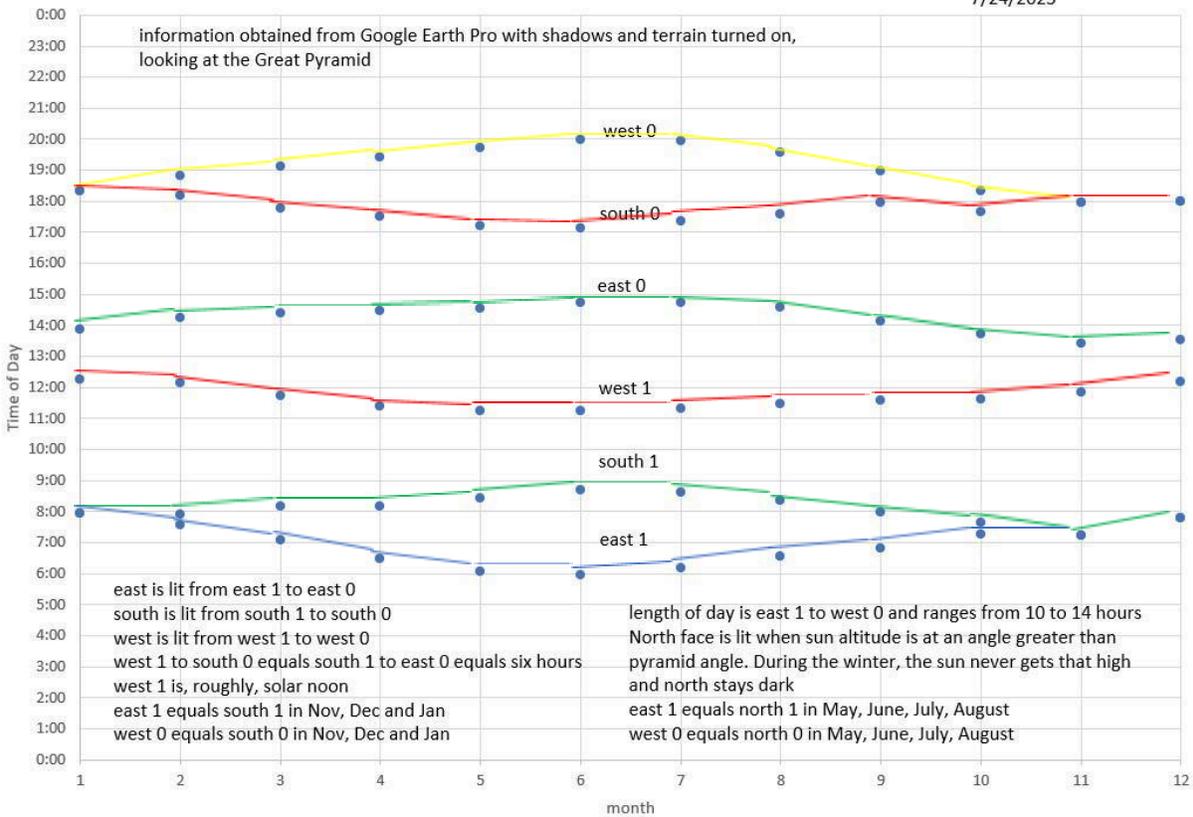
I knew the faces on all the pyramids were always lit the same way. It makes sense if they are all aligned with the sun's travel. I suspected the pyramid could tell time, somehow, and I wanted to analyze the lighting of the faces over the course of a year. I wasn't sure how accurately the shading was shown using Google Earth so I started with mathematics, CAD and time equations. It was much easier to get the information from Google Earth so I took a chance and recorded the data and I'm sharing it. I was surprised by what I found.

When displayed in a graph, some interesting patterns emerged. The summer months have the earliest sunrises and the latest sunsets. The time from lighting of the east face to darkening of the west face varies from 10 hours in the winter to 14 hours in the summer. The Egyptians considered the day to be 12 hours and the night to be 12 hours all year long. Thus, an hour in the winter went by quicker than an hour in the summer.

The graph shows two six-hour intervals (red and green pairs).

Lighting of pyramid faces on 20th of each month

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Fixed Time Interval

Using a combination of faces, the pyramid can show a fixed time span of six hours, no matter what time of year. And it does this twice a day. This interval is from the time the south face becomes lit to the time the east face starts to go dark. The same six hours is from the time the west face lights up and the south face starts to darken. Having a time span that remains constant at a known value allows one to:

Measure production (e.g., construction or farming work per interval)

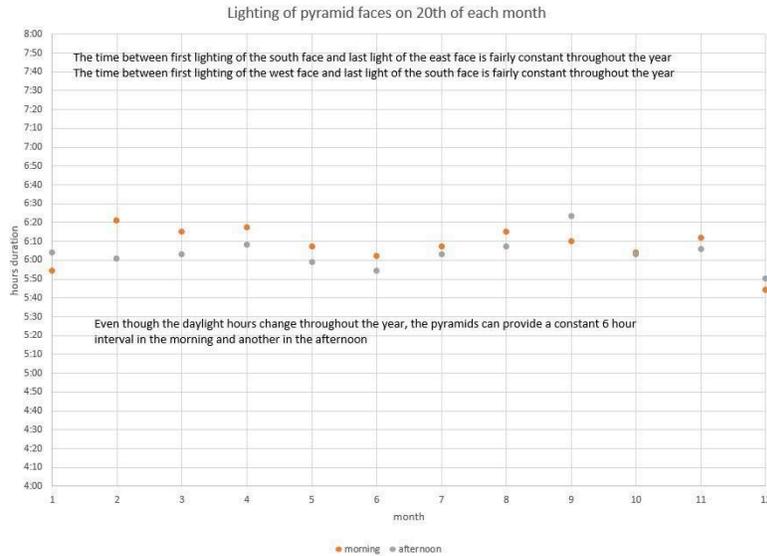
Track distance (how far a caravan travels in six fixed hours)

Standardize shifts or rotations in the workforce

Using sunrise to sunset is no good because it is different throughout the year.

month	date	time	north	east	south	west
1	1/20/2025	7:57	0	1	1	0
1	1/20/2025	7:57	0	1	1	0
1	1/20/2025	12:15	0	1	1	1
1	1/20/2025	13:51	0	1	1	1
1	1/20/2025	18:19	0	0	1	1
1	1/20/2025	18:19	0	0	1	1
2	2/20/2025	7:34	0	1	0	0
2	2/20/2025	7:53	0	1	1	0
2	2/20/2025	12:09	0	1	1	1
2	2/20/2025	14:14	0	1	1	1
2	2/20/2025	18:10	0	0	1	1
2	2/20/2025	18:48	0	0	0	1
3	3/20/2025	7:04	0	1	0	0
3	3/20/2025	8:09	0	1	1	0
3	3/20/2025	11:43	0.5	1	1	1
3	3/20/2025	14:24	0	1	1	1
3	3/20/2025	17:46	0	0	1	1
3	3/20/2025	19:08	0	0	0	1
4	4/20/2025	6:28	0.5	1	0	0
4	4/20/2025	8:10	1	1	1	0
4	4/20/2025	11:23	1	1	1	1
4	4/20/2025	14:27	1	1	1	1
4	4/20/2025	17:31	1	0	1	1
4	4/20/2025	19:24	0.5	0	0	1
5	5/20/2025	6:03	1	1	0	0
5	5/20/2025	8:26	1	1	1	0
5	5/20/2025	11:14	1	1	1	1
5	5/20/2025	14:33	1	1	1	1
5	5/20/2025	17:13	1	0	1	1
5	5/20/2025	19:43	1	0	0	1
6	6/20/2025	5:56	1	1	0	0
6	6/20/2025	8:41	1	1	1	0
6	6/20/2025	11:14	1	1	1	1
6	6/20/2025	14:43	1	1	1	1
6	6/20/2025	17:08	1	0	1	1
6	6/20/2025	19:59	1	0	0	1
7	7/20/2025	6:10	1	1	0	0
7	7/20/2025	8:37	1	1	1	0
7	7/20/2025	11:19	1	1	1	1
7	7/20/2025	14:44	1	1	1	1
7	7/20/2025	17:22	1	0	1	1
7	7/20/2025	19:57	1	0	0	1
8	8/20/2025	6:32	1	1	0	0
8	8/20/2025	8:20	1	1	1	0
8	8/20/2025	11:27	1	1	1	1
8	8/20/2025	14:35	1	1	1	1
8	8/20/2025	17:34	1	0	1	1
8	8/20/2025	19:33	1	0	0	1
9	9/20/2025	6:48	0.5	1	0	0
9	9/20/2025	7:58	0.5	1	1	0
9	9/20/2025	11:34	0.5	1	1	1
9	9/20/2025	14:08	0.5	1	1	1
9	9/20/2025	17:57	0.5	0	1	1
9	9/20/2025	18:57	0.5	0	0	1
10	10/20/2025	7:15	0	1	0	0
10	10/20/2025	7:38	0	1	1	0
10	10/20/2025	11:37	0	1	1	1
10	10/20/2025	13:42	0	1	1	1
10	10/20/2025	17:40	0	0	1	1
10	10/20/2025	18:20	0	0	0	1
11	11/20/2025	7:14	0	1	1	0
11	11/20/2025	7:14	0	1	1	0
11	11/20/2025	11:51	0	1	1	1
11	11/20/2025	13:26	0	1	1	1
11	11/20/2025	17:57	0	0	1	1
11	11/20/2025	17:57	0	0	1	1
12	12/20/2025	7:48	0	1	1	0
12	12/20/2025	7:48	0	1	1	0
12	12/20/2025	12:10	0	1	1	1
12	12/20/2025	13:32	0	1	1	1
12	12/20/2025	18:00	0	0	1	1
12	12/20/2025	18:00	0	0	1	1

This data is a log of the pyramid face lighting on the 20th of every month in 2025 at the Great Pyramid. 1 means fully lit and 0 means it is just starting to darken. Times for the north face were not recorded.



This graph shows the variation in the six-hour “fixed” time period. It looks like it is at a maximum in the spring and fall.

Solar Noon

The west face becomes illuminated very close to solar noon. It happens 45 minutes early in May and June and 15 minutes late in December, January and February. Usually,

one would expect solar noon to be halfway between sunrise and sunset. In the case of the pyramid, the west face lights up closer to sunrise than to sunset. This would allow someone to walk from sunrise to noon, get a few things done, then turn around and be back before sunset.

The North Face

Since the pyramids are north of the equator, the sun sweeps across the southern sky in an arc. In the winter, it is a shallow arc where the sun never gets very high, perhaps 30 degrees from horizontal. And it rises and sets slightly south of true east and west. In the summer the arc may reach over 80 degrees. The summer sun rises and sets north of east and west. Consequently, at sunrise, the north face lights up along with the east in the summer months and lights up the south and east face at the same time in the winter months. The Great Pyramid has sides that are 51.8 degrees from the horizon. So, during midday, the north side is lit when the sun is greater than 51.8 degrees above the horizon, which is all day in the summer. In the winter it doesn't light at all.

Calendar Function

This lighting also can be used to tell the months. On the 20th of November, the 20th of December and the 20th of January, the south face illuminates at the same time as the east face. In the evening, the south and west faces start to go dark at the same time. As soon as the south face begins to light a little after the east face, it is the end of winter and time to start counting the days. They must have learned how many days should pass before they start planting seeds. This is extremely important if several rounds of crops are to be grown. It can also guide farmers to space harvest times of crops so they don't all happen at the same time.

Similarly, on the 20th of May, the 20th of June, the 20th of July and the 20th of August, the north and east face light at the same time and the north and west faces go dark at the same time. As soon as they happen at different times, the counting of days begins again. This is useful for planting fall crops to make sure they reach maturity before low temperatures arrive.



The pictures above are taken June 20 showing the north face being lit morning and evening



The pictures above are January 20 showing south face lighting in morning and evening

Workday

The pyramids not only have two non-changing equal length intervals; they also have a slightly shorter interval that varies with the month. It happens at the beginning and end of the day and the interval is almost exactly the same in the morning and evening. As one might expect, the work interval is longer in summer and shorter in winter, ranging from 4:48 to 5:15 hours. There are three lighting changes in a workday. The first is the start of the shift. The second may or may not be halfway through the shift. The third change is the end of the work shift.

The workday can start when the east side becomes lit. Or it can start when the south face is lit. Or it can start at, roughly noon, when the west face becomes lit. Lastly, the workday can begin when the east face begins to darken. In every case, the workday ends when the second face

lighting change takes place. People may live different distances from their workplace. Therefore, some allowance must be made for late arrivals.

Shift 1	East 1	to	West 1	4:45 average
Shift 2	South 1	to	East 0	6:07 average
Shift 3	West 1	to	South 0	6:03 average
Shift 4	East 0	to	West 0	4:48 average

Shift 2 has a fixed number of hours after work is over until sunset, no matter what time of year. Shifts 1 and 4 vary throughout the year

Say you are working 2nd shift. You start work when the south face lights up. A while later, the west face lights up and the 3rd shift people show up, but you keep working. When the east face starts to darken, the workday is done.

Say you are working on the 4th shift. You show up when the east face starts to darken. The 2nd shift employees are leaving. The south face begins to darken and the 3rd shift people leave. Finally, the west face starts to darken and you can go home.

Pyramid Construction Considerations

They wanted all pyramids to act the same. This requires them all to be aligned to the north, east, south and west axes. They also needed to be square and level at the base and the peak must be directly above the center.

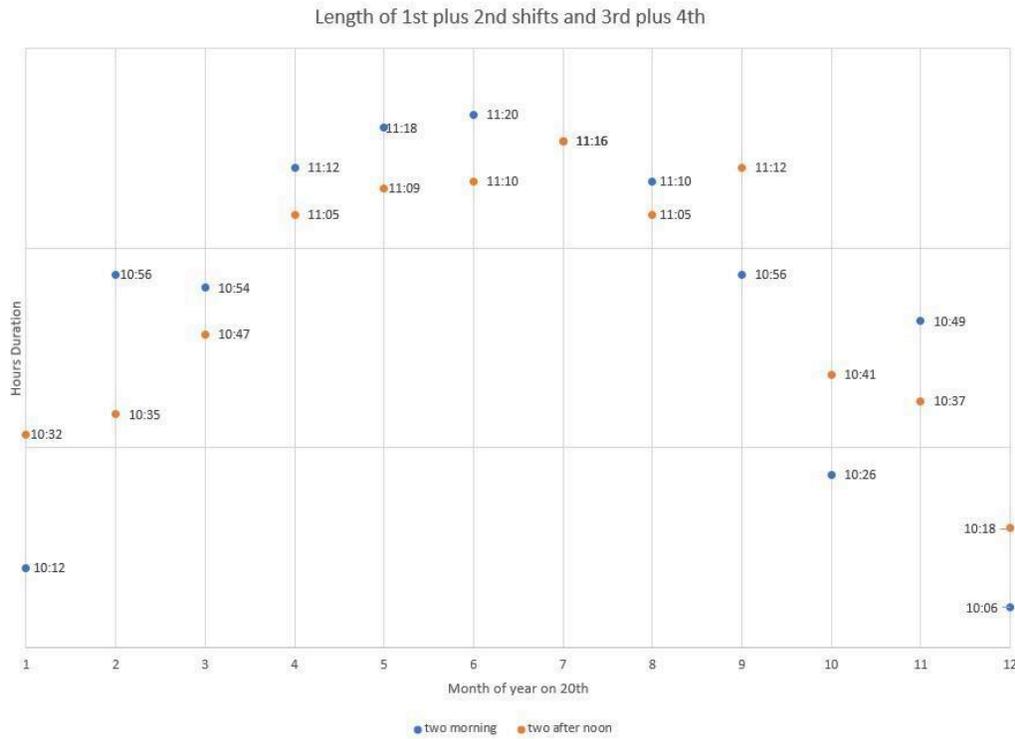
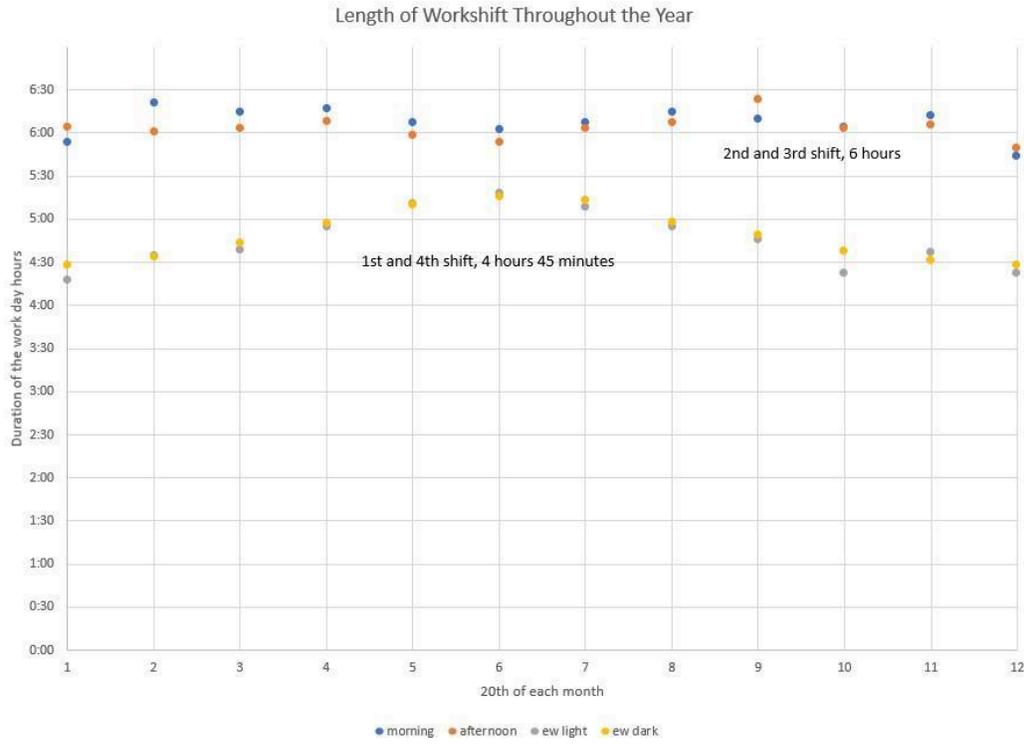
The faces can't be twisted. From bottom to top, each face must be parallel to the earth's coordinates.

Each face must be very flat. No hills or valleys or deviations from the planned slope of the sides. This makes sure the lighting is the same all over the face. The lighting should be unambiguous so a person can tell between lit and unlit.

The corners should be a straight line and sharp. The first moment the sun peeks over the corner, the lighting should evenly cover the entire face.

Careful measurements of the pyramids show that the builders got every one of the requirements right.

The following graphs include the morning and evening mini-shifts. I tried graphing it every way I could think of. Perhaps someone will see additional uses for the lighting.



The Bent Pyramid

This pyramid has the most casing stones in place. To see them in person is striking. All those stones are perfectly flat and on the same level so they combine to create an enormous flat surface with sharp corners. It is not something that workers with varying skill levels, using chisels and polishing stones could do so consistently. The stones are long and angled downward and tightly fitted against one another. There is no room for error on the squareness and angle of the face.



View of the casing stones of the Bent Pyramid. Some deterioration can be seen as some limestone is more resistant than others. The close fit of the blocks on the sides is evident. The top must be flat and the correct angle is evident. This strongly suggests some machine tool was used, particularly, considering the numbers involved

The Bent Pyramid starts off at the bottom with a steeper angle (54.5 degrees) than the Great Pyramid (51.8 degrees) then changes to a flatter angle of 43 degrees for the top half. The lighting changes from the bottom half to the upper half. It may be possible that the two angles created unique timings. One twist in the story is that modern measurements of this pyramid detected a bulge in one of the lower faces. This told the builders that they may have gone too steep on the sides. The bulge may have been visible to them from the lighting which could have ruined it for timekeeping.

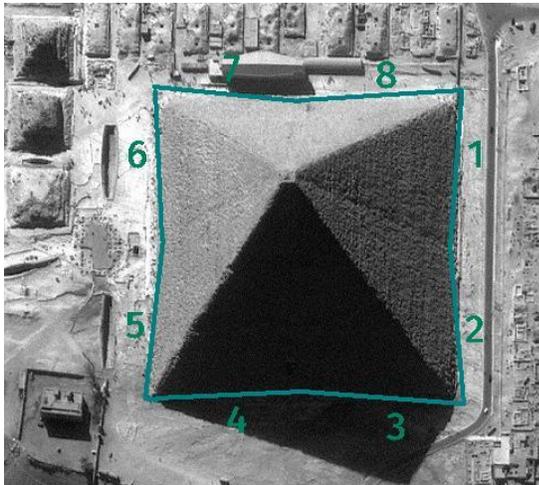
If one looks at the Stepped Pyramid with Google Earth, it appears to have a spiral shape. The lighting moves around the pyramid in a more continuous manner.

The Great Pyramid

Each face of this pyramid is actually divided into left and right halves, essentially giving it eight faces. Each half slopes inward, ending up about four feet in at the crease. Ordinarily, this is not visible from the ground except on the equinoxes. It is most evident when seen from the air.



The lighting tells us both pictures were taken between 8 and 9am because the north face is still dark. It will look this way on both the spring and fall equinoxes on the 22nd of March or September. The three small pyramids are on the east side



Obelisk

These needle-like structures are said to tell time by measuring the angle of its shadow. The problem with that is you have to walk to the obelisk to measure or see markings. One should notice a pyramid at the top of every one of them. The face lighting of this pyramid is the same as a regular pyramid so the same information can be determined. And you can do it from a distance. No need to approach the device.

Derivation of an Hour

The Egyptians knew a day was 24 hours. The fixed interval of six hours is one fourth of a day. A water clock would fill a certain amount in six hours. It could be emptied and refilled to the same level three more times so they know the time interval is one fourth of a day or six hours. They could then put six equally spaced graduations in the clock vessel and know each one was an hour. That fixed interval led to them to accurately measure periods of an hour.

Final Remarks

The casing stones would have made the lighting transitions crisper, due to the sharp edges and flatter surface. The time slider has tremendous resolution, down to the second. The hard part is determining when a face is fully lit or when it just begins to darken. It seemed to be accurate to three or four minutes. The transition time from fully dark to fully light and fully light to fully dark ranges from 30 to 35 minutes. Undoubtedly, this would be faster with the casing stones in place. They may have had terms for different stages of the transition, like one fourth, one half and three fourths lit.

Since the pyramids were all aligned with the earth's coordinates, the lighting of all changed at the same time. So, one might not see all sides of a pyramid but they might see a west side from one pyramid and the east side of another and that would tell them what they needed to know.

The pyramids are located along the Nile which runs north-south, so they all have, roughly, the same longitude. It is not known whether the orientation of pyramids slightly east or west of each other was adjusted slightly so the shadows changed at exactly the same time. This would have put them all in the same time zone, so to speak, even if solar noon was not exactly right.

The angles of the sides of the pyramids make a difference in timing and this was not explored. And the fact that these times were only taken on one day of each month, does not discern the resolution available to identify a single day of the year. I have yet to correlate sun azimuth and altitude angles with lighting of the faces, not that there is a problem but I just haven't done it.

The lighting transitions can be seen by everybody, even at long distances, so it is a means to synchronize events for a multitude of people. Perhaps time for prayer or time to be at work or time to gather together. It should be noted that the pyramids weren't built just to be clocks. This was just something extra they did to take advantage of the visibility of such a large structure.

The behavior of the face lighting is a fact that is readily observable, even without the casing stones. A tremendous amount of planning and effort went into creating the faces so the lighting works the way it does. And there is no denying the information would be useful to the Egyptians. So, it seems reasonable to conclude that the exteriors of the pyramids were purposely built to be seen from a great distance, provide synchronous and consistent time spans, denote noon time and provide some fixed points in a year.

