The solar observation and offering platform at the front of the Great Aten Temple

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[This piece is a supplement to the report http://www.amarnaproject.com/documents/pdf/GAT-report-Autumn-2017-2018-HI.pdf]

The above report on the Amarna Project web site presented evidence from the re-clearance, in 2017 and 2018, of the ground which lies on the axis of the temple immediately in front of the site of the gateway between the pair of stone pylons which marked the front of the stone temple in its final phase. The evidence gives rise to the interpretation that we have the foundations for a long and wide staircase (18.9 x 3.7 m) which rose at a low angle from west to east to end at the gap between the pylons. The staircase itself, 1.6 m wide, had been flanked by stone balustrades set in wide foundation blocks of a kind used at least in some of the royal buildings at Amarna, most notably the Great Palace and Great Temple. Figure 1 (which replaces Figure 42, p. 36 in the earlier web report) shows how a balustrade slab from Amarna provides guidance as to dimensions, slope and decoration. Figure 2 supplements Figures 53 and 54, p. 3, of the earlier web report. Figure 3 is a photograph of the platform as it is portrayed in an axial view in the tomb of Meryra (no. 4 at Amarna).

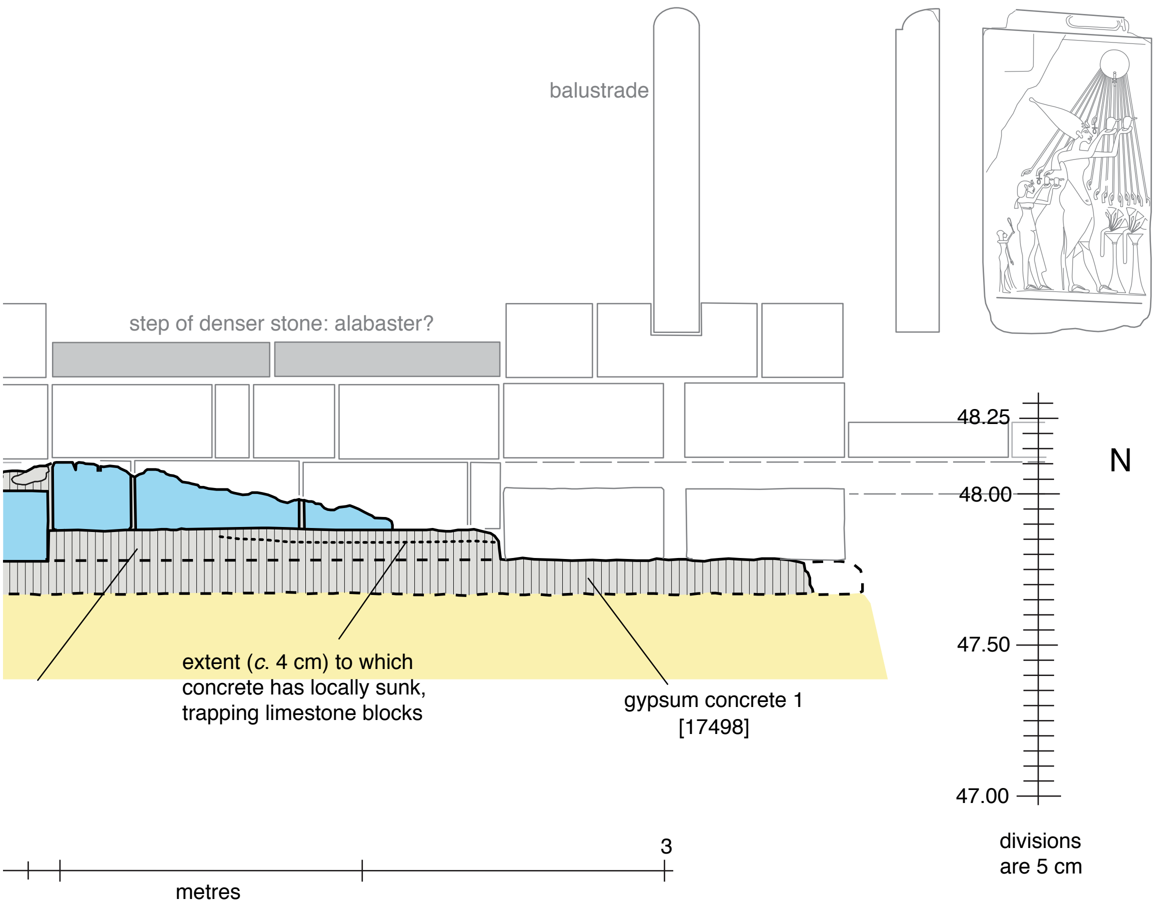

Figure 1. Partial section across the foundations of the staircase in front of the stone pylons at the Great Aten Temple, with reconstruction of how it might have continued upwards. The height of the balustrade slabs is taken from the slab in the Egyptian Museum, Cairo T30/10/26/12. It probably derives from Petrie's excavations at Amarna, but whether from the Great Aten Temple or from the Great Palace is debatable. It was decorated on only one side and so might represent half of the original thickness. Balustrade thickness varied considerably: one granite piece from the temple (S-12563) was only 8.5 cm thick. For Amarna balustrades see Shaw 1994, Wegner 2017, 70–6.

Figure 2. *Remains of the shrine in the northern house of Panehsy. It shows the ends of the balustrades which flanked a staircase leading up to the shrine which had stood upon a platform. The low balustrades fitted into slots cut into anchoring slabs which rose at an angle. View to the south. EES Amarna negative 26/05.*

Figure 3. *Detail of the staircase and platform as it appears in the tomb of Meryra at Amarna (no. 4). Figure 43, p. 37 of the earlier web report shows more of the line drawing of the whole scene. Photograph by Thomas Sagory.*

Using both archaeological and artistic sources, Paul Docherty has prepared a series of visualisations. One aim is to reconstruct what Akhenaten would actually have seen at dawn each day when standing on the platform. Art and texts from Amarna point to sunrise as the key moment in the daily cycle of the sun's passage and corresponding ceremonies within the temple. Sunrise seems to have brought to Akhenaten an intense sense of wonder, an emotional more than an intellectual response, something portrayed with great effectiveness in the twin scenes of sunrise at the temple carved on the walls of the royal tomb at Amarna (chamber *alpha* of the Meketaten suite), although these omit a depiction of the platform. The new location of the platform gives it a more commanding size and position. It placed Akhenaten at a point where the long vista of offering-tables (perhaps already bearing offerings set out in the half-light before dawn) appeared to stretch almost unbrokenly between him and the Aten.

To accomplish the visualisations the model of the temple front was extended to include a basic representation of the 1st court of offering-tables which was in turn extended further east to the full length of the Long Temple. The offering-tables have been kept as basic block constructions and the initial row began with four larger tables, two on either side of the temple axis. It may be that these were supports for statues. There is also enough in the foundations to conclude that there was a rectangular pedestal positioned between them, crossing the axis (it is outlined in red in Figure 27, p. 27 of the earlier web report). It may be that it supported a stela; therefore, this has been incorporated within the 3D model. It is not known to what height the temple walls would have risen; they have been raised to a notional height of 7 m with the intermediate pylons at 11-m heights.

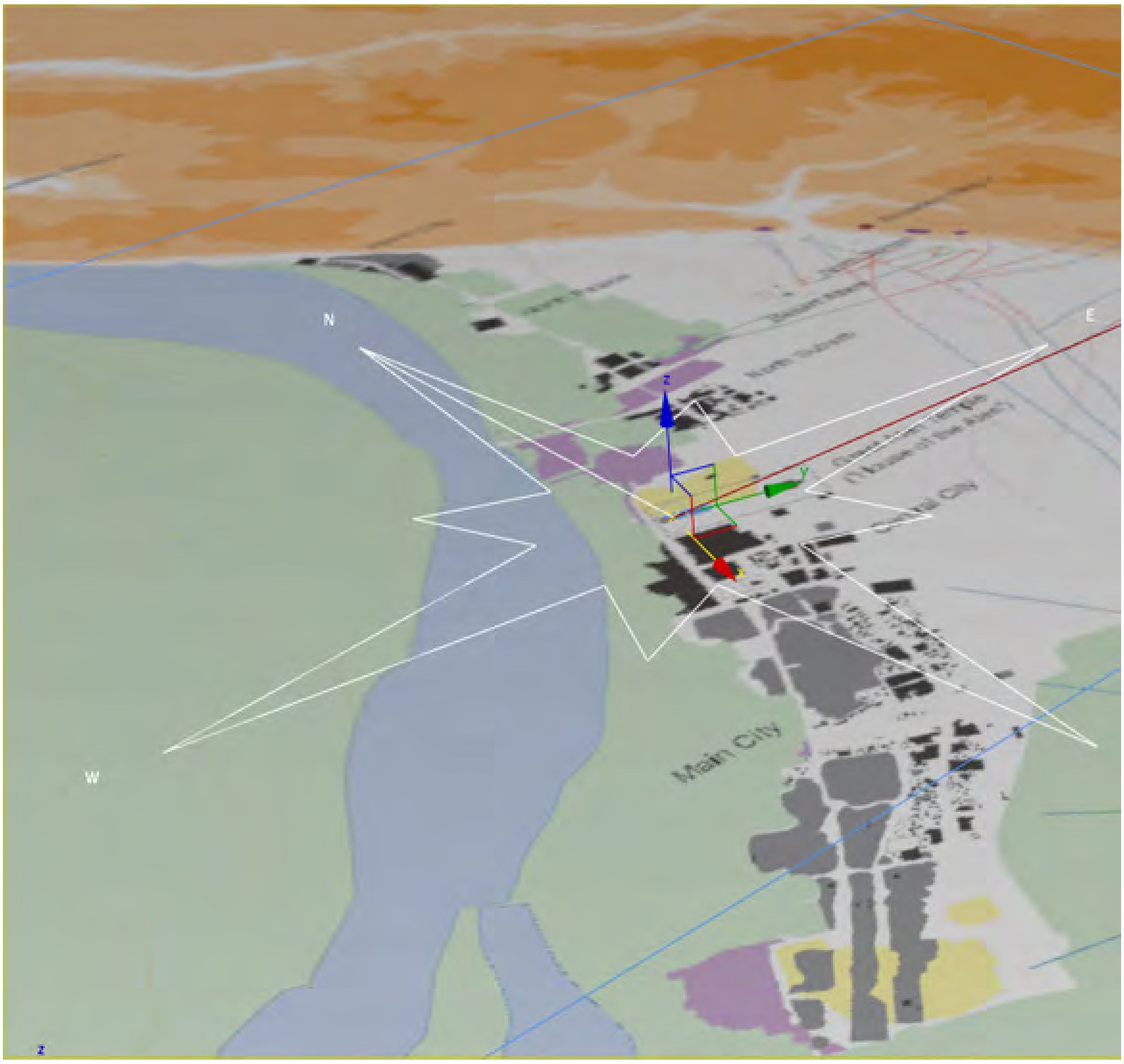

Figure 4. The Daylight System interface and lighting rig.

Calculating the position of the sun for a specific time and date involves some complex mathematics. These have been embedded inside a lighting rig within the 3D modelling software (Autodesk 3DS Max) for ease of use. 3DS Max is a professional modelling, animation and rendering software package which is used extensively in architectural visualisation. It also used widely within the games and film/visual effects industry. When coupled with Autodesk AutoCAD, which is used for plans and technical drawing, they make for a powerful visualisation toolkit (both are developed by the same company, Autodesk).

The daylight rig comes as standard within 3DS Max and brings together photometric lighting and positional aids into one easy-to-use tool. The rig needs to know the world coordinates (in latitude and longitude) for the site, the north direction and the time and date. This will generate the azimuth and altitude for the sun and position the directional light to match. The control interface can be seen in Figure 4 along with the lighting rig in the 3D viewport. To ensure that the simulated lighting is as true as possible to its real-world counterpart, the setup was calibrated using on-site reference photography. By taking a photograph of the modern stone block construction and matching the camera position within the software we can determine via the lighting and shadows if the sunlight rig is positioned accurately. The comparison can be seen in Figure 5, where the stone blocks help to act as a measure for the shadows cast. The images show a very close simulation to the real world which enables the use of the daylight rig with some confidence in its accuracy.

Figure 5. *Calibration check using a photograph from on-site (left) and the simulated sunlight and shadows (right).*

To check whether the cliffs would be seen within the temple a master plan of the location (based upon a 1990, 1:50,000 map sheet) was imported into the software (also visible in Figure 4) and a series of marker blocks were placed at the cliff ridge at between 160 and 180 m in height to simulate the elevation at those points. From within the temple these markers could not be seen until the wall height was dropped to 6 m, and even then the intermediate pylons did an effective job of masking them. Therefore, the wall height was fixed at 7 m.

To establish the view Akhenaten may have had at sunrise a generic humanoid form with a height of 1.65 m was placed at the top of the staircase platform and a camera was positioned at eye level facing eastwards into the temple along its axis. Figure 6 gives an extended view of the temple front and the staircase with the 'Akhenaten' stand-in model. Figure 7 is the opposing view; notice the sunlight illuminating the white stone of the pylons. For clarity the same time and date has been used in these rendered images.

The sunlight rig has a date range between 1583 AD and 3000 AD, which unfortunately does not cover the period of Akhenaten's reign. The reason for the date beginning with 1583 is due to the introduction of the Gregorian calendar in 1582 as our standard calendar. The removal of 10 days in October of that year makes it impossible to create a continuous solar path using one calendar. Some astronomy packages can be used for simulations spanning longer periods, but they do not have the 3D modelling and visualisation abilities found within 3DS Max.

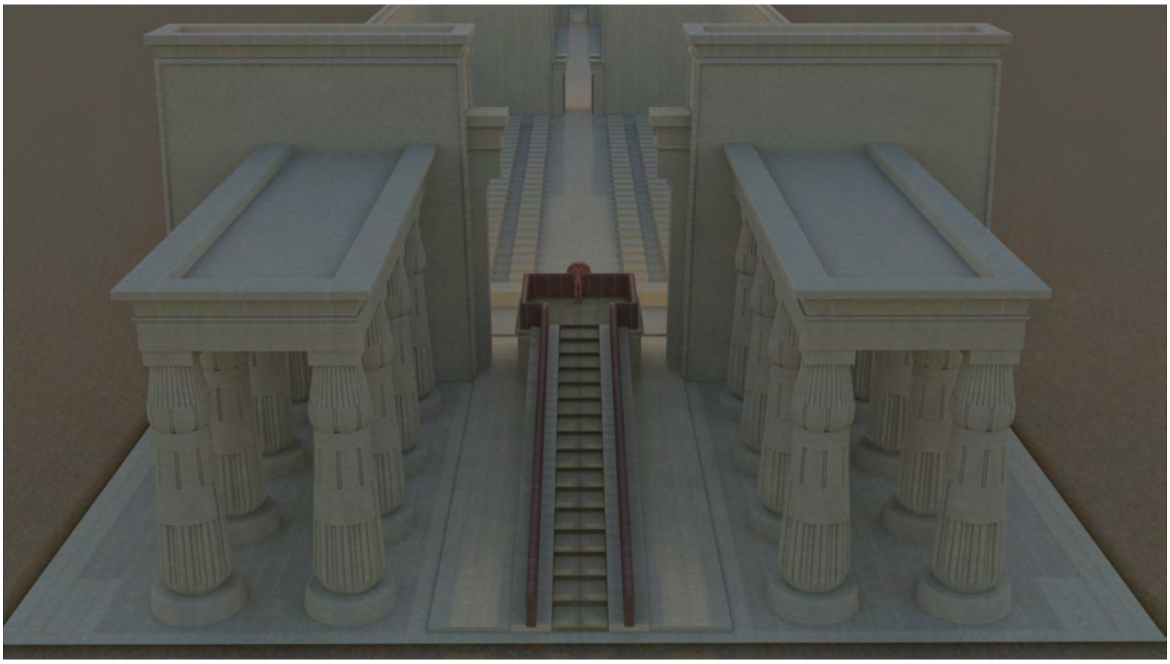

Figure 6. *View looking east along the temple axis at a simulated time of 06:40 on 12th October 2018. The small figure on the raised platform is representative of Akhenaten.*

Figure 7. *View looking to the west along the temple axis at a simulated time of 06:40 on 12th October 2018.*

The problem could be addressed in the future if a more in-depth lighting study was to be performed using raw azimuth and altitude data fed directly into the lighting rig. For the purpose of this experiment, the sun position was animated for each day of 2018 and its trajectory can be seen in Figure 8 as a red band. What is apparent is that it is not central to the temple axis. By testing different astronomical events such as the dates for the solstices and equinoxes there seems to have been little thought of any specific temple alignment with regards to any sunrise. The only periods when the sun rises in line with the temple axis is during the end of February to the beginning of March and the first two weeks in October. These are close to the equinoxes so it may be that more work needs to be done on aligning the daylight rig to see if both equinoxes have significance to the temple construction.

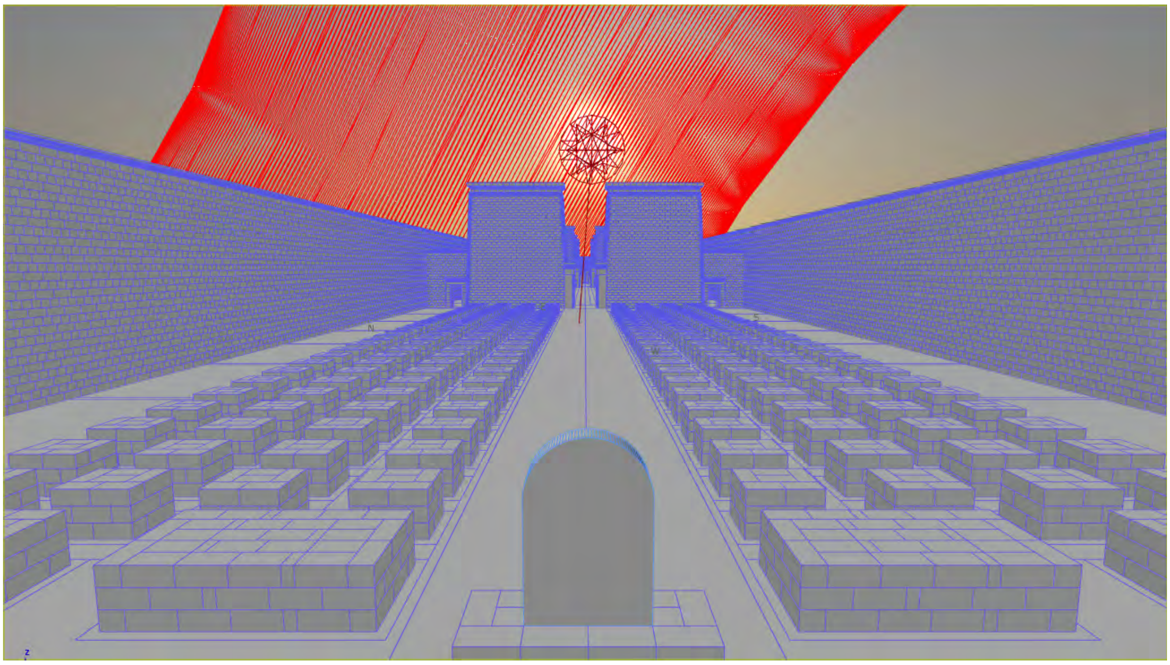

Figure 8. *The path of the sun (shown in red) over the period of one year. The 'compass' like object above the pylons is the photometric light which acts as the sun, shown here in transit.*

Comparisons of points calculated externally using the online astronomical calculator CalSky (www.calsky.com) for the year 1341 BC show that the band does have a very slight shift towards a central position but again this would need further testing and simulation to see whether it is of any consequence. This shift may be due to the small range of sample points picked for testing and again the issues regarding calendar calibration.

The final part for this simulation is to enable atmospheric haze and to set the camera's physical properties to match the aperture and exposure relevant to this kind of composition. The atmosphere is generated using a sky shading model which utilises a physical calculation of the light traveling through particles in the atmosphere and as such is connected internally to the position of the sun within the daylight rig. The rendered images shown in figures 9 and 10 give a representation of the view Akhenaten may have had from the staircase platform on two different dates. Although both images show the sunrise to be positioned central to the temple axis the sun would have begun its rise earlier behind the northern pylons (the left pylons in both images).

It is entirely possible that the dimensions of the pylons and associated architecture may have influenced the viewing conditions of the sunrise during Akhenaten's time. Some form of detailing in the architecture which is not present within any of the tomb scenes may have occluded the sunrise or enhanced it. Unfortunately, with no surviving temple architecture to help in this matter, it is unlikely that we will ever fully understand whether there is a deeper architectural relationship between the sunrise and the temple.

Whilst every effort has been taken to ensure accuracy of the temple dimensions and the path of the sun within this simulation there will always be some error due to the liberties taken during 3D construction. This simulation was intended as a visualisation aid, potentially leading to further study. For those interested in simulating astronomical orientations, the paper by Zotti and Gröller (2005) gives a good introduction to the issues surrounding this type of investigation.

Figure 9. *Possible view Akhenaten may have had of the 1st court of offering-tables from the position of the raised platform between the first pylons at a simulated time of 06:40 on 12th October 2018.*

Figure 10. *Additional view from the raised platform at a simulated time of 07:00 on 28th February 2018.*

References

Shaw, I. (1994). 'Balustrades, stairs and altars in the cult of the Aten at el-Amarna.' *JEA* 80, 109–27.

Wegner, J. (2017). *The Sunshade Chapel of Meritaten from the* House-of-Waenre *of Akhenaten*. Philadelphia, University of Pennsylvania Museum of Archaeology and Anthropology.

Zotti, G. and Gröller, M. E. (2005). 'A sky dome visualisation for identification of astronomical orientations.' *Proceedings — IEEE Symposium on Information Visualization*, INFO VIS, pp. 9–16. doi: 10.1109/INFVIS.2005.1532123.