A new analysis of geometrical implantation at Gobekli Tepe, Turkey, showing modular geometry orientated to cardinal directions.

By Howard Crowhurst (2022)

In their groundbreaking study published in 2019, Geometry and Architectural Planning at Göbekli Tepe, Turkey, Gil Haklay & Avi Gopher *examined the architectural remains excavated in the south-eastern part of the site, dated to be 11500 years old. They applied preliminary architectural formal analysis, using the latest technology, in order to reconstruct aspects of the architectural design processes involved in the construction of the monumental enclosures. They determined the exact centres of enclosures B, C and D and discovered an underlying geometric pattern which links them together, an equilateral triangle. They conclude that the three stone-built large enclosures were planned and initially built as a single project.*
Their study does not take into account the orientation of this equilateral triangle, nor the reason why it is not perfectly exact.
In this paper I will show how the builders used modular geometry to link the three centres of enclosures B, C and D, exactly orientated to the cardinal directions. This geometry accounts for the exact implantation showing why the equilateral triangle was not perfect. It consequently becomes by far the oldest example of modular geometry to have been found, some 6000 years before the start of the Sumerian civilisation.

Introduction

The idea that there exists something called sacred geometry is a very old one. It is described in the Hebrew Bible of Judaism (or Old Testament) concerning the Tabernacle of Moses (Exodus 25–31 and 35–40) and Solomon's Temple (1 Kings). In both cases, orientation according to cardinal directions is very important and also in both cases the ground plan is a triple square, a rectangle which is 3 times longer than it is wide. It would seem that historically the creation of any sacred space or temple is indissociable from sacred geometry. The pyramids of Egypt with perfectly square bases orientated to the cardinal directions are much older examples. In previous work, it has been shown that the megalithic constructions in and around Carnac were also based on these principles (Crowhurst, 2010a).
Modular geometry is simply the principle of placing squares side by side, either in a north-south or in an east-west direction or both. According to the number of squares which are used, the architect expresses a different symbolic meaning. This architectural method is based entirely on the use of whole numbers and avoids the use of irrational square roots which are present in the equilateral triangle for example.
As the monument uncovered at Gobekli Tepe is described as a temple, it would seem natural to check if these ancient principles of modular geometry were applied there.

The orientation of the base of the equilateral triangle.

Using the plan of enclosure C which was elaborated by Gil Haklay & Avi Gopher, and which indicates North, it was possible to establish the angle of the base of the equilateral triangle. The result can be seen in Figure 1.

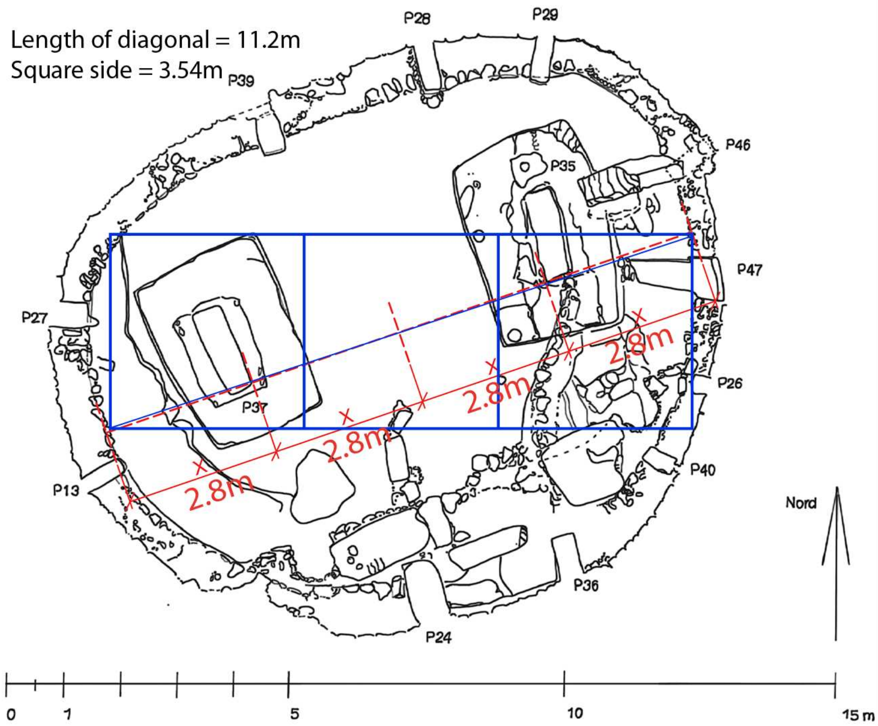

Figure 1: The diagonal of the triple square placed on the cardinal directions indicates the orientation of the baseline in enclosure C. ((Drawing superimposed over the detailed plan by Hacklay and Gopher,2019. Redrawn from Piesker 2014, fig. 8.)

The diagonal of a triple square placed on the cardinal directions overlays the line of the base as drawn by Hacklay and Gopher with a difference of 0.505°. The south side of the triangle in their diagram has an orientation of 71.06° or E18.94°N whereas the triple square is at 18.435°

This suggests the use of exactly the same geometrical orientation as that shown in the tumulus Saint-Michel in Carnac, France (Crowhurst, 2010b) (Figure 2).

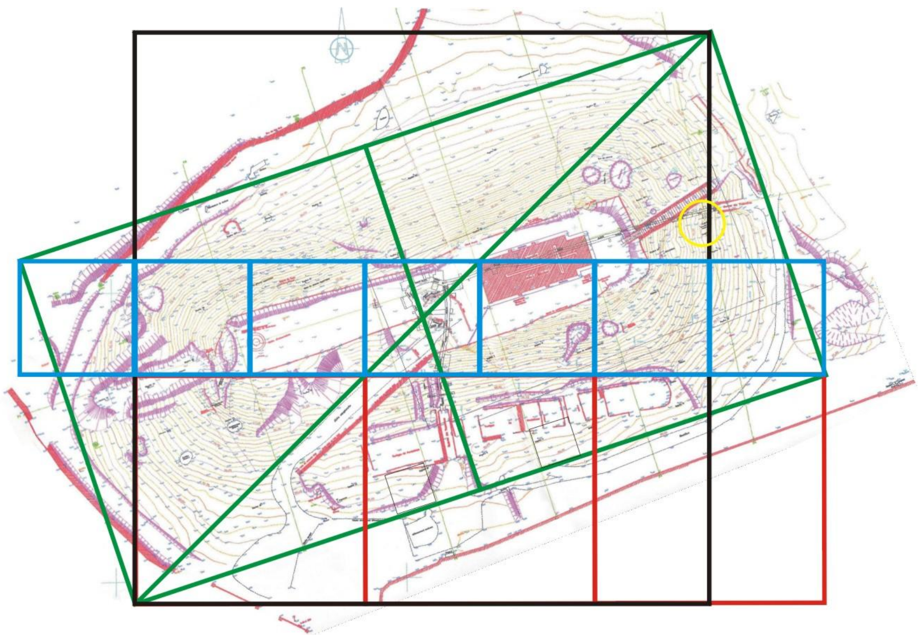

Figure 2: Cardinally orientated triple square geometry in the Tumulus Saint-Michel in Carnac.

This triple square geometry can be seen to extend to enclosure B, running through the south end of the central T-shaped pillars. (Figure 3).

Figure 3: Cardinally orientated triple square geometry (in red) between enclosures B and C. (Drawing superimposed over the schematic plan. Modified from Hacklay and Gopher, 2019, and formerly O. Dietrich et al. 2014)

The dotted blue line shown in the diagram of Hacklay and Gopher can also be seen to be the diagonal of a triple square, perpendicular to the first, with its 3 side on the north-south axis (figure 4).

Figure 4: Cardinally orientated triple square geometry (in red) from centre of enclosure D. (Drawing superimposed over the schematic plan. Modified from Hacklay and Gopher, 2019, and formerly O. Dietrich et al. 2014)

The orientation of the west side of the equilateral triangle.

We must now examine the other sides of the equilateral triangle to see if they also comply with modular geometry based on cardinal directions. First we should look at the line from the centre of enclosure B to the centre of enclosure D.
We discover that this line corresponds to the diagonal of a quintuple square, 5 times longer on the North-South axis than on the east-west axis (Figure 5). Its orientation is N11.31°E.

Figure 5: Cardinally orientated quintuple square geometry (in light blue) from centre of enclosure B to centre of enclosure D. (Drawing superimposed over the schematic plan. Modified from Hacklay and Gopher, 2019, and formerly O. Dietrich et al. 2014)

The angle beta (β) or DBC of the equilateral triangle can thus be defined as follows :

$$\beta = 90° - \mathrm{atan}(1/3) - \mathrm{atan}(1/5) = 90° - 18.435° - 11.310° = 60.255°$$

We see that the angle beta is very slightly larger than 60 degrees, the angle of an equilateral triangle. If we now come back to Hacklay and Gofer's diagram, we will see that they actually noted this difference (Figure 6). In this diagram, they have traced in red the lines which join together the three middle points of enclosures B, C and D.
In blue they have superimposed an equilateral triangle with an average side length of 19.25m (±1.5%). As the corner of the red triangle at the centre of enclosure B is inside the blue triangle, its angle is slightly greater.

Figure 6. The red triangle in Hacklay and Gofer's diagram joins together the centres of the 3 enclosures B, C and D. The blue triangle is an equilateral triangle which best fits at the centre of enclosure D. It can be seen that the angle of the red triangle at the centre of enclosure B is very slightly greater than the angle of the blue triangle. This coincides with the modular geometry suggested here. (Drawing superimposed over the schematic plan. Modified from Hacklay and Gopher, 2019, and formerly O. Dietrich et al. 2014)

The modular geometry of the near-perfect equilateral triangle.

As we have discovered the triple-square module which determines the orientation of the south side of the equilateral triangle and the quintuple geometry for the west side, we can deduce the geometry used for the east side. It can be seen in figure 7 to be a 9 by 8 rectangle. The orientation of the east side of the triangle as taken from point D is consequently 131.63° or E41.63°S.
The angles of the triangle have been named β, γ et δ at the centres of enclosures B, C and D. The angle γ can be seen to be only 7/100ths of a degree away from 60°, a precision of 99.89%. The total of the three angles shown in Figure 7 is exactly 180°, which confirms the exact modular geometry as shown.

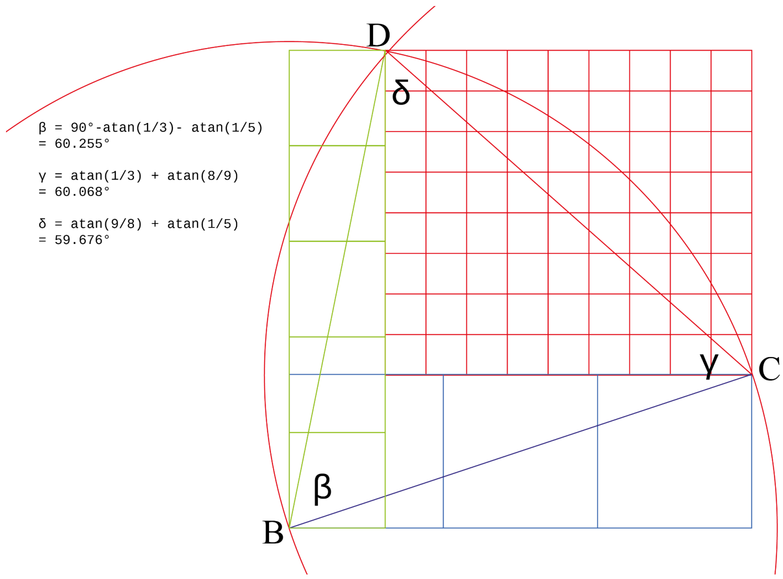

Figure 7. The modular geometry shows the equilateral triangle construction according to cardinal directions.
β = 90°-atan(⅓)-atan(⅕)= 60.255°
γ = atan(⅓)+atan(8/9) = 60.068°
δ= atan(9/8) + atan(⅕ = 59.676°
Total = 180.00°

Unfortunately, when this precise modular geometry is placed over the schematic plan used by Hacklay and Gopher but originally drawn by O. Dietrich et al, the diagonal line of the 8 by 9 rectangle does not overlay the east side of the equilateral triangle but runs slightly to the north (figure 8). This would seem to come from a slight positional error of enclosure C on the diagram, as enclosures B and D perfectly fit the geometry. A circle centred on point B goes through point D but not through point C.

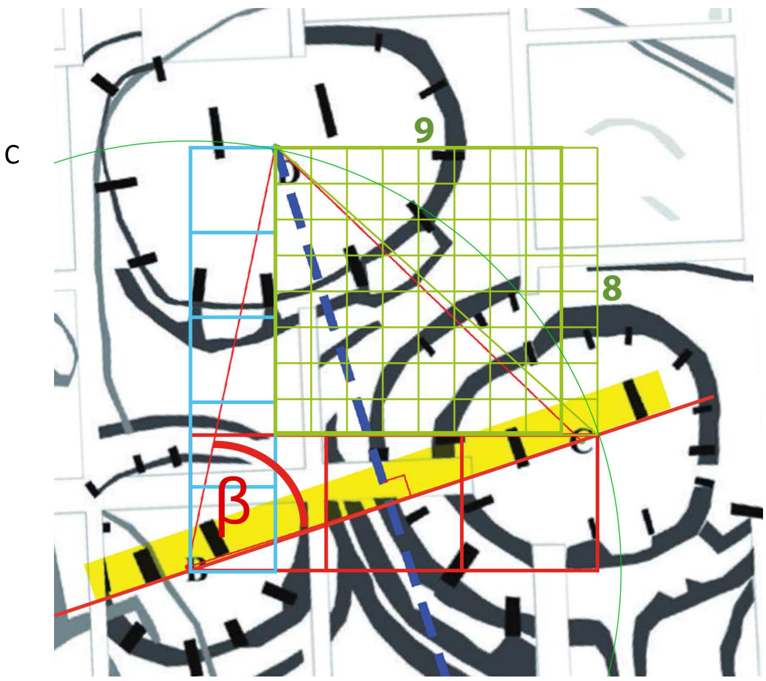

Figure 8. The complete modular geometry placed over the schematic diagram of enclosures B, C and D at Gobekli Tepe. (Modified from Hacklay and Gopher, 2019, and formerly O. Dietrich et al. 2014)

As already mentioned, Hacklay and Gopher give a side length for the equilateral triangle of 19.25 m ± 0.28m). If the line BD is considered to be 19.25 m long, line CD can be measured on the plan to be 19.10 m whereas line BC measures as 18.64 m, which falls a long way short of the given dimensions. This would consequently clearly indicate an error on the plan which does not correspond to the measurements taken in situ by Hacklay and Gopher. The geometry indicated here clearly corresponds to the data given by Hacklay and Gopher.

Conclusion

If the elements presented in this present paper are exactly confirmed by in situ data as measured by Hacklay and Gopher (2019), we can conclude the use of cardinally oriented modular geometry tor the installation of the ground plan of enclosures B, C and D at Gobekli Tepe. This pushes back the origin of sacred geometry a lot further than has previously been considered. It would confirm the sacred nature of this construction and justify the use of the word temple.

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