The GPS location of the Great Pyramid of Giza and the puzzle on the roof

Abstract

The apex of the Great Pyramid of Giza is incomplete, the top of the building being a 10 meter square plateau of uneven stonework. It has been theorised by academics that this incomplete upper portion of the pyramid has been destroyed by human activity since the pyramid was constructed.

In this paper I show that the apex plateau of the Great Pyramid is an original feature of the building and that the stonework of this level contains a series of rectangular and circular holes which comprise a sophisticated geometric puzzle. I demonstrate that the upper level of stonework is the 202nd level of the pyramid's core masonry and that it is located at an altitude of 202 meters above the lowest part of the pyramids construction, that being at the bottom of the vertical shaft of the underground chamber, when the meter is defined perfectly from the Earth's reference ellipsoid parameters.

I prove that the underground vertical shaft is a 2:1 scale model of the southern underground passage in the pyramid, and from that determine that the architecture of the whole building has been designed to be referenced to sea level and that the elevation of the major parts of the building can be determined through computation, rather than surveying measurements.

I solve the geometric puzzle that is carved into the apex plateau of the pyramid and thereby determine the latitude and longitude relationship between the building's lowest point in the underground shaft, the apex plateau, and the base center of the pyramid.

From this solution I determine the GPS coordinates of the base center point of the Great Pyramid on 26th February 2018 at 07.30 UTC from GPS measurements that were taken on that day by a team of surveyors. I then compute the tectonic plate shift of the pyramid in latitude since its construction by referencing the 2018 center point latitude to the pyramid's orginal latitude ,which is explicitly given within the building's architecture.

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The Great Pyramid papers

The GPS location of the Great Pyramid of Giza and the puzzle on the roof

A location of the center of the base of the Great Pyramid of Giza on the WGS84 reference ellipsoid can be established from a single GPS reading on the apex of the building when combined with an comprehensive understanding of the design of the structure.

Primary survey point

On the top platform of the Great Pyramid, the 200th layer of stonework counting the lowest layer as level 0, there is a small brass disk surveying point, set into concrete, which was established by the Giza Plateau Mapping Project (GPMP) team and which is known on their survey map as Station E1.This point was re-surveyed on 26th February 2018 by the Glen Dash foundation and details were published in AERAgram vol.19 no.1 in the spring of 2018. A video of the surveying expedition to the top of the Great Pyramid is available on the website of the organisation[1]. From the text and the video it is possible to determine that, allowing for a two hour period whilst the precision GPS system acquired sufficient satellite data to produce its highest possible accuracy result, the survey was conducted between 7.30am and 9.30am local time at Giza, and can therefore be time stamped in UTC and in Julian Days as

Date and time of survey	26-02-2018 07:30:00	UTC
	2458175.8125	JD(UT)

The latitude and longitude of the survey disk were recorded by the GPS device, which would have been using the WGS84(G1762) reference ellipsoid, as

Latitude	29° 58' 45.00041"	29.979166780555°
Longitude	31° 08' 03.05680"	31.134182444444°

The brass disk is specifically positioned so that it is at a 45^{o} angle S.E. from the circular drilled hole into which the vertical wooden pole that was installed in the late 1800s at the top of the pyramid was located, and the distance between these two locations was reported as being 2.413 meters by the Glen Dash team. This distance and reverse bearing can be placed into a geodesic bearing calculator along with the surveyed point's GPS location data, which gives the location of the circular post hole as

Center of principal circular hole on the top of Great Pyramid			
Date and time	26-02-2018 07:30:00	UTC	
Latitude	29° 58' 45.05582"	29.979182172673°	0.523235435968 rad
Longitude	31° 08' 03.12045"	31.134200124602°	0.543394302149 rad

It should be noted that this point is significantly different in longitude and slightly different in latitude from that calculated by the Glen Dash team and reported in their publication due to erroneous estimations that they used when calculating the latitude and longitude offset from the survey point resulting from this 2.413m length, and which they documented in note 8 of their article.

Having established a GPS reference point on the WGS84 reference ellipsoid on the top of the pyramid the task is to then connect this point to the base center of the pyramid with absolute precision.

A comprehensive understanding of the pyramid's design is essential to carrying out this task and the procedure starts, surprisingly, in the subterranean chamber of the pyramid.

The subterranean chambers

Diagram K1 shows the east elevation and the plan view of the subterranean chamber taken from a CAD drawing of the Great Pyramid on which the dimensions are taken from the numerical values of Flinders Petrie's written report.

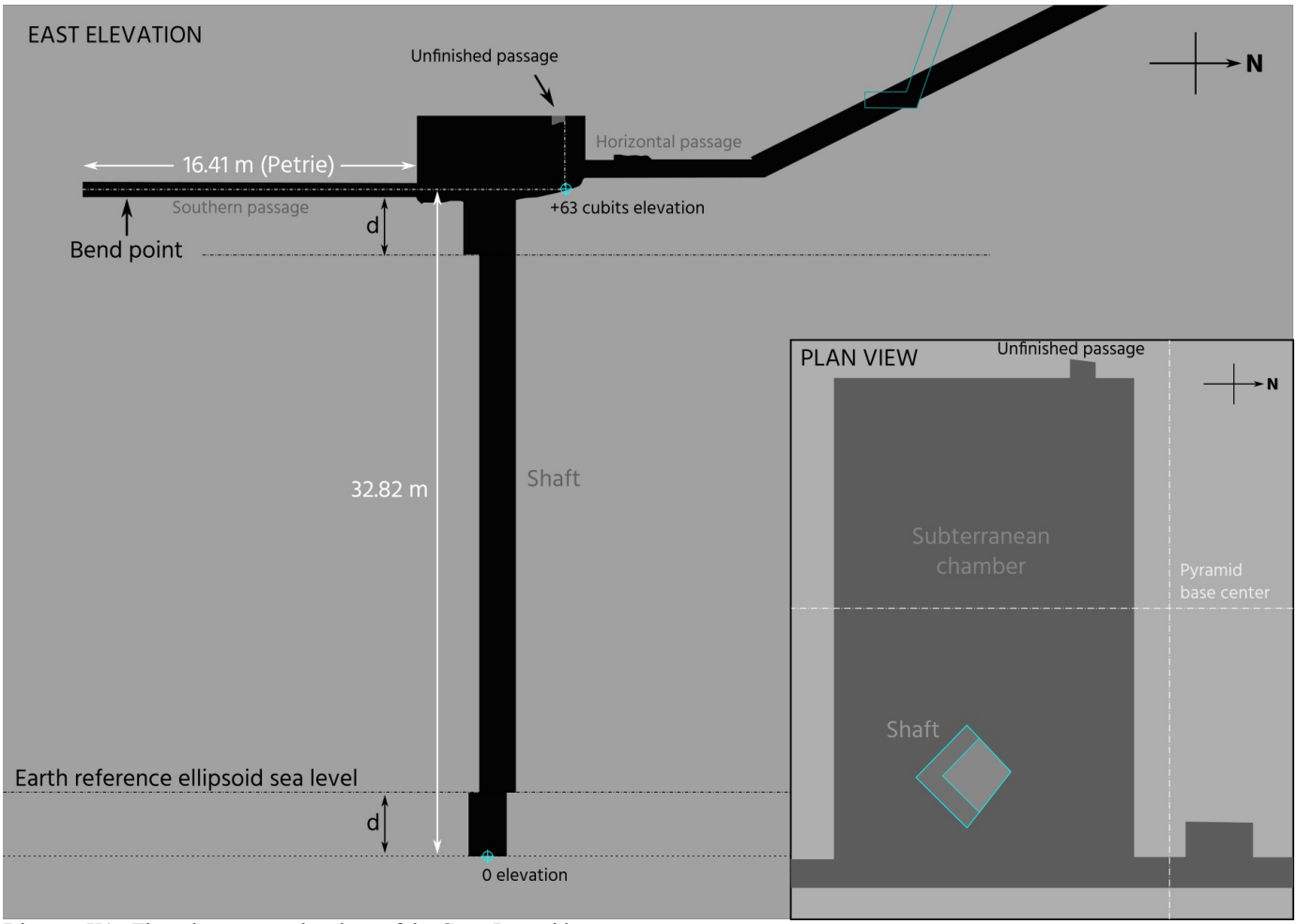

Diagram K1 - The subterranean chambers of the Great Pyramid

From analysing modern survey data around the pyramid on which the elevation of the survey points is noted and the elevation of the pavement above sea level is recorded as 60.43 (m), it is possible to establish that the altitude above sea level of the vertical center of the southern passage is constructed and designed to be at 63.0 cubits above sea level. Note that the 63 cubit elevation passage center line aligns with the north side of the small unfinished passage, which will become important at a later stage in the analysis.

The vertical shaft is impossible to survey or explore because it is only just over 1m square and is also full of debris and contains so little air that exploring it is dangerous. This is a deliberate design feature of the building. Analysis shows that the southern passage is a 50% scale model of the vertical shaft, as can be seen from Petrie's measurement of the passage which are displayed on the diagram in metric format.

The southern passage is noteworthy for its very rough workmanship, meaning that it is deliberately not possible to accurately determine the details of the vertical shaft just by surveying the passage, and only the concept that they are related as a scale model can be understood. Furthermore, the southern passage contains a lateral bend in it of 24 cm to the west[2] which means that the shaft, being twice the size, must therefore have a 48 cm bend in it at the bottom inaccessible portion.

It can be correctly deduced that the subterranean shaft descends down to sea level, located on the Earth's reference ellipsoid's surface as shown in the diagram, at which point the bend in the shaft is located, and

the shaft then descends down a further distance to the base point of the pyramid. The depth of the enlarged section of the shaft at the top and the inaccessible portion at the bottom are identical.

The measurements involved in this analysis were worked out from calculations on the course elevations of the external stonework of the pyramid as shown in diagram K2.

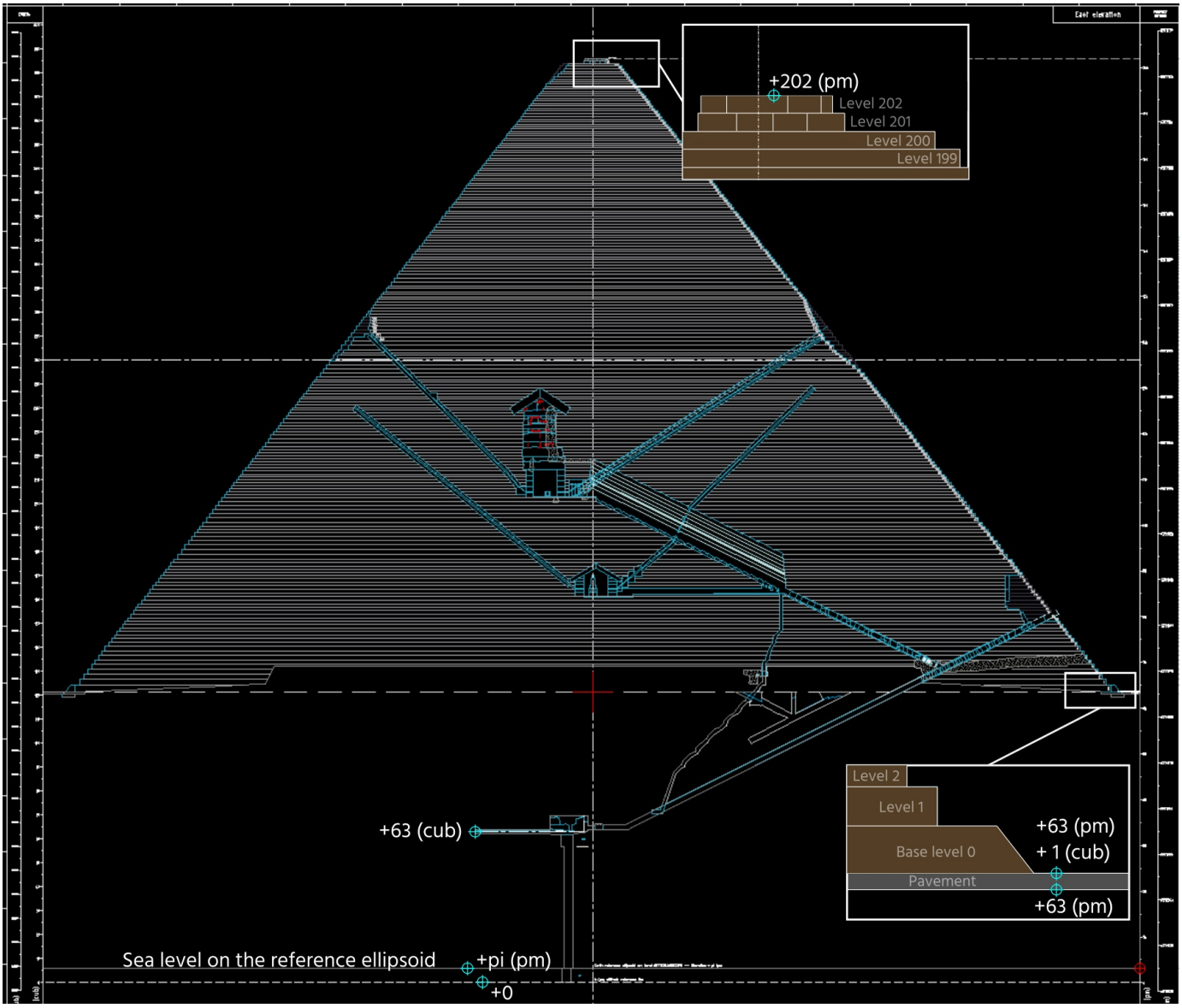

Diagram K2 - The east elevation of the Great Pyramid with the principal elevations of the design indicated.

The vertical center of the southern underground passage is at an elevation of 63 cubits above the base of the underground shaft and is designed to match with the bottom of the pavement which has an elevation of 63 perfect meters above the same point. Counting the levels of stonework of the pyramid starting at level 0, then the top level of the pyramid is level 202 and its top is at an elevation of 202 perfect meters above the bottom of the building. Sea level on the reference ellipsoid is located at *pi* perfect meters above the bottom of the building, a distance which is equal to the depth of the enlarged top portion of the shaft below the southern passage's vertical center line shown on diagram K1 as '*d*'.

This theoretical design has to match modern surveying measurements, and it does.

In the work of Mark Lehner the pavement altitude above sea level is reported as being 60.43 (m) *measured to a 1936 height datum*, and from the measurements shown in diagram K2 the altitude above sea level of the pavement is 63 (pm) + 1(cub) - pi (pm) = 60.3935 (m).

The altitude difference between the top of level 202 and the pavement is 202 (pm) - 63 (pm) + 1 (cub) = 138.504 (m) = 5452.913 inches, a value that was diligently surveyed by Petrie as being 5451.8 inches. The discrepancy between the two figures is Petrie's surveying error of 1.113 inches over the whole height of the pyramid, or 6/1000th of an inch per level of stonework.

The purpose of this verified design is to conceal the location of the bottom of the underground vertical shaft where the pyramid's architecture connects to the reference ellipsoid. Because the exact latitude of the pyramid is known at the time of its construction from the analysis of the internal features of the building documented in a previous paper[3], and this latitude must be the same as that being marked out at the bottom of the vertical shaft, then it is *essential* to determine this location in modern GPS coordinates so that the northerly traverse of the pyramid due to tectonic plate movement over the last 4750 years can be determined with absolute precision.

The whole system is a complex puzzle designed by the architects of the pyramid, and the solution to it can be found at the top of the pyramid on the final 202nd level of the pyramid's stonework.

The apex level of the Great Pyramid

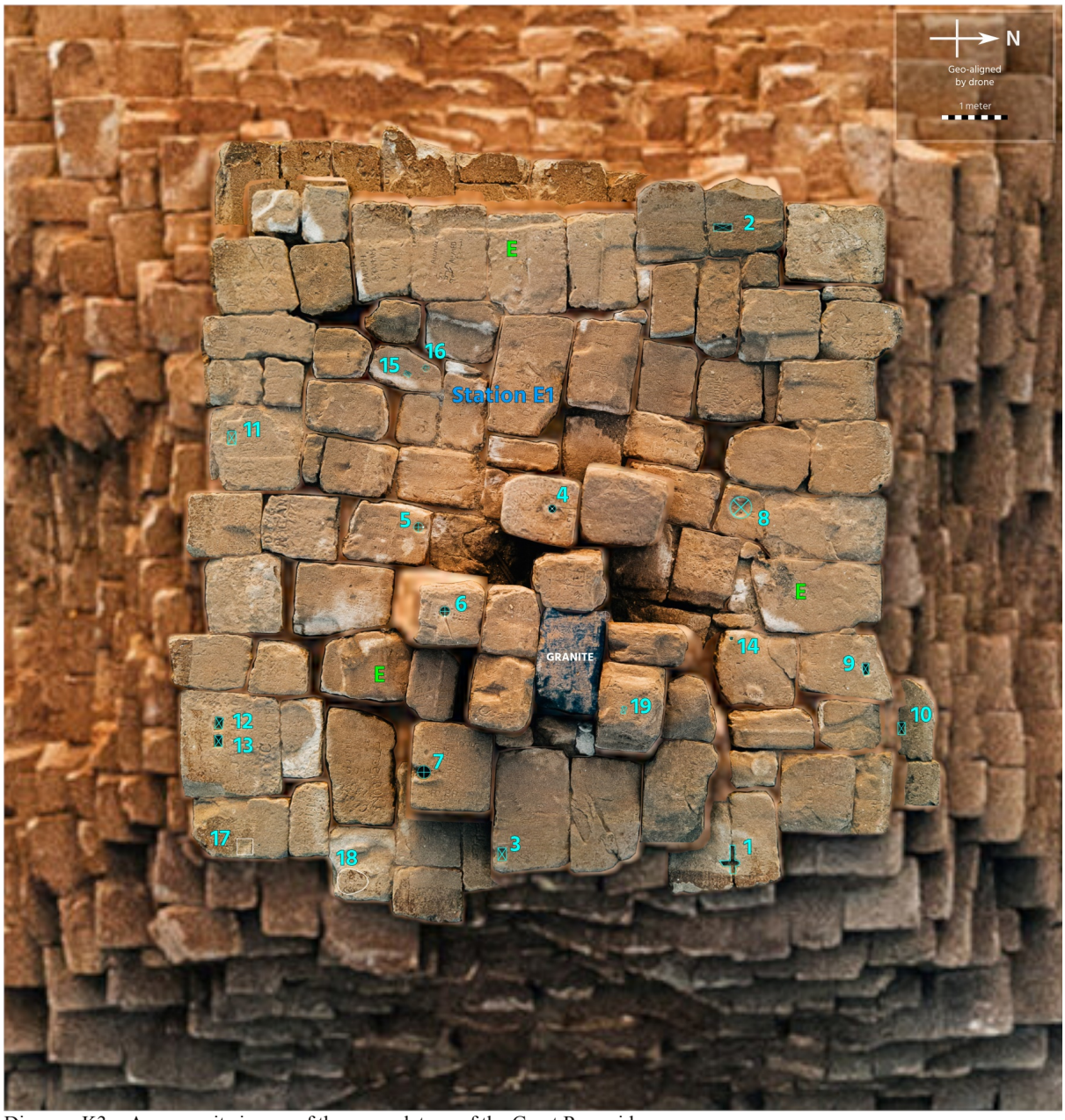

Diagram K3 - A composite image of the apex plateau of the Great Pyramid

The apex level of the Great Pyramid

The top of the pyramid was photographed using a high definition drone camera in April 2020 by the Ukrainian photographer Alexander Ladanivsky[4] in a collaboration with the tourist board of Egypt. The close up image from his series of shots shows that the top level of the building contains a series of circular and near rectangular holes cut into the masonry which need to be analysed to determine their purpose.

A combination of two factors makes this task difficult. The first is that the stonework on this level is not flat and has several stones which are nearly two meters high and which contain some of the important holes that need to be analysed. The second is that the close up image contains lens distortion and parallax error because it is taken from such a low elevation above the pyramid, making any geometric analysis of the holes impossible from the raw image. The solution to these problems was to take the highest altitude image of the series of photographs that still contained sufficient detail of the stone's surfaces so that the low altitude image of the stones could have each stone's upper surface cut out and digitally attached to the high altitude image, thereby removing the vast majority of the parallax errors and lens distortion.

This composite image on which the location of every stone has been manually corrected is shown in diagram K3. The location of the GPMP Station E1 and its surrounding concrete bed was identified allowing for accurate dimensions of the image to be determined at the outset of the analysis. The Giza Plateau Mapping Project Station E1 and the concrete area surrounding it has been digitally edited onto the composite image from a secondary photograph. By studying numerous images taken on the top of the pyramid, the post holes that were created in the 1800s to support a pole that was placed on top of the pyramid were identified along with their accompanying iron work and digitally removed from the aerial image. These digital edit points are shown by the three green letter 'E' in diagram K3. Finally, so that cross checks could be performed, the relationship between the base center and hole number 4 on diagram K3, which is the hole that used to hold the wooden mast, was checked. It was documented by Flinders Petrie[5] where he tabulates the surveying coordinates, giving the base center as 25.41 cm south of the pole hole and 41.61 cm east of it, as shown in diagram K4.

Diagram K4 - Petrie's base center location marked on the apex stone

With the surveyed location of the base center established on the aerial image it was then possible to connect the CAD drawing of the underground chamber to the photograph of the apex plateau within the error margins of the surveying, and the result of this is shown in diagram K5.

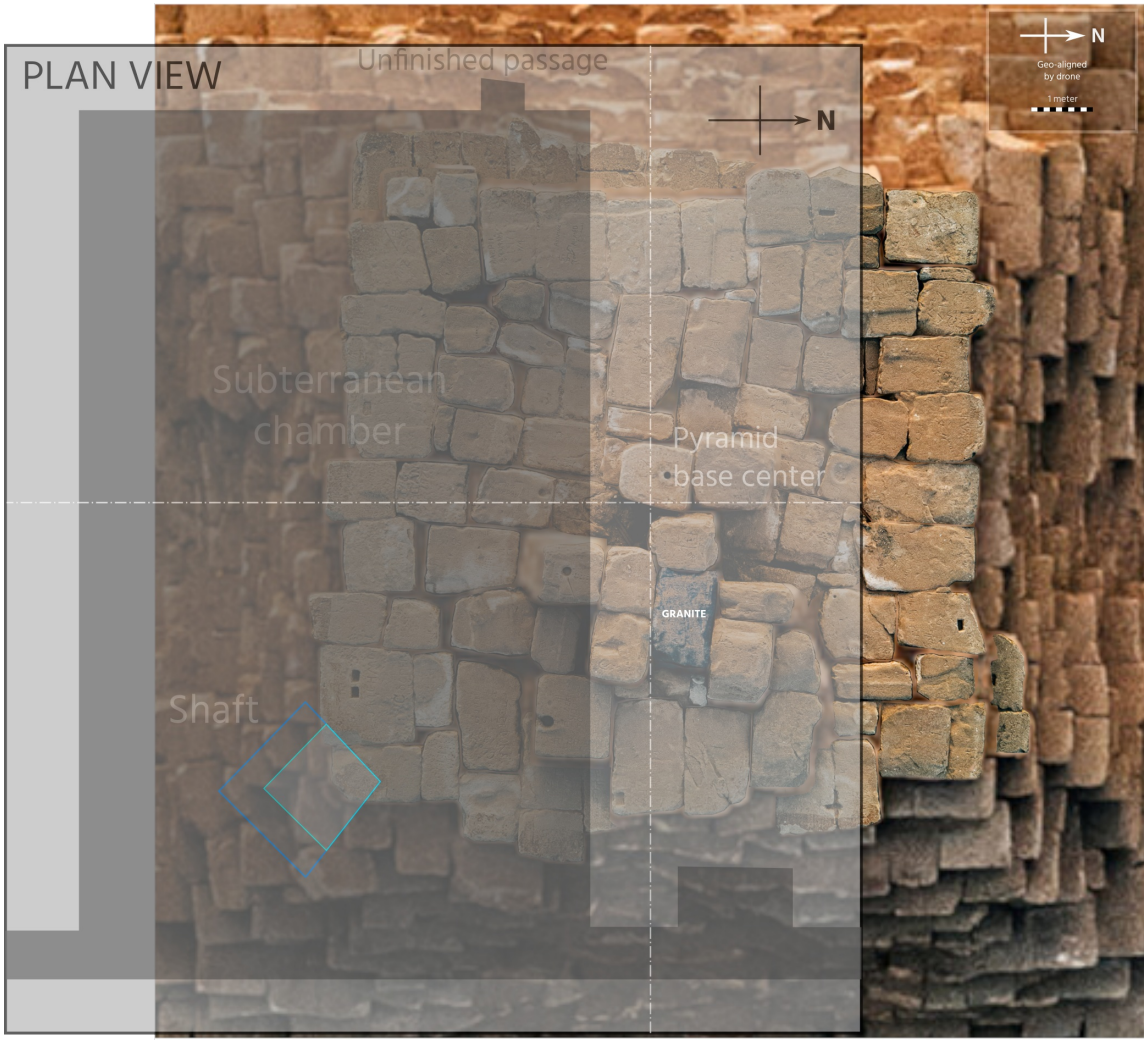

Diagram K5 - The plan view of the subterranean chamber superimposed on the apex plateau image

The cross section of the subterranean vertical shaft is located in the south east corner of the apex plateau and a preliminary analysis of this area shows that the apex stone that contains the two rectangular cut holes, which I will call the 'master stone' , has the same shape as the shaft's cross section, as shown in diagram K6. Because the shaft is not surveyed to any great detail because of its unfinished nature but the apex stone can be measured accurately it is a safe deduction to state that it is the apex stone which defines the shaft's cross section.

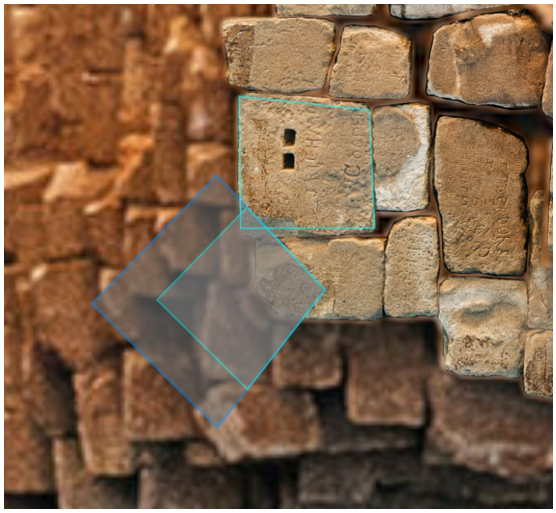

Diagram K6 - The master stone in the south east corner

Because the aerial image was taken from a professional drone camera which has been geo-aligned to north before the image was taken it is immediately possible to identify in diagram K3 that hole number 1 is an alignment mechanism created at the time of the building's construction with east-west and north-south marked out. This alignment marker *perfectly* aligns with the ends of holes number 2 and 3 to single pixel level precision, with the image resolution giving a 1 pixel to 3mm resolution. If the drone image had not been aligned to North, it would have been possible to align it digitally using the architects marks from 4750 years ago.

Having established that the stonework is not random and that the marker holes are not random, an analysis of the geometry that is created by the marker points was undertaken and the full geometric puzzle was identified after several hundred hours of analysis. The system was then recreated on a CAD drawing using a logical step by step approach, and the results of that analysis are documented in the next section.

It should be noted when reading through the puzzle's explanation that numerous iterations of the geometry were required to arrive at the final correct solution, and so when a statement is made such as "the diagonal of the granite stone is 3.5 (pm)" this value is the only value that will allow the subsequent parts of the geometry to correctly attach to each other and the logic of the system to flow. When performing the analysis it was necessary to arrive at an incorrect solution and then back-track through each part of the prior system to determine where the corrections needed to be applied. The puzzle is deliberately confusing and has been designed so that several incorrect solutions are very similar to the correct solution, requiring diligent sub-millimeter precision plotting on a CAD system to resolve which of the items is correct. Fortunately, the puzzle is so well designed that the explanation of its solution is straight forward and its geometry and logic unconfusing.

Units and constants

There are three units of measurement used within the apex plateau geometry

Perfect meters (pm)	= 1.00019657391 m
Cubits (cub)	= 0.52332657770 m
Stack constants (stk)	= 0.10707172911 m

all of which have been documented in the previous papers in this series and are known to 14 places of precision, that resulting from the computer systems on which they were calculated.

The apex plateau geometry uses the values of acceleration due to gravity in its construction, and the following values have been used in the analysis, which are taken from the 1980 International Gravity Formula applied at the appropriate altitudes

At an altitude of 0 (pm) at north pole	=	9.83025762786 pm/s^2	9.83219 m/s^2
At an altitude of 198.86 (pm) at Giza	=	9.79068540672 pm/s^2	9.79261 m/s^2
At an altitude of 0 (pm) at the equator	=	9.77840782017 pm/s^2	9.78033 m/s^2

Defining the granite key stone

Step 0

The first step in re-creating the architect's geometry is to place a pair of axis on a CAD drawing nominally representing the latitude and longitude lines that pass through the base center of the pyramid, and aligned to Petrie's surveyed base center point which he documented as being accurate to within 0.5 inch.

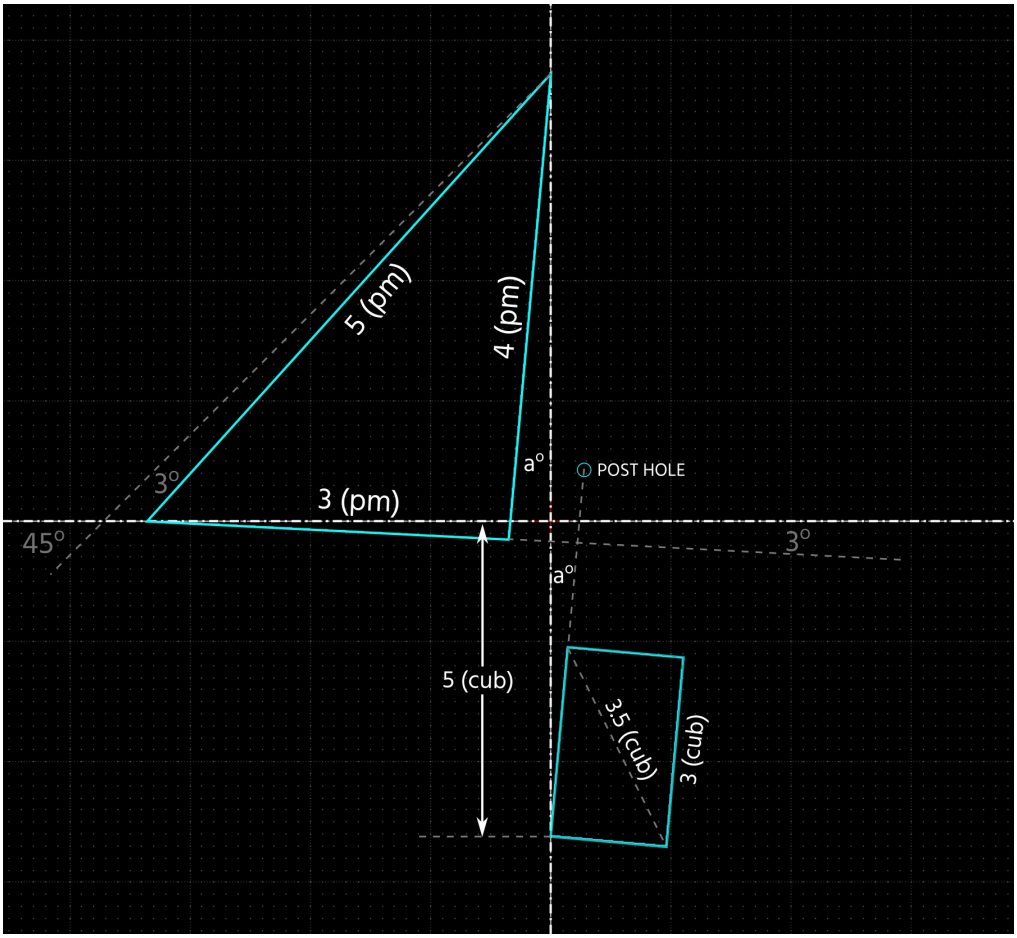

Diagram K7 - The first geometry on the apex plateau

Step 1

The geometry starts, unsurprisingly, at the single granite stone which I shall call the 'key stone'. Its dimensions are 3 (cub) on its long side and 3.5 (cub) on its *east-west* diagonal, and the south east corner of the stone is located on the pyramid's east-west axis exactly 5 (cub) from the pyramid's base center location. What needs to be calculated is the angle at which the stone has been laid, and this is contained within an ingenious opening statement from the architects which is designed to instantly focus your attention.

There is a simple Pythagorean triangle with sides of 3,4 and 5 (pm) that is hidden in the geometry - that is to say that it is not explicitly marked out in the stonework. It is reproduced in diagram K7 in which the unknown angle $\mathbf{a^o}$ has been marked next to the Pythagorean triangle and the granite stone. I have deliberately not quantified the angle on the drawing so that you can look at it and determine it yourself. The angle is *not* 3^o. It is made to look like it should be because the other two sides of the triangle are set at 3^o to the horizontal and to the 45^o degree line. The angle $\mathbf{a^o}$ is 5.1301^o and needs to be calculated using trigonometry as 45^o-3^o-atan(3/4). This geometry is not accidentally deceptive, it is an opening statement from the architects that tells you to analyse the geometry that is present on the apex plateau in minute detail because it is deliberately deceptive and will catch you out.

Having identified this triangle and its contained mathematical riddle, the granite stone can now be correctly placed on the CAD drawing set at an angle of 5.1301^o to the coordinate axis of the system. When this is done the granite stone's southern side is directly in line with center of the post hole, and therefore the drawing appears to be correct.

It isn't, and nor will any other piece of geometry on the apex plateau be on first analysis, even when the geometric alignments look correct. Every hole cut into the stonework and every geometric shape formed

from them contains a secondary twist in the construction logic which makes the analysis process time consuming due to the difficulty of finding the second layer of logic.

Step 2

The shape of the master stone (with the two cut holes) can be created from the granite key stone by taking a north-south line from the south west corner of the granite stone for a distance of pi (cub) or 1.64407 (m). The other two sides of this stone can be created at this stage by joining up the the polygon using a north-south and an east-west line as shown in diagram K8 in which the CAD drawing has had the aerial image added to it as a background so that the progress so far can be checked against the stonework. The drawing has had the line nodes added to make recognition of the principal parts of the geometry as simple as possible.

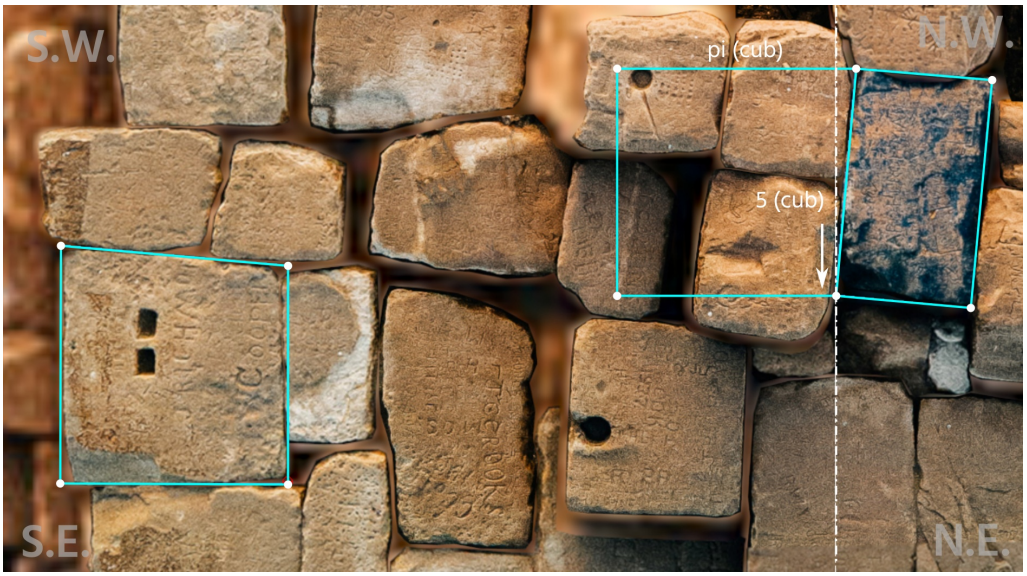

Diagram K8 - Steps 0 ,1 and 2 of the CAD drawing overlaid on the aerial image

Looking carefully at diagram K8 it is possible to see that the right side of the master stone is not aligned to the geometric shape, and when measured that this side of the stone is set exactly 2^{o} out of line. This is the small refinement that is required to the geometry that was eluded to by the architect's 'pay attention' warning, and this angle change needs to be created on the granite key stone.

The initial construction can now be repeated but instead of the south east corner of the granite stone being 5 cubits east of the base center it needs to be set at 4.5 cubits to make space for the lower line of the polygon that is attached to the granite sitting at 2^{o}, to produce the correct geometry that is displayed in diagram K9.

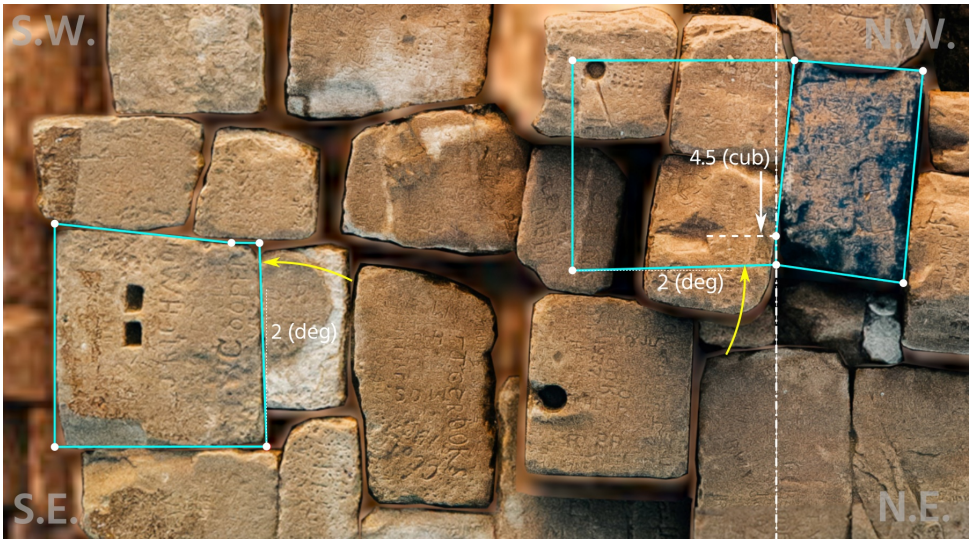

Diagram K9 - The corrected geometry of the first three steps

Step 3

During the process of the analysis of the first three stages it is necessary to move the coordinate axis away from Petrie's surveyed location to the correct position that aligns with the stone features of the apex plateau. Diagram K10 shows the close up of the axis center area with Petrie's surveyed point marked on, which is located within an inch of the correct geometric axis center point.

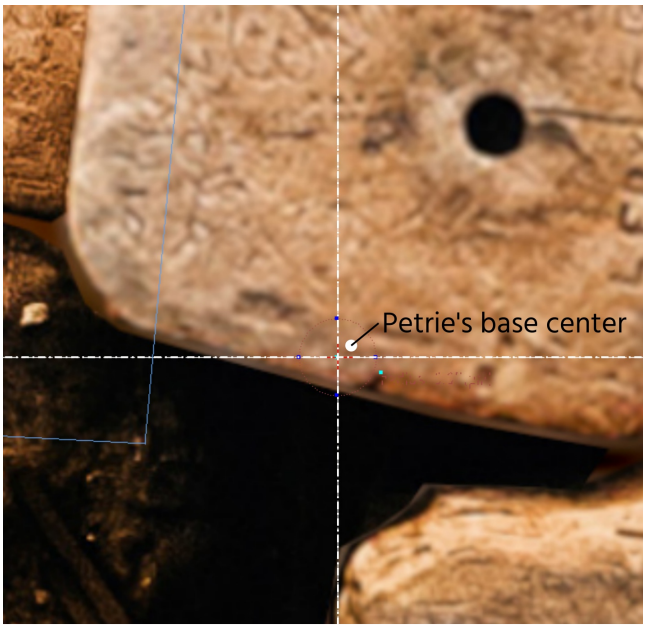

Diagram K10 - The base center and axis on the apex plateau

Step 4

The circular hole that is present in the polygon to the left of the granite key stone in diagram K9 needs to be geometrically located and 'drilled' into the polygon so that when the master stone's geometry is created from the granite stone attachment, the hole's location also appears on that stone.

The circular hole is set an an angle of 0.7 radians east of south around the axis center, has a radius of 0.7 (stk) and is at a distance of 3 and 1/3 cubits from the coordinate center as shown in diagram K11.

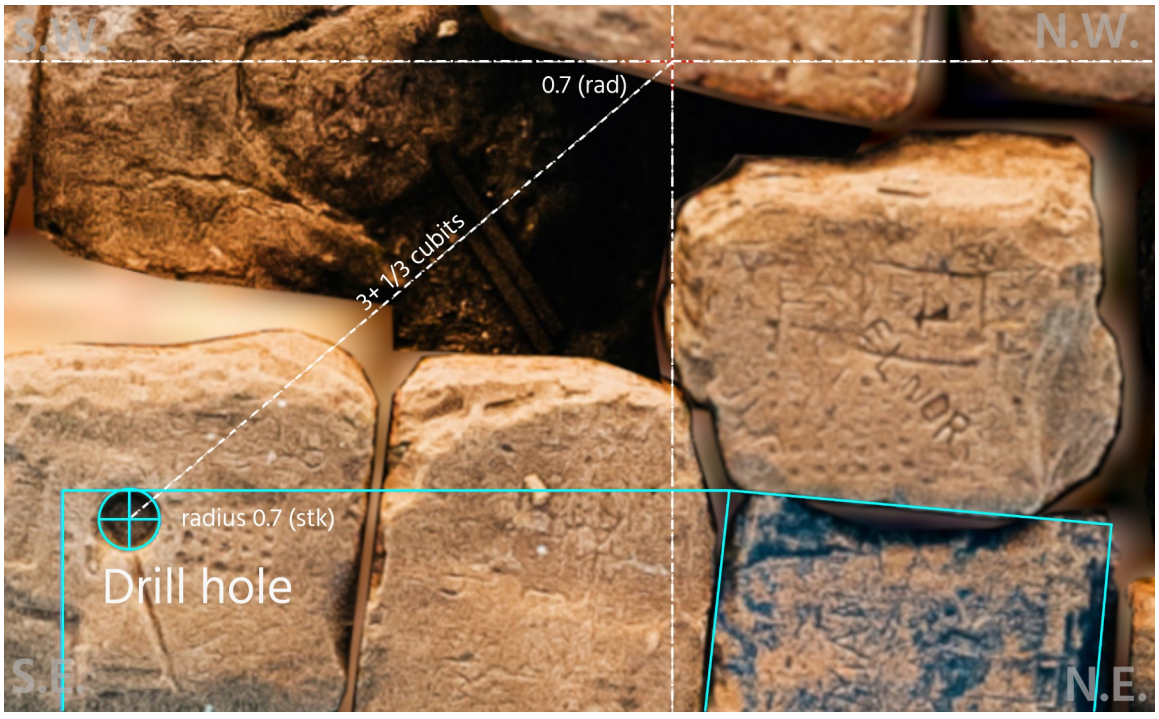

Diagram K11 - The circular hole location within the first polygon.

This circular hole can now be geometrically attached to the polygon.

Through analysis it is possible to determine how the master stone is positioned and the ingenious system ensures that the dimensions and angles of all parts of the geometry up to this stage need to be correct for the positioning to correctly match the stonework. The alignment mechanism is shown in diagram K12.

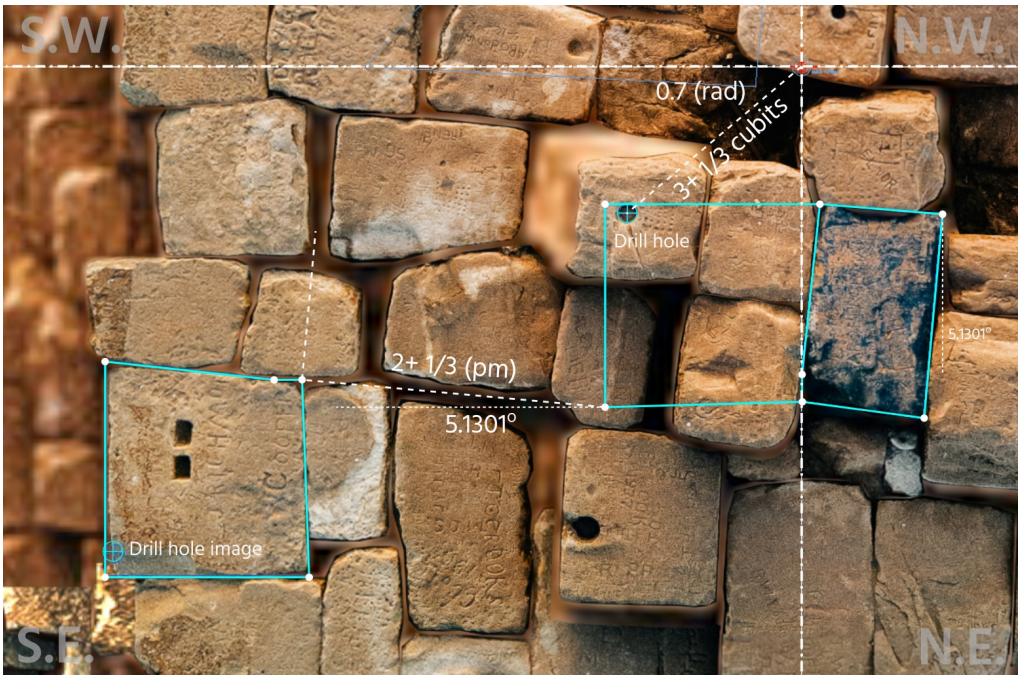

Diagram K12 - Placing the master stone's polygon

Aligning the image

Step 5

The geometric construction of the north south alignment mechanism that was identified on first inspection of the aerial image can now be determined from the previous geometry steps and is shown in diagram K13.

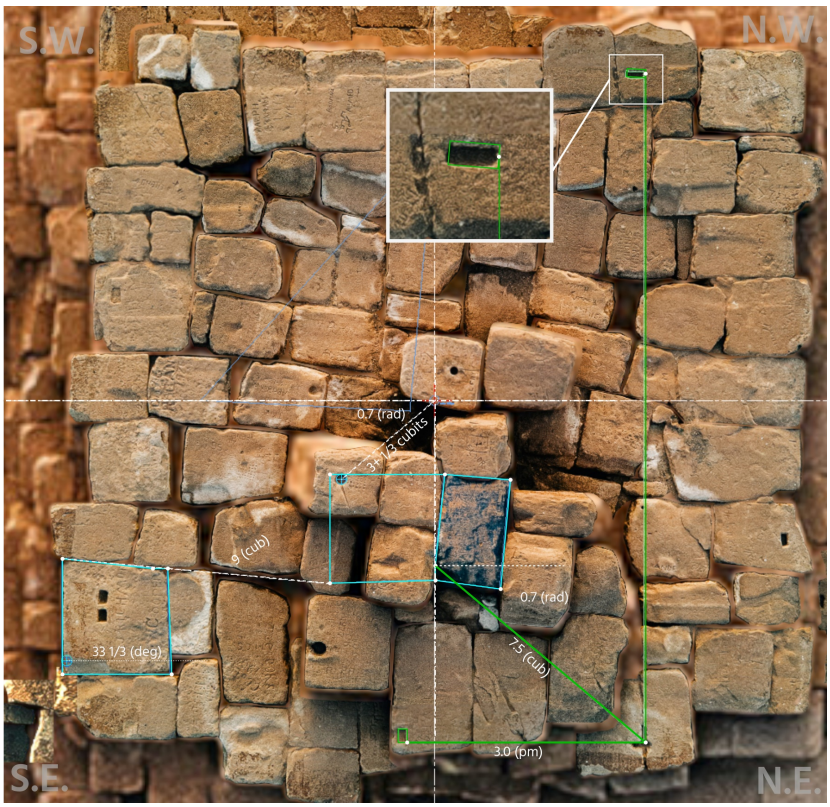

Diagram K13 - The geometry of the north-south alignment holes

The crossed hole used for the alignment is located 7.5 (cub) from the key stone's split edge point at the same angle as was seen in the previous geometry steps, 0.7 (rad) east of north. From this point there is a rectangular hole cut into the stonework 3.0 (pm) to the south which has its sides parallel to the cardinal axis and the line joins it at its north east corner. Another near-rectangular stone hole is to the west, the hole is rotated by an as yet unknown angle and the line joins this hole at the mid point of its north side, as shown in the inset image of diagram K13.

Defining the perimeter

It should be noted when reading through steps 5 and 6 that the geometric stone alignments are deliberately vague by design. They are all fully discarded once their purpose has been determined.

Step 5

In the south west corner of the apex plateau it is possible to superimpose a triple sized copy of the granite key stone, the north west corner of which is 6 cubits west of the center of the key stone's west face. The key stone is first reflected in the east-west axis and then rotated clockwise by 90 degrees and fits the stonework as shown in diagram K14. The points on the polygon that match the stonework are shown with the small white arrows, but it is clear that on the top right side the stone joint does not run east-west and therefore is not in line with the east-west running side of the polygon.

Diagram K14 - The triple sized key stone shape in the south west corner

The geometric shape needs to be rotated, and through accurate analysis it can be determined that the required angle is 0.02 (rad) in an anticlockwise direction with the center of rotation located 6 cubits from the polygon's north west corner on the mid point of the face of the granite key stone, diagram K15.

Diagram K15 - The rotation of the key-stone shape in the south west corner

The six points where the stonework and the geometric shape coincide are shown with the small white arrows. The purpose of this system is to define the rotation angle required for the next polygon which is shown in diagram K16.

Step 6

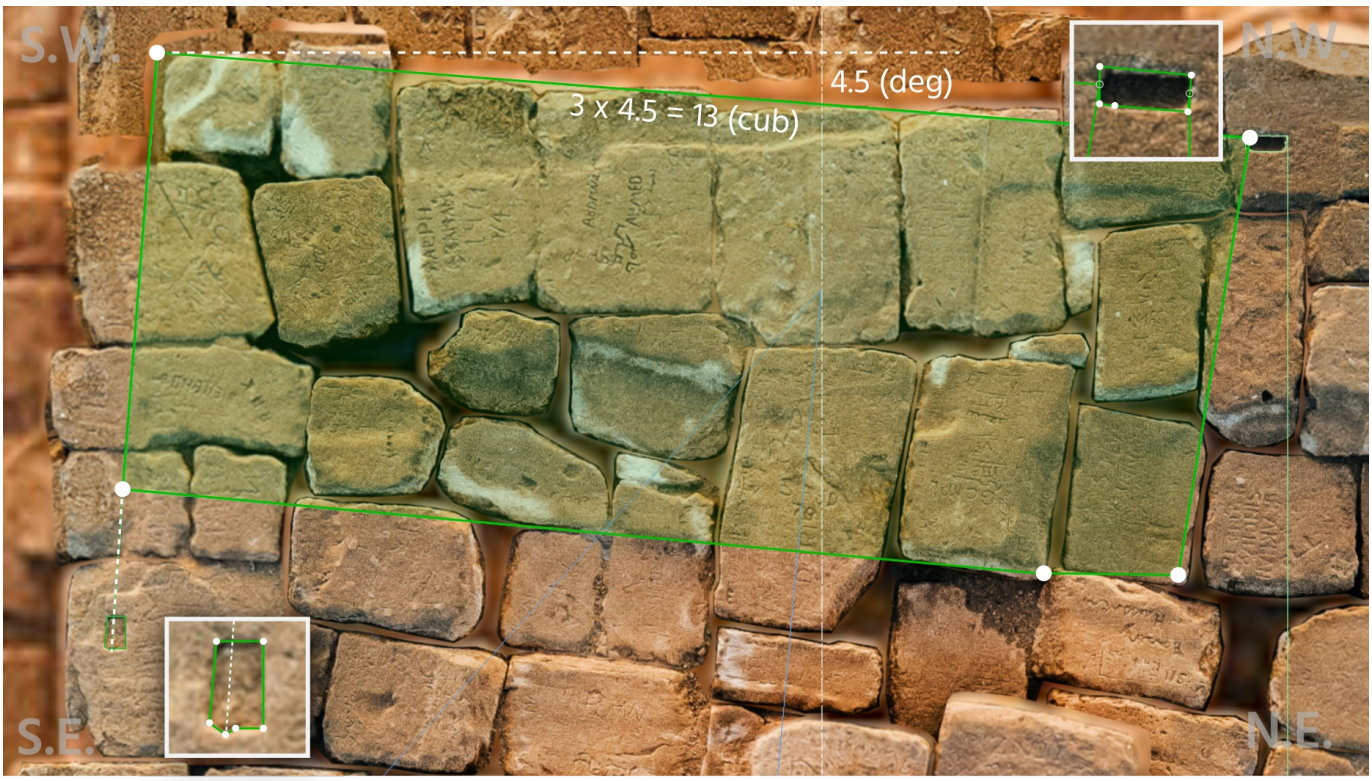

Diagram K16 - The elongated key-stone shape in the south west corner

On the apex plateau the rectangular holes that are cut into the stones are in the same proportions to the polygon that they are attached to, and so for the elongated rectangular hole at the top right side of diagram K16 the measurements of the hole can be taken and from this it can be deduced that the the polygon is another 3:1 scale copy of the key stone but which has been stretched by 1.5 times in the direction of its longest side making the long side 4.5 times that of the keystone. It has been rotated by a matching 4.5 degrees around its N.W. corner point.

The two inset images on diagram K16 show the cut holes and the infuriating nature of their design. The top right hole has the geometry of the polygon reflected in the east-west axis, and the geometry lines that attach to it do so on the mid points of the sides. The bottom left hole is curiously designed and has the extension line of the polygon's south side attached to the line end node at the bottom. These details are logical to explain once the design has been established but make the reverse engineering of the system particularly difficult.

With this polygon determined it is necessary to perform the same rotation upon it as was performed on the previous one in step 5, that is to rotate it by 0.02 (rad) in an anti clockwise direction which results in the alignments shown in diagram K17.

The purpose of this second polygon is to confirm that the first polygon is correct, because the alignments with the cut hole on the left side, shown in the inset image of diagrams K16 and K17 with its unusual shape, are so precise that even the smallest of errors in the creation of the geometry shows up on the hole's alignments.

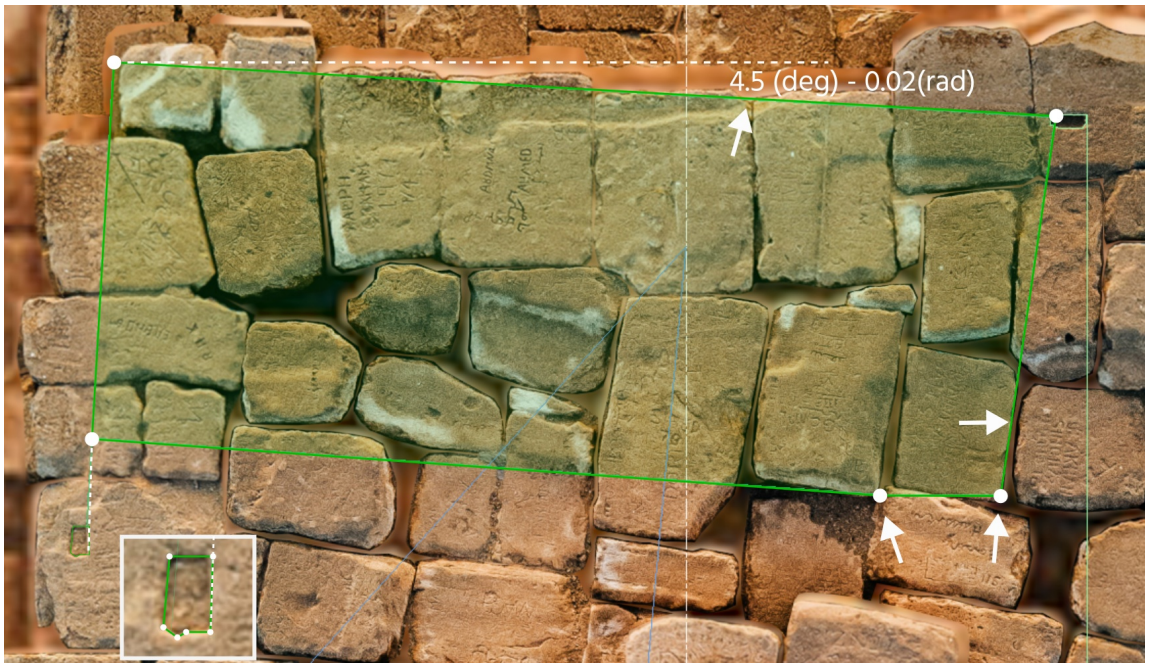

Diagram K17 - The elongated key-stone shape after a secondary rotation

Step 7

The purpose of steps 5 and 6 is to establish the south west corner point of the perimeter of the top layer of the pyramid, which can be found at the location of the S.W. corner of the polygon shown in diagram K16 at the exact coordinates of 10 (cub) west and 40 (stk) south of the axis center point.

By careful measurement and logic analysis it is possible to determine that there is a square with a side length of 9.83 (pm) that aligns with this corner point and with the northerly most rectangular stone cut hole, which is shown inset (B) in diagram K18.

Diagram K18 - The perimiter square of the apex plateau

The alignment on the stonework on the east side (A) at the bottom of the image marked with the small white arrow is precise and this stone can be seen to clearly have been cut and placed with its outer side aligned to due north and allows the square alignment to be determined.

The northerly alignment hole which is shown in the inset image (B) is not aligned to north, and therefore the yellow border square must require a secondary movement, because at this point the alignment is ambiguous and could align to either the mid point of the east or west of this hole. The answer to the adjustment that is required is held in the south east corner of the of the perimeter where there is an alignment mechanism carved into the stonework, shown in diagram K19.

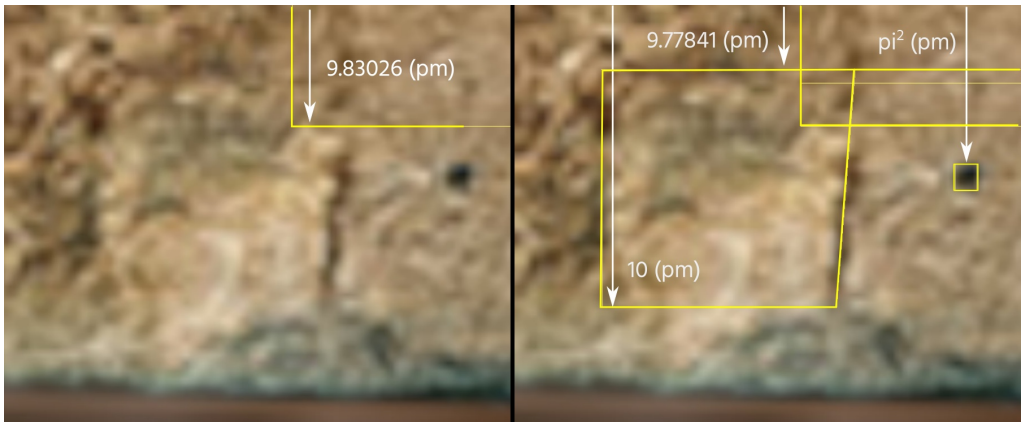

Diagram K19 - The alignment carving in the south east corner of the apex plateau

The size of the perimeter square is 9.83 (pm) and the the distance along the southern perimeter edge to the alignment shape intersection is 9.78 (pm). Additionally the value of pi squared, 9.8696 (pm) is marked by a small square hole in the stone, and the value of 10 (pm) by the lower line of the carving, which allows precision alignment to be acquired and from which it can be deduced that the perimeter squares sizes are the values of acceleration due to gravity at the Earth's pole and at the equator respectively. A second perimeter can be placed on the drawing to give two perimeter squares which share a common S.W. corner (the same system that is used in the subterranean shaft). Diagram K20 shows this arrangement.

Diagram K20 - The double perimiter squares

The inset image in diagram K20 shows the alignment of the perimeter squares to the angled rectangular hole with the inner square aligning to the top left corner and the outer square aligning to the midpoint of the top side of the hole.

Step 8

With the perimeter established is is possible to resize the CAD drawing and the connected image to the size of the gravity constants, which are known to several decimal places of precision, so that the outer perimeter square is exactly 9.83025763 (pm) in side length on the CAD drawing and in so doing *the initial sizing based on surveying measurements is eliminated from the drawing*.

Step 9

The northern rectangular stone hole that is shown in diagram K20 is the anchor point for another triple sized copy of the granite key stone, the geometric shape having been reflected in the east-west axis prior to being placed. This geometry establishes the principal of reflection that was used in the previous geometric shapes, it aligns to the stonework, and is shown in diagram K21.

Diagram K21 - The north side reflected triple key stone geometry

By far the most significant part of this construction is that the line nodes on the crooked side of the key stone shape align with the two perimeter lines and therefore the shape of the key stone must coincide with the gravity constant measurements that are contained within the perimeter squares. This geometric system defines the granite key stone's shape, and not the other way around. It is worth noting that the alignment hole of this all important piece of geometry is set into a stone on the 199th level, one below the apex plateau, and is butted up against the stones above so that it is no longer visible on low altitude images.

It is fortunate that the close up image being used in this analysis was taken with the drone at just the correct altitude to make part of the hole visible. Had the drone been a meter or two lower this crucial part of the geometry would have been hidden from view.

Steps 5-9 are concerned with defining the perimeter squares of the apex plateau and once the association with the acceleration due to gravity has been established and the perimeters drawn onto the CAD drawing, the green polygons can be hidden on the CAD drawing leaving just the initial geometry of the key stone and the perimeter as shown on diagram K22 which is a raw screen shot from the CAD programme.

Diagram K22 - The apex plateau geometry with the perimiter established.

At this stage the features that have been established with geometric precision are the key stone, the attached master stone template, the master stone and the outer and inner perimeter squares which show the numerical values of acceleration due to gravity at sea level at Earth's pole and at the equator.

It is upon this geometric framework that the rest of the puzzle is laid out and it should be noted that because the outer perimeter's dimensions are known scientifically through modern measurements of gravity there is effectively no error margin in the CAD drawing. More precisely, the error margin in the drawing is that of our ability to measure the acceleration due to gravity, and the CAD drawing is therefore an accurate facsimile of the architects design to at worst one ten thousandth of a millimeter.

The inner mechanisms

Step 10

The next stage in the geometric system is to define the two rectangular holes that are cut into the master stone and the architects have gone to considerable effort to incorporate as much confusion into this creation process as possible. It is only after following what appears to be the logical design and then encountering errors further down the line that it is possible to return to this section and determine the correct construction method.

The holes' north and south sides are located on the circumference of two circles and the initial step is to define the center point of those circles and a geometric reference line from which the radii appear to have been drawn. These features are shown in red in diagram K23.

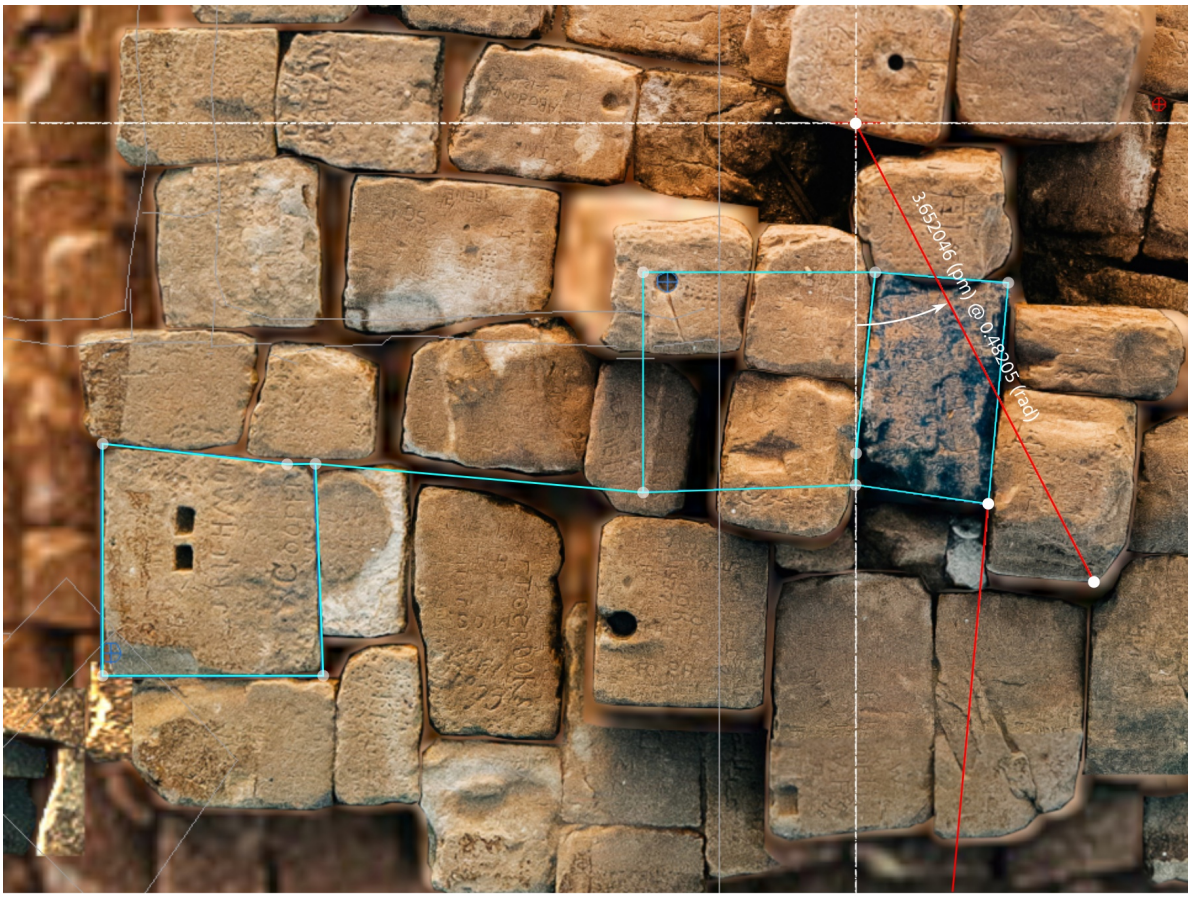

Diagram K23 - The apparent starting geometry for defining the master stone's rectangular holes.

From the geometric center of the pyramid the red line that passes over the key stone is set at an angle of 0.48205 (rad) north of east. This angle is derived directly from the latitude of the building that was determined in an earlier paper, and its value is the arc tangent of the latitude of the pyramid or atan(0.523214216) (deg). Note that this value is the *arc tangent of an angle*, given in radians, and with the result in degrees - as confusing a mix of systems as could be imagined. The length of the line is one hundredth of the instantaneous sidereal orbit period of the Earth at the winter equinox of 2729 BCE, a length of 3.652046 (pm). This value can only be determined once the full system has been finished and initially needs to be approximated using the value of a hundredth of the average year length, 3.6525 (pm).

This line terminates at the distinct NE corner of the tall stone to the right of the key stone.

The second red line on diagram K23 is a continuation of the north side of the key stone and is therefore set at 5.1301 (deg) south of east.

The two rectangular holes can now be constructed by using the termination point of the first red line as the center of a circle and the second red line as a perpendicular to the initial line of the construction as shown in diagram K24.

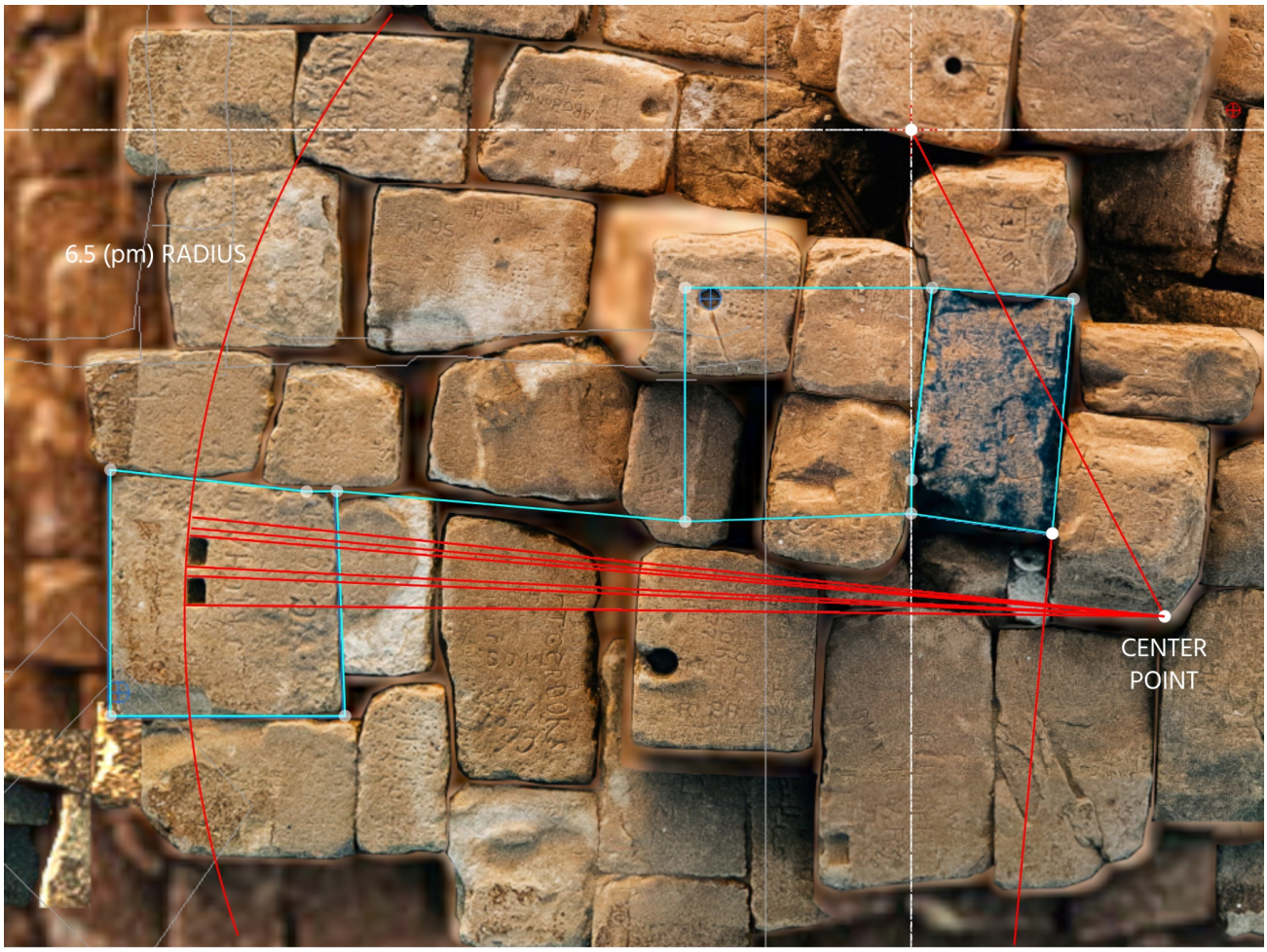

Diagram K24 - The incorrect geometry for the creation of the rectangular holes.

The lines have a length of 6.5 (pm), the fifth line from the bottom is perpendicular to the key stone's north side, and it appears that the rectangular holes' east and west sides are defined by the red lines which are to be created by making adjustments to their angles relative to the perpendicular line. This is not the case. There are two distinct systems interwoven which separate out as follows.

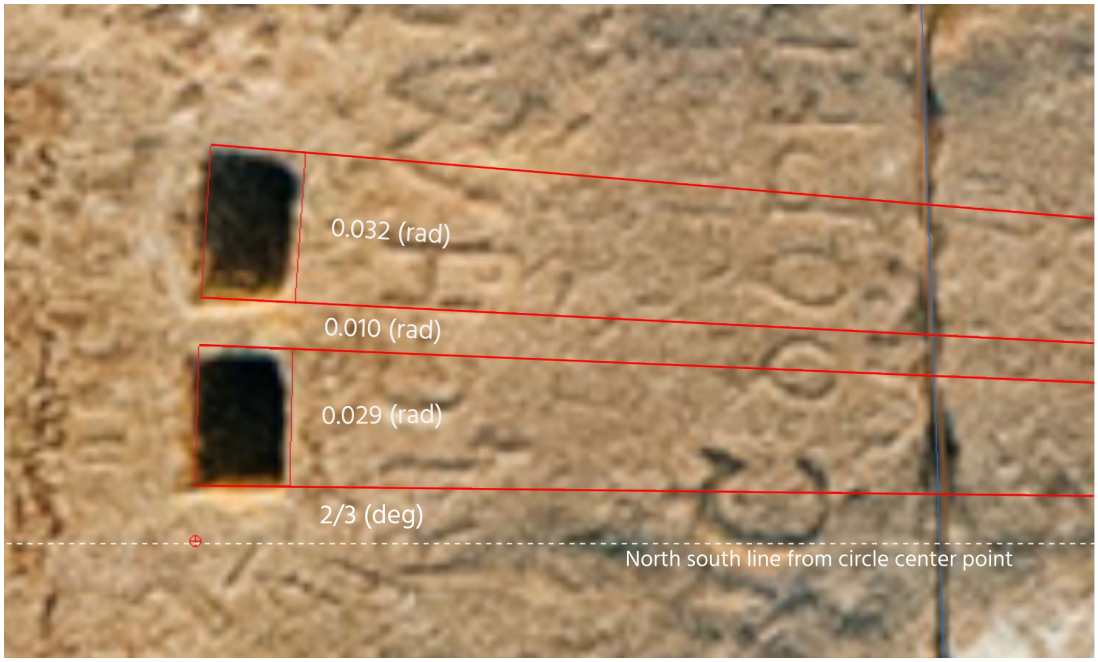

Diagram K25 - The correct creation geometry for the rectangular holes

The east side of the lower hole is set at 2/3 of a degree from the north-south line that passes through the circle center. The three remaining lines are designed in radians and are set at 29,10 and 32 hundredths of a radian greater angle than the previous line angle. The line that is perpendicular to the north side of the key stone is not used at all in the creation of these rectangular holes, however it is used to form a second system as shown in diagram K26.

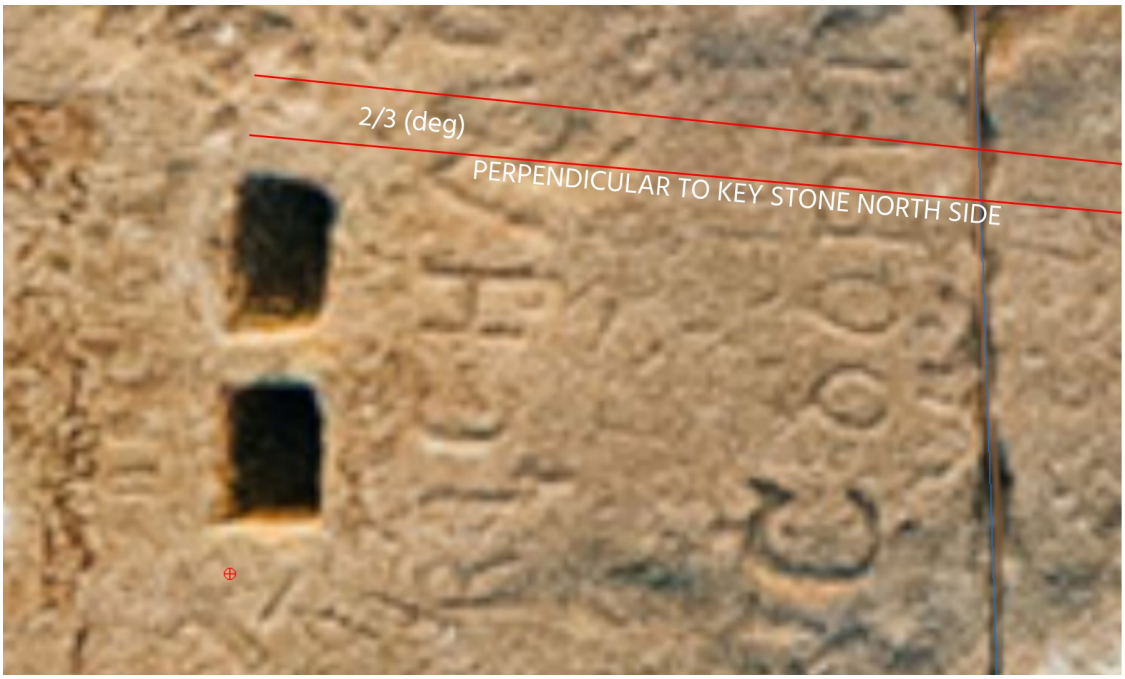

Diagram K26 - The unconnected but very similar geometry above the rectangular holes.

This secondary system is dependent upon the first system because the upper line is set at 2/3 of a degree from the perpendicular lower line, and therefore the system cannot be resolved without first resolving the rectangular holes' construction system in diagram K25, because the 2/3 (deg) value is taken directly from that system. This second system comes in to play towards the end of the overall design and will be referred to later in this paper.

The second circle that is used to define the north side of the rectangular holes is shown in diagram K27. Its radius is taken directly from the radius of the Earth at the location of the Great Pyramid 6371525.084 (pm) and at the altitude of the apex plateau on the 202nd level of stonework 198.8584 (pm), giving a total of 6371723.9422 (pm). This value is divided by one million to give the circle's radius.

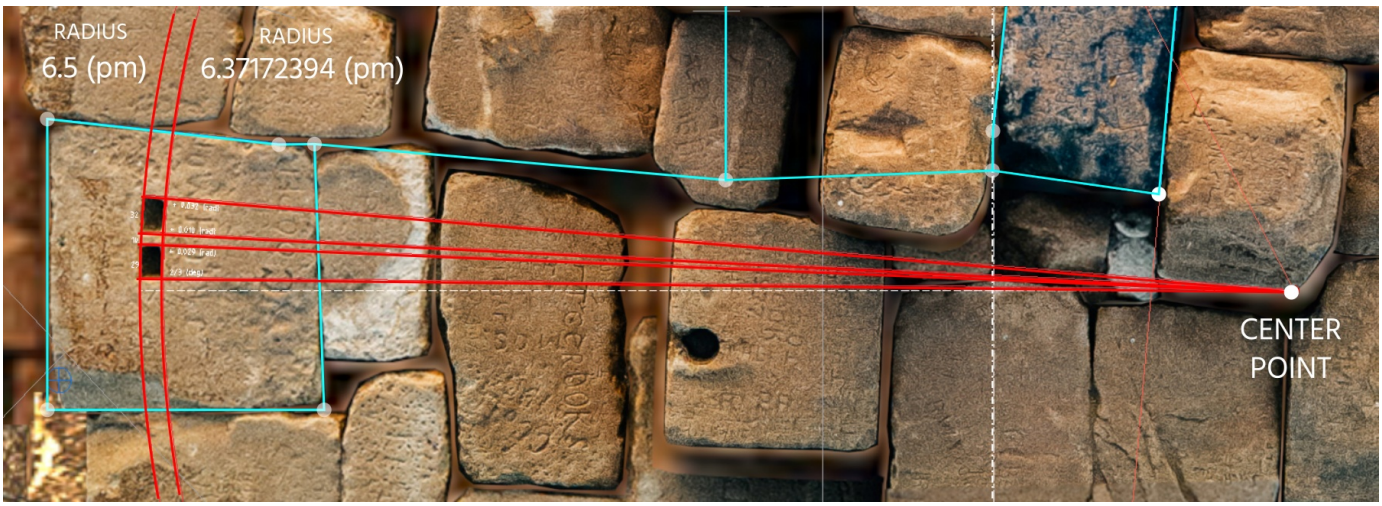

Diagram K27 - The Earth radius circle defining the north side of the rectangular holes.

Step 11

Having defined the rectangular holes the next stage is to understand how to use them, and once again this is presented in a manner that leads any analysis in the wrong direction whilst at the same time containing vital information. Diagram K28 shows the rectangular holes aligned with an 11 (pm) long line system that runs north to south across the apex plateau.

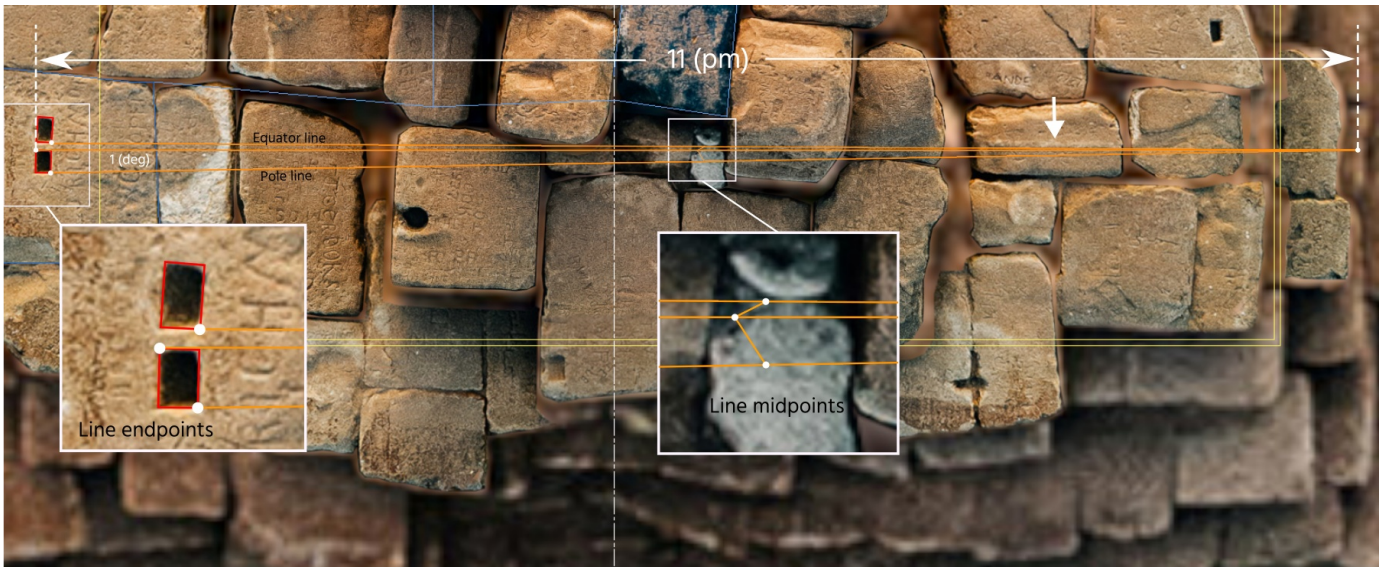

Diagram K28 - The geometry lines that diferentiate the rectangular holes end points

The lines are initially identifiable from the stone carving that is shown by the small white arrow. Subsequent analysis shows that there are three lines which are set at specific angles to each other. The central of the three lines runs due north-south and the lower of the three lines is set at an angle of 1 (deg) relative to the central line. The angle of the upper line has to be calculated, and through investigation it can be deduced that the three lines represent the values of gravity at the pole, at Giza and at the equator.

The difference between gravity at the pole and the value at Giza is represented by the one degree angle, and the difference between gravity at the equator and at Giza is represented by the remaining angle, allowing the upper line to be drawn.

Because the geometry is precise, when it comes to attaching these lines to the rectangular holes' corner points, the upper and lower lines attach to the north side of the holes, and the central line attaches to the south side of the eastern hole. The reason for the disparity in the end points can be determined when analysing the geometry in detail and realising that the lines and points will only match up correctly if the value of gravity at sea level is used at the pole and at the equator, and the value of gravity at the top of the pyramid is used for the Giza value, rather than the Giza sea level value.

What is being shown, and what is required as the next step, is to add the Giza gravity line value to the external perimeter gravity squares that were drawn earlier so that there is a third perimeter square placed in between the previously created ones.

It is the creation of this third perimeter square that leads the analysis deliberately in the wrong direction.

There are now three perimeter squares designed from the three lines in diagram K28 and therefore the logic suggests to try to create the remaining parts of the geometry using all three gravity values. In fact, the values at the pole and at the equator are no longer required and only the Giza gravity line needs to be drawn onto the geometry system, and the previously drawn lines representing gravity at the pole and at the equator need to be removed. Diagram K29 shows this step of the geometry.

Diagram K29 - The addition of the Giza gravity perimiter and the removal of the previously drawn lines.

Step 12

The next step in the geometric construction is the principal part of the geometry and although it can be drawn onto the CAD drawing, it was not possible to resolve the precision of the geometry using a drawing based analysis. The system, which is shown in the next section 'step 13' involves refining two variables until the the point is reached where there is no error within the system, making numerical analysis essential.

To this end, the geometry shown up to this stage was calculated on a spreadsheet and subsequent geometric steps drawn out on the CAD drawing using linear algebra solutions from within the spreadsheet.

The final spreadsheet is published as a supplementary piece of material along with this paper, along with the CAD drawing and both documents are colour coded throughout so that the geometric features can easily be identified and matched up on both documents.

Step 13

The geometric construction in step 13 is complex and took hunderds of hours to resolve.

The principal part of the apex plateau's geometry is shown in its entirety in diagram K30. Because many parts of the system are co-dependent it is not possible to separate out them into separate illustrations, and so the diagram is substantially more complex than those that have proceeded it.

The reverse engineering of this section of the system took a large amount of time, running into hundreds of hours, due not only to its complexity and the forward references that appear in it but also because of the volume of decoy information that is deliberately placed on the stonework of the apex plateau that needs to be ignored. Deciding which parts of the system are required and which need to be rejected can only be done by adding all the parts to the system, and then when the solution is found, backtracking through the geometry and removing the superfluous entries. This is exactly the same process that was required with the perimeter lines shown in diagram K29 where the outer and inner lines can only be removed at the end when the system is fully understood.

The 'mechanics' of the system are sublime, and require making forward references to lines that have yet to be created, and creating the geometric drill holes that appear in the stonework that create circular references in the mathematics which need to be logically resolved.

Diagram K30 - The principal geometry at the heart of the apex plateau's design.

The drawing is comprised of the following features

A. Giza perimeter gravity line
B. Master-stone image
C. Master-stone image first anchor line
D. Master-stone image second anchor line
E. Drill hole x-coordinate definition
F. Upper gravity line
G. Lower gravity line
H. Escape velocity acceleration line

At the outset of solving this system, from the items listed above, only half of them are defined and either have specific numerical values or defined geometric relationships as follows

C. Length 3.652046 (pm) at an angle of atan(0.523214216) as defined in diagram K29
D. A line which is the extension of the western cut hole image's east side
E. X coordinate of -pi (cub)
G. 1 (deg) less than the angle of line F

All other values in the system are undefined and can be determined by understanding how the geometry works and then by adjusting the value of the acceleration due to gravity within the spreadsheet with reference to a balance point within the system. The logic is as follows.

The perimeter line, A, is drawn at a distance from the fixed SW corner of the perimeter which is equal to the value of acceleration due to gravity at the top of the pyramid.

Lines F and G are offset by exactly 1 (deg) from each other. Line F, the upper line, is drawn from a point on the perimeter that has the same y coordinate as the center of the key stone and which also passes through the drill hole on the left of the illustration.

The drill hole is set at pi cubits to the south of the coordinate axis center point and is located on the line extension of the east face of the rectangular hole in the image of the master stone, B.

The master stone image's east side is aligned with the perimeter, and the master stone image's SW corner defines the constant in line G. This means that the master stone image has one point which is fixed, at the end of line C, and the other points and lines are dependent upon the value of gravity.

Line G is defined as being fixed to the SW corner of the master stone image and is offset from line F by one degree. Therefore there is a point at which lines F and G meet up. This is shown in the inset image and corresponds to the hole that is cut into the stonework at that point.

The portion of line F that is to the north of this point, marked as H on the diagram, represents an acceleration in the opposite direction to gravity and is the acceleration required to be applied to an object at rest on the top of the pyramid that would result in that object reaching the escape velocity of the Earth calculated at that location in precisely 20,000 seconds. The value of H is dependent upon the acceleration due to gravity at the top of the pyramid and the radius of this location relative to the center of the Earth.

This sublime system only has two input variables. The acceleration due to gravity at the top of the pyramid (which defines the perimeter and master stone image location), and the instantaneous sidereal orbit period of the Earth at the moment of the 2729 BCE winter solstice (which defines the length of line C). It can be calibrated by adjusting these two values so that the intersection of lines F and G occurs at the point that correctly enumerates the value of the escape velocity acceleration, H.

Because the instantaneous sidereal orbit period has not yet been given in the architecture, the only way of logically balancing the system at this stage is to input the modern value of gravity derived from the International Gravity Formula and then balance the system by adjusting the sidereal orbit period.

When this is done it gives a value for the instantaneous sidereal orbit period of 365.2046 days or 31553677.493 seconds, which corresponds to the value given in NASA's DE441 ephemeris data at 21:58:13.64 on Jan 13th 2729 BCE. The time of the winter solstice in the same ephemeris data is given as 17:29:25.64 on Jan 14th 2729 BCE and so the value is within a 20 hour window of 'where it should be'.

The purpose of trying to solve the geometry puzzle on the top of the Great Pyramid was not to determine this piece of information, but was to determine the location of the pyramid on the reference ellipsoid. However, what the architect's have done is to place this piece of information within the geometry puzzle so that if you solve the pyramid location puzzle you must have also extracted this piece of data. The numerical value of the sidereal orbit period is needed in a future section of the work which will be covered in a subsequent paper and by hiding its value at the top of the Great Pyramid the architects are ensuring that the overall system is being solved in a linear manner.

Step 14

Because of the way in which the drill hole is defined in diagram K30, it is possible to rotate the master stone image around the drill hole so that the east side of the western rectangular hole aligns perfectly

with the upper gravity line F in the diagram. This rotation and the alignment is shown in diagram K31. The angle of the rotation can be mathematically determined from the line equations in the spreadsheet of line F and the east side line of the west rectangular hole, and is 0.273233 (rad) or 15.9988 (deg).

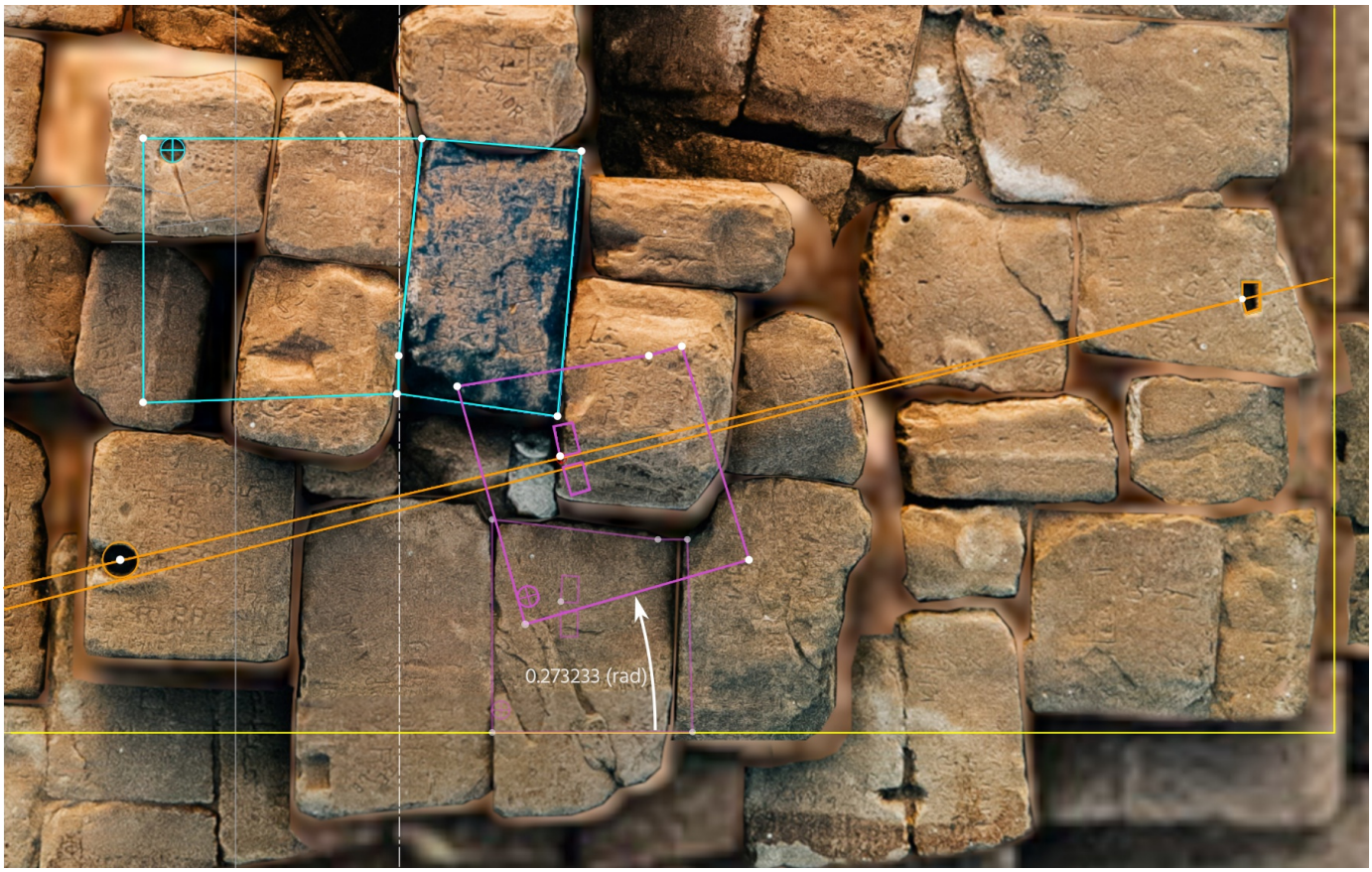

Diagram K31 - The first rotation of the master stone's image.

Step 15

The underground chamber and passages now comes into play, and in particular the unfinished passage that is located in the west wall of the underground chamber can be defined directly from the geometry of the apex plateau, as shown in diagram K32.

The unfinished passage runs across the underground chamber from west to east, and the eastern end's geometry is defined from the apex plateau geometry as shown in the inset image. Starting from the fixed drill hole a line is constructed at 45^{o} east of south for a length of pi/2 perfect meters so that the southern side of the unfinished passage is defined. This gives the x-coordinate of the passage as being the addition of the x-coordinate of the drill hole, pi (cubits), plus the x offset from the drill hole of the construction line's end point, pi/sqrt(8) (pm).

The south eastern side of the passage geometry is pi (pm) in length running from the perimeter line of the apex plateau geometry in an easterly direction. The width of the unfinished passage in a north-south direction is 6+2/3 (stk), and the diagonal line that runs from the south east corner to the north west corner is 14.5 (pm) in length. This allows for three of the four corners of the unfinished passage to be perfectly defined with only the south west corner being unknown.

The diagonal line's angle is used in the creation of the stonework on the apex plateau and, as can be seen in diagram K32 where the two tall stones with the drill holes located within them are both aligned on their southern sides to the diagonal line's angle when drawn from the north east corner of the unfinished shaft, which is now no longer unfinished as it has been defined from the apex plateau geometry.

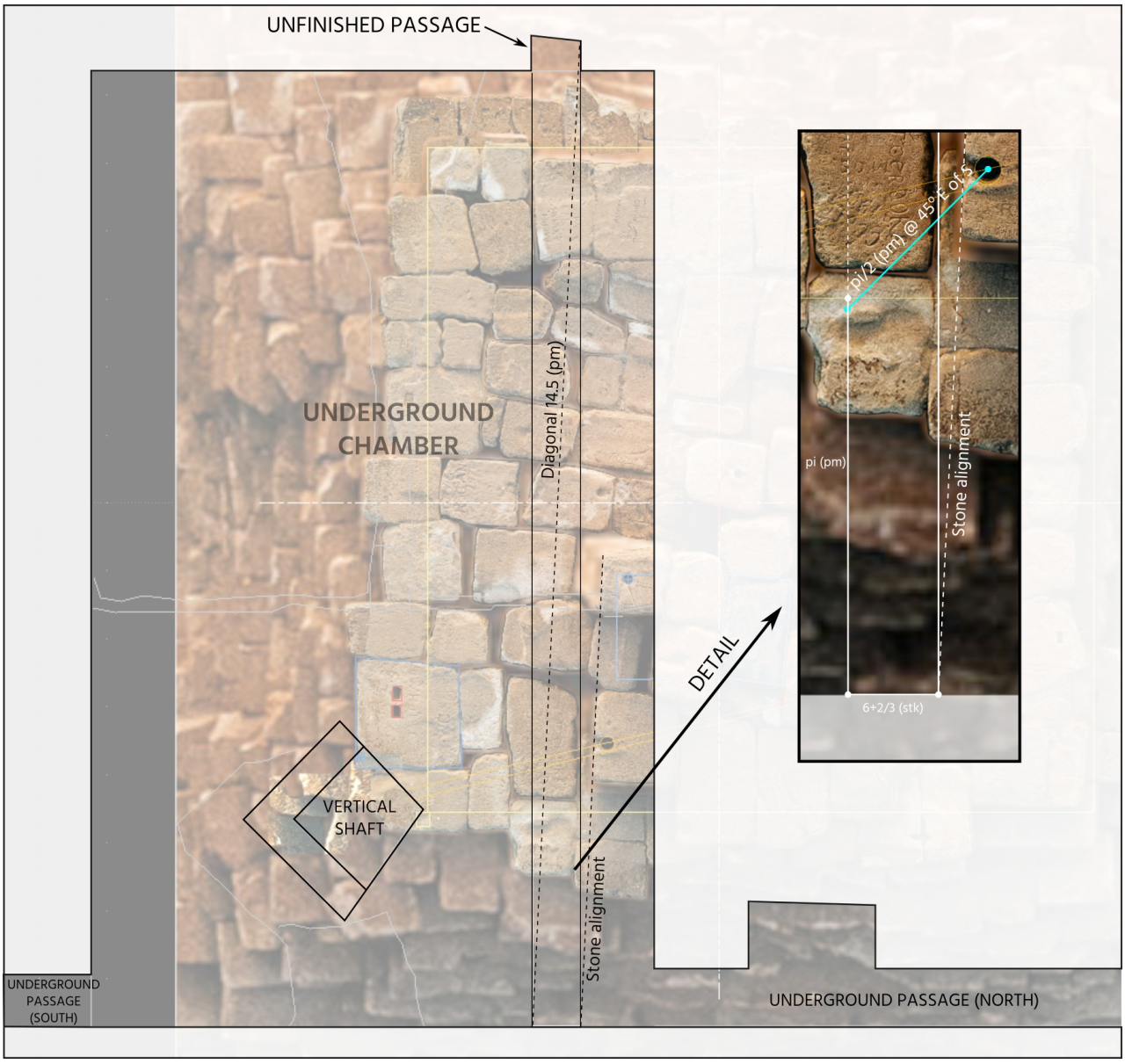

Diagram K32 - Defining the unfinished passage of the underground chamber.

Step 16

On diagram K32 the vertical shaft which is located in the underground chamber is marked and the penultimate part of the geometric construction is to apply a second rotation to the master stone image shown in diagram K31 so that it rotates into position and aligns with the vertical shaft.

To make the final rotation, the center point of the rotation needs to be determined, and through analysis it was determined that this rotation point is situated on the north side of the underground 'unfinished' passage geometry at the point where it intersects with the unused upper line that was shown in diagram K26. Both of these geometric lines are particularly difficult to find. The underground passage line also uses all three of the architect's measurement units, perfect meters, cubits and stack constants, in the line's definition.

The reason that they can be identified as being the correct formation geometry is that the final rotation, which is applied in the next step, is so perfectly logical and conforms exactly to the surveyed measurements of the pyramid, that it is possible to accurately determine the rotation point through analysis and then investigate which lines within the geometry would provide a solution that coincides with the analysed location of the rotation point.

The final rotation point and associated geometry is shown in diagram K33.

Diagram K33 - The final rotation point location.

The 'unfinished' passage of the underground chamber is shown as a white opaque rectangle and the rotation point, on its northern side, is marked with the yellow circle. The formation geometry of the red lines has been explained earlier - the north side of the key stone and the dotted red line running below the rotation point are perpendicular to each other and the upper red line is angled at 2/3 of a degree relative to the dotted line below it on the diagram. Because all of the lines are defined within the geometry, the rotation point also has a mathematical definition.

Step 17

The master stone image that is shown in diagram K31 rotated onto the orange gravity lines can now have a second rotation applied to it around the rotation point that is shown in diagram K33.

The rotation required to align the master stone image to the vertical shaft is 3.652046, that being the instantaneous sidereal orbit period of the Earth at the 2729 BCE winter solstice divided by 100 to give the angle in radians. This rotation is applied in an anticlockwise direction as shown in diagram K34.

As can be seen in the diagram, the rotated master image's SW side aligns with the vertical shaft hole's side in orientation and contains a small half inch surveying error in its position. The S.W. side angle is very close to but not quite 45^{o} and this is exactly as was reported by Petrie in his surveying where he states that the shaft is not quite set at 45^{o}.

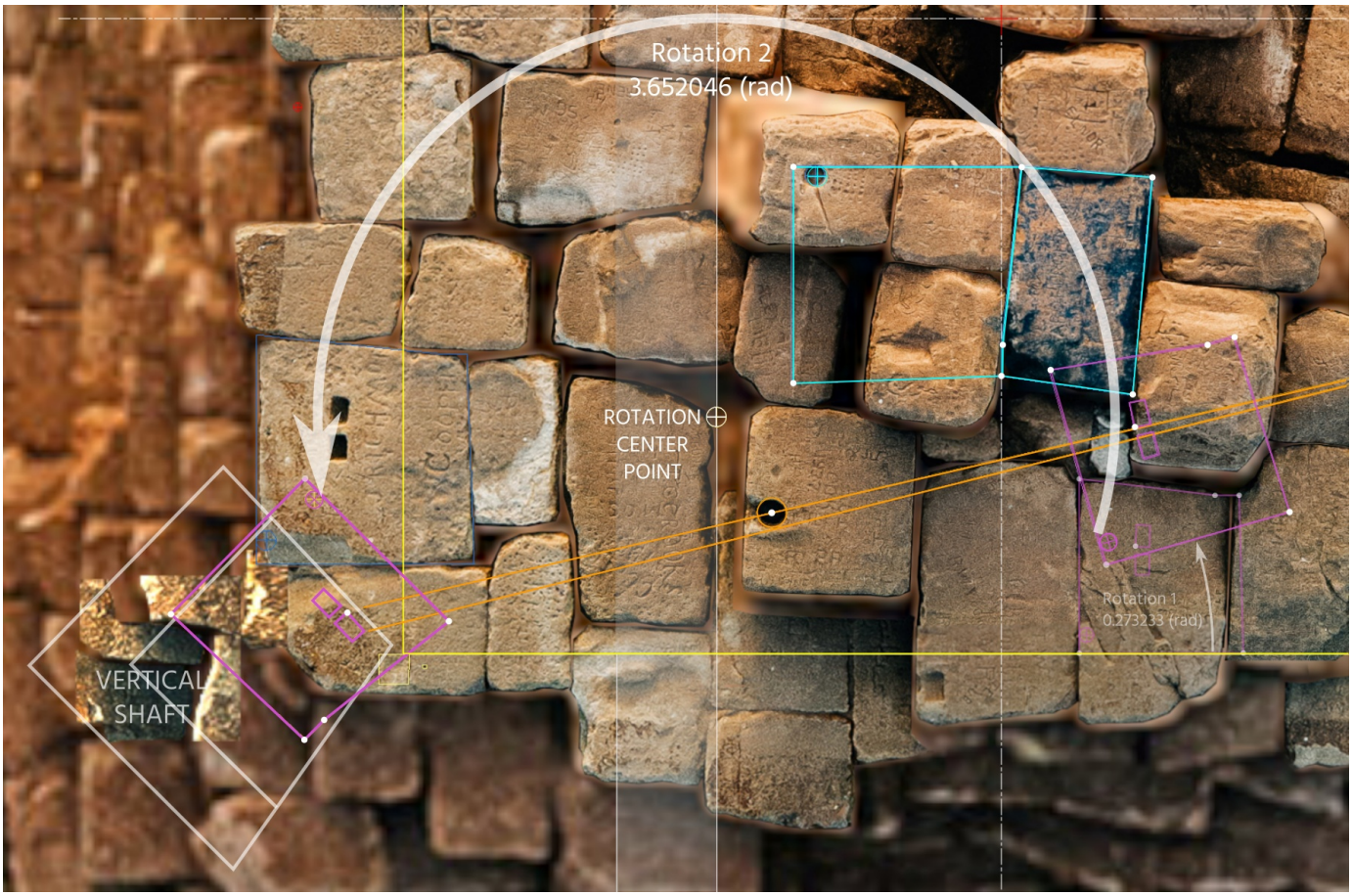

Diagram K34 - The second rotation of the master stone image.

Step 18

If you look at the formation of the NE side of the master stone image you can see that the angle at which it is set is the opposite of the angle at which the vertical shaft has been cut in the underground chamber. The final check that is written into the geometry is that a reflection is required to the master stone image so that the image slots into the vertical shaft hole.

The reflection of the rotated image is shown in diagram K35.

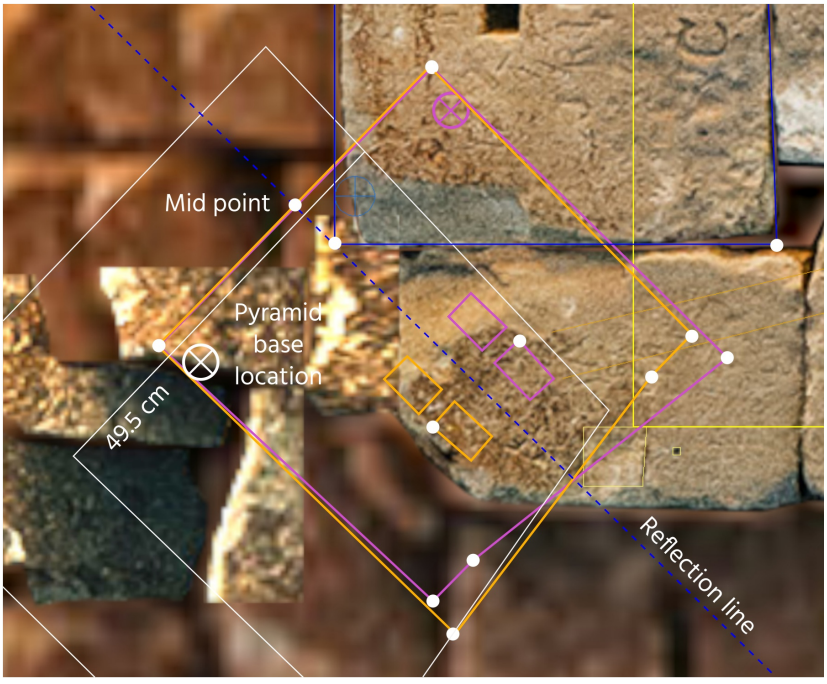

Diagram K35 - The reflection of the master stone image.

The line of reflection is perpendicular to the SW side of the rotated master stone image and passes through that side's center point and also through the SE corner of the master stone. Only if you have all of the geometry up to this point correct will the reflection line pass through both of these points, and this reflection is designed to indicate that the geometric system has been correctly solved.

The drill hole that was first identified in Step 4 and shown in diagram K11 has been transported around the apex plateau of the Great Pyramid using the geometric system and its final resting place indicates the base location of the building where it attaches to the reference ellipsoid. This drill hole is shown in diagram K35 by the white circle and is labeled 'Pyramid base location'. As can be seen, it is not located on the 202nd level of stones and further analysis of the aerial images was required to determine on which level it is positioned. The stonework analysis is shown in diagram K36.

Diagram K36 - The location of the base point hole at the top of the pyramid.

The inset image shows the aerial view of the apex of the pyramid with coloured dots indicating points which could also be identified on the main image, which is taken from a high resolution drone image of the SE corner of the apex. The location of the base point is on the 196th level of the pyramid and it is clear from looking at the manner in which the stonework has been created that the architecture is once again designed so casual inspection of the aerial image will result in an incorrect determination of the level at which the base point is located, because level 197 under-hangs level 198 on the SE corner.

The elevation of level 196 is set at 10 pi stack constants below level 202, and this is to allow for an adjustment to the length of the sidereal year to be incorporated into the design. At present, the geometric system is being solved by using a modern day value of gravity and using this to output the sidereal year

value which is used throughout the geometry.

What is required to solve the puzzle using only data from the architects is the exact value of the sidereal year, at which point it will then be possible to return to this geometric puzzle and cross check the sidereal year value against the gravity value on the 196th level to check the the former has been correctly determined. The sidereal year value is contained in another system located in the desert some 1400 km to the west of Giza, and is covered comprehensively in a future paper. For now, the apex puzzle can be finished knowing that it has been solved to the best precision possible at this stage and that the base point's latitude and longitude will have been determined to sub-millimeter accuracy and sufficiently to conclude this section of the work.

Step 19

There is one final part to the apex plateau puzzle. If you look back at diagram K3 you will notice that the rectangular hole marked as number 15 has not been used anywhere in the geometric system. Because all of the systems encountered so far throughout the pyramid are perfect, this rectangle cannot be ignored and must relate to the solution just determined.

Diagram K37 shows the final piece of geometry which closes off the system and which is a deliberate drawing of a flag, inserted into the base location drill hole, and which aligns with the unused rectangular cut hole and the initial Pythagorean triangle which was used at the outset of the puzzle, bringing the system back to where it started from, by design.

Diagram K37 - The geometric flag at the top of the pyramid.

The flag pole, the yellow line on the left of the diagram, starts at the drill hole, passes through the southern apex of the Pythagorean triangle and then aligns with the rectangular cut hole. The flag itself is a 3:1 scale model of the key stone and the line join point on the irregular side of the flag is coincidental with the irregular side of the key stone.

The 2018 latitude of the undeground anchor point of the Great Pyramid

The primary purpose of solving the geometry puzzle was to determine the GPS coordinates of the base point of the pyramid where it attaches to the reference ellipsoid, and this can be now done by determining the location of the flag post drill hole in relation to the GPS survey location that was taken by the Glen Dash team on the 26th February 2018 and which is shown on the first page of this paper.

The distance from the survey point to the pyramid's base point flag post hole is 7.8065134 (m) at an azimuth of -55.81228198 (deg). Placing the surveyed location's GPS coordinates into a geodesic calculation programme, along with the bearing and distance between the two points gives the location of the base point of the pyramid as

Underground anchor point of the Great Pyramid

Latitude	29.97912720879841	(deg)	0.523234476668	(rad)
Longitude	31.13424935890672	(deg)	0.543395161450	(rad)
Date of measurement	26-02-2018 07:30:00	UTC	2458175.8125	JDUT

For the accuracy of this location to be of any use the tectonic plate movement of the Giza plateau needs to be determined so that any surveying locations on the plateau that were determined at a different time can be correctly adjusted to this base datum.

The tectonic plate movement in latitude of the Great Pyramid

From the internal architecture of the building in which the original latitude of the base point was given[4], and knowing that the pyramid is built to represent the 2729 BCE winter solstice astronomy which is dated on the NASA DE441 ephemeris as having occurred at the Julian Day time of 724669.228769 (JD), the tectonic plate movement of the North African plate on which the Giza plateau is located can be calculate with precision.

Date of GPS measurement	2458175.812500	JDUT
Date of 2729 BCE winter solstice	724669.228769	JDUT
Date difference	1733506.583731	JDUT
Original latitude of the pyramid	0.523223725572	(rad)
2018 latitude of the pyramid	0.523234476668	(rad)
Latitude difference (north)	0.000010751096	(rad)
Tectonic plate movement in latitude	$6.20193548782 \times 10^{-12}$	(rad/JD)
	$3.55344728265 \times 10^{-10}$	(deg/JD)
	1.4387455	(cm/year)

The design logic

The reason for the base point of the pyramid being at the bottom of the vertical shaft, and therefore completely inaccessible, and the geometric puzzle to locate this point being on the apex plateau of the building can be understood by considering the tectonic plate movement problem. In order for the

architects of the pyramid to be able to specify the base location at the precise moment of the 2729 BCE winter solstice, having started the construction of the building at an unknown date numerous years before, the positioning of the base point needs to have been performed as the very last part of the pyramid's construction. The exact latitude of the building is pre-determined in the architecture, but the tectonic plate movement is not necessarily regular for any given year, and therefore the calculations and design of the apex plateau puzzle need to have been determined from an exact latitude reading at the moment of the winter solstice in 2729 BCE and then built onto the apex after this time.

From this logic it can be concluded that the duration of the building project was significant and that the selection of the 2729 BCE winter solstice was pre-determined before any of the building work was started. The whole system was designed in advance and the detailed precision added at the end of the work.

The 2018 GPS location of the base center of the Great Pyramid

The base center of the pyramid at the level of the pavement, 60.39 (m) above sea level, is located 7.2392955 (m) from the vertical shaft's connection point with the reference ellipsoid at an azimuth of -36.71696864 (deg). These values can be used within a geodesic calculator along with the location of the base point calculated above to give the base center point of the Great Pyramid as

Latitude	29.979179557901	(deg)	0.523235390332	(rad)
Longitude	31.134204511078	(deg)	0.543394378708	(rad)
Date of measurement	26-02-2018 07:30:00	UTC	2458175.8125	JDUT

Diagram K38 shows the relationship between the base point at the bottom of the vertical underground shaft and the base center of the pyramid at pavement level with the North direction adjusted so that it is located at the top of the diagram and conforms with the illustrations in the previous and future papers in this series.

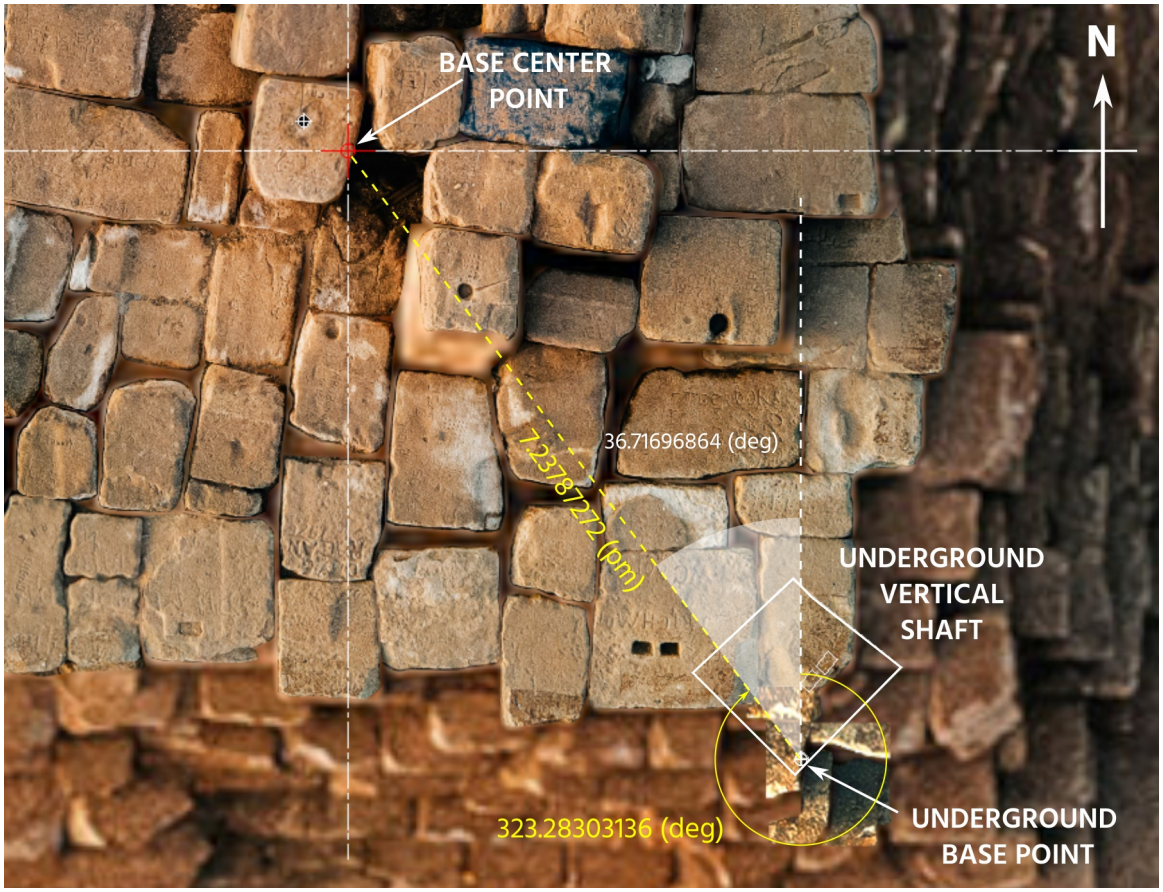

Diagram K38 - The relationship between the underground base point and the pavement level base center point.

Surveying cross-check problems

It would be useful to compare the latitude and longitude just calculated against previous surveying measurements. Before doing so it is necessary to cross check the surveying measurements of the Glen Dash team, and by implication the GPMP survey. The 2018 GPS location of Station E1 was shown in the first section of this paper, and the 2015 Glen Dash survey of the base of the pyramid is also available online[6] as a Google Earth kmz file, in which the base center point of the Great Pyramid is specified.

The two pieces of data are as follows

2018 apex GPS location		
Latitude	29.9791667806	(deg)
Longitude	31.1341824444	(deg)
2015 base center location		
Latitude	29.979177	(deg)
Longitude	31.134201	(deg)

These two locations can be placed into a geodesic calculator, the distance and bearing between the two points calculated as 2.1189764 (m) at an azimuth of 57.68202 (deg) and the result plotted onto the apex plateau, as shown in diagram K39.

Diagram K39 - The Geln Dash survey point comparison.

The calculation was cross checked on two independent geodesic calculators to ensure they were in agreement, which they were, because the Glen Dash 2015 survey point for the base of the pyramid is nowhere near the axis coordinates of the apex plateau, which are known to be very close indeed to Petrie's documented base center coordinates as shown in diagram K4 of this paper. The 2015 Glen dash survey point has an error of 28 cm in latitude and 34 cm in longitude.

The reason for this is that their 2015 survey is based on an old location of the GPMP survey disk at station E1 which was part of the Survey of Egypt system and was quantified on the Helmert reference ellipsoid[7] and is a surveying measurement from about 100 years ago. This value has been transposed into modern WGS84 coordinates by the GPMP team but the errors in the surveying from the early 1900's is still inherent in the value as is the tectonic plate movement between when the point was first surveyed and when it was being used. The GPMP and Glen Dash surveys and all of their published latitude and longitudes prior to 2018 contain this error, which is why they sensibly use the GPMP survey grid as their reference datum which is a fixed, meter based, local reference system and independent of latitude and longitude values.

As a consequence of these errors it is impossible to compare the latitude and longitude of the Great Pyramid calculated in this paper to any previously published values.

The survey of Flinders Petrie was documented entirely on a local fixed surveying grid, he states that the apex staff was included in his triangulation measurements, and it can be concluded that his base center point location in relation to the apex plateau drill hole is correct. The Glen Dash 2018 GPS survey point needs to be considered as a definitive GPS location and the values of the 2015 Glen Dash survey translated onto this new datum accordingly. The transposition is as follows

Great Pyramid base center point

2015 survey latitude	29.979177	(deg)
2018 GPS calculation	29.979179557901	(deg)
Latitude transposition	+0.000002557901	(deg)
2015 survey longitude	31.134201	(deg)
2018 GPS calculation	31.134204511078	(deg)
Longitude transposition	+0.000003511078	

The 2018 coordinates of the Great Pyramid, transposed from the 2015 survey, are therefore

	Latitude	Longitude
Base center	29.97917955	31.13420451
S.W. Casing corner	29.97813955	31.13301251
N.W. Casing corner	29.98021855	31.13300951
N.E. Casing corner	29.98021955	31.13539551
S.E. Casing corner	29.97814155	31.13539951
Date of measurement	26-02-2018 07:30:00	UTC
	2458175.8125	JDUT

There is no tectonic plate movement to take into account because it is already included in the transposition values in both latitude and longitude.

Supplementary material

CAD Drawing

Because the underground chambers, passages and shafts are now fully resolved, as is the apex of the pyramid and thereby the levels of stonework of the pyramid, the CAD drawing of the Great Pyramid can be considered as being complete in so far as the internal structure of the building is currently known in December of 2022. It is available to download in two file formats

DXF file format for open source CAD programmes
https://www.giza%2Dpyramids.com/images/dxf/Great_pyramid_V22_12.dxf

DWG format for AutoCAD
*https://www.giza%2Dpyramids.com/images/dwg/Great_pyramid_V22_12(autocad2010).dw*g
*https://www.giza%2Dpyramids.com/images/dwg/Great_pyramid_V22_12(autocad2018).dw*g

Spreadsheet

The spreadsheet containing the mathematical solution to the apex plateau puzzle is available to download in open source file format, which will open on all operating systems, from the following location

ODS spreadsheet format
https://www.giza%2Dpyramids.com/documents/spreadsheet/Apex_great_pyramid_puzzle.ods

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