The Great Pyramid, the Earth and the Cubit

Abstract

The Great Pyramid of Giza, a well known ancient monument on the outskirts of Cairo, has had its internal architecture analysed in the previous papers in this series in which the vertical and horizontal interlocking nature of the chambers within the building has been established. It was shown within this body of work that the architecture of the Great Pyramid contains a scale model of the Earth within it, and that two of the fundamental parameters of the Earth's reference ellipsoid are explicitly defined in the architecture.

In this paper I show that the cubit length of the base of the pyramid, which is explicitly documented on the north wall of the upper chamber of the building, is precisely half the circumference of the Earth model that is found within the architecture. I then show, by way of conjecture, that there is a secondary principal unit of measurement contained in the pyramid which is defined from the circumference of the Earth in an identical manner to the definition of the modern meter.

I then determine that the cubit length, which is the commonly accepted measurement unit used by the builders within the Great Pyramid, is defined from the latitude of the building when expressed in radians, and thereby determine the original value for the latitude of the pyramid.

By comparing the current and original latitudes of the pyramid I calculate the movement of the African tectonic plate upon which the pyramid is built and show that this value falls within the measurement error margins of modern GPS station movement results and thereby verify the conjecture regarding the pyramid's units of measurement and their relationship to the building's latitude.

Having determined the method of definition of the cubit I then quantify the dimensions of the model of the Earth that is contained within the pyramid in metric units and show that it is based upon a full sized reference ellipsoid that is indistinguishable in size and proportions to our modern WGS84 reference datum.

ISBN 978-0-9566588-8-3

9 780956 658883 >

www.giza-pyramids.com

G

The Great Pyramid papers

The Great Pyramid, the Earth and the Cubit

In the previous paper[1] in this series the architect's half-height of the pyramid was established by completing the vertical stack of chambers from the pavement level of the pyramid up to the building's mid height horizontal axis. The architectural features that define the vertical stack include a value for the reciprocal polar flattening (RPF) of the Earth of 298.257566 and the half height of the pyramid was shown to be very nearly equal to the polar radius of the Earth scaled down by 87,500, the difference between the modern accepted value and the value in the pyramid being just 4mm in the architecture.

It is therefore possible to make a drawing of a 1:87,500 polar cross section of the Earth and then superimpose this upon the east elevation of the Great Pyramid with the purpose of investigating the building's design further, and to do so requires a further understanding of the base reference level of the building.

The base level of the architecture

The surveying of the pyramid by William Petrie was conducted using the top of the pavement as the horizontal reference plane, but the 'top of the pavement' is a somewhat arbitrary statement because this level is dependent upon fixing the surveying base datum to a level, and therefore Petrie's reference plane must be an unknown absolute value, even though it is known relative to the internal architectural features that he surveyed. His explanation of the diligence that he used when obtaining the base level of his survey is contained within his work[2] which explains why his absolute vertical surveying values were so close to the actual and he clearly obtained a base reference plane remarkably close to that of the pyramid's original.

The architects of the pyramid have ingeniously removed this arbitrary surveyors reference plane in two ways within the architectural design. The first way is to include the plug block section in the ascending passage of the pyramid which forces the surveying to be disjointed from the base reference level as explained and corrected in the first paper in this series[3]. The second method is by constructing the pyramid on a section of raised bedrock so that when the chamber stack is discovered and re-constructed it is done to the level of this raised ground, the altitude of which can only be specified theoretically as being 11 cubits above the top of the pavement as it cannot be surveyed to the outside of the building. Both of these methods cleverly force any analysis of the pyramid to start from the upper sections of the building and descend downwards to the architect's absolute base level, and not the surveyor's.

In the upper chamber of the pyramid the architects made it clear that it is the under side of the granite floor that is intended as the horizontal reference plane of the room and placed this reference location at an altitude of exactly 81.125 cubits above the top of the pavement in the first analysis. Therefore the under side of the pavement that surrounds the pyramid must also be a horizontal reference plane if the architectural logic is to remain consistent.

The pavement of the pyramid, just like the floor of the upper chamber, does not have a regular thickness and therefore surveying measurements of this thickness can only provide the approximation of the true intended value. From the work of Petrie[4] the average of his six measurements of the pavement thickness was 22.03 inches, with the lower and upper values of this thickness being 17 and 27 inches. From these values, combined with the knowledge from the upper chamber of why the values would vary so much, and the fact that there are several levels in the stack which have to fall on integer cubit altitudes, then it is a logical conclusion that the reference level of the absolute base of the architecture is exactly 12 cubits below the raised ground level in the center of the pyramid or one cubit below the architect's reference level at the top of the pavement, making the pavement nominally one cubit deep.

This being the case, then the nominal 1 cubit thick pavement scales up to a distance of 87500 cubits or 45.79 km if the pyramid contains a 1:87500 scale model of the Earth. Because the half height of the building when measured from the top of the pavement represents the polar radius of the planet then the pavement thickness must be external to the Earth model and must represent the Earth's atmosphere.

This data fits modern atmospheric models on which the Stratopause of the atmosphere can be found at an altitude of 46km above the Earth's surface.

It is now possible to make a drawing of a 1:87,500 polar cross section of the Earth with the Stratopause at 45.79km included in the drawing and then superimpose this upon the east elevation of the Great Pyramid, as shown in Diagram G1.

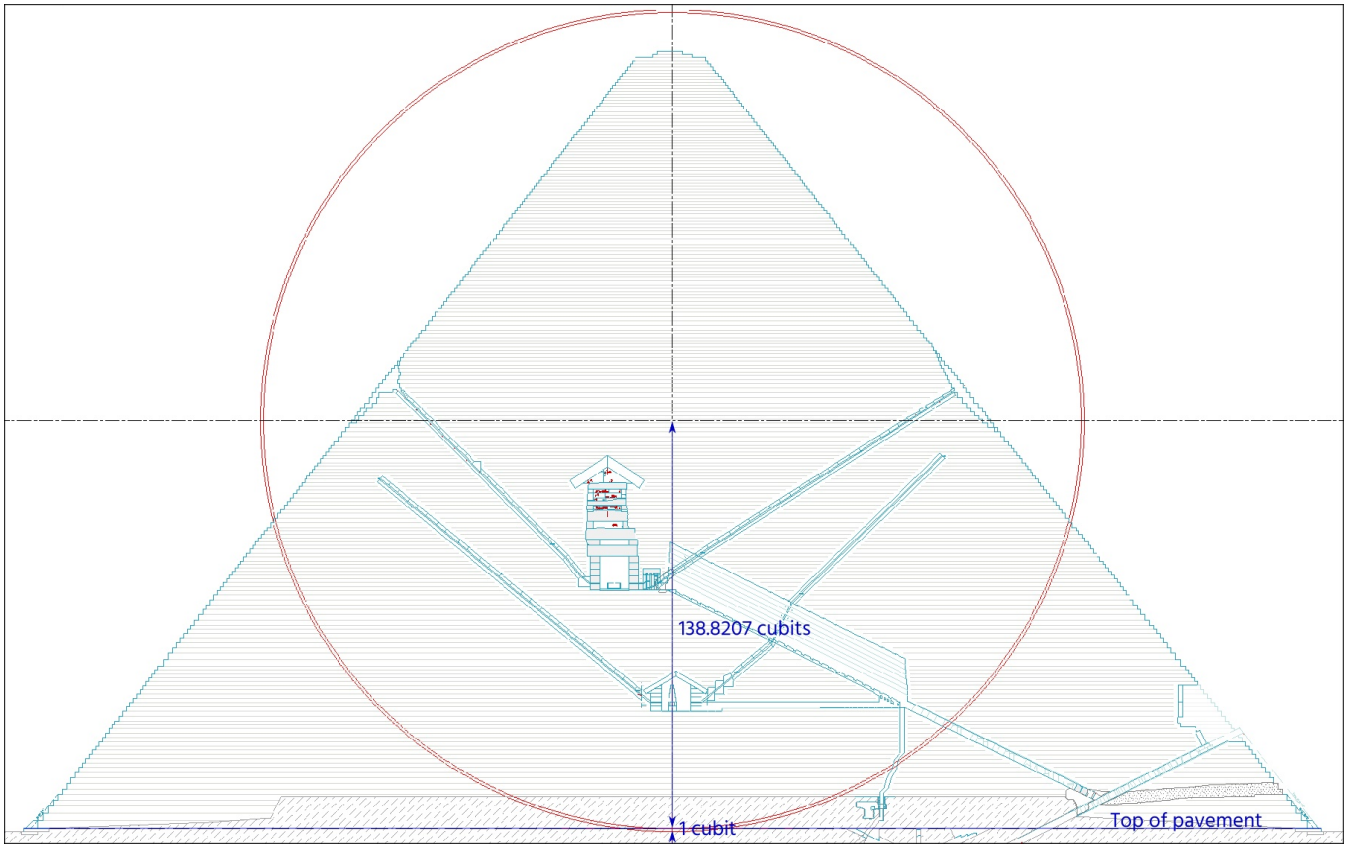

Diagram G1 - The Earth polar cross section model superimposed on a CAD drawing of the pyramid

Because the RPF of the Earth is included in the stack construction it is possible to use this architect's value, or a derivation of it, to calculate the equatorial radius of the 1:87500 scale model of the Earth. The definition of RPF for an elliptical planet is that it is the denominator of the fraction of the equatorial radius that needs to be removed from the equatorial radius in order to arrive at the polar radius. Therefore in the case of Diagram G1 where the polar radius is known and the equatorial radius needs to be computed, the value of RPF-1 is required, as this is the denominator of the fraction of the polar radius that need to be added to the polar radius to arrive at the equatorial radius.

Dealing with the planet model first without the atmosphere, from the stack details in the previous paper the architecture gives RPF-1 as 297.257566 and the polar radius of the Earth part of the model is that shown in Diagram G1 of 138.8207 cubits, allowing the equatorial radius of the planet model to be calculated as 139.2878 cubits. From these two radii the circumference of the Earth model can then be calculated, using the highly accurate approximation formula of Srinivasa Ramanujan[5], as 873.7044 cubits. These values can be scaled up to full size by multiplying by the scaling factor of 87,500 to give the dimensions of the architects full size Earth as shown in Table G2 alongside the model's dimensions.

The Earth

	1:87500 Earth Model (cubits)	Full Size (cubits)
Polar radius	138.8207	12,146,817
Equatorial Radius	139.2878	12,187,680
Circumference	873.7044	76,449,132

Table G2 - The architect's Earth dimensions and those of the scale model

Looking now at the atmosphere model, the same procedure can be undertaken with the ellipse of the Earth's Stratopause, which is defined in the architectural model as having a thickness of 1 cubit at the South Pole as shown by the pavement thickness on Diagram G1. When these calculations are performed, the circumference of the atmosphere ellipse on the model comes out at 879.9981 cubits.

When the binary digits of the upper chamber north wall were decoded in a previous paper, the lower level of stonework contained the value 22000 which is the architect's definition of half of the base length of the pyramid measured in 1/100ths of a cubit.

From these two facts it is clear that the half base length of the pyramid of 220 cubits must be a representation of the scaled circumference of the atmosphere of 880 cubits but which contains a small numerical discrepancy. From the experience gained when analysing the architecture of the chamber stack where there was an adjustment to be made at the end of the calculation, this discrepancy is most likely not to be an error but to be an additional value which has been added to the architecture for a specific purpose.

This is the exactly the case, and the architect's have added a checksum to the calculations so that the system will only resolve if its constituent parts are also correct. The value that has been used as the checksum is highly relevant to the part of the architecture that is under analysis and is

$$\text{Checksum value} = \frac{\text{RPF-1}}{1{,}000{,}000}$$

and this value of 0.000297 needs to be added to the pavement thickness of 1 cubit to complete the architectural design. On the model of the Earth, the resulting radii and circumference for the ellipse of the atmosphere up to the Stratopause are shown in Table G3.

The Atmosphere

	1:87500 Atmosphere Model (cubits)	Full Size (cubits)
Polar radius	139.8211	12,234,343
Equatorial Radius	140.2914	12,275,501
Circumference	880.0000	77,000,000

Table G3 - The architect's Atmosphere dimensions and those of the scale model

The numerical data for the full size Earth and atmosphere in Tables G2 and G3 has been shown to 8 significant digits, making all of the full size values integers. This has not been done arbitrarily but from the implicit precision in the calculations whereby if the model's atmospheric circumference is the only number that has been defined by the architects as 220 cubits, and it is an integer value, then the full size value from which it is derived must implicitly also be an integer, and therefore these numbers need to be rounded at 8 significant digits to make that the case.

The updated spreadsheet calculations of the Great Pyramid's architectural chamber stack, from the bedrock of the Giza plateau up to the half height horizontal axis of the pyramid, are shown in Table G4.

				UNITS		
	Stack constant n = 3 / sqrt(215)		0.204598302	(cubits)		
	Upper roof chambers height = [3 x (20+2n)] / n		299.2575660			
	RPF = Upper roof chambers height -1		298.2575660			
	RPF-1		297.2575660			
	Stack Height from pavement top		**Architecture**			**Scaled up**
	Upper roof chamber stones, implicit ones	7 * -1 / 100	-0.07	(cubits)		
	Plan view upper roof chamber length	Sqrt (399)	19.97498436	(cubits)		
	All the upper roof chambers	n*rpf/3	20.40919660	(cubits)		
	First roof chamber ceiling from false ceiling	(87.5 / 3) n	5.96745047	(cubits)		
	Upper chamber wall to false ceiling	11 + 2 n	11.40919660	(cubits)		
	Upper chamber unfolded floor	10 + 2 n	10.40919660	(cubits)		
	Upper chamber wall to false ceiling	11 + 2 n	11.40919660	(cubits)		
	Upper chamber unfolded roof	10	10	(cubits)		
	Gap between upper and lower chamber stacks	2 n	0.409196604	(cubits)		
	Lower chamber wall height	(87.5 / 2) n	8.951175706	(cubits)		
	Lowerchamber unfolded floor	10	10	(cubits)		
	Lower chamber unfolded wall	(87.5 / 2) n	8.951175706	(cubits)		
	Lowerchamber unfolded flat roof	10	10	(cubits)		
	Ground level above pavement	11	11	(cubits)		
	Total		**138.82077**	(cubits)		
	Scale				87500	
	Polar radius of Earth		138.82077	(cubits)	12146817.31	(cubits)
	Equatorial radius of Earth		139.28777	(cubits)	12187680.25	(cubits)
	Circumference of Earth		873.70437	(cubits)	76449132.65	(cubits)
	Pavement					
	Pavement thickness, nominal		1	(cubits)		
	Checksum = (RPF-1) / 1000000		0.0002973	(cubits)	26.010037	(cubits)
	Polar atmosphere thickness		1.0002973	(cubits)	87526.010	(cubits)
	Polar atmospheric radius		139.82107	(cubits)	12234343.32	(cubits)
	Equatorial atmospheric radius		140.29144	(cubits)	12275500.70	(cubits)
	Atmosphere circumference		880.00000	(cubits)	77000000.20	(cubits)
	Quarter atmosphere circumference		220.00000	(cubits)	19250000	(cubits)

Table G4 - The spreadsheet calculations of the full chamber stack of the Great Pyramid including the pavement thickness

The values in this spreadsheet for the pyramid's Earth model are correct and final, but the scaled up values culminating in a circumference of 77 million cubits undergo a further refinement in a later paper.

The Cubit definition

The details of the architect's Earth ellipsoid cannot be compared to our modern values with any accuracy at present because a conversion value between the cubit and any modern measurement unit is not known to sufficient precision. In Petrie's surveying[6] he determined a number of plausible values for the cubit from the measurements that he took within the pyramid and he settled on 20.62 inches (0.5237 m) as his adopted cubit length. For the purposes of this work a value of 0.5233 m has been used in the papers up to this point (20.6034 inches) whenever a conversion has been required for the work.

However, the precise value of the cubit can be determined from the architecture of the building once the model of the Earth has been identified.

The basis of the architect's cubit definition can be determined by recognising what looks like a numerical coincidence in the latitude of the Great Pyramid when compared to the metric value of the cubit.

The latitude of the Great Pyramid is 0.5232 radians.
The value of the Cubit in meters is 0.5233 meters.

Because the meter is defined from the circumference of the Earth, and the Great Pyramid's architecture has already been shown to use the atmospheric circumference of the planet, then the numerical similarity between the cubit in meters and the pyramid's latitude in radians will not be coincidental if the cubit's definition is directly related to the pyramid's latitude and the circumference of the planet.

Referring back to the azimuths of the internal passages that were established when analysing the north elevation of the building[7] in a previous paper, the primary azimuth that the architect's have defined for use in the passage system is one 4000th of a circle. The reason for this azimuth definition becomes more apparent when you consider that the intention when the meter was defined was to make it equal to 1/40,000,000 of the polar circumference of the Earth. Because the meter was defined before the precise scientific data was available about the Earth's exact shape and size, the actual definition of the meter ended up as being 1/40,007,862.9 of the Earth's polar circumference, the difference being due to surveying measurement error margins.

It can reasonably be proposed as a point of conjecture from the foregoing information that the architect's of the Great Pyramid have defined a master measurement unit, *the perfect meter,* of exactly 1/40,000,000 of the Earth's polar circumference and that the cubit is a proportion of this master length unit, that proportion being defined by the Great Pyramid's latitude.

If this conjecture for the definition of the cubit is correct, then it must be possible to logically process the cubit definition in reverse and determine the original latitude of the Great Pyramid from the building's architecture by equating the architect's given polar circumference in cubits to the planet's circumference in perfect meters as follows:

From Table G4 the circumference of the Earth given by the architecture is 76449132.65 cubits. The planet's polar circumference is being defined in perfect meters is 40,000,000. Dividing these two values through gives the cubit definition as 0.52322373 perfect meters to the 8 significant figures that are implicit in the architectural design.

If the conjecture is correct, this value must be the original latitude of the Great Pyramid in radians, which converts to decimal degrees as 29.978511 and to degrees minutes and seconds format as 29° 58' 42.6396". This latitude is shown on Diagram G5 which is taken from a satellite image of the pyramid.

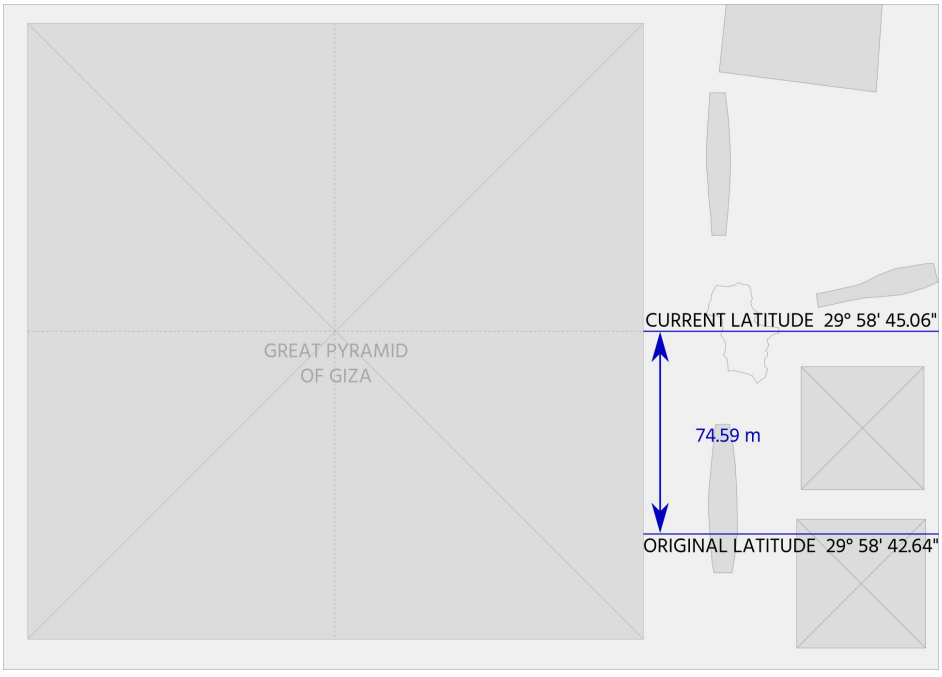

Diagram G5 - The original latitude of the Great Pyramid derived from the architecture

As can be seen in diagram G5, the original latitude of the Great Pyramid is south of the current latitude, and the distance between the two lines, taken from mapping software, is 74.59m. The commonly accepted date of construction of the Great Pyramid is 2560 BCE making it around 4580 years old, and so the movement of the tectonic plate upon which the pyramid is built can be determined as being 16.3 mm /year in a northerly direction if the conjecture is correct.

This value can be compared against the observed movement of GPS base stations that was tabulated in a 1996 journal article[8] which gives the current tectonic plate movement of the African plate as 16.9 ± 1.3 mm per year in a northerly direction. The two values can be seen to be in agreement with each other and the conjecture regarding the latitude of the Great Pyramid can be seen to be correct.

The conversion between the meter and the cubit can be calculated by first working out the conversion between the perfect meter, given the symbol *pM*, and the French meter:

$$1 \text{ pM} = 1.000196573 \text{ m}$$

and from this the cubit conversion to the meter and inch is

$$1 \text{ cubit} = 0.52332658 \text{ m}$$
$$1 \text{ cubit} = 20.603409 \text{ inches}$$

Comparing the Earth reference ellipsoids

With the cubit conversion to the meter literally fixed in stone, a comparison can now be made between the modern GRS84 reference ellipsoid and that of the pyramid's architects, which for now I will call the Great Pyramid reference ellipsoid from 2560 BCE or the GP-256 reference ellipsoid, in deference to the presumed date of construction of the building and the 16 bit data format found within the upper chamber.

Table G6 shows the modern WGS84 reference ellipsoid's defining data in the left column and the GP-256 reference ellipsoid data in the right column converted from cubits to metric measurements.

	WGS84	GP-256	
Reciprocal polar flattening	298.257224	298.257566	(m)
Equatorial radius	6378137.00	6378136.99	(m)
Polar radius	6356752.31	6356752.33	(m)
Geocentric gravitational constant	398600.4418	-	($km^3\ s^{-2}$)
Angular velocity	7.292115	-	($x10^{-5}$ rad s^{-1})

Table G6 - A comparison of reference ellipsoids

The table rows show the complete set of data that is required to define a planetary reference ellipsoid, with the last two lines showing the values of gravitational 'pull' of the planet and the rotation speed for the WGS84 ellipsoid.

For the pyramid's reference ellipsoid to be scientifically complete, these two missing values need to be included somewhere within the architectural design.

References

1. Brabin, S.H. *The vertical chamber stack of the Great Pyramid - part 2* , ISBN 978-0-9566588-7-6
   http://www.giza-pyramids.com/documents/pdf/GPP_F-VerticalChamberStack1.pdf
2. Petrie, W. M. Flinders. *The Pyramids and Temples of Gizeh*. 1st ed. London: Field and Tuer; New York:
   Section 12
3. Brabin, S.H. *Surveying errors within the Great Pyramid of Giza* , ISBN 978-0-9566588-2-1
   http://www.giza-pyramids.com/documents/pdf/GPP_A-SurveyingErrors.pdf
4. Petrie, W. M. Flinders. *The Pyramids and Temples of Gizeh*. 1st ed. London: Field and Tuer; New York:
   Section 27, Pages 45 & 46
5. Ramanujan, Srinivasa *Modular equations and approximations to π*
   Quarterly Journal of Mathematics , XLV, 1914, 350 – 372 , Secion 16 Equation 49
   http://ramanujan.sirinudi.org/Volumes/published/ram06.pdf , accessed 23 Dec 2020
6. Petrie, W. M. Flinders. *The Pyramids and Temples of Gizeh*. 1st ed. London: Field and Tuer; New York:
   Section 136 page 178
7. Brabin, S.H. *The horizontal chamber stack of the Great Pyramid*, ISBN 978-0-9566588-4-5
   http://www.giza-pyramids.com/documents/pdf/GPP_C-HorizontalChamberStack.pdf , Page 6
8. Larson, Kristine M et al. *Global plate velocities from the Global Positioning System*
   JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 102, NO. B5, PAGES 9961-9981, MAY 10, 1997