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Assumption And Challenges To Make A Planning And Scheduling For Egyptian Khufu Pyramid Project Using Building Information Modeling (BIM)

Dr. Sarah Saeed Ryad[1]

[1]Project Management Program, Department of Engineering science, The High Institute of Engineering, El Shorouk Academy, Cairo, Egypt, BSc.at year 2004 from Ain shams university in Cairo, master at year 2009 and PhD at year 2013 both from Ain shams university in Cairo, working as a lecturer of project management in high institute of engineering in El Shorouk Academy.

Abstract:

This paper depends only on two assumptions and a trail to prove both of them which will be the base for the researcher for her future researches, the assumptions are:

- The Khufu Pyramid is a project with the main aim to build it as a Castle during live in case of danger in additional of cemetery after die and the builder of Khufu pyramid were Egyptian army during pharaoh era and their camps were near to their project site (the pyramid) and not the slaves were the builder, each Egyptian soldier worked 24 days/month and had vacation only 6 days. (the researcher will use Primavera program (Calendar) to prove this).
- The Khufu pyramid project consisting of very high percentage industrial lime stones (casting on its place) and very low percentage of nature stones. (the researcher will deal with casting stone rate as casting plain concrete rate with considering old technique).

Depending on this two assumption the researcher will make a planning and scheduling of Egyptian Khufu pyramid using Building Information Modeling (BIM) using Primavera program, Tekla structure program and AutoCAD program, and will show the challenges that appear during this work.

Keywords: Khufu pyramid- Phyles- Planning

1. Introduction:

This paper is a scientific paper based on researches, brainstorming and applying of engineering programs tool, intended be for all categories of people not engineers and scientists only with aim to prove that the Khufu great pyramid is a castle project built by Egyptian army in Khufu age by casting stones on their place during 20 years using logic and Building Information Modeling (BIM) consist of Primavera, Tekla structure program and AutoCAD program.

The secret of build the great pyramid still not discover until now, there were a lot of trails to find the answer for how Egyptian pharaohs built the pyramids? Which was and still common that the methods employed by the Egyptians in cutting the hard stones which they so often worked, have long remained undetermined. Various suggestions have made, some very impracticable; but no real proofs of the tools employed, or the way of using them not obtained (W.M. Flinders Petrie, 1990.), (theglobaleducationproject.org)

The Greek historian Herodotus, who traveled to Egypt at around 450 BC, told by local priests that the ancient Egyptians used “machines” to lift the blocks. Scholars believe that such “machines” were some type of crane. Another Greek historian, Diodorus of Sicily, wrote, three hundred years later, that the Egyptians used ramps to move the blocks (Brier, 2007), (Rigby, (brown.edu) . 2016),

There is debate about the materials used for the stone blocks. Some advance the idea that they were cast 'polymer' concrete (in its original place). The conventional understanding is a quarried stone. The casing stones and the chamber-forming blocks are large quarried stones. Either way, they represent large volumes of material and these large stone blocks had lifted to great heights (Harris, 2010).

In 2009, Samo Kosmrlj dealt with the hypothesis that some parts of the pyramids were cast in place using granular limestone aggregate and an alkali alumina-silicate based binder. The evidence for this idea was provided by comparing limestone samples from pyramids and samples from nearby sites using scanning and transmission electron microscopy. The pyramid samples contain micro constituents with amounts of Si in a combination with elements, such as Ca and Mg, in ratios that do not exist in any of the potential limestone sources. The microscopic structure of the pyramid samples also suggests that the material from parts of pyramids is a man-made precipitate and not natural stone.

Our ancestor Pharaohs built pyramids since 5000-year before Christ, they built the great pyramid during 20 years. its aim which is common between scientist, that the Great Pyramid project is the tomb of King Khufu. It consists of 2,000,600 stone are cohesive without cement, with weight (2.5-15) ton, roof of king room from granite is 70 ton, great pyramid with high=149.4m=high rise building 48 floor, base area=230.4m*230.4m, perimeter ratio to high =3.14, king room perimeter ratio to its high=3.14, king coffin perimeter to its high=3.14 and coffin cover=10 ton, distance between earth and sun=149.4 million km, pyramids place is in the center of the five continents, in the magnetic north, pyramid sides to west, east, north and south, the entry path to the pyramid refers to the polar star, it covered by limestone cover, in the end of entry path there is a corridor with length=153 foot and in the end of corridor we find the king room (Mustafa) ,today if we decided to build pyramids we will need 1500 labors during 5 years with cost 5000000000$=3 times cost of Khalifa tower, in British there is a plan to build small copy of pyramids during the next 10 years from precious stones around the world, to show our technology now for the humanity in the future after thousands years (mind), with note that Add's folk* are not builders for pyramids for two reasons, first reason that those people body sizes not let them to move through corridors of pyramids and second reason that when they opened the rooms of great pyramid, they found writing on the walls by pharaohs and coffin belong to them also It's not logical to say that aliens come from the space and built pyramids.

Michel W. Barsoum in 2006 has ended his research by that the inner and outer casing stones of the great pyramid are not natural, the micro structure is consistent with a reconstituted lime stone where the cementing, reconstituted lime stone where the cementing phase is either silicon dioxide or a Ca - Mg-silicate, the starting materials believed be diatomaceous earth, dolomite and lime and in other words, some of the blocks must have been cast in place.

* Add's is a name of folk was in the past, it was common that those folks were have a greater volume than us, so stones of pyramids were small on them hands.

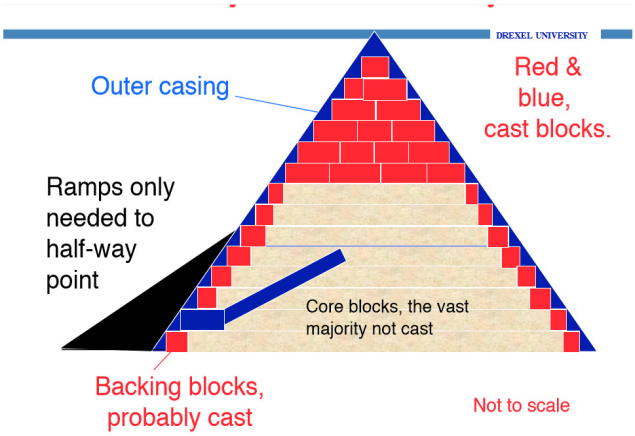

Fig.1. Michel W. Barsoum in 2006 research in Department of Materials Science and Engineering Department of Materials Science and Engineering Drexel University, Philadelphia, PA 19014

This paper contains:

2.Main Aim:

Assumption (1):

Let's assume that the main objective of the pyramids is using it as a Castle during danger according to the following:

Actually our ancestor Pharaohs lived in this world and not paradise, so where can we find their castles from attackers, raiders and enemies?

For the past we saw a lot of castles in Egypt for Various Ages like Qaitbay castle and Salah Eldin castle but we didn't saw any castles for our ancestor pharaohs except these pyramids.

A pyramid shape: all rooms in the pyramid have ventilation to breathing oxygen, in the king room at the end of 1/3 the pyramid if you leave a piece of meat, it will not rot, milk will change to yogurt and will not rot also fruits will not rot, Cereals The and seeds germinate faster inside king room than out pyramid (to eat and drink), razor blades become more sharp inside king room than outside the pyramid (for safety and daily use for tools as knife, razor for men's hair and chin), so the pyramid shape has an energy of form called positive green, also this atmosphere is important for the nervous system to accept to living there (Mustafa).

All those elements give life and helped them to still alive in a solid pyramid without any window, be safe from the aggressors and this show why not open the end of corridors, also have wells to drink and get fishes and have corridors to river to escape from aggressors if all protection systems had exhausted, this explain why the coffin of the queen was empty because this room planned to use for hide the queen during her live also for hide her things and golds there if there is any attack, and if she dies during this, her coffin will be there and ready, this explain that there are rooms whose purposes are unknown, and only recently a robotic camera sent up the air shafts in the Queen's Chamber discovered tiny doors with copper handles. What lies behind these doors is still unknown (Bob Brier, 2008), duplication of these doors is for more safety for them during the life in danger conditions and behind this tiny door you will

find empty room and coffin may you will find it empty or not and may have another existence to another corridor (emergency exit) not discovered until now, also air pressure in Khufu room avoided to not kill hem when he live inside the room and to breathing easily. And this what you will read something semi for this in a holy Quran about Surat the cave which good tell us about persons, they were 4 or 5 persons with one dog they still sleeping inside the cave for many years and our god make them sleep on the right side and left side of them body (and those directions considered during building of pyramids before holy Quran).

So king Khufu decided to leave the great pyramid castle as gift over the ages for all Egypt kings and Presidents to use it as castle to protect them and their family if there is a strong danger.

So I will deal during my future researches on the great pyramid as a Castle not cemetery.

3.Methodology:

Assumption (2):

- The Great pyramid project consisting of very high percentage industrial stones (casting on its place) and very low percentage of nature stones.

Let's assume that this is a correct method according to the following:

1- Von Daeniken is scientist who assumed that pyramids consist from industrial stones not natural and its nearest to logical to casting and pouring stones on its place except small number of them.

2- They found vacuums in pyramid stones also amount of water which are not existed in the natural stones.

3- Cutting this quantity of equal shapes of stones with equal edges and carry them is not logical but pouring them on their places is logical.

4- Which kind of ropes can carry this weights of stones during this age and bear this great force of tensile and friction force even in water existence. The timber plates with ropes used to carry material and tools over the ramp which required for pouring the pyramid stones also carry nature stone if required with less quantity.

5- God say in holy Quran that pharaoh asked Haman to heating the clay to build an edifice for him, maybe he can see the god.

Rate of stone pouring:

Time to build Khufu pyramid was probably maximum 23 years (Khufu reigned from 2551 to 2528 before Christ). Herodotus writes about 10 years of preparation and 20 years of building (details of the text) and rate of working per day: with 2,500,000 stones 342 stones have to be pouring daily (working during 365 days a year) or 431 stones daily (working during 290 days a year), so rate of pouring per minutes :10-hour day: every 2 minutes a stone (34 to 43 per hour), 8-hour day: nearly a stone every minute (42 to 53 stones per hour) so While construction the pyramid the rate of pouring was 1 stone weighting 2.5 tons every minute (Franz).

Number of crews for pouring (neglecting crews to transfer material as their rate must more than or equal pouring crews also there is no cost calculation)

Assume pouring 400 stone/day, with 2320000 stone/20 years (20000 extra for wastage) and working 8hr. /day, this mean 50 stone/hr., so 50x8x20x290=2320000 stone.

2000 labor divided into two groups each of them =1000 labor and the 1000 labor divided into five crews each of them contain 200 labor (mixing labor, pouring men, polishes, building supervision and helpers) (Dhab), so using 200 labor/each crew/day and use two crews working parallel during 8 hours with rate 400 stone/day this mean use 400 labor/day.

Rate of pouring=400 stone/day=400m^3/day (assume each stone 2*1*0.5 and assume pouring for stones need only 400 labor/day (two competitors military crews) (assumed as plain concrete pouring and with old technical), those crews agreed to work only 4 years so to finish half of pyramid during 20 years you need 5 military crews each of them worked four years only from 20 years, so 200 (stone/day) *4 (years)*290 (day/year) *5 (military crew) =1160000 stone for half pyramid, for two halves of the great pyramid=1160000*2=2,320,000 stone and you will always find only two crews competed, (the researcher assume 4-year duration for men service to build pyramid castle and fortress, it's Military target like our army service now a day. So total men services during 20 years:

$$\text{Numer of solider during 20 years} = 200\ conscript\ \left(\text{working } 4\ \frac{\text{years}}{\text{half pyramid}}\right) * 2\ (\text{two halves of pyramid}) * 5\ (\text{military crew}) = 2000\ \text{soldier during 20 years}$$

This mean that the pyramid base (first stone raw) may approximately need half years to pouring it:

$$\left(\frac{230.4\ m \times 230.4 m}{\left(400\ \frac{m}{day}^{\ 2}\right)}\right) = 132.7\ days\ (as\ stone\ hight\ approximatly = 1m)$$

And 132.7 days is approximately= 0.46 *290 day = half a year (assuming working 290 day/year).

Fig.2. labor resources for Khufu Great Pyramid project (National Geography Abu Dhabi)

4.Quantity surveying for Stones:

Using calculation:

pouring 2,320,000 stones with dimension 2*1*0.5 m^3 (Casting in place from 3. Methodology).

Using Tekla structure program:

After researcher made 146 layers each with one-meter depth and with different part marks according to different volumes of layers of Khufu Great pyramid refer to its shape:

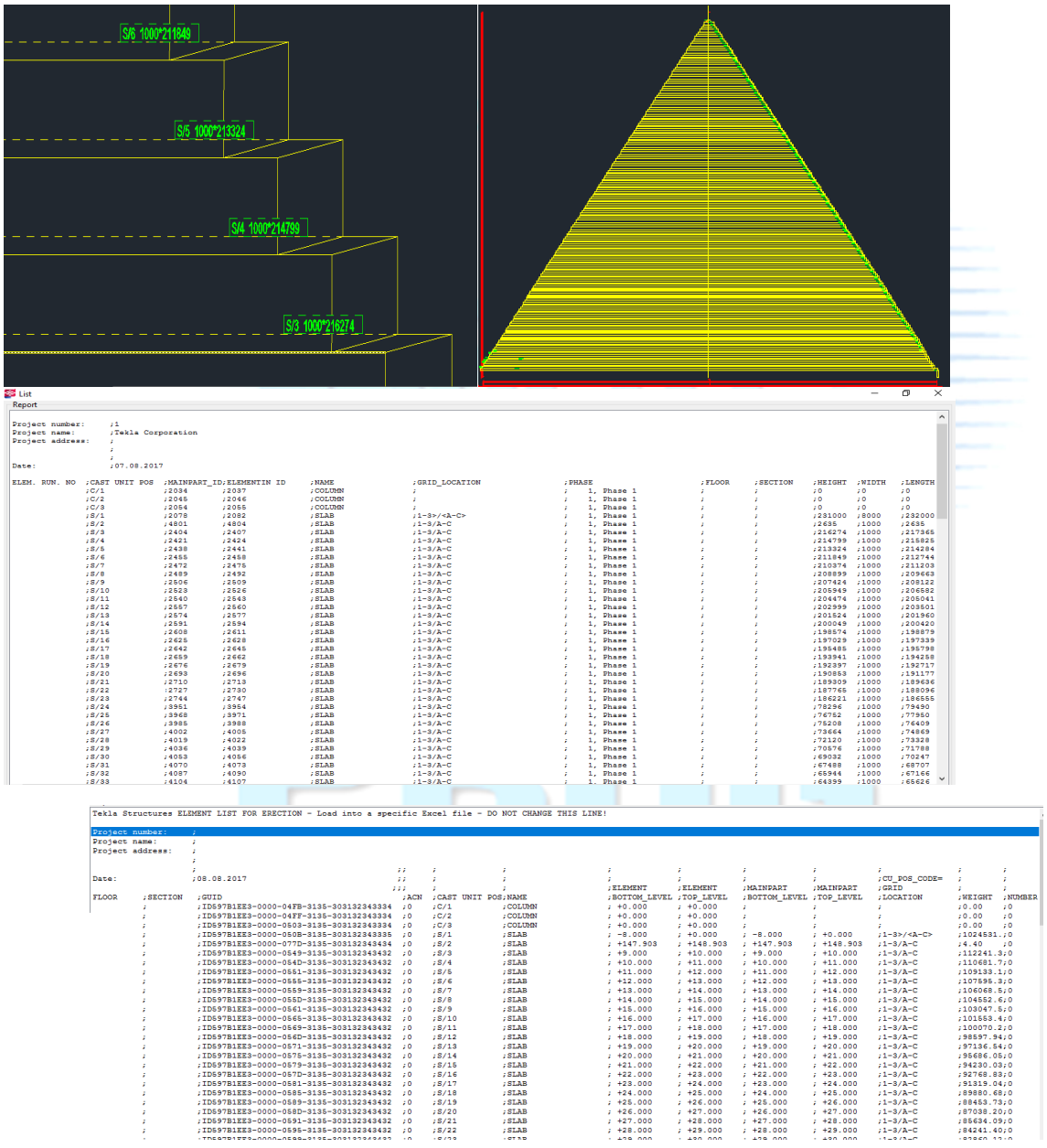

Fig.3. Tekla structure detailing drawing w/part marks and element list report and element erection report

According to this report total volume= (Σtotal volume for the 146 layers) / {2(length) * 1(depth) *0.5(thickness)} =2647149.79/ (2*1*0.5) =2,647,150 stones.

2,647,149.79-2,320,000=327149.79 =327150 stones and to remove volume of rooms and corridors:

Volume of chambers and corridors=10.47*5.234*5.852 (Khufu room) +6.85*1.05*1.11 (corridor for Khufu chamber) +8.6*46.68*2.06 (Grand Gallery) +5.75 *5.23*6.23 (Queen's chamber) + (38*1.05*1.17) (horizontal corridor for queen chamber) + (17+7.29) *0.96* 1.04+1.09*1.2*34 (corridor for down) + 61*1*1(condition corridor) +1.2*1.05*37.7 (corridor for up) =1567m3=1567 stones

So 327150(different between Primavera program calculation and Tekla structure program calculation) -1567 (rooms and corridors) =325583 stones.

%error 325583/2320000=14% error (deviation Tekla structure program result from primavera program result). (this is according to researcher drawing accuracy in Tekla structure program).

With extra 325583 stone by tekla this mean extra approximately 3 years by tekla structure program:

325583 (stone)/ 400 (stone/day)=813.95 day and 813.95(days)/290(days/year)=2.8 years=3 years.

so total duration by tekla structure program=23 years for Khufu Pyramid project.

5.Planning and scheduling Khufu pyramid project using Primavera:

challenges in planning and scheduling Khufu pyramid project using Primavera:

- In Primavera there is no date or calendar belong to before Christ so I used Khufu calendar with our present date just to calculate the duration only, I started from 10-7-2017 and primavera finished at 19-4-2037, so the project duration approximately=20 years.
- Manually entrance for 6 days' vacations in Khufu calendar for Military vacations:

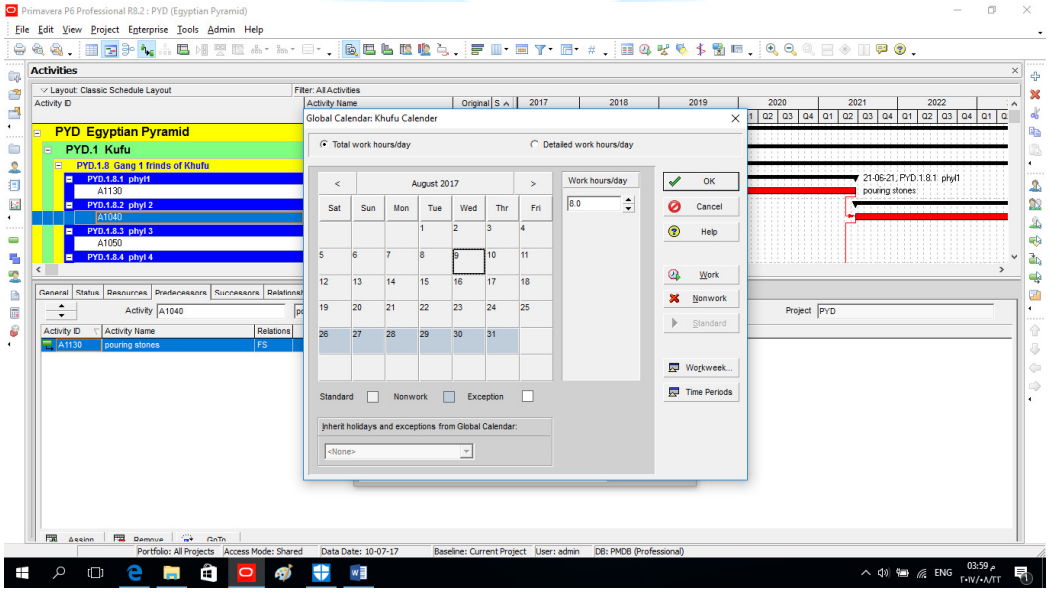

Fig.4. Khufu Calender

- I assumed resources roughly as this need material engineering scientist, geology scientists and maybe physical and chemical scientist as well.

Table 1
Planning and scheduling for Khufu Great Pyramid using Primavera:

Egyptian Pyramid | Classic Schedule Layout | 26-07-17 13:51

Activity ID	Activity Name	Original Duration	Start	Finish	الكمية الاجمالية	الوحدة
PYD Egyptian Pyramid		5800	10-07-17	19-04-37	2320000.00	
PYD.1 Kufu		5800	10-07-17	19-04-37	2320000.00	
PYD.1.8 Gang 1 frinds of Khufu		4640	10-07-17	08-05-33	1160000.00	
PYD.1.8.1 phyl1		1160	10-07-17	21-06-21	232000.00	
A1130	pouring stones	1160	10-07-17	21-06-21	232000.00	ston
PYD.1.8.2 phyl 2		1160	10-07-17	21-06-21	232000.00	
A1040	pouring stones	1160	10-07-17	21-06-21	232000.00	ston
PYD.1.8.3 phyl 3		1160	22-06-21	08-06-25	232000.00	
A1050	pouring stones	1160	22-06-21	08-06-25	232000.00	ston
PYD.1.8.4 phyl 4		1160	09-06-25	21-05-29	232000.00	
A1060	pouring stones	1160	09-06-25	21-05-29	232000.00	ston
PYD.1.8.5 phyl 5		1160	22-05-29	08-05-33	232000.00	
A1070	pouring stones	1160	22-05-29	08-05-33	232000.00	ston
PYD.1.9 Gang 2 Drunkureds of Khufu		5800	10-07-17	19-04-37	1160000.00	
PYD.1.9.6 phyl 6		1160	10-07-17	21-06-21	232000.00	
A1080	pouring stones	1160	10-07-17	21-06-21	232000.00	ston
PYD.1.9.5 phyl 7		1160	22-06-21	08-06-25	232000.00	
A1090	pouring stones	1160	22-06-21	08-06-25	232000.00	ston
PYD.1.9.7 phyl 8		1160	09-06-25	21-05-29	232000.00	
A1100	pouring stones	1160	09-06-25	21-05-29	232000.00	ston
PYD.1.9.1 phyl 9		1160	22-05-29	08-05-33	232000.00	
A1110	pouring stones	1160	22-05-29	08-05-33	232000.00	ston
PYD.1.9.2 phyl 10		1160	09-05-33	19-04-37	232000.00	
A1120	pouring stones	1160	09-05-33	19-04-37	232000.00	ston

Actual Work | Critical Remaining ... | Remaining Work | Milestone | Page 1 of 2 | TASK filter: All Activities | © Oracle Corporation

Khufu Pyramid Work Breakdown Structure (WBS):

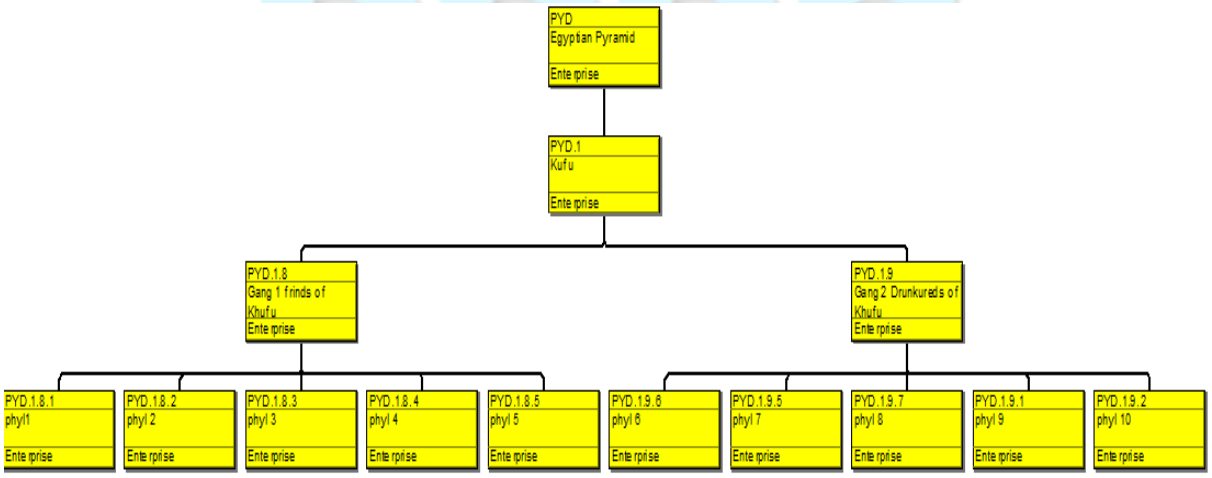

Fig.5. Khufu Pyramid Work Breakdown Structure (WBS) using Primavera program

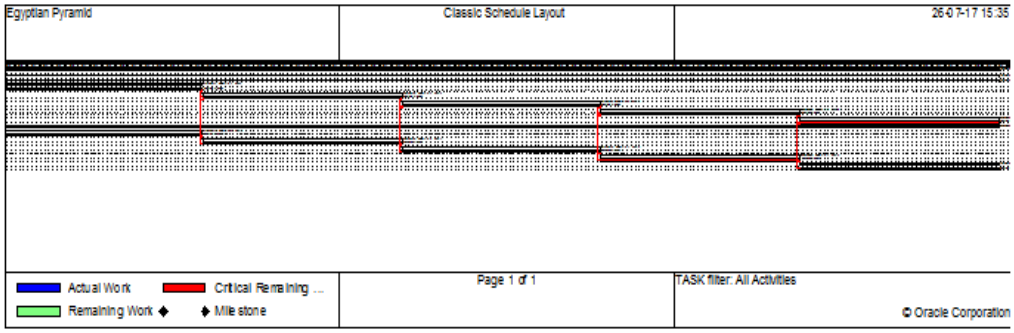

Fig.6. Khufu Pyramid Gant Chart using primavera program

In Gant Chart all activities are critical activities and all project is a critical path.

Roughly resources which need more researches by scientists in different science branches:

Table 2
Roughly resources for Khufu Great Pyramid using Primavera:

Activity ID	Activity Name	Resource ID Name	Start	Finish	Remaining Units
XY Resources			10-07-17	19-04-37	
Milwr		Mlr.Milw	10-07-17	19-04-37	
A1040	pouring stones	Mlr.Milw	10-07-17	21-06-21	
A1050	pouring stones	Mlr.Milw	22-06-21	08-06-25	
A1060	pouring stones	Mlr.Milw	09-06-25	21-05-29	
A1090	pouring stones	Mlr.Milw	22-06-21	08-06-25	
A1100	pouring stones	Mlr.Milw	09-06-25	21-05-29	
A1110	pouring stones	Mlr.Milw	22-05-29	08-05-33	
A1120	pouring stones	Mlr.Milw	09-05-33	19-04-37	
A1080	pouring stones	Mlr.Milw	10-07-17	21-06-21	
A1070	pouring stones	Mlr.Milw	22-05-29	08-05-33	
A1130	pouring stones	Mlr.Milw	10-07-17	21-06-21	
labor for cutting and transfe		cs\labor for cutting	10-07-17	19-04-37	
A1040	pouring stones	cs\labor for cutting	10-07-17	21-06-21	
A1050	pouring stones	cs\labor for cutting	22-06-21	08-06-25	
A1060	pouring stones	cs\labor for cutting	09-06-25	21-05-29	
A1090	pouring stones	cs\labor for cutting	22-06-21	08-06-25	
A1100	pouring stones	cs\labor for cutting	09-06-25	21-05-29	
A1110	pouring stones	cs\labor for cutting	22-05-29	08-05-33	
A1120	pouring stones	cs\labor for cutting	09-05-33	19-04-37	
A1080	pouring stones	cs\labor for cutting	10-07-17	21-06-21	
A1070	pouring stones	cs\labor for cutting	22-05-29	08-05-33	
A1130	pouring stones	cs\labor for cutting	10-07-17	21-06-21	
Material			10-07-17	19-04-37	
A1040	pouring stones	MTR.Material	10-07-17	10-07-17	
A1050	pouring stones	MTR.Material	22-06-21	22-06-21	
A1060	pouring stones	MTR.Material	09-06-25	09-06-25	
A1090	pouring stones	MTR.Material	22-06-21	22-06-21	
A1100	pouring stones	MTR.Material	09-06-25	09-06-25	
A1110	pouring stones	MTR.Material	22-05-29	22-05-29	
A1120	pouring stones	MTR.Material	09-05-33	09-05-33	
A1080	pouring stones	MTR.Material	10-07-17	10-07-17	
A1070	pouring stones	MTR.Material	22-05-29	22-05-29	
A1130	pouring stones	MTR.Material	10-07-17	10-07-17	
ston e			10-07-17	19-04-37	
A1040	pouring stones	stn.stone	10-07-17	21-06-21	
A1050	pouring stones	stn.stone	22-06-21	08-06-25	
A1060	pouring stones	stn.stone	09-06-25	21-05-29	
A1090	pouring stones	stn.stone	22-06-21	08-06-25	
A1100	pouring stones	stn.stone	09-06-25	21-05-29	
A1110	pouring stones	stn.stone	22-05-29	08-05-33	
A1120	pouring stones	stn.stone	09-05-33	19-04-37	
A1080	pouring stones	stn.stone	10-07-17	21-06-21	
A1070	pouring stones	stn.stone	22-05-29	08-05-33	
A1130	pouring stones	stn.stone	10-07-17	21-06-21	
sand		snd.sand	10-07-17	19-04-37	
A10	pouring stones	snd.sand	10-07-17	21-06-21	

5.Detailing Khufu Pyramid project using Tekla Structure and AutoCAD after export Tekla drawing (BIM):

The Challenges:

- After a lot of trails, Tekla structure program take a very long time to running and execute commands such as copying, moving and others according huge number of stones:

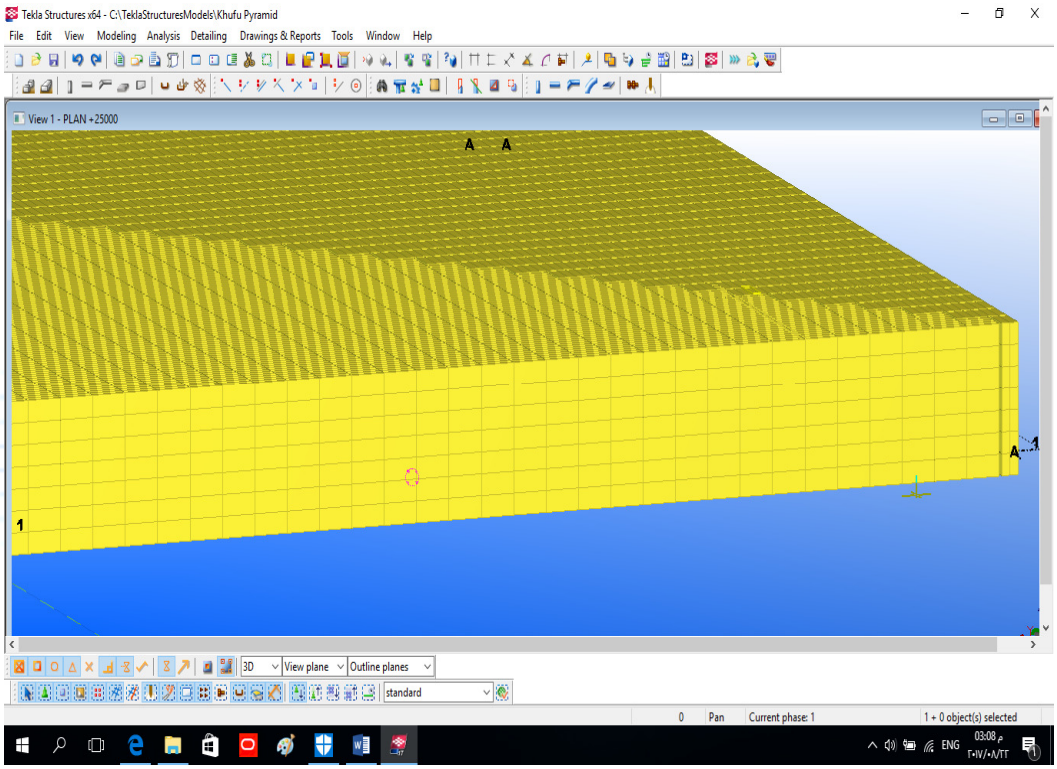

Fig.7. Challenges for Khufu Pyramid 3D using Tekla Structure program

so I created the pyramid from 146 layer of stone each layer with height 1 meter and these layers are above Giza hill which has 8m high.

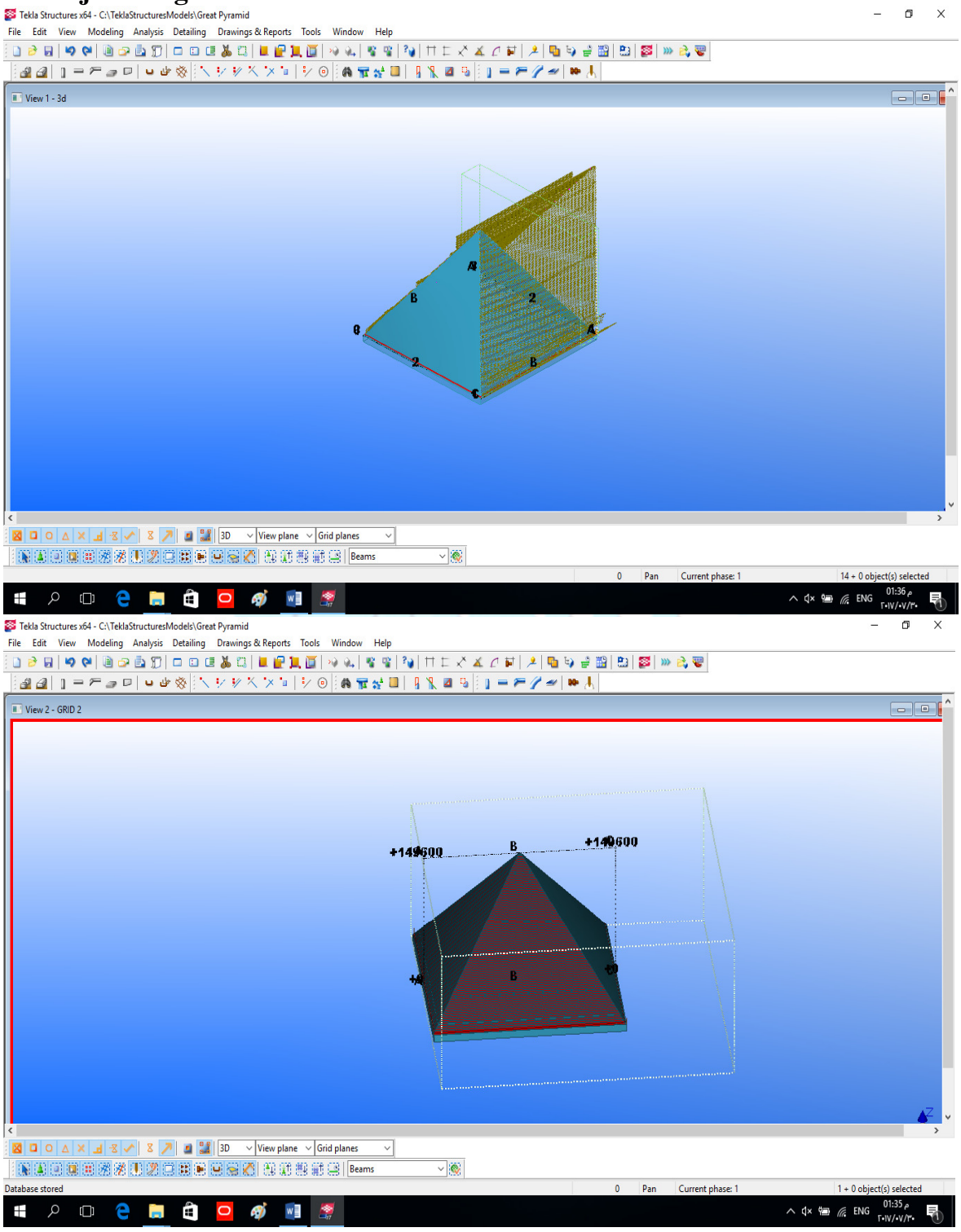

Fig.8. Khufu Pyramid 3D using Tekla Structure program to scale 1:1

6.Tekla structure program export to AutoCAD program:

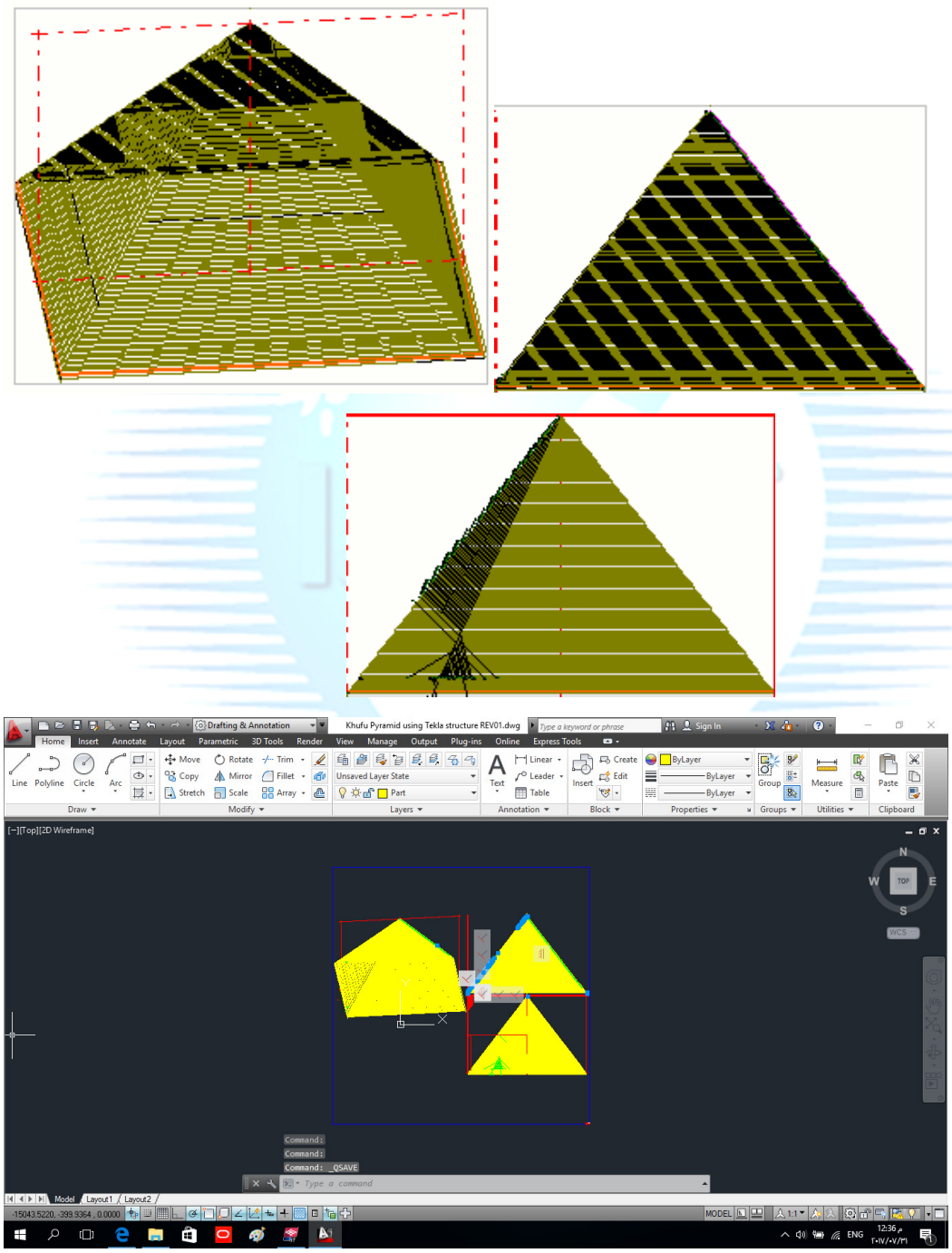

Fig.9**.** Khufu Pyramid 3D using Tekla Structure Program Export to AutoCAD Program to scale 1:50

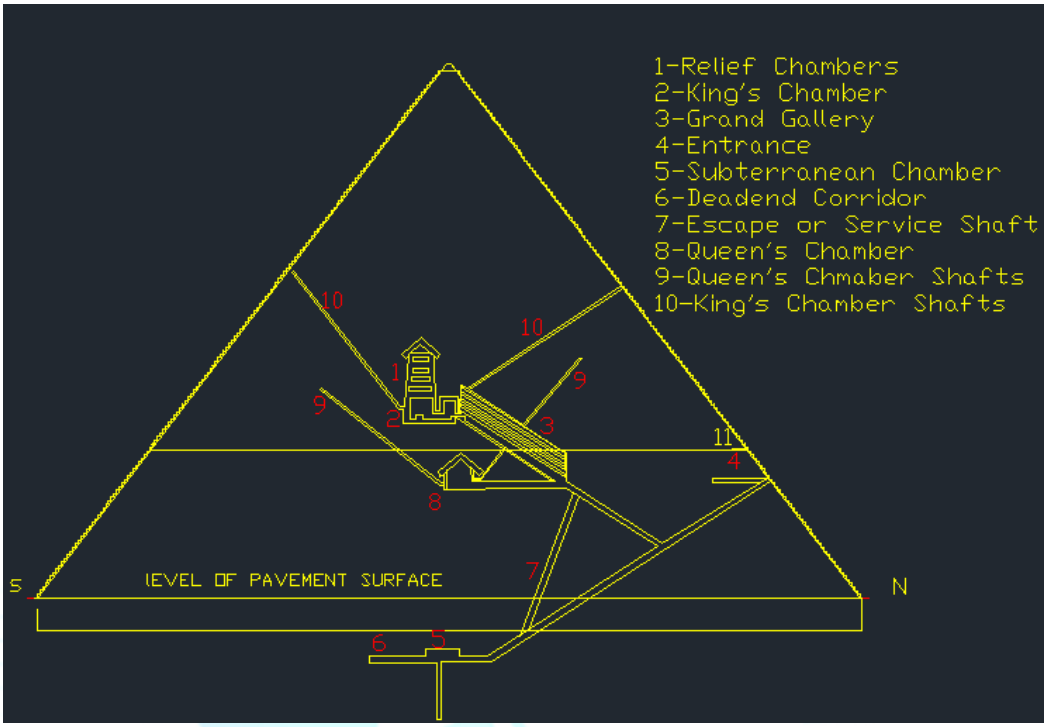

Fig.10. Khufu Pyramid 2D using AutoCAD Program (the interior parts is to appropriate scale)

Lessons learned from study Khufu Castle (great Pyramid):

1- Drawings on walls show pharaohs soldiers pull or run the wooden skate and their backs are straight vertical with land and not curved (as shown in the below figure), this mean skate was not heavy and may include materials and tools of pouring industrial lime stones and sometime natural stones.

Fig.11. Drawings on walls show pharaohs soldiers pull or run the wooden skate from national geography movie on YouTube.

2- God says on holy Quran that the mountains are wedge on the land so Khufu selected Giza plateaus as a base for greet pyramid as it is a wedge in land to resist earth quick for great pyramid castle.

3- Pyramid stones not interrelated to each other as any mountain, if part of it damaged it will not affect in the other part beside it.
4- you can also use Rivet program with Primavera as another trail for create Khufu pyramid project using BIM (Building Information Modeling).

Conclusion:

The Khufu Pyramid is a project with the main aim be a Castle during live in case of danger and not only as cemetery after die and the builder of Khufu pyramid were Egyptian army during pharaoh era and their camps were near to their project site (the pyramid) and not the slaves were the builder, each Egyptian soldier worked 24 days/month and had vacation only 6 days. (Using Primavera trail) and the Khufu pyramid project consisting of very high percentage industrial lime stones (casting on its place) and very low percentage of nature stones.

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