

Reconstruction of the Project Intent of Snefru's Bent Pyramid

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ABSTRACT

In previous works we have shown that the apartments of the three major pyramids of Snefru North, Khufu and Khafre have been designed on a modular scheme.

In the Pyramid of Snefru, apart from the choice of the profile, the apartments are not similar to any other example, due to the presence of two separate apartments, placed at different levels and with entrance on two different faces. In particular, the upper one has unique features, such as the crypt which is the only one placed to the left of the related corridor, an unusual east-west axis, the western entrance and the descending corridor with a clear and sharp change of slope.

We can state that the current configuration of the apartments is proved to be the result of alterations to a precise original project with both apartments aligned on the same north-south plane, which designers continued to refer to.

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In previous works¹ we have shown that the apartments of the three major pyramids of Snefru North, Cheops and Chefren have been designed on a modular scheme (fig. 1) consisting of a grid of squares of 3.5 cubits size (small measure), which can be grouped for more extensive measures in bigger squares (large measure).

Reproducing those apartments on this abacus (fig. 2) the archaeological measures slightly differ from the theoretical project; but we must also notice that those archaeological measures can rarely be expressed with whole numbers according to the Egyptian measurement system.

Since Snefru's southern pyramid is the first non-step example and the prototype of the canonical ones, it was surprising that in those major pyramids this design system would appear in a more and more developed form, while in the bent pyramid it seemed absent.

Summing up briefly (fig. 3) the characteristics of this pyramid², apart from the choice of the profile which was perhaps influenced by weak confidence in building large smooth casing, having the only experiences of the earlier step pyramids, the apartments are not similar to any other example, due to the presence of two separate apartments, placed at different levels and with entrance on two different faces. In particular, the upper one has unique features, such as the crypt which is the only one placed to the left of the related corridor, an unusual East-West axis, the western entrance and (fig. 4) the descending corridor with a clear and sharp change of slope.

Our analysis originated from the accidental graphic determination (fig. 5) to render both apartments on the same North-South section, shifting the upper one having a south entrance, but keeping strict match with the archaeological measures³. By this expedient it was immediately obvious (fig. 6) that by extending the upper corridor we could meet the lower one in the virtual point Σ' with manners and measures quite similar to those of the apartments of the Cheops' pyramid, letting us suspect a relationship in these projects too.

Whilst this was an encouraging start, in applying that scheme that was detected in major pyramids⁴ to the bent pyramid, we noticed that some identities existed, such as for example the level of slope-changing point **C**; many other matches were similar, but they seemed to belong to the same schemes, only differently applied.

Extending the deductions of Rinaldi and Maragioglio (fig. 7) that led to the presumption of the exis-

¹ Manzini 2006. VI OKAA Congress Acts (publication pending).

² Rinaldi – Maragioglio 1964.

³ Dorner's detailed excavation report currently in the author's archive (unpublished). Rinaldi – Maragioglio 1964. Dormion - Verd'hurt 2016.

⁴ Manzini 2006.

tence of a P2 pyramid, interior to the actual P3 pyramid⁵, we thought that the slope-changing point **C** of the upper apartment could have been the entrance of a further P1 inner pyramid. We observed that, starting from the previous E2 Meidum pyramid, the basis sides of the pyramids increased by at least 21 cubits compared to the previous ones; this observation allowed us to assume the size of the base side, and the inclination for this supposed P1 Dahshur pyramid, and they were completely compatible with the existing features⁶.

We verified this possibility and, keeping a match with the archaeological measures (fig. 8), we tried then to redesign both apartments, simply following the assumed scheme, with the only restriction to match the intersection point Ω with one of the abacus' corners. In this perspective we supposed that both corridors had a constant slope of 1 on 2, slightly different from the actual one, and that, according with the features of the earlier pyramids, the pyramid axis could overlap the lower crypt axis.

It was very important to notice that in this theoretical project the level of the lower crypt floor was exactly coincident with the level of point Σ , and we could deduce that this was an intentional relative position. We will see how this will have significant consequences in the architectural evolution.

From this reconstruction (fig. 9) many concordances emerged with the actual situation, such as the level of external entrance **E**⁷, which differs from the actual entrance by only 1 meter circa. The main points opposing this schematic design were: 1) the failed coincidence between the real lower crypt's and the pyramid's axis, 2) the level of the virtual point Σ' of the intersection between the two descending corridors (that was slightly higher than theoretical Σ of about 1 meter), and 3) the slopes of both descending corridors, albeit very close to the theoretical ones.

We hypothetically presumed that (fig. 10) while building the lower descending corridor, the first one to be built⁸, there may had been a minimum but substantial tilt error that obliged designers as a result, to adapt the slope of the upper one.

By correlating all these observations, we grasped that the upper corridor mitigated its inclination in order to maintain its geometrical, evidently binding relationship, both with the new point Σ' and with the original point Ω_2 .

Up to this point this reconstruction of the project was perfectly compatible with what had been actually made, and it justified the apparent irregularities.

Nevertheless, there was an inconsistency in the correlation between the theoretical axis and the axis of the alleged P1 pyramid. The Dorner's surveys⁹ would in fact indicate (fig. 11) a fracture in the lower descending corridor, at the level we predicted it should meet with the North face of the P1 pyramid but

⁵ Rinaldi – Magagioglio 1964.

⁶ Dorner 1986.

⁷ Dorner's detailed excavation report currently in the author's archive (unpublished).

⁸ Manzini 2006. Arnold 1981.

⁹ Dorner's detailed excavation report currently in the author's archive (unpublished).

at a farther distance to the North from the actual pyramid's axis of about 5 meters from what expected. We concluded hypothetically (fig. 12) that the apartments were built first in a P0 pyramid of the same size of the P1 and aligned on the same North-South axis corresponding to the actual pyramid, but with its axis moved to the North from the actual axis by 5 meters.

As a confirmation of this assumption we could notice that if we move the P0 pyramid onto P1 (fig. 13), this one would take the current vertical axis, and both ends of the deepest rooms of the project (that is the North wall of the lower antechamber and the South wall of the upper crypt) would become symmetric to the new axis according to the egyptian love for order and symmetry¹⁰, and in such foreseeing the decisions that would be made for the North pyramid of Snefru (fig. 14)¹¹.

We evaluated in particular (fig. 15) the current presence, in the corridor leading from the lower crypt to the «chimney», of the unexplainable vertical shaft¹², which was never completely surveyed, and of the hint of a tunnel heading South in continuation of the lower crypt's antechamber. The alignment on the same North-South axis of these two elements let us suspect that they were the traces of a different originary access to the crypt, soon abandoned and similar to what was made in the immediately previous Meydum pyramid¹³ (fig. 16).

For some unknown reason, before completing this access (fig. 17) it was decided to abandon it, even if still under construction, in order to build the current hall, the antechamber and the consequent North entrance to the crypt. Since this shaft became useless, due to the new access, it was decided to move the crypt to the North by the measure of this shaft's side, in order to avoid it.

But this shift needed a consequent adjustment of all the components of these apartments that had not yet been built (fig. 18). The error in building the lower descending corridor caused the shifting up and more to the North of the new point Σ' from the designed point Σ . In fact, since they wanted to maintain the same designed distance between the middle of the crypt floor and point Σ , they had to move the crypt to the North and closer to the ground level, that is at the same level of the new point Σ' .

If these were the given deviations of the lower apartment from what had been planned, having altered the fundamental points of reference had substantial consequences on the upper apartment inasmuch we saw they were bound.

Perhaps the decision to build the cultual place to the North, the temple to the East and the satellite pyramid to the South, let them decide, in the next phase P1, to move to the West side the entrance to the upper apartment from the South face, since the West face was the only one which was not occluded by other buildings and what's more, it was in the underworld's direction.

¹⁰ Arnold 1981.

¹¹ Dorner 1998.

¹² Rinaldi – Magagioglio 1964. Dormion - Verd'hurt 2016.

¹³ Dormion - Verd'hurt 2013. Rinaldi – Magagioglio 1964.

Although the most striking change which happened in this P1 phase consisted in the rotation of the upper apartment from the designed North-South axis to the actual East-West axis, it is of great support to our reconstruction that all the data continued to find confirmation uniquely in the original project's geometry with aligned apartments, as we happened to represent by chance.

After this rotation, and as we will see in other subsequent developments, they had been keeping all the relationships and sizes that appear only in this project with opposed entrances, thus indicating that the designers themselves conceived it and they always maintained reference to this provision.

It is quite clear (fig. 19) that the upper corridor's slope, which was obtained by connecting the new point Σ' with the designed point Ω_2 where the upper corridor meets the ground line, reaches the face of the alleged P1 pyramid both at the level of the theoretical project and at the current point **C** level. But above all, this new angle was preserved identically even after the rotation.

Moreover, we know that in all other pyramids the crypts always lay on the right-hand side of the corridors; so (fig. 20), a rather interesting further consideration is that since this crypt's floor had been already placed in the previous phase P0, the shift of the corridor had as a result that this crypt was unusually placed on the left-hand side.

An equally significant confirmation that the designers continued to obtain sizes basing themselves on the project in which the two apartments were on the same section, is given by the fact that the value in that original project between the end of the descending corridor and the East-West axis of the pyramid was exactly reproduced, after shifting, in the distance between the East-West-axis-corridor and the North-South axis of the pyramid.

After the shifting, the different distance that came out between the apartment entrance (point **C**) and the crypt made it necessary (fig. 21) to build the horizontal corridor, which was not expected in the initial project. It is very important to indicate the presence in its floor of a neatly finished shaft that has not yet found convincing explanation. As it is evident in table, a simple geometric reconstruction, based only on archaeological data, indicates that the center of the basis of that shaft is the mentioned Ω_2 point, thus giving to the shaft the meaning of an essential element for verifying the punctual construction.

Reaching at least the level of point **C** of the upper apartment's entrance, they decided to expand the building to its final size but, probably due to previous adaptations that had become necessary in such a prototype, we think they chose to try an intermediate stage of verification, resulting in the P2 pyramid alleged by Rinaldi and Maragioglio.

For this purpose (fig. 22), the base of the superstructure was enlarged, and they had to joint the existing **C** entrance in P1 pyramid with the level of the ultimate **E** entrance¹⁴ as expected from the original

¹⁴ Dorner's detailed excavation report currently in the author's archive (unpublished).

project, therefore requiring an abrupt change of slope in the new corridor.

Also in this case, however, it was not a random choice, but it can be dated back to the original project, with both apartments aligned on the North-South axis (fig. 23), as is evident from the table in which the slope of the new corridor, almost orthogonal to the face of P1, had to compensate for the anomalous position of the **C** entrance compared to the original project. In particular, extending the slope of the floor of this part of the corridor until we meet the ground line in point Ω_3 , it is evident by archeological measures that it coincides exactly with the vertical of the South wall of the crypt, but only if we assume the upper apartment stands on a North-South projecting level.

In the final passage from the P2 pyramid to current P3 there was no further change; it consisted uniquely in the expansion of the superstructure and in the extension of both corridors, upper and lower, with the previously determined slopes until they reached their external faces.

In the end of this complex presentation, it should be pointed out anyway that these alleged, internal pyramids should not be interpreted as actual and finished buildings (or conceived as such). They probably are constructive stages which could have been available in case of death of the sovereign. In fact, as we found in the pyramid of Djeser more building stages, we have to think that the designers might not have a very clear idea about the time required by a huge size construction of which they had no building experience.

Although the exposed considerations may seem factitious, the geometric concordance of the results and the incontestable existence of a same design logic make us believe how this could be shared with you. On the other hand, even in astronomy the existence of the supernovae stars is certain, although we theorized their existence only by analyzing their evolution. In any case we wish to underline that we used only ascertained archaeological measures, from which our theoretical data differ only in a few cases and from negligible entity, and that we limited ourselves to re-enact the events that may have happened from the original will to their effective implementation.

In conclusion, we can state that the current configuration of the apartments is proved to be the result of alterations to a precise original project with both apartments aligned on the same North-South plane, wick designers continued to refer to.

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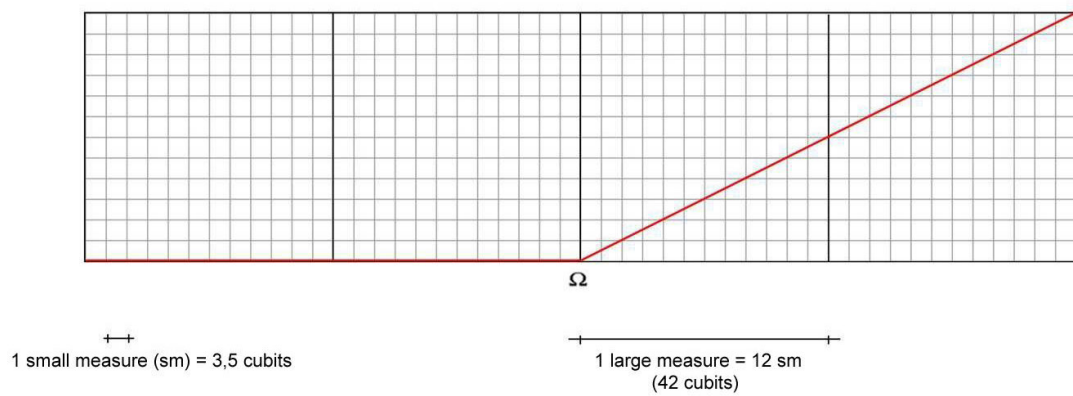


fig. 1 – Modular scheme at the basis of the design of the Pyramids of Khufu and Khafra

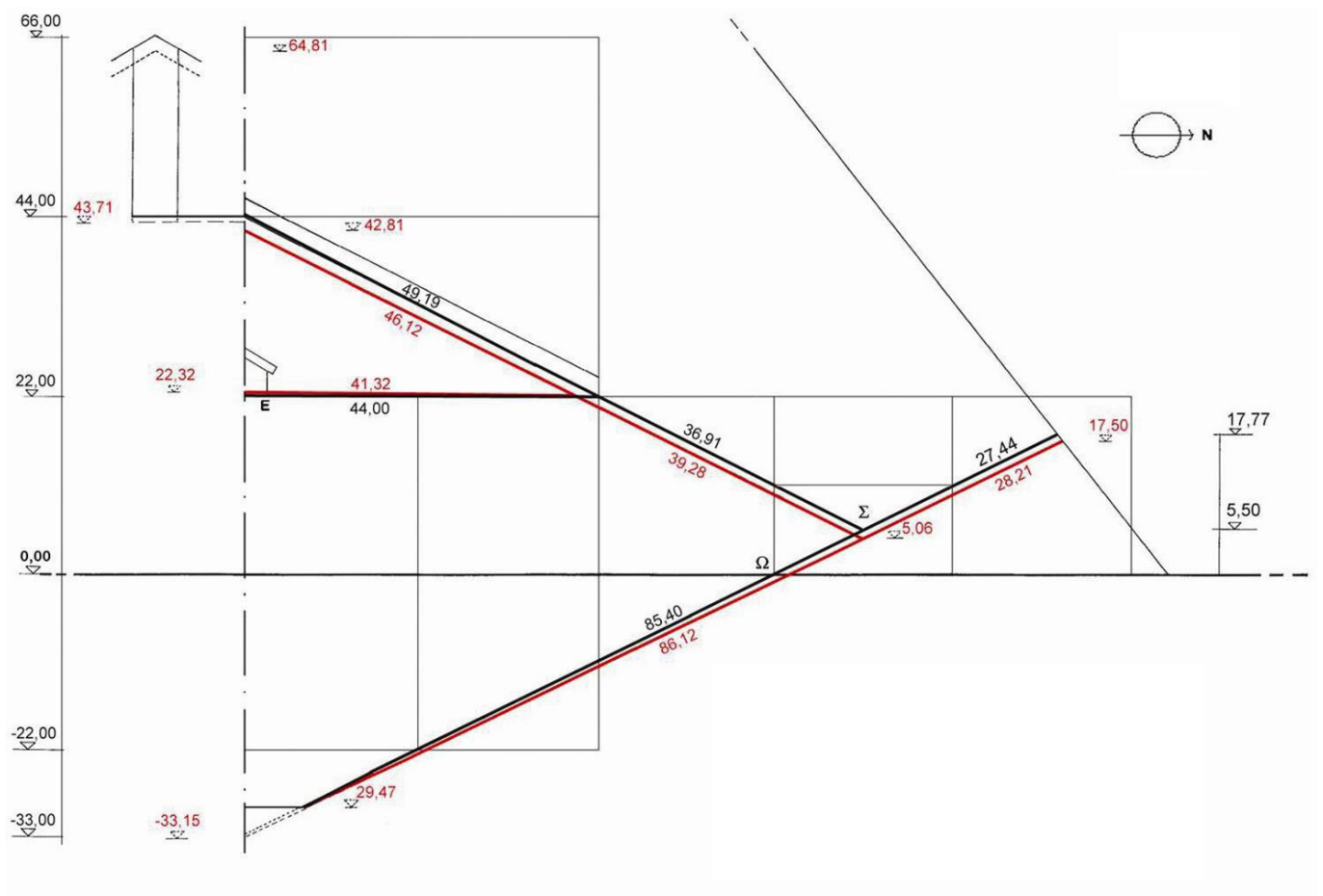


fig. 2 – The apartments of the Pyramid of Khufu with the actual measurements in red and the prospected ones in black (meters)

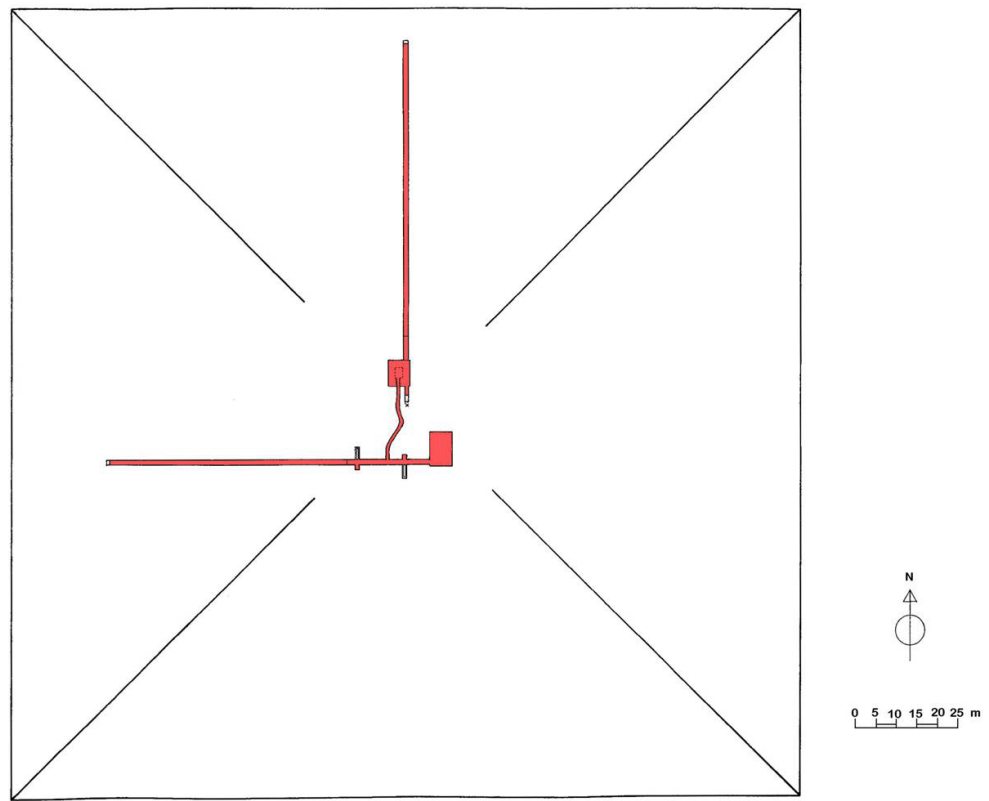


fig. 3 – Planimetry of the Southern Pyramid of Snefru

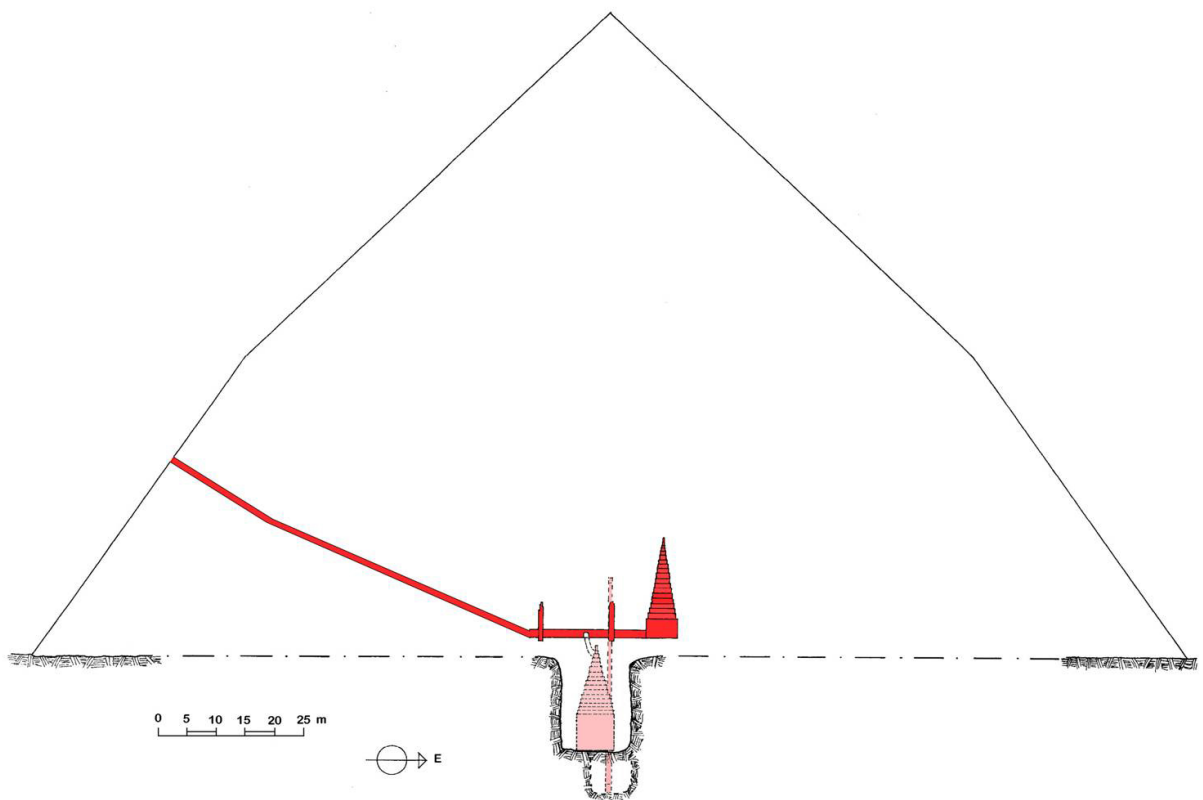


fig. 4 – East-west section of the Southern Pyramid of Snefru showing the western apartment

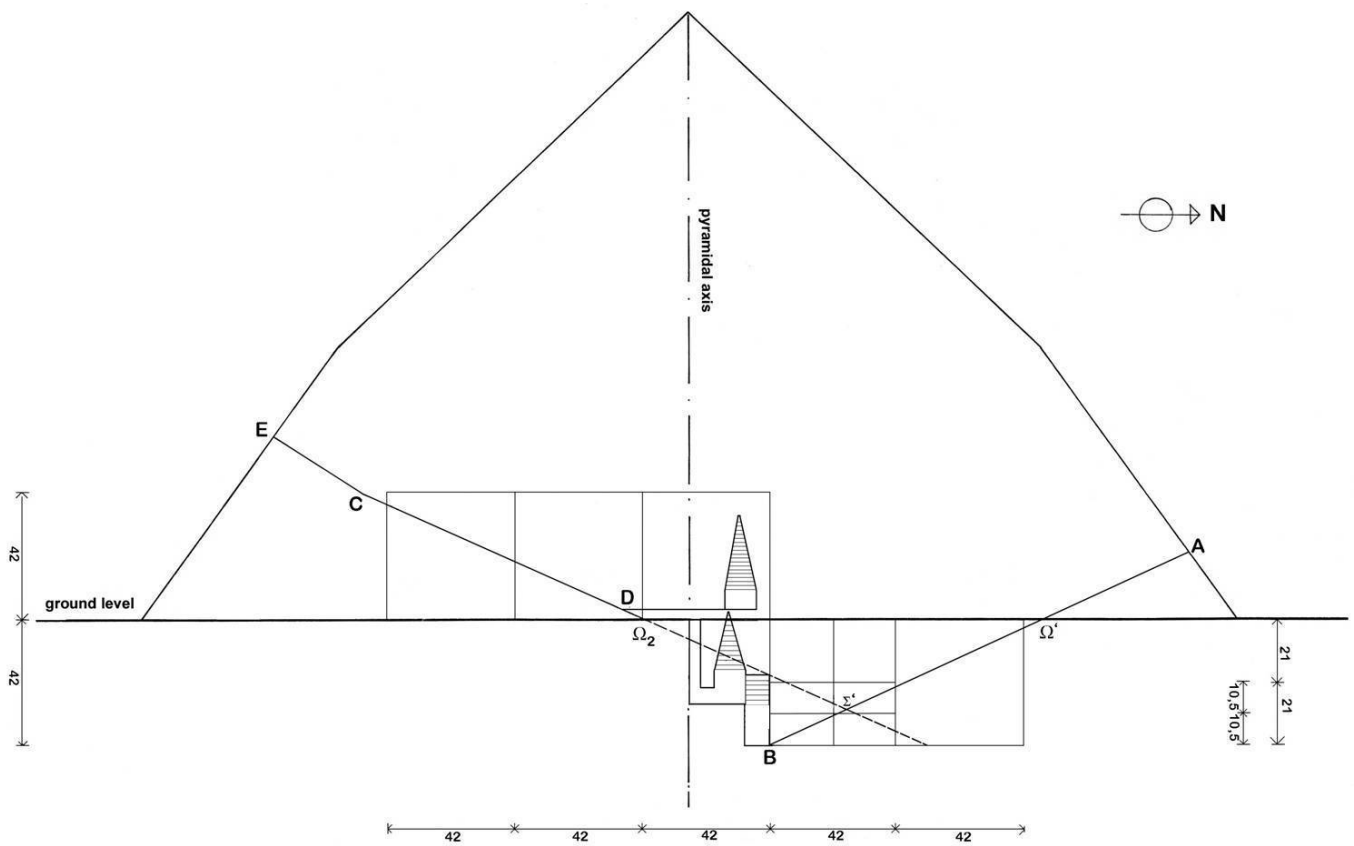


fig. 5 – North-south section of the Pyramid of Snefru showing both apartments on the same axis (cubits)

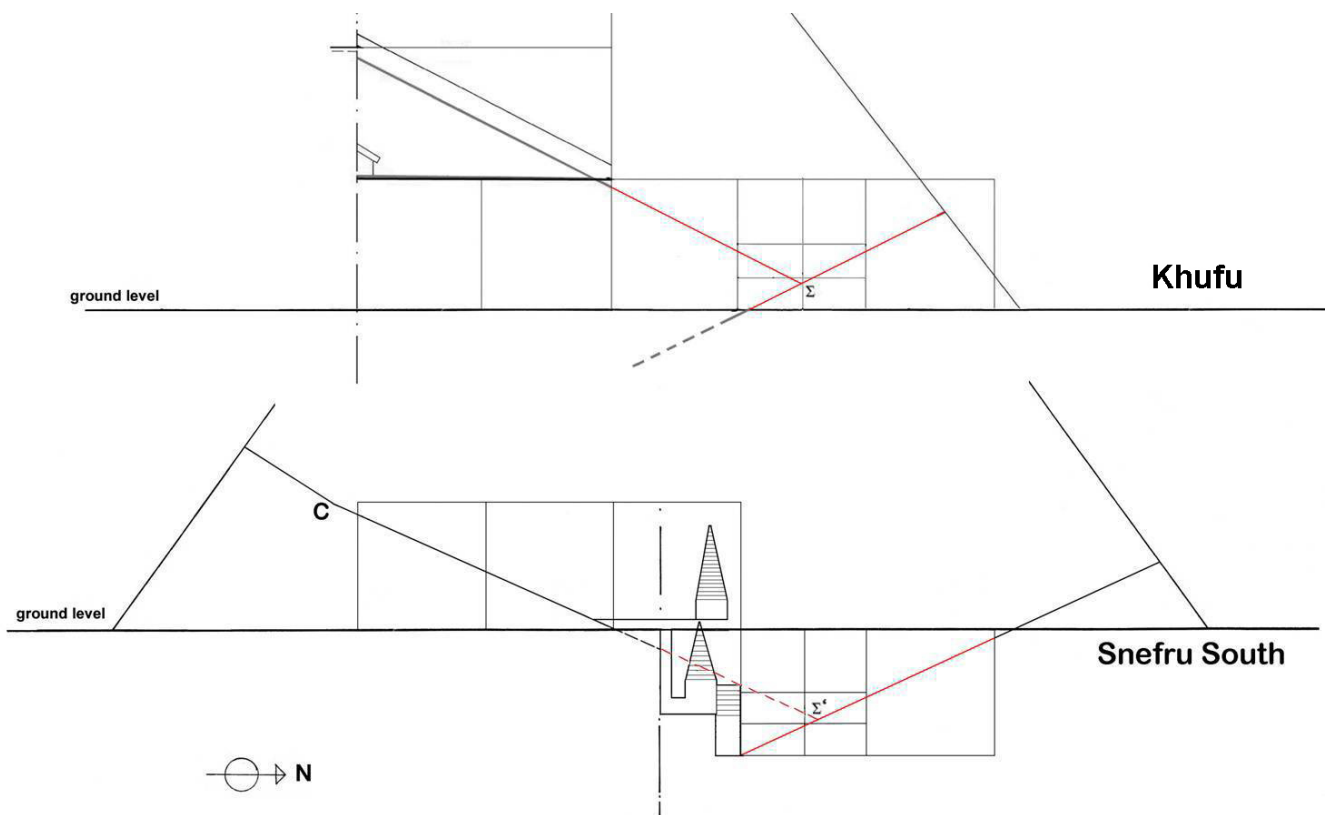


fig. 6 – Comparison between the innermost parts (in red) of the apartments of the Pyramid of Khufu and the Southern Pyramid of Snefru

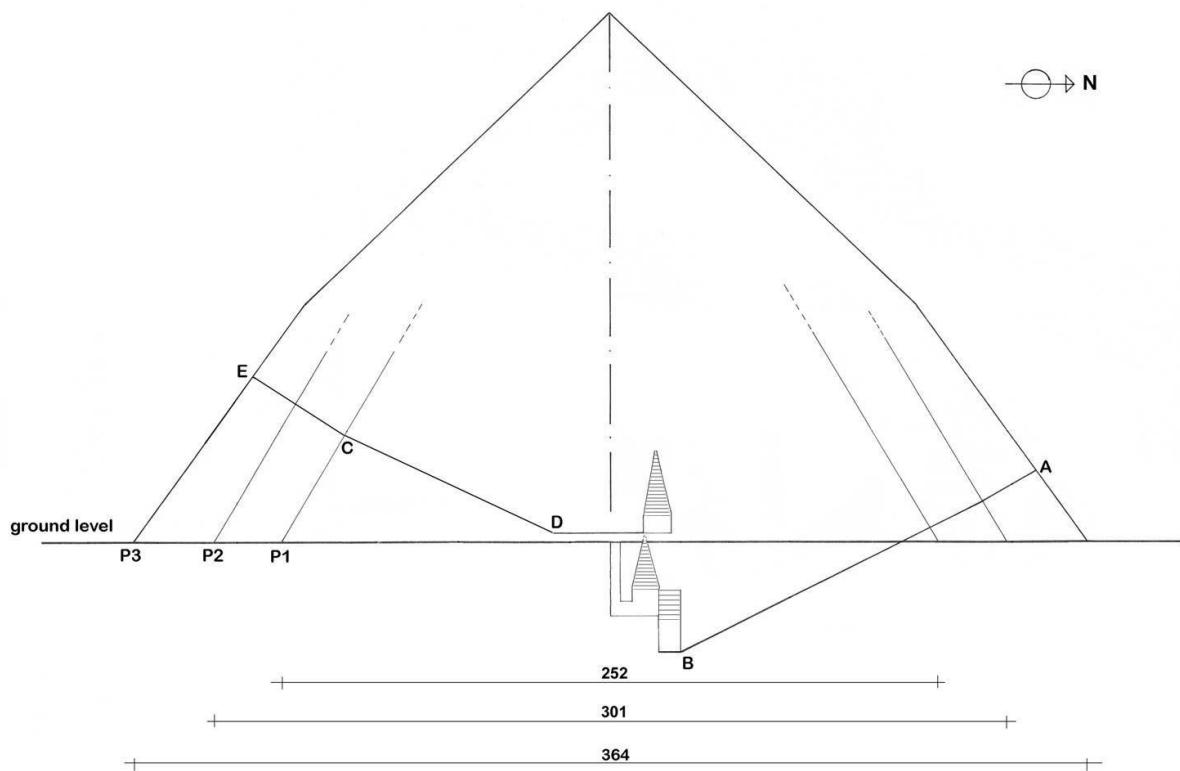


fig. 7 – The supposed inner pyramids in the Southern Pyramid of Snefru (cubits)

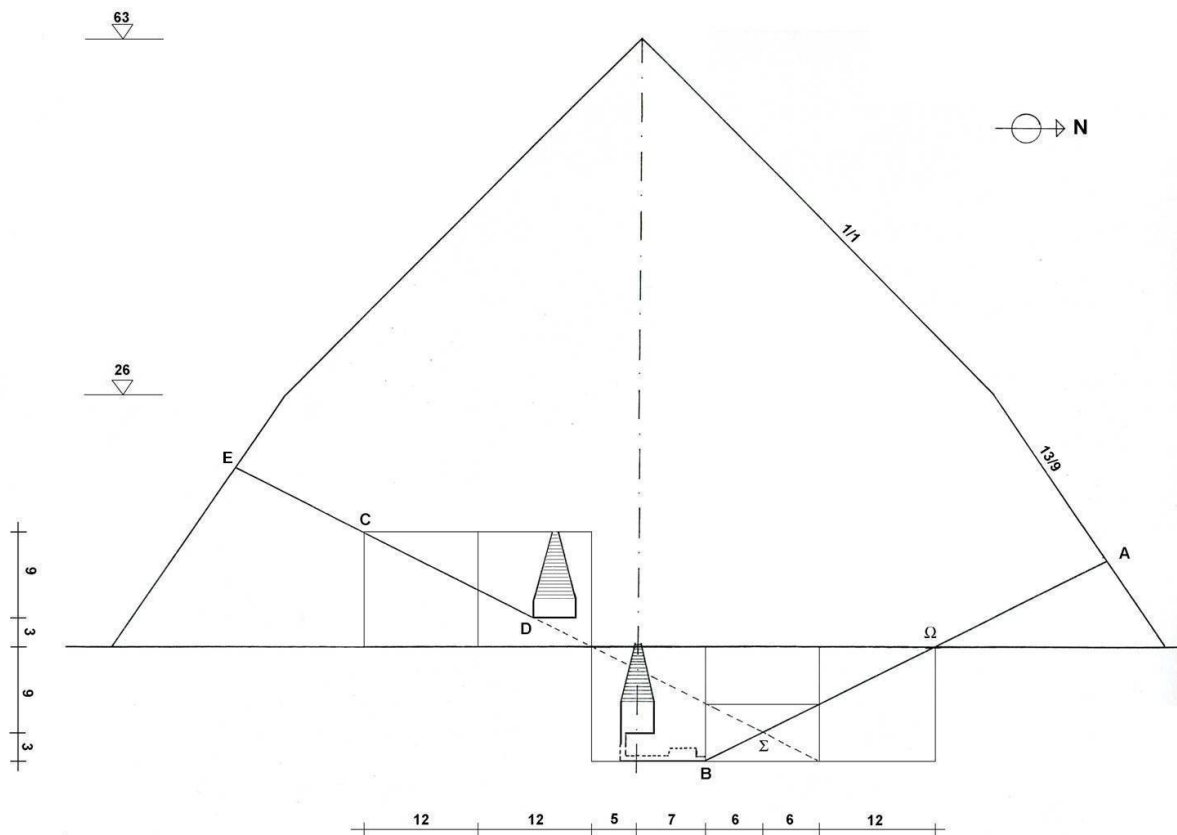


fig. 8 – Theoretical project of the Southern Pyramid of Snefru according to the Egyptian measuring system (small modules)

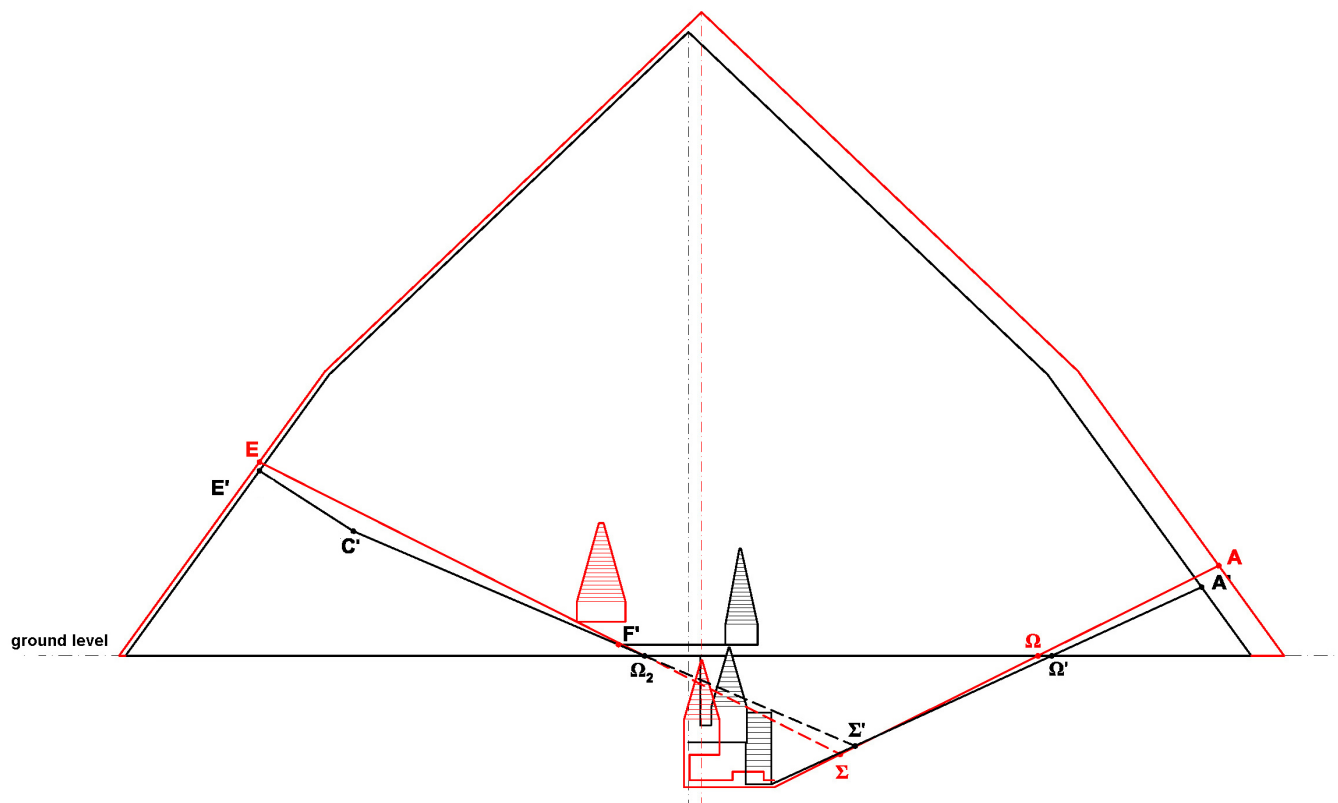


fig. 9 – Comparison between the theoretical original project (red) and the current one (black) with the apartments positioned on the same north-south axis

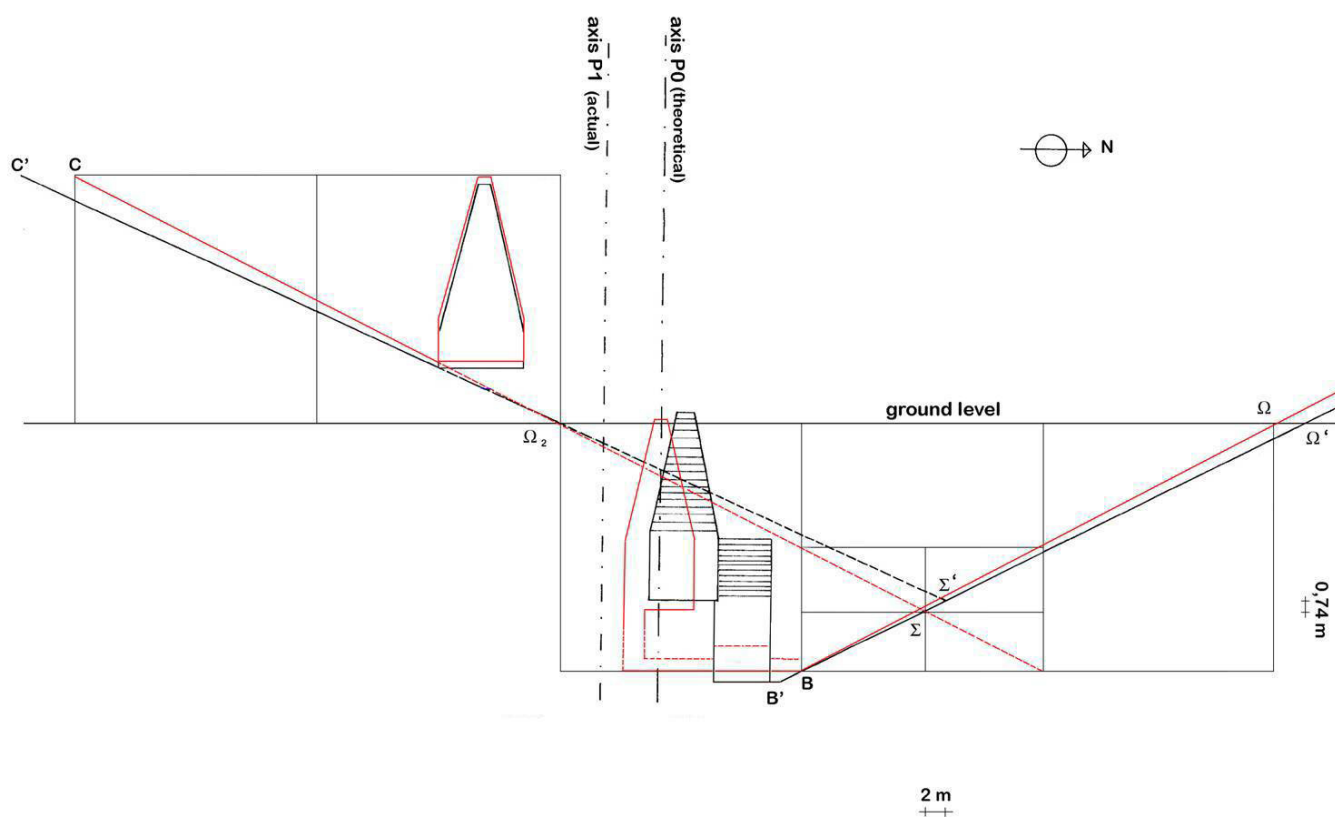


fig. 10 – Comparison between innermost part of the theoretical apartment (red) and those of the current ones (black)

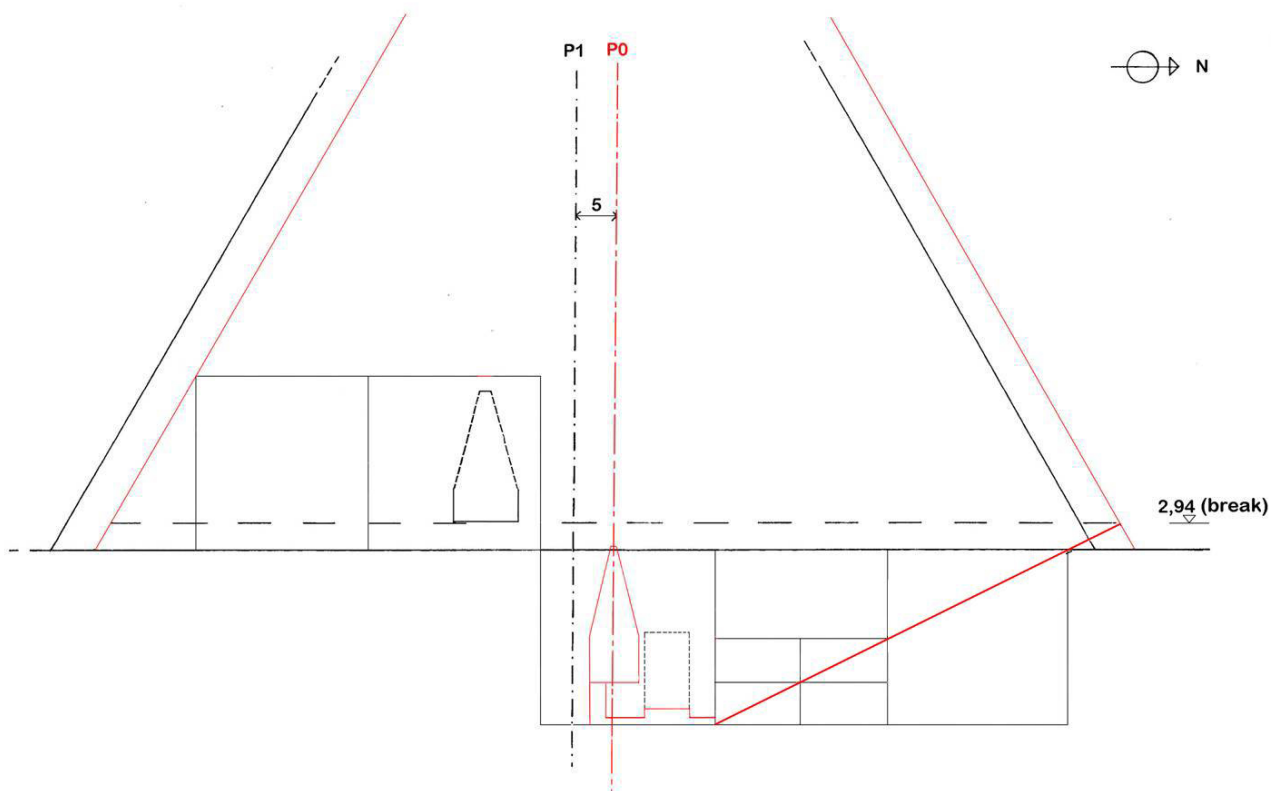


fig. 11 – Comparison between the expected layout of the apartments and pyramid (red) and the current layout of the pyramid (black)

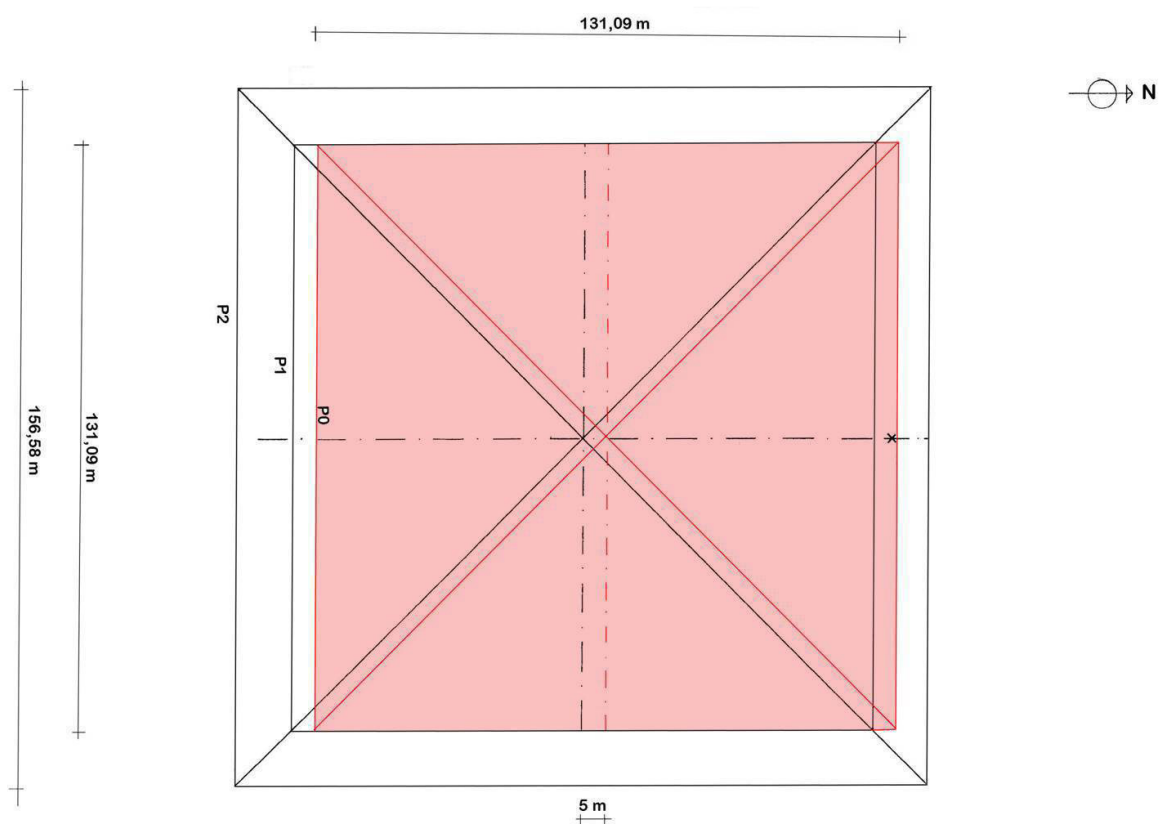


fig. 12 – Comparison between the expected projectual original planimetry (red) and the current ones (black)

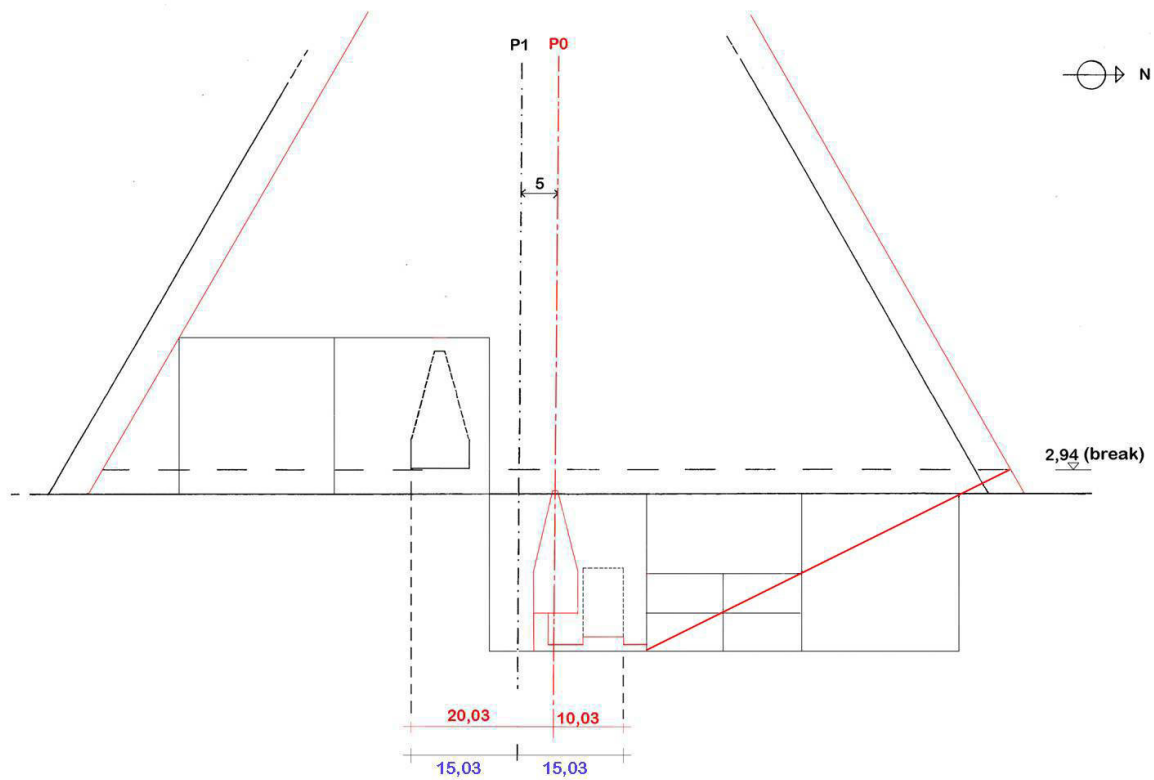


fig. 13 – Shift of the pyramidal axis between the original (red) and current one (black)

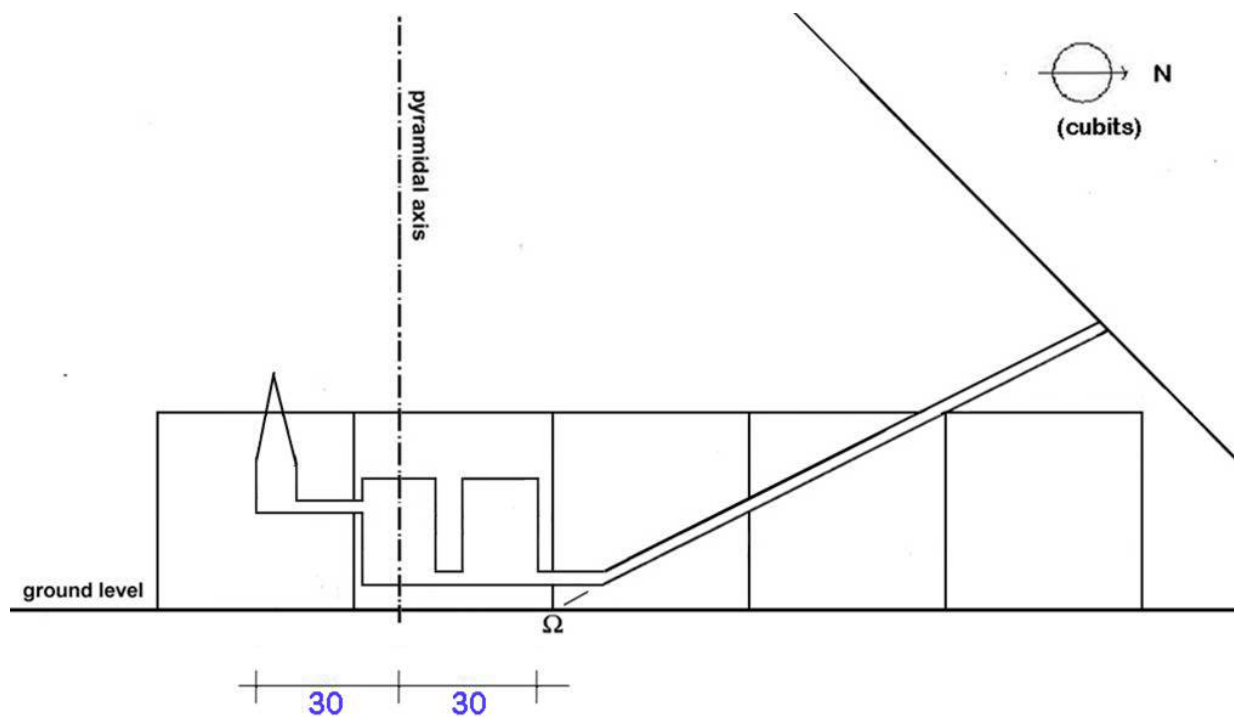


fig. 14 – The symmetry of the innermost part of the apartment of the Northern Pyramid of Snefru (cubits)

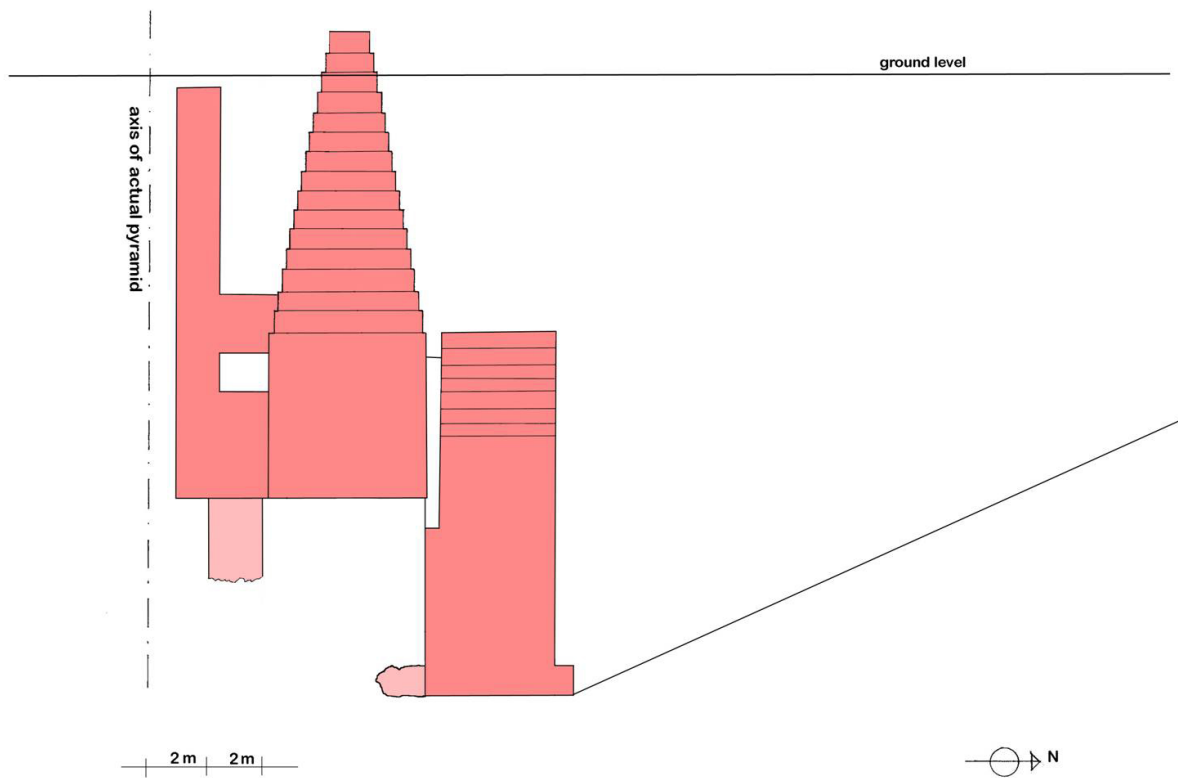


fig. 15 – The deepest rooms of the Southern Pyramyd of Snefru

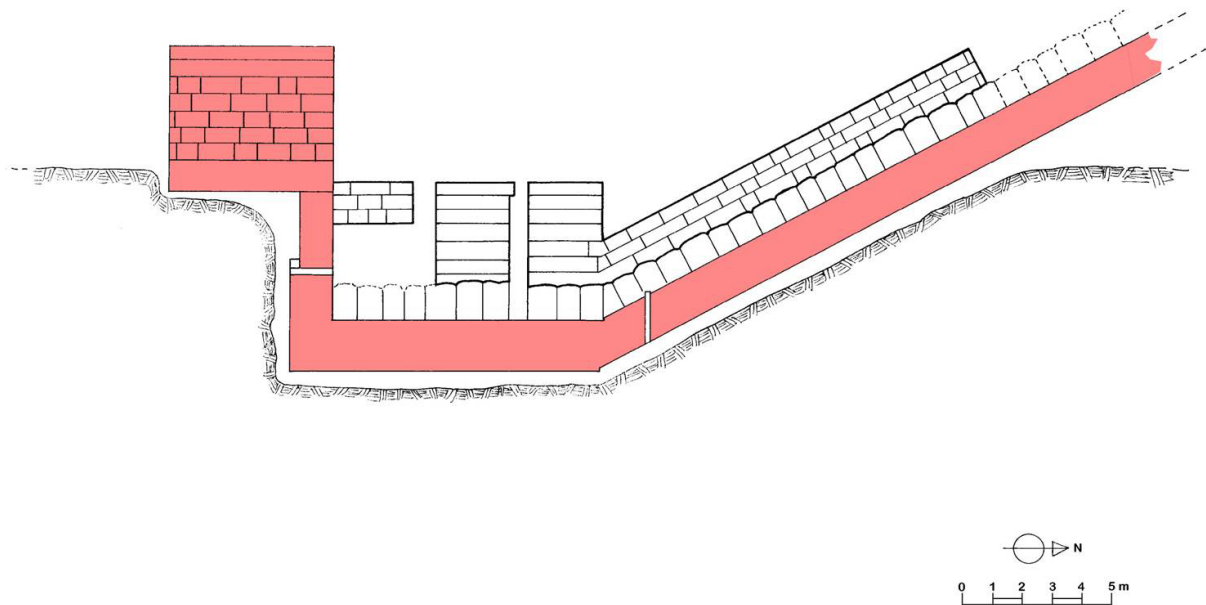


fig. 16 – The apartments of the Pyramid of Meydum

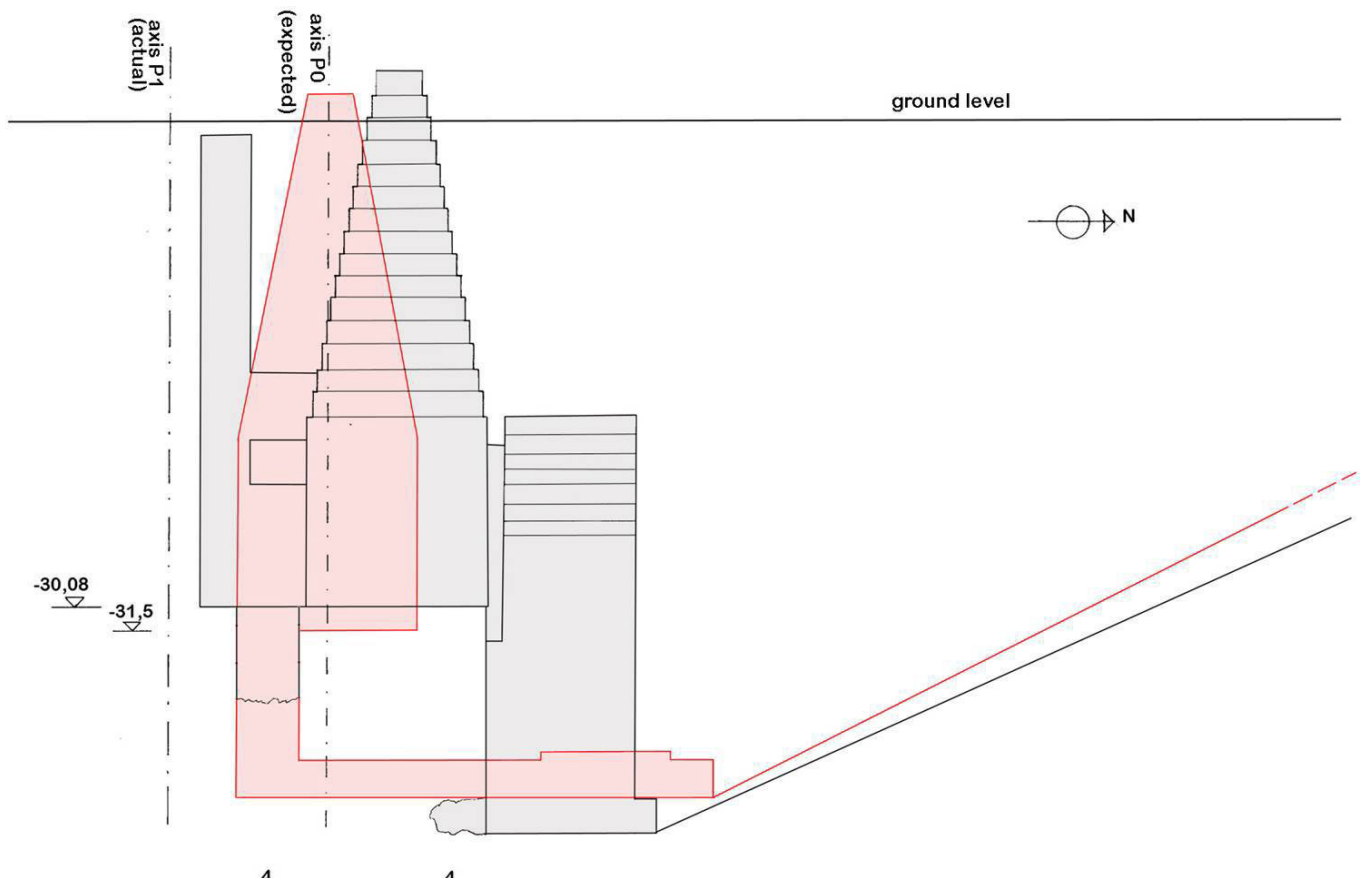


fig. 17 – Comparison between the expected deeper apartment (red) and the current one (black) (cubits)

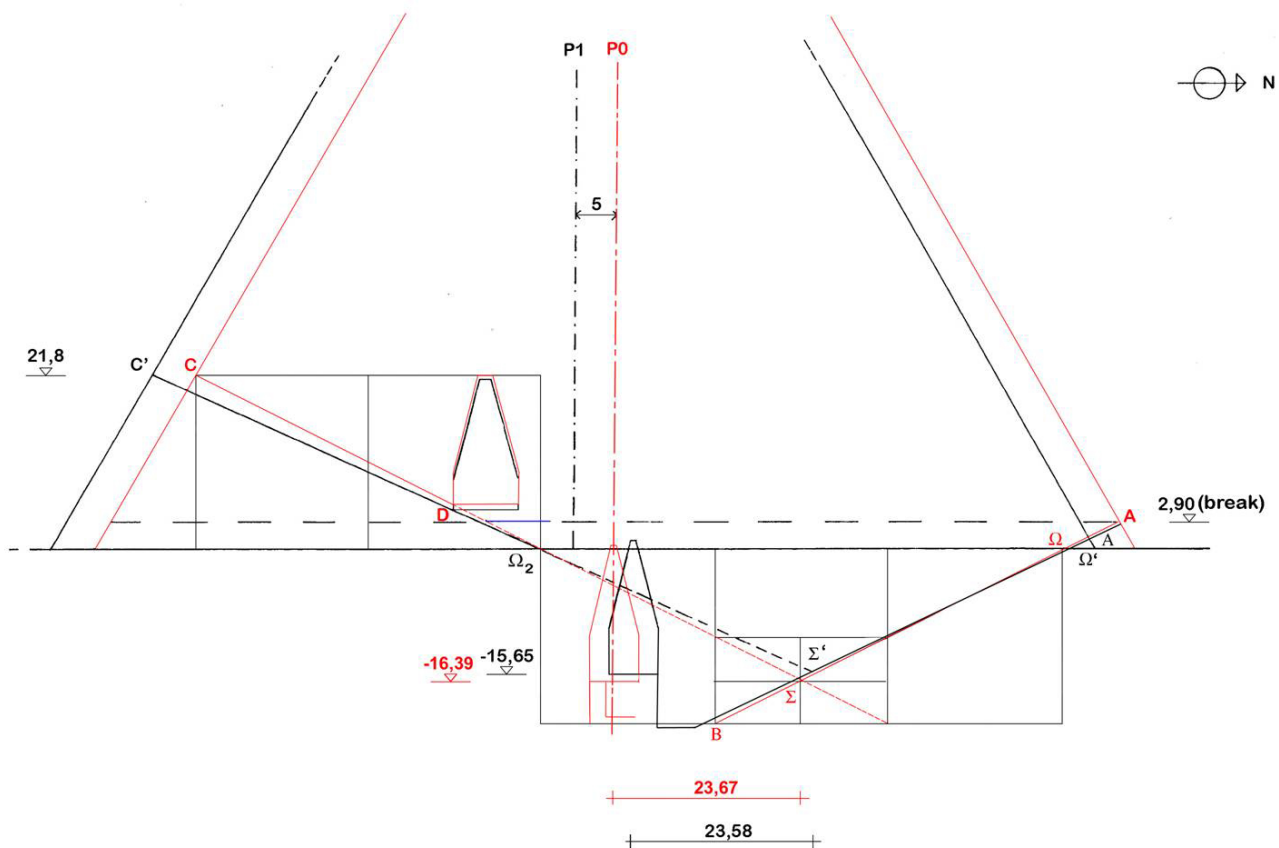
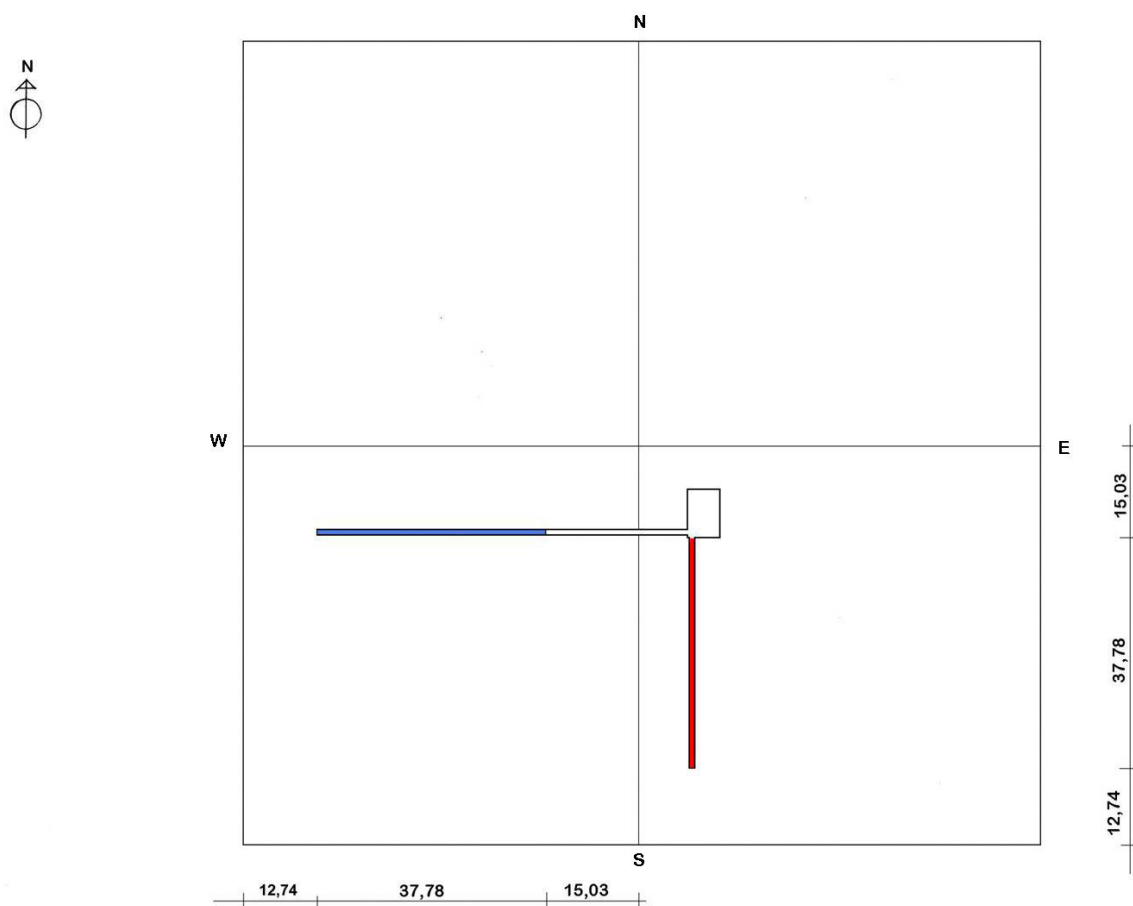
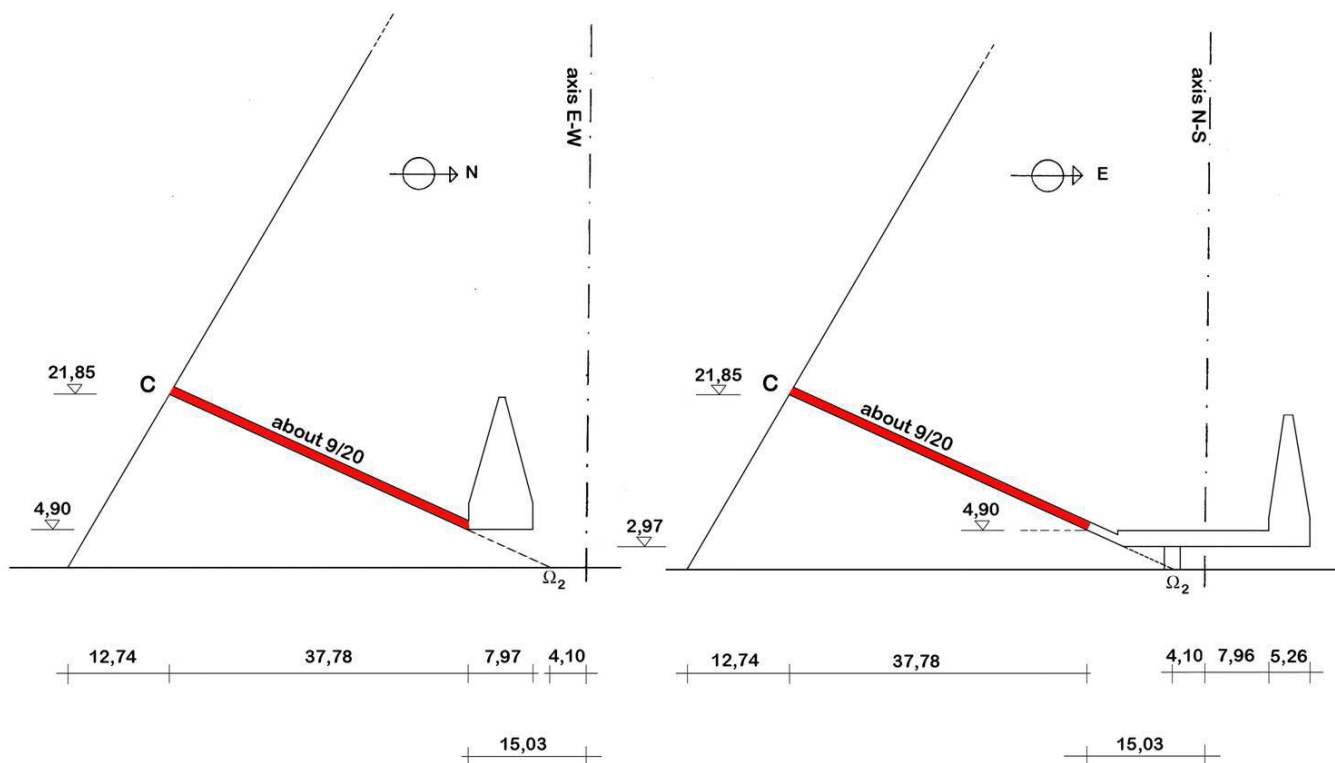


fig. 18 – Comparison between the innermost apartments and pyramid in the original project (red) and the current ones after shifting of the axis (black)



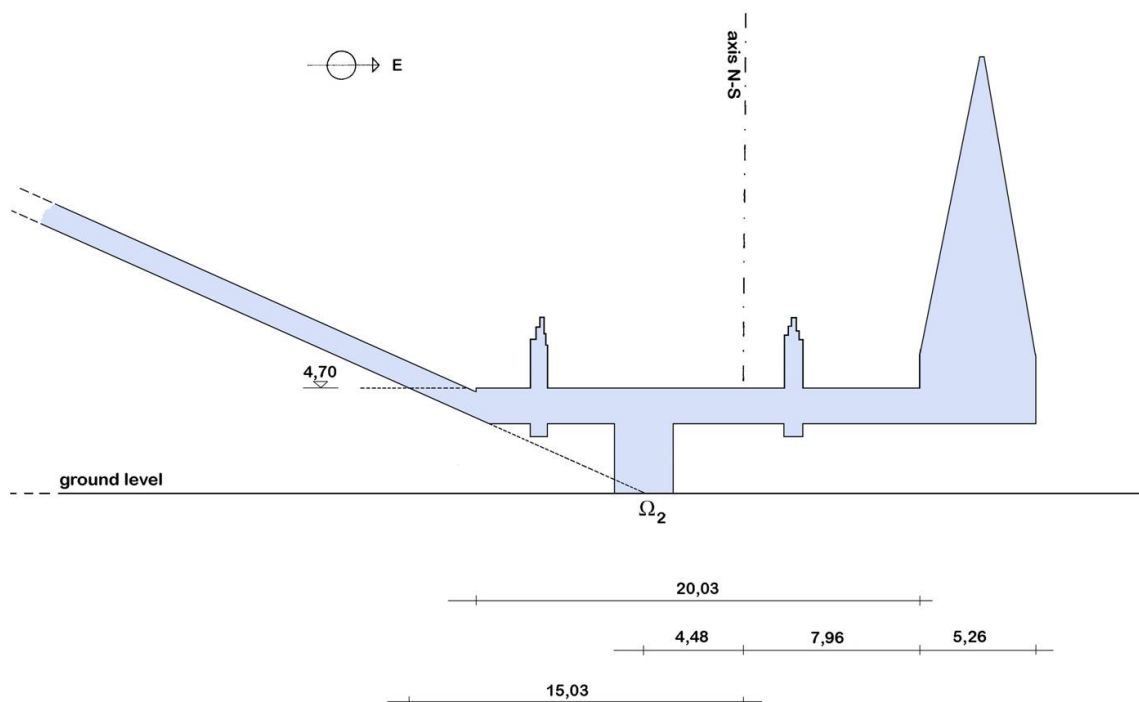


fig. 21 – East-west section of the upper apartment

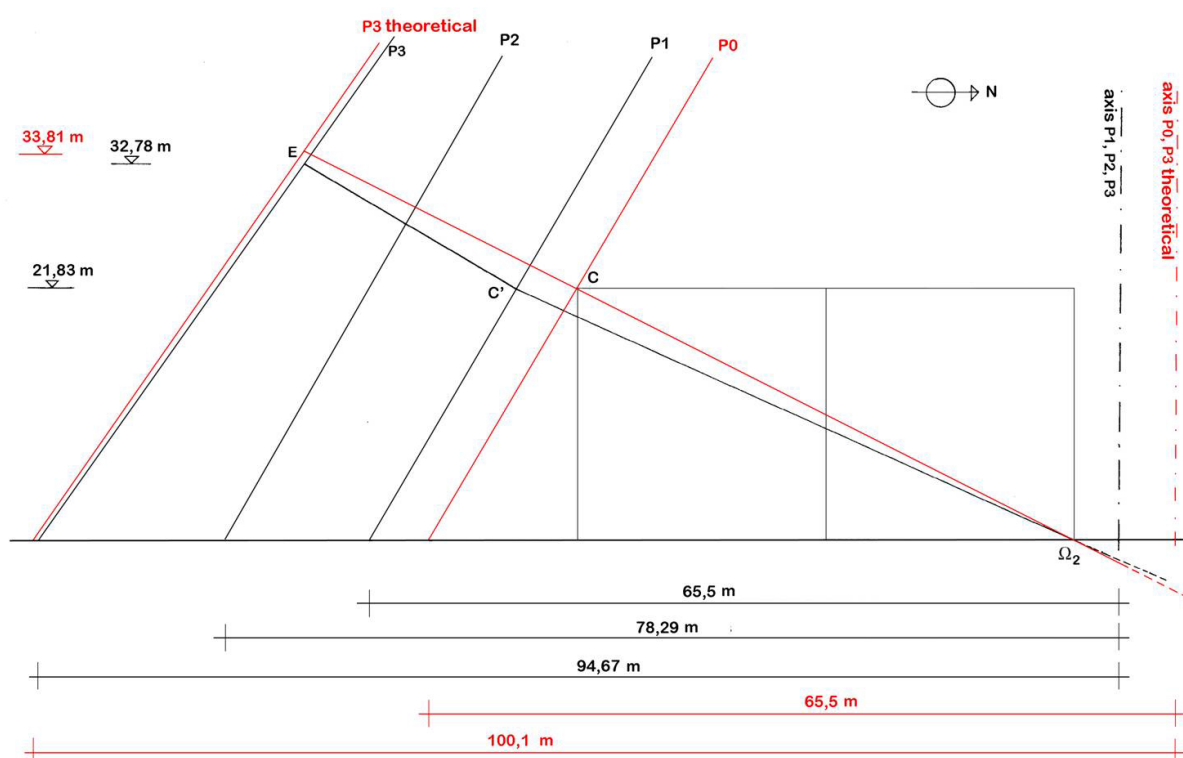


fig. 22 – Comparison between the theoretical projects and measures (red) and the actual and hypothetical pyramids and apartments (black)

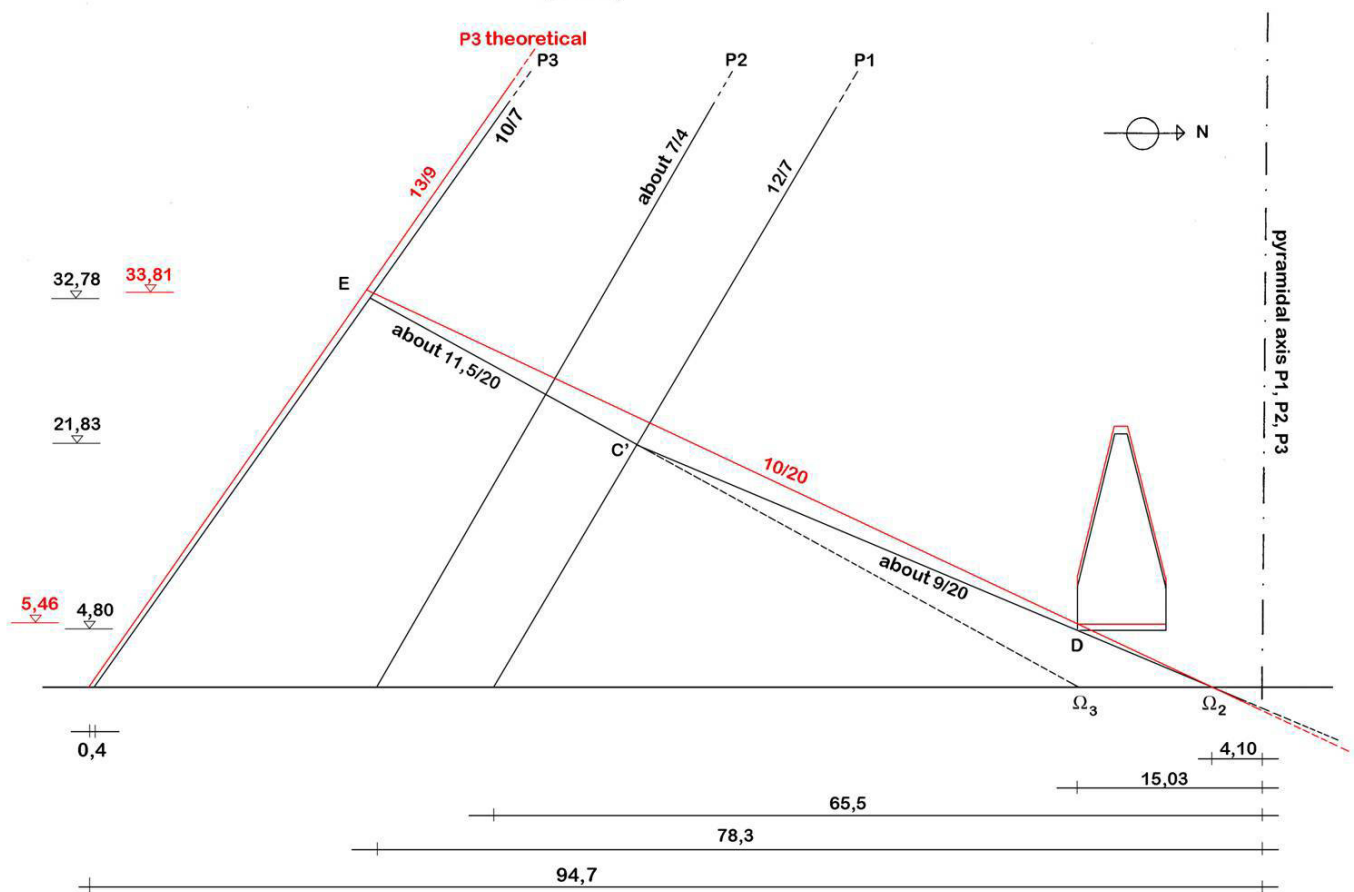


fig. 23 – Comparison between the theoretical project (red) and current one; evidence of Ω_3 point