STEEL CANOPY IN THE ARCHEAOLOGICAL SITE OF KALAPODI

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1. ABSTRACT

The archaeological site of Kalapodi is situated in the area of the ancient Fokis, in the road that connects Atalanti and Delphi. The archaeological importance of the site is not easy to be perceived. In this site, many monuments from the 15th century BC down to Roman Times can be found, side by side or one on top of the other, composing a dense and confusing complex. The importance of the site is well testified from the scientific work of the German Archaeological Institute the last 50 years.
The architectural study of the site aimed to present as much as possible the continuity of the worship during antiquity. The main target was the presentation of the uncovered ancient constructions and the protection of their vulnerable material, as Kalapodi is a very windy, rainy and snowy place. In order to protect the antiquities, a structural steel canopy has been designed that has an orthogonal plan view of 860m^2. As the shelter would be built in an archaeological site surrounded by an untouched environment it should be discrete so as to integrate in the landscape as well as not to impose emphatically its presence over the ruins. This shelter is also expected to serve as a multifunctional structure as an open museum for the visitors.

2. INTRODUCTION

The importance of the archaeological site of Kalapodi is well testified from the scientific work of the German Archaeological Institute and the numerous publications in the course of the last

50 years. Kalapodi is situated in the area of the ancient Fokis, in the road that connects Atalanti and Delphi. It is a very windy and snowy place, near the Atalanti seismic fault in Central Greece.

During the excavations, which have been conducted with interruptions since the ‘70s, mainly two successive temple complexes have been unearthed (Fig. 1), with 13 sacred buildings superimposed one on the other starting from the 15th century BC down to Roman Times. The northern temple complex with two huge succeeding temples from Classical Times has been recovered with earth after excavation in the ‘80s in order to protect its fragile stone material. The southern temple complex was excavated down to the Mycenaean strata in the years from 2004 to 2013. This temple complex is particularly important for different reasons as for the architectural development of Greek sacred buildings that can be seen through time. The archaic peripteral temple possessed wooden columns and a stone pediment. This Archaic temple had been destroyed by the Persians, and the western pediment was found in the place where it collapsed when the wooden construction burnt down. The succeeding Classical phase left the heavily burnt building untouched, as Pausanias mentioned.

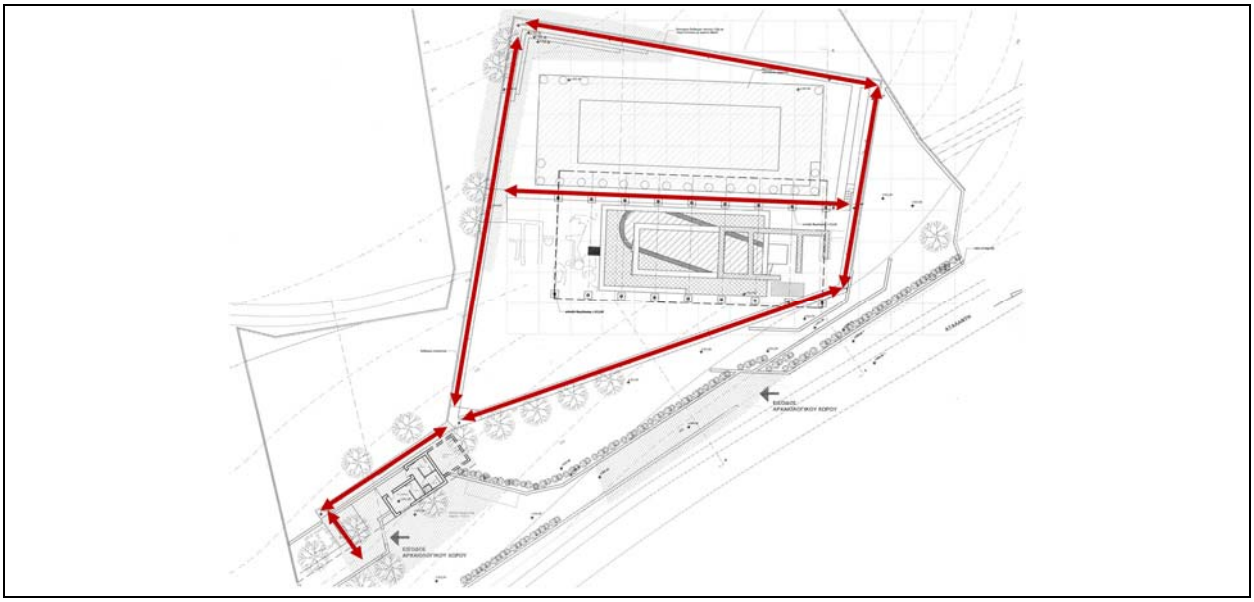

Fig. 1. Kalapodi. The master plan of presentation study, the footpaths.
The circular footpath and in the middle the path between the, southern and the northern.

3. SHELTER FOR THE PROTECTION OF SOUTHERN COMPLEX

The archaeological importance of the site is not easy to be perceived. In this site, many monuments from different eras can be found, side by side or one on top of the other, composing a dense and confusing complex. The site is closed to the public. So, it is isolated from the network of the region’s monuments and as a consequence isolated from the society. A shelter has been designed, as a part of the presentation study of the archaeological site, so as to protect the fragile material of the temples. The main concept of the presentation study aimed to unify the two almost separate monumental parts, the north and south one so as to present as much as possible the continuity of the worship during antiquity *(Fig. 1).* Hence, the

demand to design a shelter for the south complex had to support also the presentation of the north temple, in a simple way leaving the possibility for future research. So, a slight extension of the shelter has been decided towards the north so as to cover also the south colonnade of the north temple.

As the shelter *(Fig. 2)* would be built in an untouched environment, it should protect the temples and in the same time it should be "discrete" as much as possible, so as to be integrated in the landscape. It should also be delicate as a new construction in an archaeological context in order not to impose emphatically its presence over the ruins. It has been considered quite crucial to avoid the imitation of established symmetrical building forms that would provoke misunderstandings. In the same time, it has to be a long-lasting construction, resistant to the extreme conditions of snow, strong winds and seismic activity of the area and in the same time easy to be maintained.

Fig.2. Kalapodi. The final idea for the visit of the temples

Trying to satisfy these requirements the shelter has been designed as a shed roof according to the slope of the site, with a slight change of inclination just for the better protection of the north temple. It is designed to be made of ordinary structural steel and construction type, painted in color of the summer landscape on the exterior of the roof, in light color from the inside so as not to absorb the light and in grey color for the frames so as to be differentiated from the ruins *(Figures 3,4)*. A path has been decided to run along the stylobates at the level of the north temple, allowing the visitors to have a comprehensive view of the south temple from above, reading also some information material in front of them and in the same time admiring the shafts of the north temple. In that way, this intervention in the archaeological site is supposed to declare its presence by the strength of the tranquil. This shelter is also a multifunctional structure since it is expected to offer the conditions as an open museum for the visitors (Fig. 5).

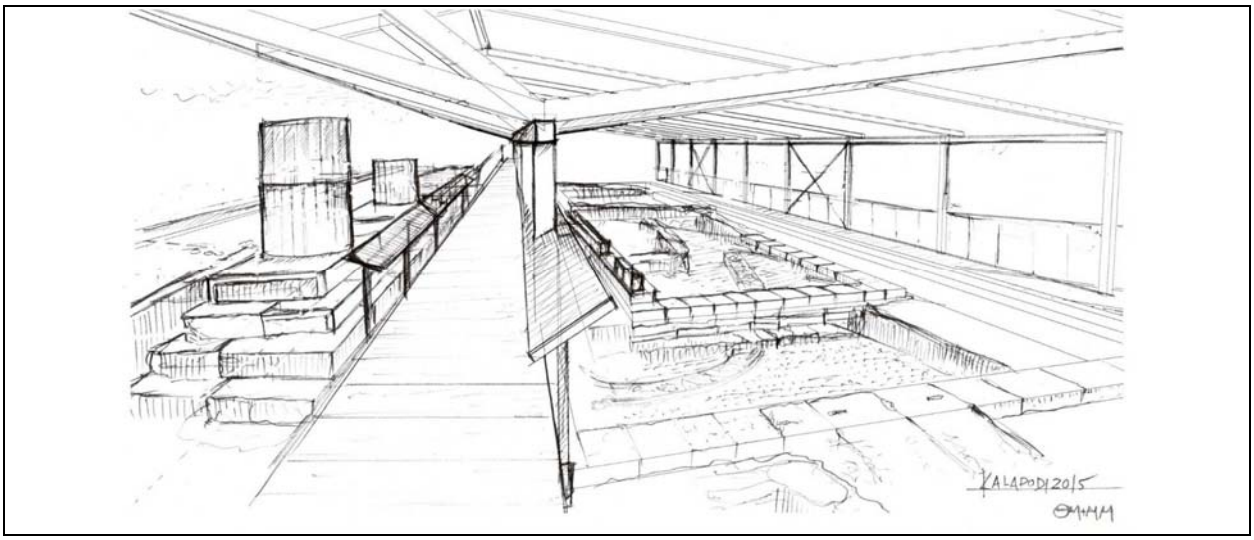

Fig.3. Kalapodi. The first idea for the visit of the temple. View from the path.

Fig.4. Kalapodi. The shelter from inside

Fig.5. Kalapodi. The model of the shelter

4. CANOPY STRUCTURAL SYSTEM

In order to protect the antiquities, a steel canopy has been designed that has an orthogonal plan view with dimensions 21.5x41.85m. It consists of nine (9) parallel, planar frames *(Fig. 6)*. The frames are composed by steel columns that are connected with a triangulated beam having a total span of 15.3m. The final roof cover, of almost 840m^2, is trapezoidal thin-walled insulated steel sheeting *(Fig. 4)*.

Fig. 6 presents the elevation of the typical frame. The column at axis A is a standard HEA300 profile, while the column at axis B is stronger (HEB300). The columns are connected by a HEA300 beam which has a bracing connecting its mid-span with the column at axis B. This specific configuration was adopted in order to significantly increase the lateral stiffness of the frame, while it gives an architecturally interesting shape, emphasizing the required asymmetry of the structural form. The columns are supported on standard reinforced concrete footings.

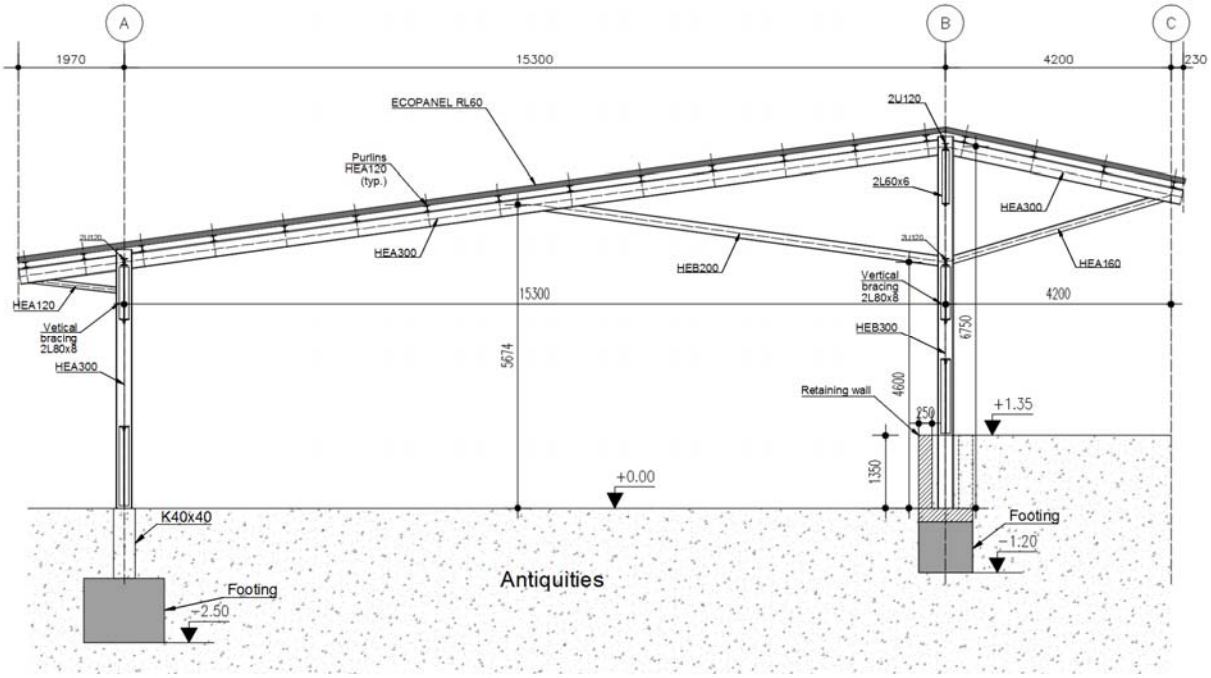

Fig.6. The typical frame

The roof system is extended with triangulated cantilevers beyond axes A and B. Fig 7 presents the elevation along the longitudinal axis of the buildings (axis A), while Fig 8 presents the elevation along axis B. The spatial stability of the typical frames is ensured through the arrangement of standard X bracings. At these locations (between axes 3-4 and 6-7), larger foundation elements are arranged that easily undertake the increased lateral forces transferred by the bracings. The footings at axis B are connected together by a reinforced concrete retaining wall that supports the pathway between the two temples.

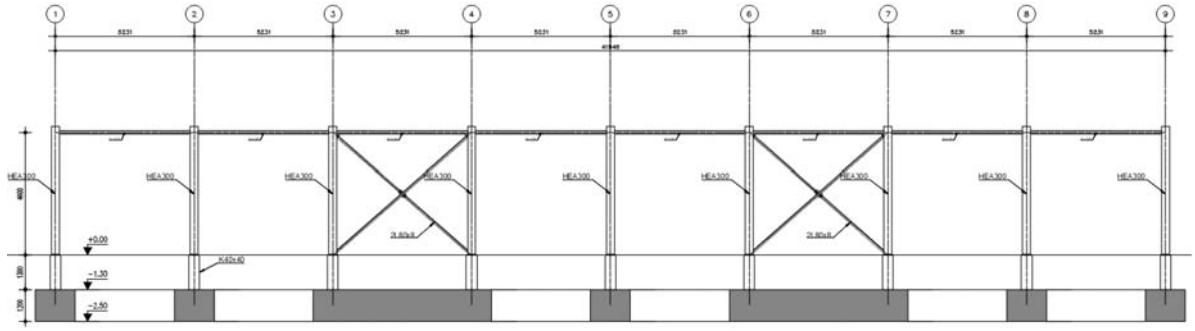

Fig.7. Elevation at axis A

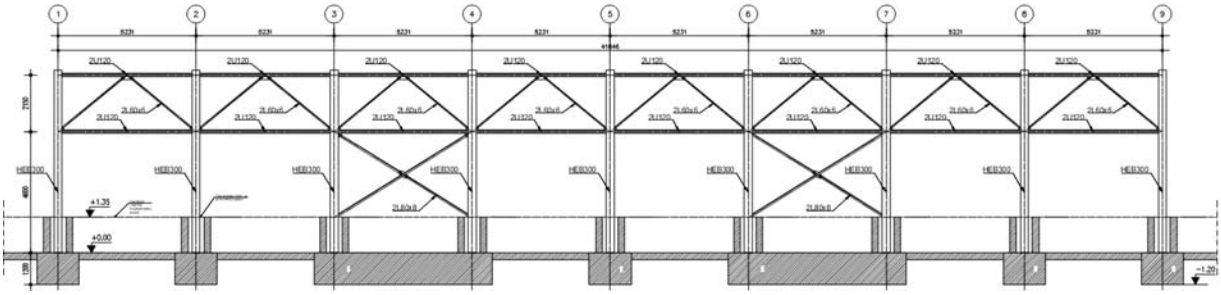

Fig.8. Elevation at axis B

On top of the main beams, standard HEA120 purlins are placed that receive the insulated panel. The roof system is completed by means of appropriate roof bracings (Fig. 9).

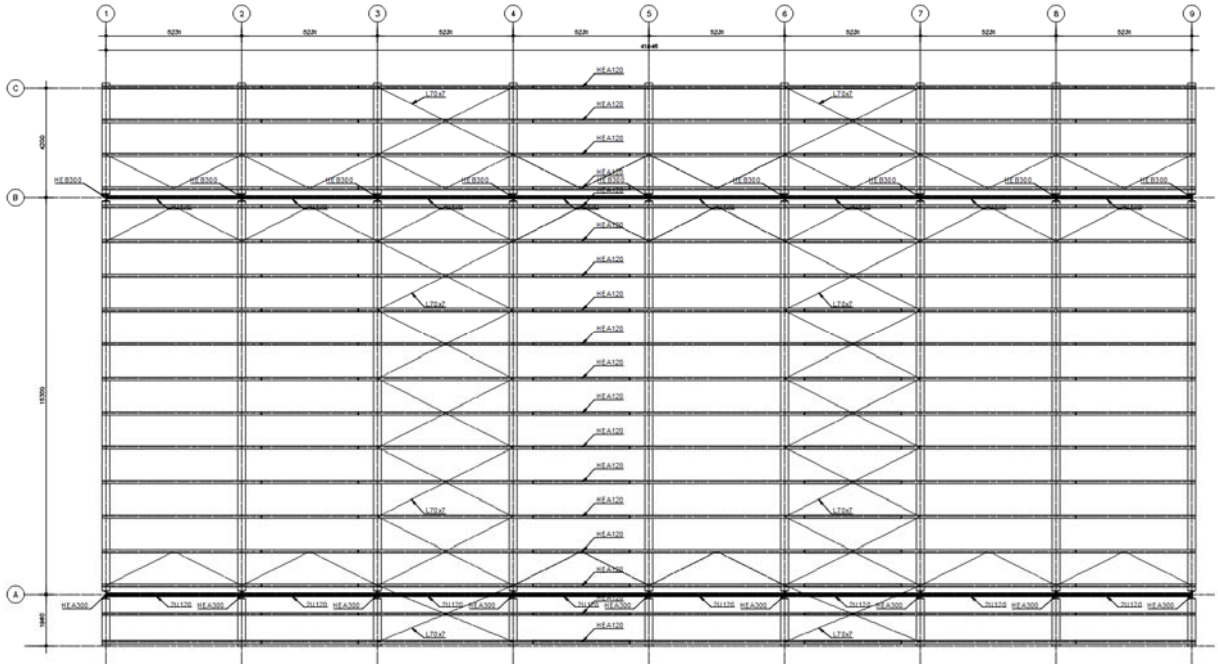

Fig.9. The roof structural system.

As mentioned earlier, the location of the structure suffers from strong winds and heavy snowfalls. The corresponding loadings were considered in the design according to the Eurocodes framework. Regarding the wind loading, a design wind velocity of 27m/s was taken into account, according to Eurocode 1-part 1.4 [1]. The canopy was considered as an open structure, and a total of 15 different load combinations were considered in the design. For the snow loading, the calculations according to Eurocode 1-part 1.3 [2] led to an imposed load of 1.9kN/m^2. Finally, the seismic design was done according to the Greek seismic code [3] for design ground acceleration a_g=0.24g, critical damping ζ=0.04, importance factor γ_I=1.0 and behaviour factor q=1.5. For the structural calculations, an appropriate analysis model was used (Fig. 10) and the design of the steel members was done according to Eurocode 3-part 1-1 [4].

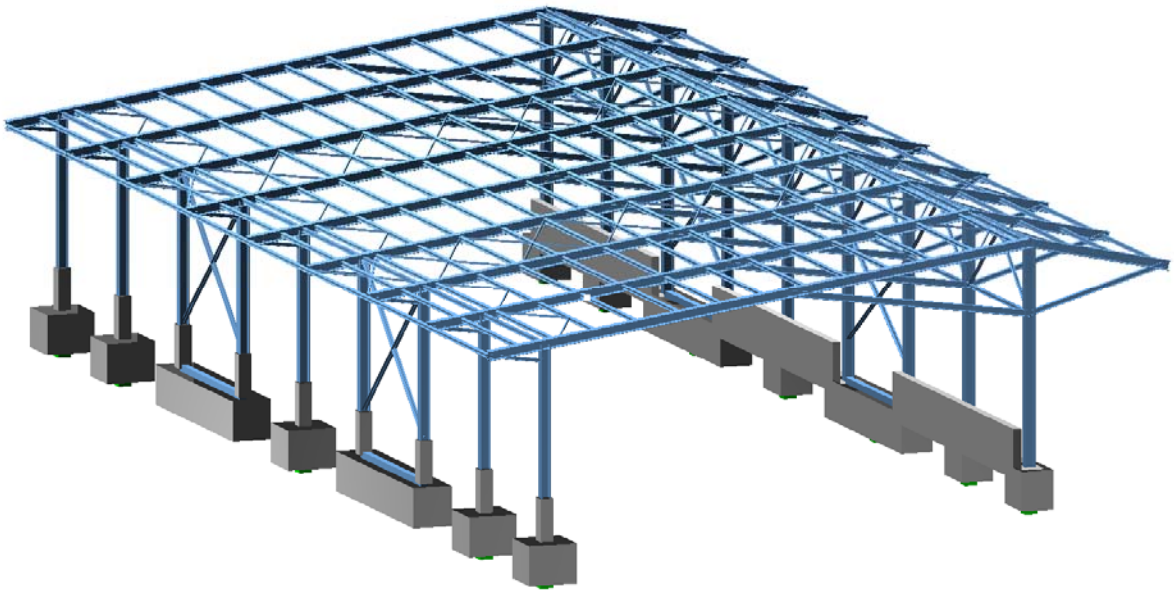

Fig.10. The structural analysis model of the canopy

5. REFERENCES

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[2] EN1993-1-1, Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings, European Committee for Standardization, 2005.

[3] EAK2000, Greek Code for Seismic Resistant Structures, Organization for Earthquake Resistant Planning and Protection, Ministry for Environment Planning and Public Works 2000.

[4] EN1991-1-3, Eurocode 1 - Actions on structures - Part 1-3: General actions -Snow loads, European Committee for Standardization, 2003.

ΜΕΤΑΛΛΙΚΟ ΣΤΕΓΑΣΤΡΟ ΣΤΟΝ ΑΡΧΑΙΟΛΟΓΙΚΟ ΧΩΡΟ ΚΑΛΑΠΟΔΙΟΥ ΦΘΙΩΤΙΔΑΣ

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ΠΕΡΙΛΗΨΗ

Ο αρχαιολογικός χώρος του Καλαποδίου εντοπίζεται επί της δημόσιας οδού Αταλάντης-Δελφών. Στον χώρο βρίσκονται τα ερείπια ενός αρχαίου ιερού το οποίο παρουσιάζει συνεχή λατρευτική δραστηριότητα από τον 14ο αιώνα π.Χ. μέχρι τους αυτοκρατορικούς χρόνους. Η μεγάλη σημασία του έχει γίνει γνωστή, ύστερα από τη συστηματική έρευνα που διεξάγει το Γερμανικό Αρχαιολογικό Ινστιτούτο, ήδη από την δεκαετία του ‘70. Τα ευρήματα έως σήμερα, εντοπίζονται σε δύο μνημειακές ενότητες στις οποίες παρατηρείται μια αλληλουχία θεμελίων ξεχωριστών περιόδων που βρίσκονται σε επάλληλα βάθη.
Στόχος της μελέτης είναι η ανάδειξη του αποκαλυμμένου μνημειακού συνόλου και η προστασία του ευπαθούς πορώδους υλικού. Το στέγαστρο θα περιορίσει την συνεχή φθορά από τις ακραίες συνθήκες που ισχύουν στην θέση αυτή. Το αρχαίο μνημειακό σύνολο θα παραμένει προστατευμένο ανεξάρτητα από την αμφίβολη δυνατότητα συνεχούς φροντίδας και συντήρησης της εποχής. Το μεταλλικό στέγαστρο που προτείνεται καλύπτει έκταση επιφάνειας 860m^2 και συνδυάζεται με την κατασκευή διαδρόμου επίσκεψης των ναών. Κατά συνέπεια, δεν προορίζεται απλά μόνο ως ένα στέγαστρο προστασίας αλλά δημιουργεί τις συνθήκες για την πολυεπίπεδη προσέγγιση του χώρου ως ένα επιτόπιο μουσείο.