From Survey to Representation of ancient monuments: new methodology and technology

The cases of the Golgotha site in Jerusalem and the Stoa of Eumenes at the South Slope of the Acropolis of Athens

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The purpose of this paper is to present the characteristics of laser scanning technology, based on two examples for the modeling at the reconstruction of the Golgotha site in Jerusalem and the ancient Stoa of Eumenes II, located at the South Slope of the Athens Acropolis. Terrestrial 3D laser scanning is a new methodology for three dimensional object modeling. Especially, the reconstruction of the ancient Stoa of Eumenes II comprises one of the most important restoration programs of the Greek Ministry of Culture. This paper will focus on the main steps of the laser scanning processing chain, starting from the acquisition of the data and ending with the evaluation of the 3D models.

Keywords: *Golgotha; Eumenes Stoa; Laser scanning; archeological architectural documentation*

This paper initially presents the aspects of the inquiring subject of the archaeological and architectural documentation of an ancient monument, aiming at the more precise representation and attribution of its constructional phases through time. The use of digital technology in this case such as 3d laser scanner and point cloud operations in AutoCad environment, imports a new methodology to the exploitation of the archaeological and architectural data, but also a new aesthetics in the planning and the attribution of architectural representation of ancient buildings and archaeological sites. With the growth of questioning, that concerns the coexistence of digital technology with the traditional techniques of research and documentation in the Architectural Heritage, the lecturer will present two concrete cases of monuments, studied with the new methods.

The scientific representation of the Golgotha in Jerusalem, during the period of the Crucifixion of Jesus Christ, constitutes product of this questioning and central subject of this speech. With the supervision of the Academician and Professor Emeritus George Lavvas (2004), responsible for the Archaeological, Architectural and Survey Research project for the Temple of Resurrection (Moutsopoulos, 2005), this difficult undertaking is completed, developing the possibilities that the new technologies can give, in combination with the archaeological data of the excavations and the precise surveying measurements in the foundation of the Temple.

The excavations in the Golgotha site, elected certain essential points of its topography, as that the

wider region around the temple of Resurrection was already an ancient quarry from the 7th century B.C. and a tomb area, in which at least four tombs were revealed. The Tomb of Christ was one of them, carved on the rock of the quarry. At the excavations of 1987 from the Professor George Lavvas, an earthquake crack was revealed on the top of the rock of Golgotha, while the measurements and the excavation sections restore the real 3d topography of Golgotha, not as a hill (Lavvas, Lefantzis 2001), but as a ledge of rock in the ancient quarry.

The Stoa of Eumenes II is a long, two-storeyed building measuring 163.00 m in length and 17.65 m in width. This building was a gift to Athens from the king of Pergamon, Eumenes II (197-159 BC).

Most clearly seen today, is the retaining wall constructed by conglomerate blocks and in front 42 arches of hard Piraeus Actites. A part of the Stoa's inner wall has also survived, as well as the foundation of the interior colonnade's bases and the foundation of the exterior stylobates.

The arches and their buttresses have suffered a great number of cracks and ruptures.

The conglomerate blocks behind the arches are also in a very bad condition. They are worn with large parts missing, which leads to the elimination of their structural stability.

In 2002, at the beginning of the restoration project of the Stoa of Eumenes at the South Slope of the Acropolis of Athens by the Greek Ministry of Culture (Lefantzis, Mpriana, 2005), it became obvious that only a "total station" survey, could present the geometrical and structural divergences of the monument.

For the most complete, therefore, architectural and archaeological documentation of the monument was rendered necessary the existence of a complete digital system of data in which would be included also an accurate 3d model. This special survey yielded a particularly important background of information on the existing situation of the monument and on its structural maintenance and restoration.

For the definition of the geometrical form of the monument and the creation of a 3d model, a 3d laser scanner system was used (CYRAX), combined innovatively with all the essential surveying procedures.

Since this system has not been used never up to now as a basic system for the architectural survey of ancient monuments in Greece, we had to find a new method, in which the product of these scannings, the Point Cloud, could be transformed in the AutoCad environment as a detailed architectural drawing.

The retaining wall's East arches were the first to be restored. Fragments have been joined with the use of white concrete, stainless metal bars and supplemented partially with new Piraeus Actites replicas.

Restoration also part on the conglomerate retaining wall, which was in great danger of collapsing. This retaining wall has been restored by using ancient conglomerate complete blocks, taken from the area of the South Slope of the Acropolis.

Marble fragments belonging to the Stoa have been collected, grouped and documented in a project of architectural research for the reconstruction of some marble parts of the monument (Lefantzis, Jensen, 2006). Many of them, after the research, can be placed at their exact position on the monument.

References

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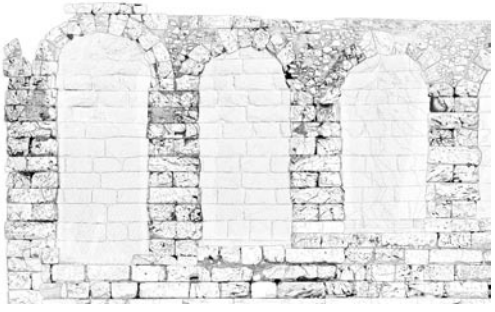

Figure 1
Architectural interpretation of the Laser scanner's point cloud (AutoCad environment), at the retaining wall of the Stoa of Eumenes (Lefantzis, Pagounis, 2004)

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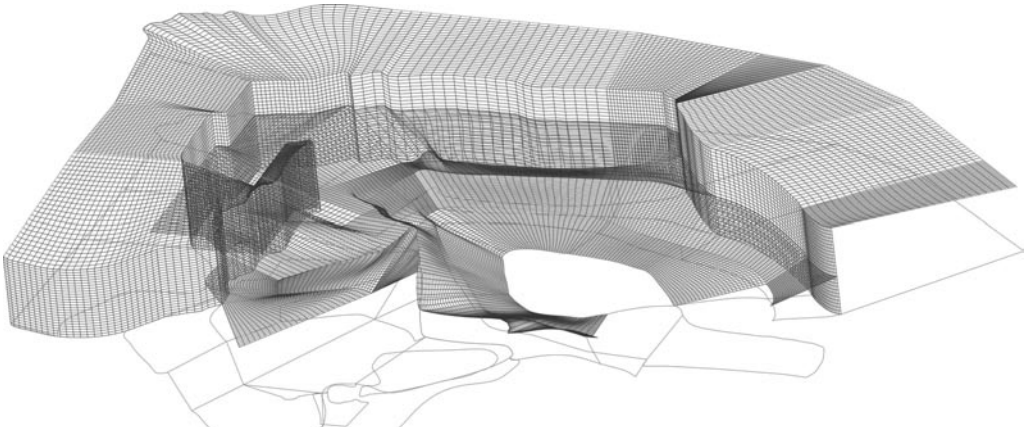

Figure 2
3D surface elaboration of the geometric model of the site of Golgotha, Jerusalem. (Prof. G.Lavvas, Dr. M. Lefantzis, architects, 2002)

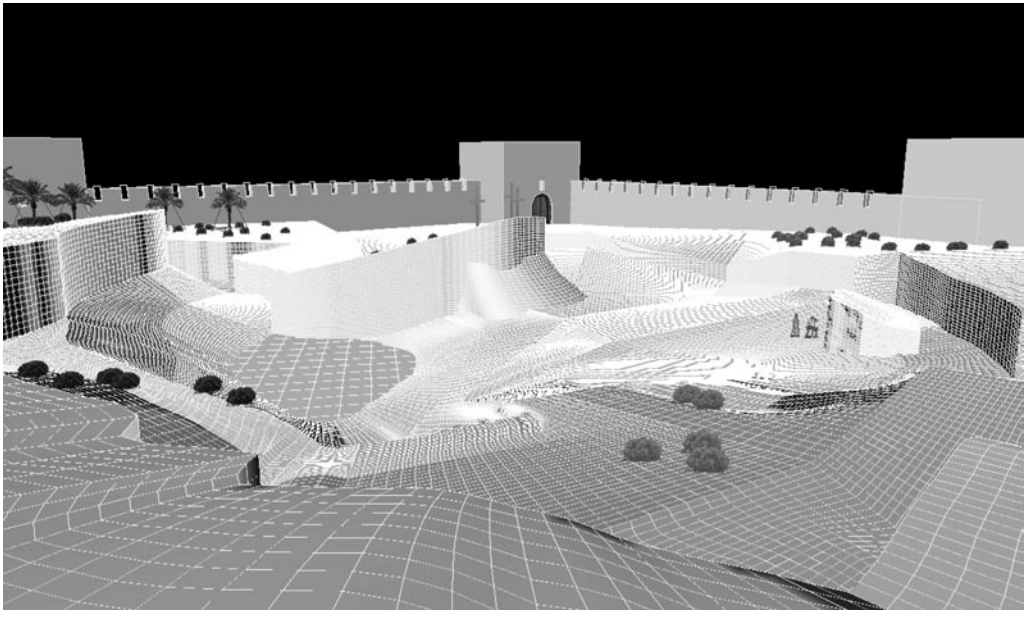

Figure 3
3D surface elaboration of the geometric model of the site of Golgotha, Jerusalem. (Lavvas, Lefantzis, architects, 2002)

Figure 4
Rendered 3D representation of the site of Golgotha, Jerusalem. (Lavvas, Lefantzis, 2003)

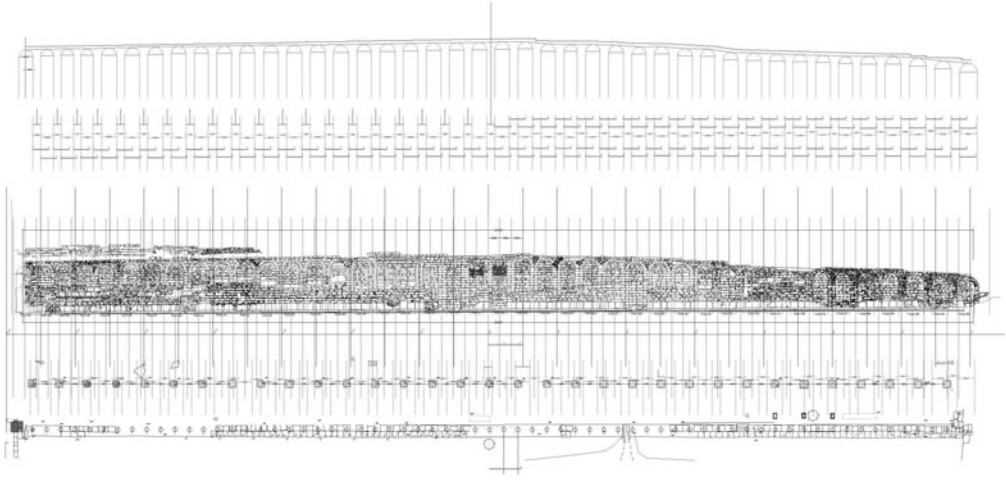

Figure 5
Geometric approach of the south view of the retaining wall of the Stoa of Eumenes (Lefantzis, 2004)

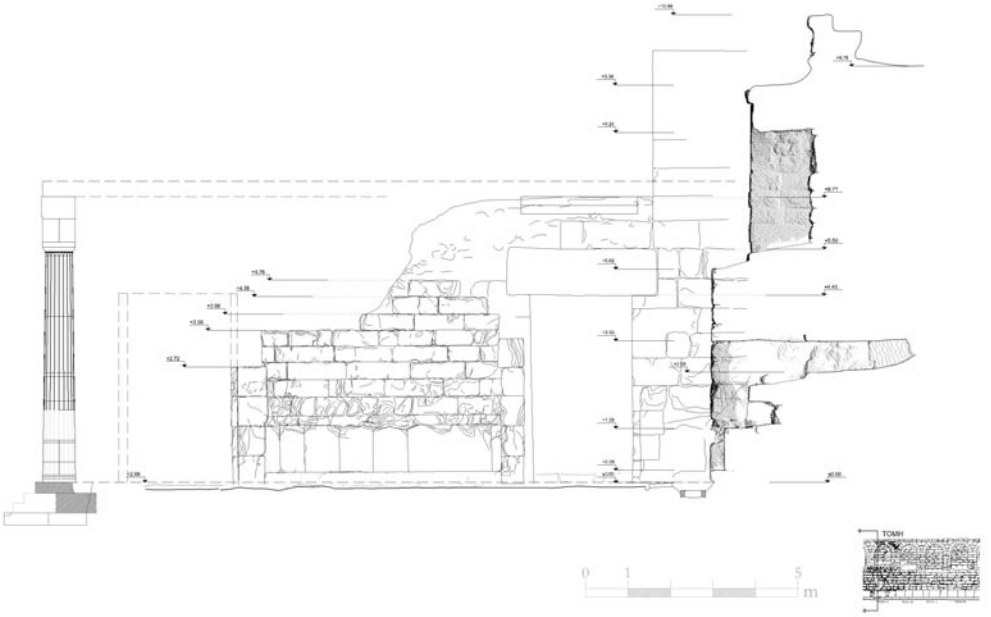

Figure 6
Architectural interpretation of the Laser scanner's point cloud (AutoCad environment), at the west side wall of the Stoa of Eumenes (Lefantzis, 2005)

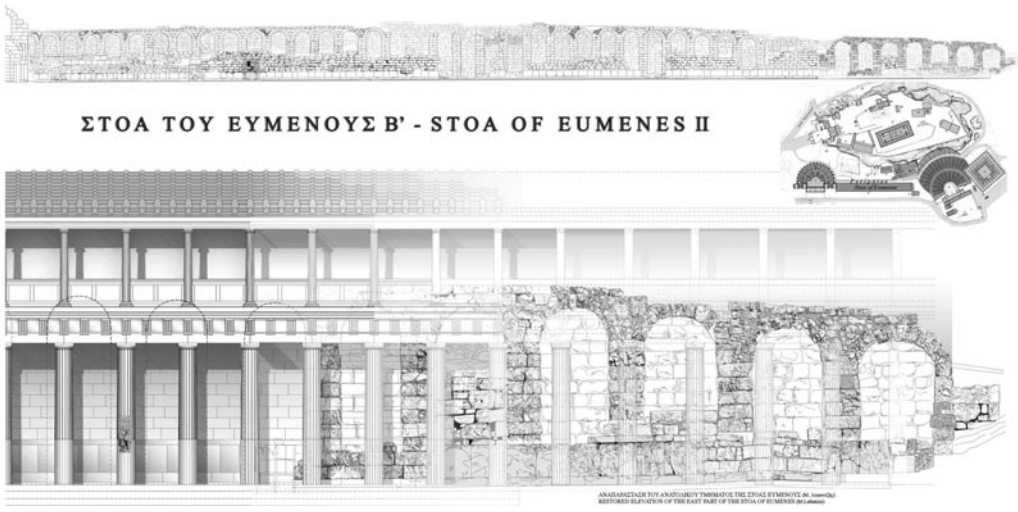

Figure 7
Reconstruction of the monument for the Greek Ministry of Culture (Lefantzis, 2006)