

Geometry, Mechanics and Architecture: The dome of the Diana's temple at Baia

A. Sinopoli*, Valenti G.M. †, Romor J. †, D. Aita††

* Emeritus Professor, Sapienza University
e-mail: anna.sinopoli@uniroma1.it

† Sapienza University
Department of Architecture History, Design and Restoration
e-mail: grazianomario.valenti@uniroma1.it

††Pisa University
e-mail: danila.aita@unipi.it

ABSTRACT

The main purpose of this paper, which belongs to a research project started in 2018 [1], is that of investigating the geometry and stability of the dome of the Diana's temple, which survived with its half part along many centuries. *Opus caementicium* in fact allowed the Romans to build domes and vaults of great amplitude, thanks to an expert use of rubble, mortar, laying techniques and, above all, geometrical parameters, especially as regards to the appropriate outline of the profile and the choice of span and thickness to ensure stability.

In this respect De Angelis d'Ossat [2] affirms: "We do not know if the dome's profile – graphically never detected – corresponds to either one or more curves (catenary, *parabola*, circle's arcs), nevertheless the typical curve trend by us defined as ovoid, can be usually observed in the vaults of all the ancient Orient, by starting from the rare significant Egyptian examples of barrel vaults".

After in time, Rakob [3] tried to solve the debated question of the dome profile through a photogrammetric analysis. As result he proposed a polycentric profile composed of two circle arcs characterized by different *radii* and aligned circle centers in order to guarantee the tangency continuity at the parallel connection. However, while the circle center of the lower arc lies at the same height of the dome springing, the center of the upper arc is located at a low strange position unlikely ascribable to an easy and efficient building technique. It is probable that Rakob followed the analyses performed by Choisy [4], who observing the form of many Egyptian vaults, proposed a simple oval form composed of circle arcs with aligned centers and suggested how it might be constructed using a simple system of strings [5]. This is not the case of the profile suggested by Rakob. As a matter of fact, the oval form appeared in Europe in Roman times for the design of amphitheaters, while it seems that the Romans did not built oval domes made of circle arcs: the central symmetry was considered a requisite.

It is the Authors opinion that ascertaining the geometric profile of a dome is not only a matter of measuring, but also of historical geometric knowledge, constructive tradition and problems posed in practical building by the use of a given profile [6].

By taking into account all the points above, and on the base of the data of the architectural relief performed by Valenti and Romor [1] for the intrados of the Diana dome through two instrumental technologies (3-D laser scanning and digital photogrammetry), this paper aims at illustrating the analytical elaborations of the obtained measures. They will allow to identify both the theoretical design probably proposed by the architect and the building technique adopted to proceed in elevation during the constructive phases. Finally, mechanical considerations on the validity of the most probable parabolic profile so identified and the consequent stability of both the overall and damaged structure will be made.

REFERENCES

- [1] Sinopoli A., Valenti G.M., Bruno M., Conti C., Romor J. and Martines G. (2018), Primato romano delle volte: Il tempio di Diana a Baia, *Proceedings of the International Conference on History of Engineering*, Naples, April 23-24, 2018, D'Agostino S. and d'Ambrosio Alfano F.R. (eds.), Cuzzolin Editore, Napoli 2018, Vol I, pp. 57-72.

- [2] De Angelis d'Ossat G. (1977), L'architettura delle «Terme» di Baia, *Atti dei Convegni Lincei*, 33, Roma, Accademia Nazionale dei Lincei, pp. 227-274.
- [3] Rakob F. (1988), Römische Kuppelbauten in Baiae, in «*Mitteilungen des Deutschen Archäologischen Instituts, Römische Abteilung*», 95, pp. 257-301.
- [4] Choisy A. (1904). *L'art de bâtir chez les égyptiens*. Paris: E. Rouveyre.
- [5] Huerta, S. (2007). Oval domes: History, Geometry and Mechanics, *Nexus Network Journal*, 9(2), pp. 211-248.
- [6] Migliari R. (1995). Elissi e ovali: epilogo di un conflitto, *Palladio*, 8 (16), pp. 93-102.