

IDENTIFICATION OF THE PATTERN OF AN ATYPICAL ANCIENT THEATRE USING ANALYTICAL TECHNIQUES

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Abstract

An ancient Greek (4th century BC) theatre of very unusual, consisting of a arcuate wing and a smaller linear wing of seats, style has been excavated near Patras, Greece. Because of their poor foundation many of the slabs, defining the rows of the seats, have slid from their original position, making the reconstruction of the exact geometry of the ancient structure not easy. In order to identify this geometry, the best preserved arcuate rows of seats were analytically approximated by circles and the linear lines by straight lines. The results of this analytical approach is that the design of this ancient theatre seems to be based on a 90⁰ arc of a circle. The arcuate rows of the seats correspond to concentric circles, while the linear rows of the seats are normal to the chord of the design arc.

1. Introduction

Archaeological excavations brought to light between 1984 and 1989 remains of a small ancient theatre next to the fortified archaeological site (Fig. 1), close to the modern village of Makyneia, at a distance approximately 20 km from Patras.

The Makyneia theatre is very unusual (Fig.2a, 2b). While all the other known theatres of this period are symmetric (Dinsmoor,1975) (Fig. 2b), the Makyneia theatre is asymmetric and includes an arcuate wing, consisting of 12 arcuate rows, and a linear wing at the right side, consisted of 3 rows, probably corresponding to seats for honored people.

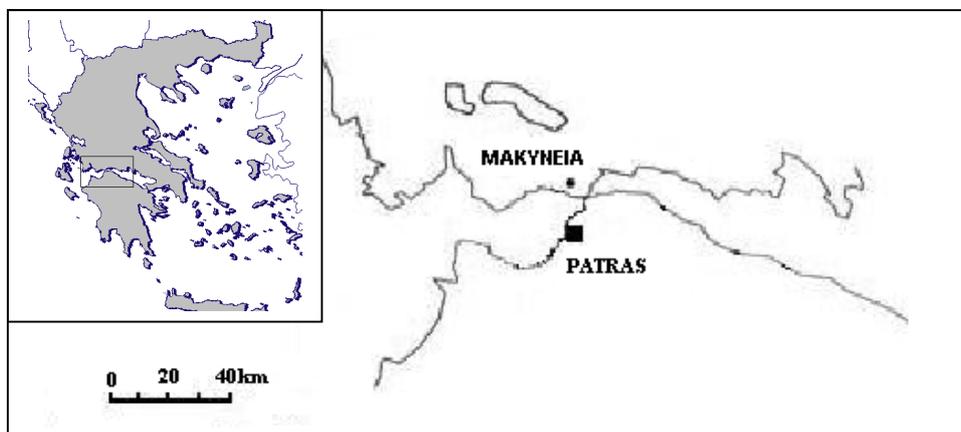


Figure 1: Location map of Makyneia

The seats were made of hewn sandstones slab, fixed on slightly excavated ground without mortar. Because of the instability of slab foundation and the bad geological conditions many of these slabs have tilted or even slid from their initial position. For this reason the details of the original geometry of the ancient structure are not known.

In 1998, a topographic study of the theatre (Fig.3) and the broader ancient site was made in the framework of the research activities of the Geodesy and Geodetic Applications Laboratory of the Department of Civil Engineering of the Patras University. An effort at the identification of the geometry of the ancient structure was made, based on a graphic approximation of the ancient structure by idealized geometric figures (circles and straight lines). In order to improve the modelling of the structure, analytical approximation techniques are adopted in this article.

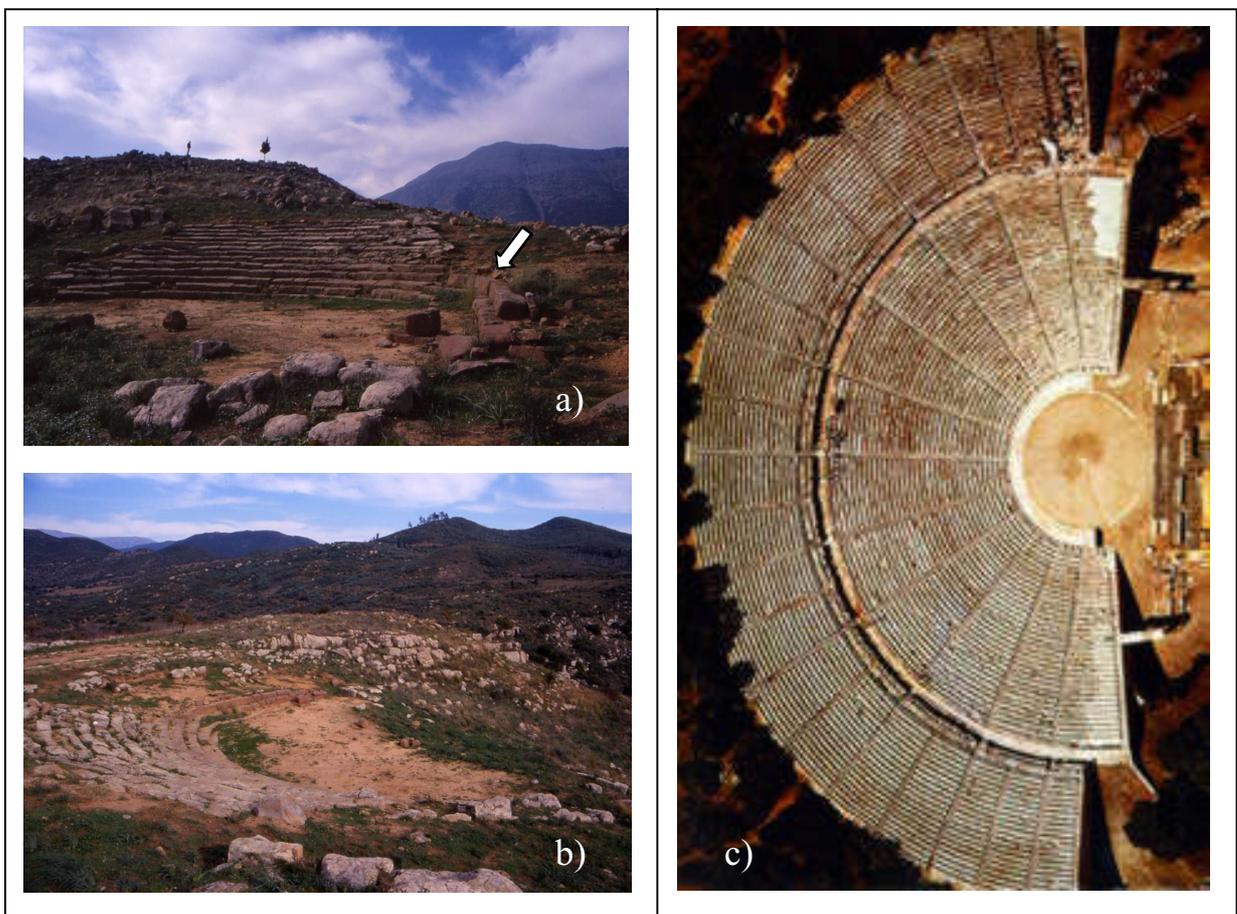


Figure 2: a) Front view of the theatre (an arrow indicates the linear wing)
b) Back view of the Makyneia theatre
c) A typical ancient greek theatre

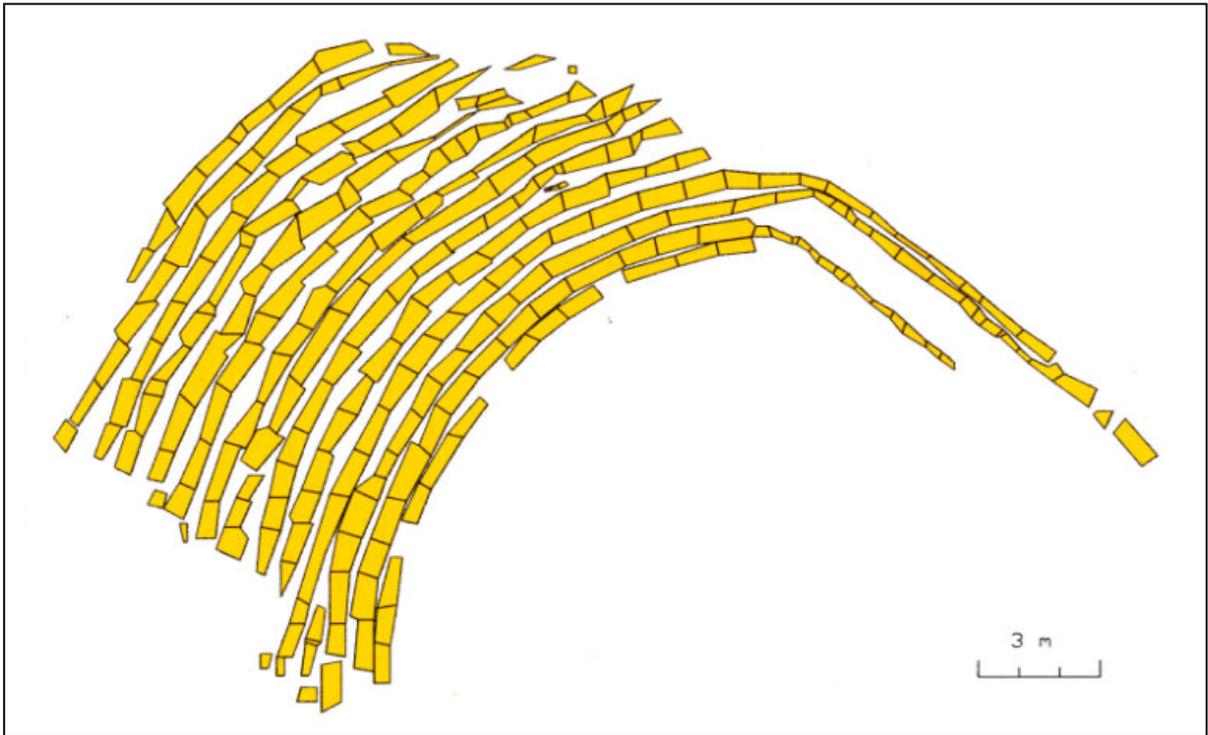


Figure 3: Plan of the remains of the Makyneia theatre made using a total station

Methodology and computations

Our study of the ancient structure was based on the hypothesis that the arcuate wing was constructed on the base of a design circle and that the blocks have slid mostly to a single direction. According to this hypothesis the best fitting circle to the edge of each row of seats should be determined, and the centers of all these circles should be close to each other. Our study was focused on the 12 lower, best preserved rows of the seats, excluding the two highly displaced and poorly preserved ones.

At a first step, each arcuate row was approximated by circles in an arbitrary coordinate system and the coordinates of the centers of the circle best fitting to each row was computed (Fig.4).

A percentage of the seats were displaced downwards due to ground instability, but given the arcuate form of the rows of seats, it is expected that there was a systematic tendency for shifting of the center of the circle along an axis. For this reason it was expected that the difference between the initial and the present-day geometry of the rows of seats is reflected in the distribution of the centers of the circles, and the latter are confined to a line. This linear displacement is clearly observed at the lower 8 of the 12 best preserved rows. However, the centers of the best fitting circles for the upper 4 rows, which are marked with circles (Fig.4), are on the left of all the others centers, which shows

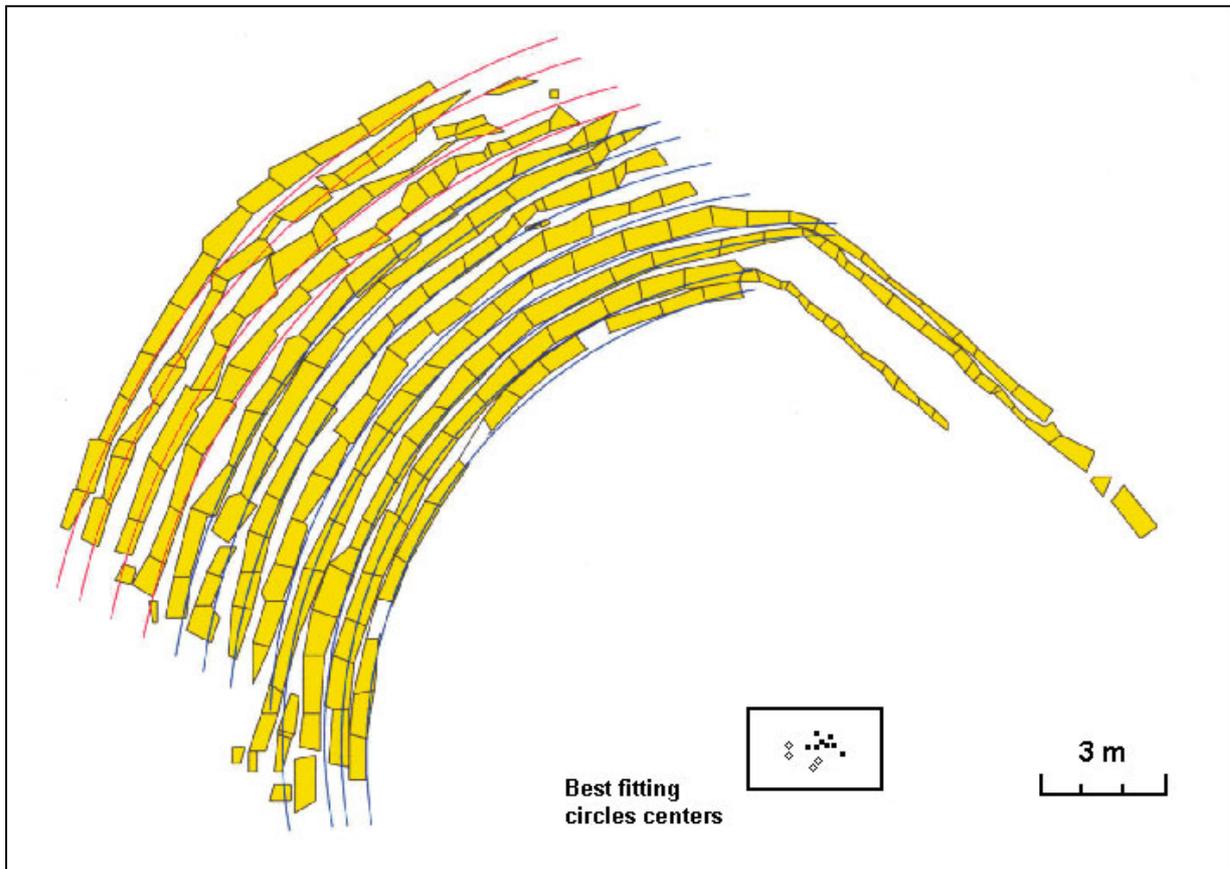


Figure 4: The approximation of the arcuate rows by the best fitting circles

that these rows were probably rotated apart from being displaced. All the centers, computed above, are confined to an area of 1.2x1.0m wide. The mean value of coordinates of these centers, indicating the center of the ancient theatre, was computed. The 3 straight lines of blocks of the linear wing on the contrary, were approximated by straight lines.

At a second step, all 12 arcuate rows of seats were approximated by concentric circles corresponding to the mean centre of the circles computed above. The differences between the radii of any two successive circles (except from the first one, because the first row was narrower) range between 0.62m and 0.75m. The mean difference of the radii of any two successive circles is 0.70 ± 0.05 m (Fig.5). This indicates that our approach is satisfactory.

At a third step we assumed that the difference between successive circles is equal to the computed mean value. Finally, lines normal to the trend of the linear wing and passing from their brake points were drawn. Within the errors of our approximations, these lines correspond to the chords of the design circles of the lower rows of the seats. The lower of these chords corresponds to a 89° arc. This value is within the error margins of our calculation equal to 90° (Fig.6).

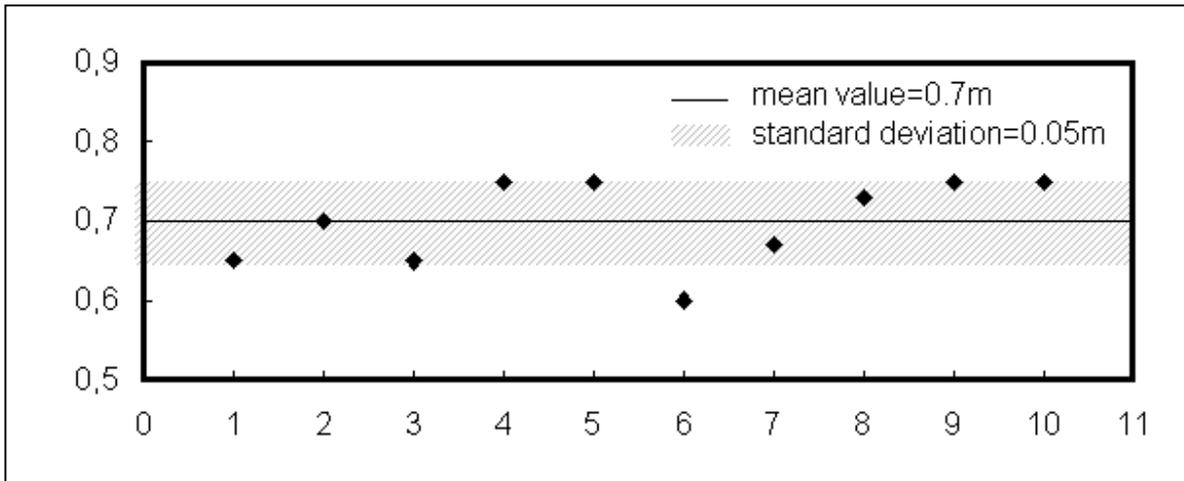


Figure 5: The diagram of the values of the radii differences of the successive circles

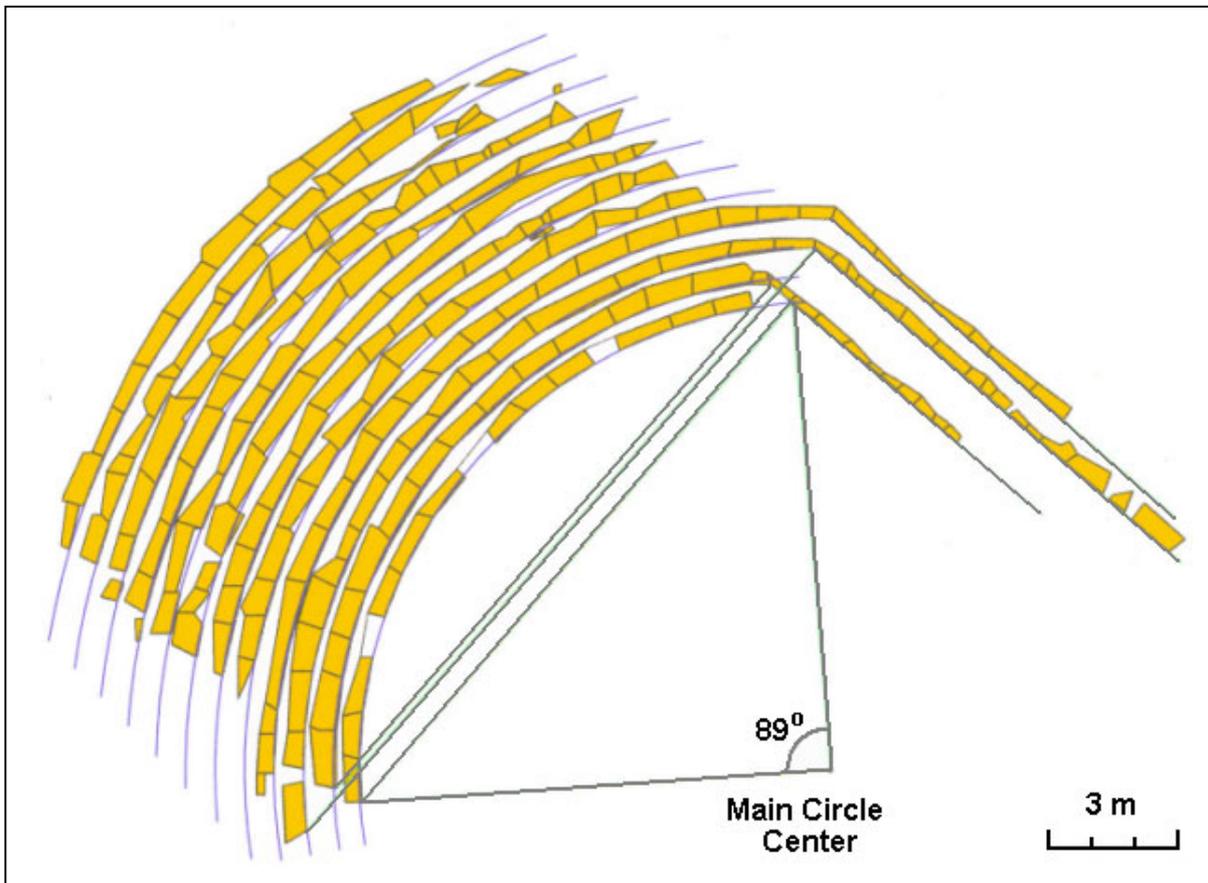


Figure 6 : The inferred design pattern of the ancient theatre

Conclusions

The conclusions of our research is that the Makinia theatre is not just a theatre with a “unique” shape, as Frederiksen (2000) suggested based on the available poor bibliografic evidence, and as can be deduced from a comparison with the famous, though later, theatre at Epidavros (Fig.2a). The construction of the theatre was based on a certain, geometric plan. The arcuate wing corresponded to a 90^0 arc and the linear wing is perpendicular to the chord of this arc. Our results indicate that the Makinia theatre, as well as other early ancient “atypical” theatres were constructed on the basis of a detailed geometric plan which can be modeled through simple analytical techniques.

References

- Dinsmoor, W.B., 1975. *The architecture of ancient Greece*. B.T. Batchford, London.
- Frederiksen, R., 2000. Typology of the Greek Theatre Building in Late Classical and Hellenistic Times, *Proceedings of the Danish Institute at Athens*, 3, 135-175.
- Kolonas, C. (1998) *Makynia: Geography and Topography* Diploma degree thesis, Geodesy Lab., Dept. of Civil Engineering, Patras University
- Stiros, S. and Kolonas, C. 2003. The theatre of the Aitolian Makynia (in preparation).