The function of the First Ancient Theatre of Larissa within the soundscape of the contemporary urban fabric

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During the process of urban development in Greece a part of the First Ancient Theatre of Larissa was revealed. Today, after several expropriations and support frameworks, the theatre is fully excavated and partly reconstructed. Recently, an International Open Ideas Competition was launched for the urban regeneration of the surrounding area and the enhancement of the theatre's value and function. This paper presents the historic information of the theatre, it describes its evolution through the centuries, responding to the city's development, it investigates its acoustics based on previous measurements, noise maps, land use and the contemporary soundscape. Moreover, it discusses the competition axes and urban design approaches aiming to identify the effect of the application of design proposals to the theatre's function and future use.
Keywords: acoustics, ancient, theatre, soundscape, urban design

1 | Introduction

The process of urban development of Greek cities in the mid-20th century, involved construction procedures that revealed a palimpsest of the cities' history, a layering of materials and structures. In Larissa, a part of the First Ancient Theatre of the city was revealed during the construction of new residential buildings. Today, after several expropriations, two Community Support Frameworks and research sub-projects, the theatre is fully excavated and partly restored.

Aiming to introduce the theatre to the public, not only as a monument but also as an active cultural landmark, an International Open Ideas Competition was launched in 2021, to reconsider its reflection on its surroundings and the wider central area. The objectives of the competition included monument connections, enhancement and enrichment of the theatre's value, functional issues for its operation and landscape design.

This paper presents the First Ancient Theatre of Larisa, it discusses the contemporary soundscape by overlaying noise maps and sound sources that rely on land uses, discussing recent research on the acoustics of the theatre as well as urban design approaches, as part of an overall investigation in the fields of soundscape planning, urban design, architecture and noise control that could be considered in similar cases, establishing the cultural significance of the monument, incorporating it in the city's contemporary social life and facilitating its use for performances.

2 | Background information: the story of the First Ancient Theatre of Larissa

In many Greek cities construction procedures of the 20th century provided information of previous eras, a palimpsest of their history, translated into a layering of materials that led the researchers back to antiquity, Neolithic, Classic, Hellenistic or Roman times. The palimpsest of Thessaloniki is widely discussed, especially in relation to the present construction of the underground. Similarly, in Larissa, the fourth largest city in Greece, a part of the First Ancient Theatre of the city was revealed – namely a part of the *koilon*- during the construction of a new residential building in 1968. The new building was erected, despite the Ephorate of Antiquities' opposition and, after several years of discussion, the expropriation was completed in 1979, and the building was demolished in 1981. Today, after two Community Support Frameworks and several research sub-projects the theatre is fully revealed. Recent studies have investigated its potential regarding the cultural and financial development of the city and school education and it is important for the authorities to consider all parameters for its optimum use.

However, its position in the city centre, next to high rise buildings can result in acoustic conditions inappropriate for its use, while commercial activity and nightlife of the area increase background noise. How can the theatre be used for performances again while all city functions remain untouched? Is it possible to limit background noise and allow for optimum conditions of speech intelligibility?

In an attempt to open the theatre to the public, not only as a monument but also as an active cultural landmark, an International Open Ideas Competition was launched in 2021, to «reconsider the theatre's reflection to its surroundings and the larger central area» [1]. The objectives of the competition include carving the city's character to establish a fresh identity, connections between the theatre and other important landmarks, establishing a new attraction, landscape design, enhancement and enrichment of the theatre's value as a landmark and functional issues for the theatre's operation – namely organisation of paths, entrances / exits and support-

ing spaces. The competition participants were provided with a considerable number of maps, plans, elevations and technical reports. However, no mention had been made to performance conditions that should take into consideration its acoustics, the land use of the surrounding area, existing noise maps and present background noise, future noise control, the evolving city's soundscape that continuously changes during the day and night.

A need thus arises to discuss the theatre's position within the urban fabric, mainly in terms of the acoustic environment; and consequently, to develop guidance for its contemporary use.

2.1 | The palimpsest of the theatre

The First Ancient Theatre of Larissa, at the north-eastern part of the Thessalian plain, near the banks of river Penaeus (Pinios), was inhabited, developed and reconstructed at the same location for many centuries. The reuse of the constructing material of ancient public buildings, markets, temples and the city walls during the development of the city throughout the centuries was common. Therefore, only a few monuments have survived, including the two ancient theatres [2].

The First Ancient Theatre was constructed on the slope of Frourio hill (*frourio* in Greek means fortress), as part of the fortified citadel of the ancient city, developed on top of a prehistoric Neolithic settlement. The ancient city being surrounded by Pinios developed only towards the south and east of the citadel, since the north and west sides were restricted by the river. The First Ancient Theatre's construction is chronologically placed in the 1st half of the 3rd century BC. It was one of the largest ancient theatres in Greece, with a 10.000 audience capacity, and it is suggested that it also served as a public place of congregation of the citizens of Larissa and the wider area of Thessaly.

The theatre accommodated events until the 4th century A.D. – late Roman times. Following the construction methods of the Classic and Hellenistic times [3], the *koilon* was initially formed on the hillside, later covered by marble. It was divided by the *diazoma* to the main theatre, consisting of twenty-five rows of seats including the *proedriai* (seats of honour and sponsors), and the *epitheatre*, the upper part of the *koilon*, consisting of fifteen rows [4]. The orchestra, measuring 25.50m in diameter, was initially covered by marble and later by soil to accommodate Roman fights. It was encircled by a sewage corridor of 1.90m width. The *skene*, the stage building, which is relatively well preserved, can be associated with three construction phases. The first, during the original construction of the *koilon* and the retaining walls, was a *skene* 37.50m in length and 3m height, consisting of four rooms. Later, in early 2nd century B.C., a 20m long and 2m wide *proskenion* was added, while in Roman times Doric semicolumns, marble linings and honorary inscriptions for emperors were added. In Hellenistic times the theatre was functionally related with the worship of God Dionysus, functionally connected with temples, and the performance of tragedy and comedy, whereas in Roman times it was converted into an arena, to allow performances of animal fights. The latter lead to the citizens' initiative to construct the Second Ancient Theatre of Larissa (1st century B.C.) to accommodate more collective and participatory events.

The theatre underwent various design stages and modifications, also due to earthquake activity (1st century B.C. and 7th century A.D.). During the Byzantine years the lowest part was buried, whereas in the late years of the Ottoman Empire a complex of buildings covered the theatre's area. For their construction seats of the ancient theatre were used as a building material. Up to 1985, after seventeen centuries of the city's development in layers and residential buildings' construction, the theatre area was fully covered, while two main streets, Al. Papanastasiou str. and El. Venizelou str. bisected the theatre from north to south and from east to west respectively. The progressive development of the city in the 20th century laid the foundation for the present exploitation of the theatre. In 1910 and 1968 preparations for the foundations of new buildings revealed parts of the *skene* and the *koilon* respectively. Figure 1 illustrates the site plan of the theatre area in 1968, retrieved from the material provided to the competition participants [1].

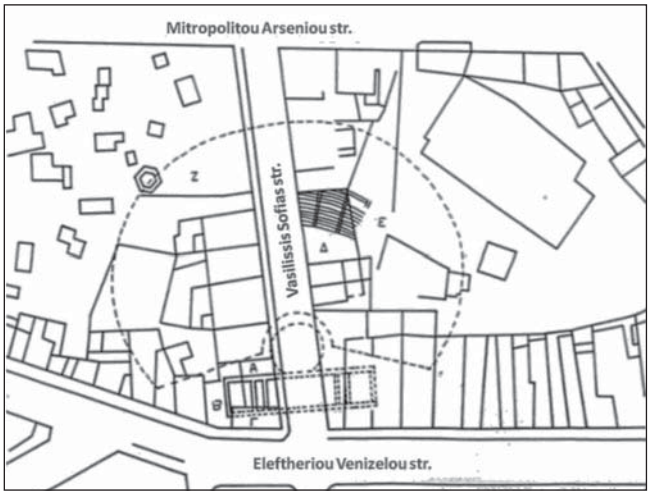

Fig. 1 – Site plan of the First Theatre of Larissa area in 1968

By 1985 the north-east part of the theatre had been revealed, whereas the south and west remained under other constructions. Between 1977 and 2008, after several expropriations, private and public building demolitions and street abolishment, the *epitheatre's* area (only traces of which still exist), the *skene*, the west and east entrances (*parodoi*), the latter leading through a pathway to the Second Ancient Theatre, were found [5]. Marble seats used in the buildings' infrastructure were discovered and transferred to appropriate places. Recently, the Central Board of Antiquities of Greece approved the restoration of the theatre – initially the *koilon* to its latest architectural phase (arena), and later the retaining walls, the stage building, which is the best-preserved part

of the monument, and the accessibility [6]. Figure 2 illustrates the plan and section of the theatre in its present condition, compared to its original layout.

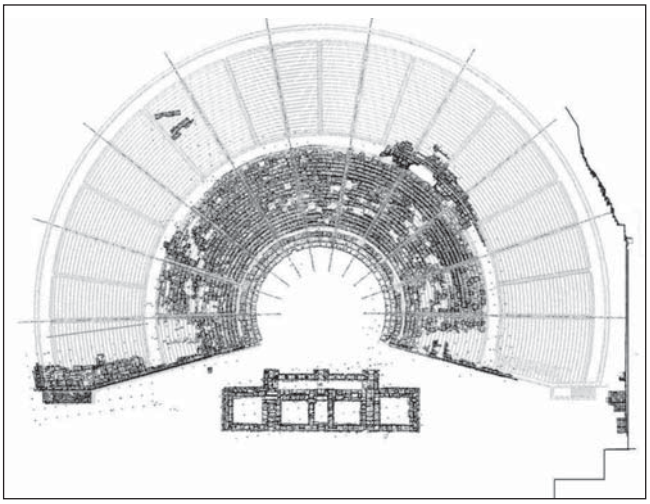

Fig. 2 – Plan and section of the First Theatre of Larissa, in the present condition (black) and the original layout (grey)

3 | Contemporary use of the theatre: acoustics and soundscape

Building heritage is a multidisciplinary field of study, involving history, social science, architecture and engineering. Since the revival of ancient drama in the 20th century, many ancient theatres have been excavated, investigated and restored. Research has revealed the effectiveness of their architectural evolution, from the Classic to the Hellenistic and later the Roman times, on the acoustics [3]. Moreover, the process of the *skene*'s evolution enabled conventional use during the dramatic performances and changed the focal point from the orchestra to the stage, allowing for further enhancement of the actors' voices due to relative source-receiver heights. In some cases, the theatre's restoration was accompanied by appropriate architectural and acoustic interventions to ensure optimum visual and acoustic conditions during their contemporary use. Studies have indicated the contribution of ephemeral scenery, designed and applied to the theatres for performance purposes to replace missing stage buildings, to the soundscape of ancient theatres, either positively or negatively [7], [8], and [9].

However, although scenery application can activate the acoustic capabilities of an open-air theatre, an important factor for the acoustic quality of many ancient theatres was low background noise, important for the unassisted speech to be audible. Contemporary conditions – theatres situated in city centres or nearby busy roads – imply the necessity of an acoustic treatment to ensure optimum conditions during performances [10]. Recent research on European cities has indicated the significance of the soundscape approach for the preservation and promotion of cultural heritage [11], where appropriate architectural and urban design can contribute to the overall experience and comfort, depending on the uniqueness of each theatre, its position, its construction characteristics and background noise.

3.1 | Acoustic analysis

Regarding the First Ancient Theatre of Larissa, a recent preliminary study focused on the acoustics of the unoccupied theatre in its present condition – with the low part of the *koilon* partly restored [12]. The measurements were conducted for three rows of seats and three vertical angles with the use of an omni-directional free field microphone for acoustic parameters, a binaural head for interaural cross correlation (IACC) and auralization and a sound pressure level (SPL) meter for direct measurement of the SPL differences and ambient noise. The results present a variation in SPL with distance, comparable to Epidaurus, exceptional values of clarity C80 (dB) and definition D50 (%) and excellent speech intelligibility, especially in long distances. However, the measurements were performed on a weekend, with closed restaurants and cafes, with some noise caused by people and wind at the top of the Frourio Hill, with signal-to-noise ratio (SNR) above 30dB.

3.2 | Soundscape investigation

The city is a place of coexistence of many different social groups, a synthesis of architectural forms, deriving from different socio-political circumstances over the centuries. Identifying and studying the independent elements that form the collage of urban space can lead to understanding the development and function of the city [13], based on the context, background, prior experiences, familiarity with the place, so that each person constructs a different image of the city. According to Lynch [14], grouping these images reveals common elements that emerge as characteristics of the city. He distinguishes five types of elements that constitute its structural features (paths, edges, districts, nodes and landmarks), the interrelations of which determine the clarity of the city's 'imageability'. Similarly, as previous research has indicated [15], one can identify such elements of the urban fabric associated with auditory perception.

In this case study, namely the First Ancient Theatre of Larissa, the elements defining the city can be applied to the surrounding urban fabric. Adjacent buildings as well as the high retaining wall behind the *skene* act as edges for the acoustic environment, reflecting sound, whereas congested pedestrian roads are paths, constant linear sources. Moreover, nodes are represented by cafes and restaurants. The acoustic environment of the urban fabric surrounding the theatre was investigated through the collection of the latest noise maps [16] and the use of the sound map technique, namely the visual representation of the sound sources identified in the area, as a research tool from Amphoux's 1st approach, "sound memory" [17].

Figures 3 and 4 present the overlapping of the two illustrations, namely the noise maps that present the day-evening-night level (Lden) and night level (Ln) and the sound map that focuses on land use, characteristically providing different sound sources for day and night. As expected, linear sources provide the effect of boundaries and omni-directional sources constitute distinct features to the sound environment. Size of symbols reflects intensity of phenomena. Traffic noise prevails (Lden>70dB that exceeds 75dB at crossroads – Ln>60-65dB), forming strict acoustic boundaries at the perimeter, intruding the area where no building shells exist. At this end, an important decision by the municipality to demolish the two building blocks marked with black at the south of the theatre will increase the impact of traffic noise at the area.

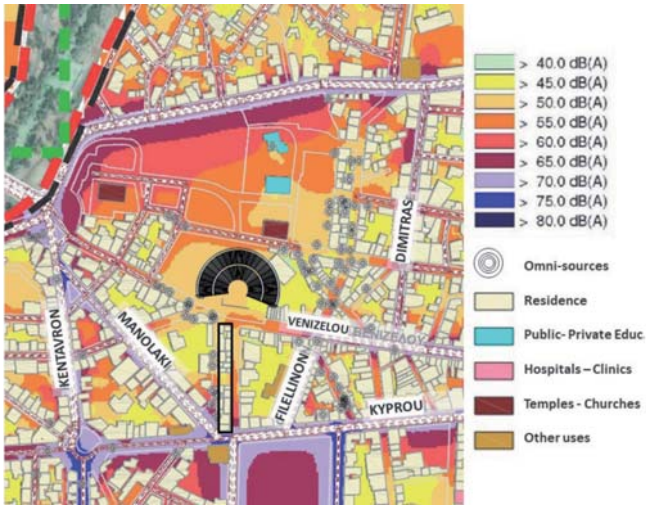

Fig. 3 – Lden map with overlapping sound sources

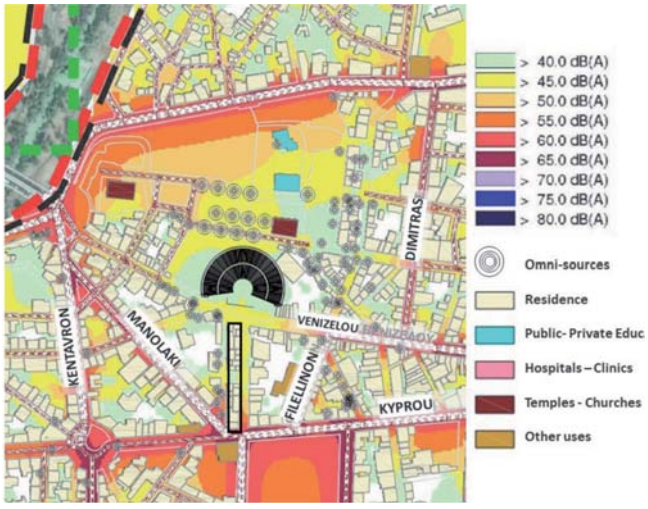

Fig. 4 – Ln map with overlapping sound sources

Pedestrian roads surrounding the theatre present lower values in Lden and Ln (56-60 and 45-55dB respectively), while the Lden and Ln at the theatre is above 50-55dBA and 40-45dBA respectively. It needs to be mentioned that these noise maps (created in 2013) present residence as the prevalent land use surrounding the theatre. Since then, the city has evolved and, apart from its commercial life, the recreational quarter (cafes, restaurants, bars etc.) has moved from the city centre to the eastern and northern parts of the theatre, as indicated by the omnidirectional source symbols. In total, 69 bars and restaurants are located in this area, out of 82 at this part of the city, all of which mostly use their outdoor space. Additionally, a recent urban installation created a promenade and resting points at the linear pathway at the tangent of the *epitheatre* (former Arseniou str) and, as can be seen in Figure 5, that area is the new "meeting point" (symbolised in Figure 4 by the large omnidirectional sources). During the day, traffic noise and bird singing are the major sound sources, whereas in the evening and late night Frourio Hill accommodates several thousands of young people. For the present study, additional measurements were performed early in the afternoon, with an average of 71.8dB (min 61.7dB, max 87.5dB) at the top of the theatre (M. Arseniou str.), and 70.0dB (min 48.9dB, max 82.8dB) at the pedestrian road behind the stage building (El. Venizelou str.).

Fig. 5 – Photos of the area surrounding theatre in the evening

3.3 | Discussion on Future Urban Design

Regarding the International Competition on the design of the area surrounding the theatre, this section presents some reflections on the overall effect of design proposals on the acoustic and performance conditions of the theatre. After careful examination of the proposals, one can clearly identify that the functionality of the theatre was taken under consideration as far as its operability is concerned (entrances, exits etc.). Entries' proposals that stood out include new city tower landmarks (1st prize) or sheds (3rd/4th/5th prizes), replacing the soon-to-be-demolished building blocks, which would reduce traffic noise propagation from the main road but at the same time create visual obstacles for the view of the theatre. Proposals (2nd prize) that incorporate movable sound barriers behind the *skene* could help reduce external noise coming from the paved Venizelou str. Crossing the *epitheatre* with new pathways (3rd prize) or allowing the public to walk through

the *skene* (5th prize) would not assist the theatre's operation, neither dramatically nor acoustically. Figure 6 illustrates the competition prizes.

As far as the adjacent buildings are concerned, a suggestion for the future could include the treatment of the building shells that act as sound reflectors, which has already been mentioned in previous guidelines for urban sound propagation [11], as an important factor that would contribute positively to the acoustic performance of the theatre. The analysis presented in this paper will be further investigated through the soundscape approach, which will incorporate organised soundwalks, objective and subjective evaluation and analysis, based on methodology that has been applied in previous studies [11], [15], [18].

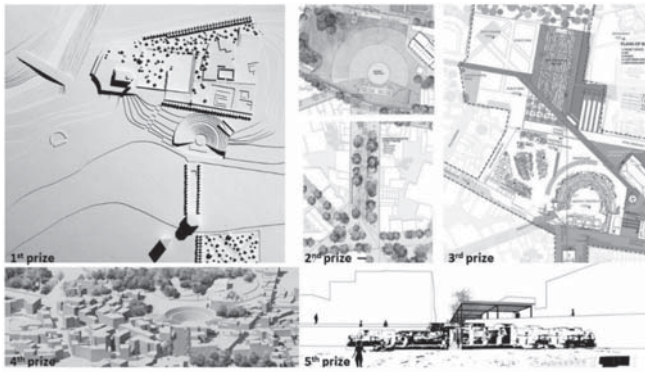

Fig. 6 – Urban design proposals, competition prizes

4 | Conclusions

Considering the wider theatre area as surrounded by road axes, one can easily distinguish three areas: the high density building area at the east, where commercial uses and leisure are mostly concentrated, the open area at the top of the Frourio hill that provides a vibrant and rich soundscape at the north, fluctuating in level and sound source categories according to the season and time, and an urban environment, concentrating commercial, leisure, administrative, educational and similar functions at the south and west. The distinction coincides with the spatial distribution of existing land uses.

Overall, establishing the cultural significance of theatre as a monument and ensuring its operation, requires an interdisciplinary study that will reconsider the impact of the surrounding land use on the soundscape, apply urban design decisions for monument connections and architectural design for building treatments. Future research based on the soundscape approach, combining measurement and subjective evaluation, can form the basis for the theatre's functionality. Furthermore, acoustic simulation of the restored theatre within its surroundings can be carried out to suggest further improvements and scenery design applications.

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