

The acoustics of the current conditions of the Roman amphitheatre of Avella in Italy

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ABSTRACT

In the ancient Rome, the shows entertained by gladiators were very numerous, due to the always growing request from the spectators. After the disuse of the amphitheaters, a wide number of philosophers, writers and poets have described the shows performed in these arenas. Nowadays, this type of shows represents a source of inspiration for books and movies. The Roman amphitheaters had an elliptical plan, which allow to enlarge the capacity of seats and to improve the view along the steps of the *cavea*. The development of Christianity established the immorality of the theatrical shows, while the barbaric invasions contributed to convert these places into military barracks, whenever they were not demolished. This study described the acoustic study of the amphitheater of Avella, found only a few decades ago by archaeologists. The geometrical characteristics of this amphitheatre are typical of other Roman ones built in Campania during the Imperial age. An acoustic survey is described to understand better the acoustic parameters and discuss its current possible usages.

Keywords: acoustic measurements; amphitheatre; Avella; arena; elliptical plan.

1. INTRODUCTION

The word “amphitheatre” refers to a specific place elected to undertake events, where the spectators could assist in any position, meaning that they could stay all around the action. This is one of the reasons why the amphitheatre has an elliptical shape, enlarged from the circular geometry to increase the audience capacity.

Due to the importance of the gladiators’ shows during the Classic age, Romans attributed a specific building type to these performances. The amphitheaters were erected mainly in the areas most prosperous of the Roman Empire, such as the Province of Campania in Southern Italy. The most elegant amphitheaters of this region have been built in Capua and Pozzuoli, to be second to the Coliseum in Rome for capacity and dimensions.

Based on archaeological excavations, Capua, Littorinum and Cuma, all in Campania, are considered the first three amphitheaters, erected in stone during the 2nd century BC, in order to replace the previous temporary construction in wood [1].

Few decades later, during the 1st century BC, the amphitheater of Avella was built on top of structural walls belonging to the residential properties of Samnites. Nowadays, this amphitheater is located within a green belt of 300 m distant from the current town of Avella, and will be the object of this study.

2. HISTORY OF THE OLDEST AMPHITHEATER

The amphitheater of Avella has been used for the gladiators’ shows other than for the hunting of fears, although it is believed that sometimes the arena was filled with water, allowing the sportive races by boats.

The amphitheater of Avella has a typical elliptical geometry, having dimensions comparable with the amphitheater of Pompeii. The arena was covered by sand and was surrounded by the steps of the *cavea*, subdivided in wedged sectors. The existing ruins consist of structures made of a technique called *opus reticulatum*, and of tuff cover sheets preserved in the *ima cavea*, as shown in Figure 1. Historical sources document the presence of an ambulatory (*ambulacrum*) above the whole *cavea*, but unfortunately this structure has been lost [2].

The dimensions of the main axes of the arena are equal to 62 m and 35 m, smaller than the amphitheaters of Rome and Capua. Avella was located on the road connecting Naples with Brindisi, two important ports placed respectively on the west and east coast of the Italian peninsula.

Figure 2 shows the view of the amphitheater of Avella, with main dimensions.

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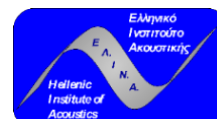




Figure 1 – View of the amphitheater of Avella.



Figure 3 – Amphitheater in present state during the acoustic measurements



Figure 2 – View of the amphitheater of Avella, with main dimensions.

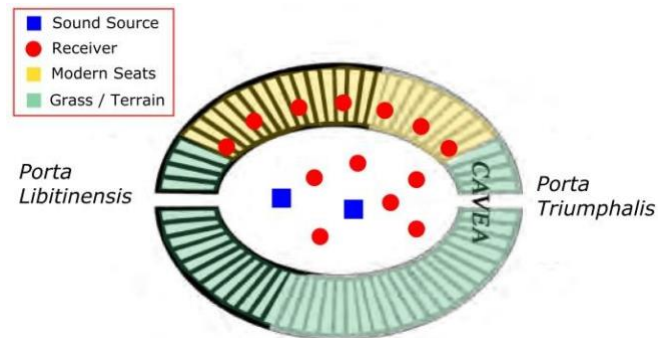


Figure 4 – Measurement positions.

3. ACOUSTIC MEASUREMENTS

Acoustic measurements have been carried out inside the amphitheater of Avella by using firecrackers as impulsive sound source, which is provided with a good signal to noise ratio (S/N) to be outdoor. A Brahma microphone has been used as a receiver. Figure 3 shows the amphitheater during the acoustic measurements.

The sound source was placed in two positions in the arena, while the microphone was moved in the *cavea*, specifically across the modern seats, and also in the arena, as shown in Figure 4. The choice of taking the survey in the *cavea* only where the modern seats are installed is due to safety reasons established for this archaeological site.

The calibration process of a digital model consists of a loop procedure of room acoustic modelling to increase the accuracy of the simulated results. As such, the absorption coefficients have been tuned based on the measurements undertaken in situ [3-5].

By analyzing the recorded impulse responses (IRs) with Dirac software package, a strong late reflection can be detected as an echo. This phenomenon is due to the geometry of the amphitheater and to the length of its axes that determine the temporal delay of the echoes.

4. ACOUSTIC RESULTS

The results of the main acoustic parameters have been assessed in accordance with ISO 3382-1 and compared with the measured values of the amphitheater of Pompeii, having similar dimensions. Figure 5 to 8 show the values of EDT, T_{30} , C_{80} and D_{50} in the octave bands between 125 Hz and 4 kHz. Figure 5 shows that the value of EDT related to Avella are more uniform across the spectrum than in Pompeii, where a deep dip at 500 Hz has been recorded. Over the other octaves, the values are very comparable between the two amphitheatres, fluctuating around 1.5 s, which is good considered to be unroofed spaces and like other Roman amphitheatres [6, 7].

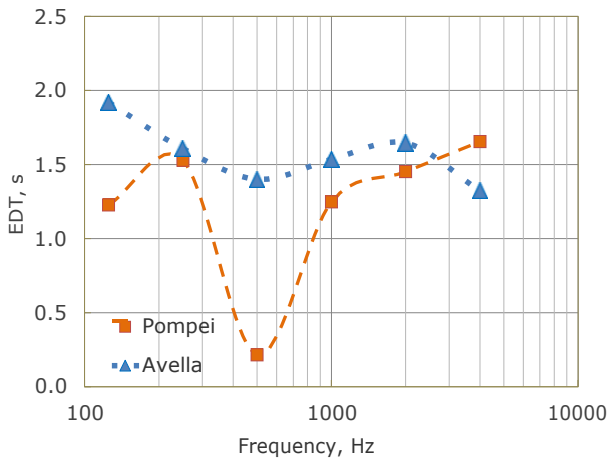


Figure 5 – Measured values of EDT.

Figure 6 shows also the values of T_{20} , which have been found to be around 1.5 s across all the spectrum in relation to Avella, while the measurements in Pompeii recorded T_{20} values to be around 2.1 s at 125 Hz and fluctuating around 1.4 s at mid-high frequency bands [8].

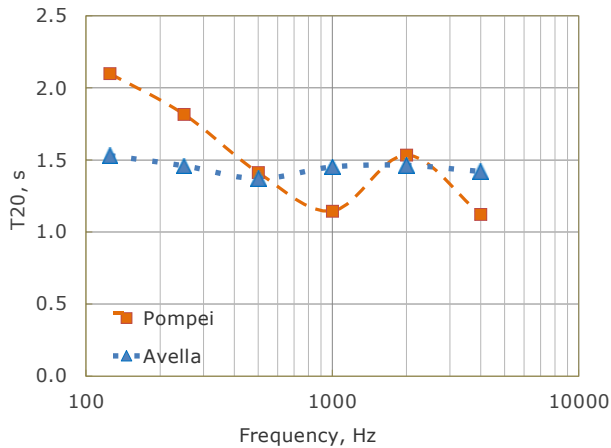


Figure 6 – Measured values of T_{20} .

Figure 7 shows that the values of D_{50} are very similar between Pompeii and Avella, especially at 125 Hz and 4 kHz, fluctuating around 0.75 if considered averaged across all the spectrum and having a soft peak at 500 Hz. This means that the definition of speech is good in both amphitheatres [9,10].

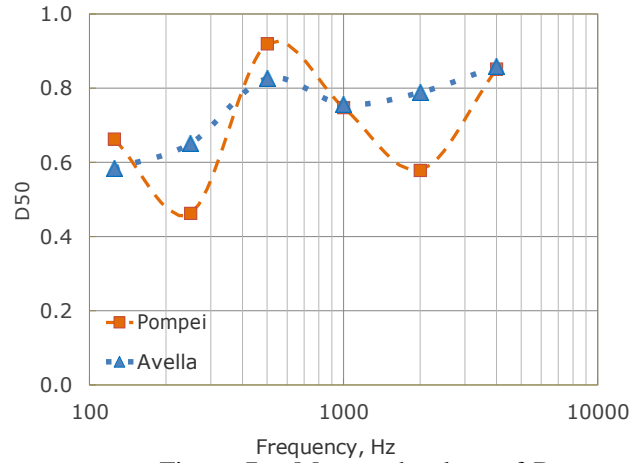


Figure 7 – Measured values of D_{50} .

Figure 8 indicates that the measured values of C_{80} are all more than 0 dB but above the upper range limit set for a good music listening (i.e. +2 dB), although these results have been found to have similar characteristics in other Roman theaters and amphitheatres. It shall be noticed the similar curve trend in both spaces, showing a soft peak at 500 Hz to be equal to 9 dB in Avella and 11 dB in Pompeii.

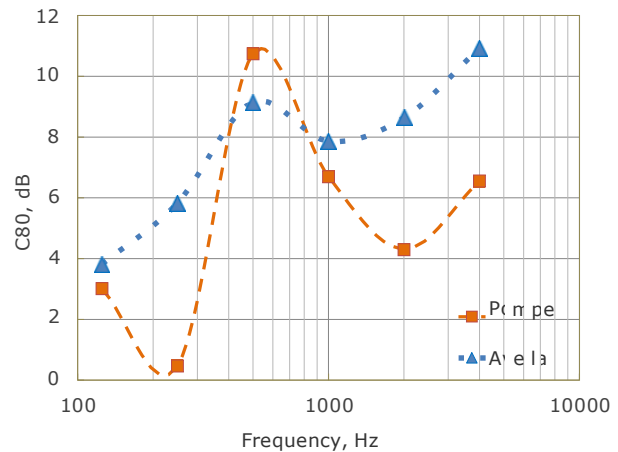


Figure 8 – Measured values of C_{80} .

5. CONCLUSIONS

The archaeological sites have always been investigated under an architectural perspective throughout the centuries. It was only during the second half of the 20th century that the amphitheatre of Avella has been discovered. This paper presents the acoustic measurements undertaken inside the amphitheatre of Avella.

The analysis of the measured results highlights a good reverberation time, suitable for potential acoustic shell that would be inserted for live musical events.

The clarity index has been found to be above the threshold limits but comparable with the results of other Roman theatres and amphitheatres.

6. REFERENCES

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