



Technical Note

The acoustics of the caves

Gino Iannace*, Amelia Trematerra



Department of Architecture and Industrial Design, Second University of Naples, Borgo San Lorenzo, 81013 Aversa (Ce), Italy

ARTICLE INFO

Article history:

Received 21 April 2014

Received in revised form 11 May 2014

Accepted 19 May 2014

Available online 12 June 2014

Keywords:

Caves

Underground places

Room acoustics

ABSTRACT

This work shows the acoustic measurements realized at three underground places: the caves of Pertosa or of the Angel, the caves of Castelcivita and the caves of Castellana. These places are used for some years to represent music and theater performances, whose success is also due to the mystery and the charm that distinguish them, based on the natural setting of the caves. The places of the caverns where the shows are played were characterized analyzing the monaural acoustic parameters (T_{30} , EDT, C_{80} , D_{50} and Rasti) obtained with the impulse response resulting from blowing up some balloons inside them. The values of monaural acoustic parameters measured in the caves can be compared with the parameters of the concert halls currently in use.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

The acoustics of the underground places has also drawn the attention of archaeologists and anthropologists because studying them it could be possible to deduce useful information about the prehistoric man behaviors [1]. There are strong elements supporting the hypothesis that during prehistory the caves with special acoustic properties were used for ritual ceremonies with songs, music and dance, although in European caves rock engravings representing human figures are rare and even less in attitudes regarding activity related to music or dance, in fact most of the subjects are animals. Some studies have been performed with acoustic measurements in situ to evaluate the possible relationships between the acoustics, the graffiti painted on the walls of the caves and the evidences discovered [2,3]. The use of caves for musical performances during modern times comes from the second half of the '700 when in the Caves of Osselle (France) [4], illuminated with torches, were performed music and dance. In 1822, the Postumia Caves in Slovenia were opened to the public for dancing parties with popular music and for public events. The cave of Romanesti, in Romania, on the Poiana Rusca mountains in the Transylvanian Alps, hosts regularly charming concerts followed by a few thousand people. In the Greek island of Kefalonia, the cave of Drogarati is accessible the room of Apotheosis, a nearly semicircular room, that, thanks to its good acoustics, hosts concerts and other events during the summer with about 500 spectators. The "Cueva de Nerja", a cave near Malaga (Andalusia, Spain), was

discovered in 1959; starting from the '60 s it was equipped with a large stage placed in front of a natural backdrop in the Room of Waterfall and for many years there are shows of symphonic music, ballet, flamenco and other genres. In Lanzarote, in the Spanish archipelago of the Canary Islands, there is a system of tunnels and caves that was formed more than 3000 years ago as a result of the eruption of the volcano La Corona; in 1968 the artist architect Cesar Manrique designed inside it an accommodating, cultural and natural complex, called "Jameos del Agua", and inside one of the largest galleries in 1987, was completed the adaptation of an Auditorium with a capacity of about 550 seats. The caves of the Angel in the town of Pertosa (in South of Italy), dating back to 35,000 years ago, have been visited by people since the Bronze Age (2nd–3rd millennium BC). The initial part of these caves is crossed by an underground river, the entrance is on board of a barge and it has a landing inside from which begins paths and rooms along three directions, whose geo-morphological characteristics are such that they have inspired a natural scenery for performances. In addition to "The Dante's Inferno" [5], in Pertosa takes place for more than fifteen years a festival of ethnic music (Negro) and occasionally also other forms of musical performances and concerts. Fig. 1 shows a schematic plan of the caves of the Angel, in the parts of touristic path. Not far from Pertosa there are the caves of Castelcivita, a karst cave inhabited during the High Paleolithic in which have been found human artifacts, also in this site the play "Orpheus and Eurydice" is represented for some years; it is a traveling performance made along a path of approximately 1 km, with plays, dances and songs. The site is really interesting for geologists, spelunkers, paleontologists and archaeologists because the fossils and stone tools found are the proof of a human

* Corresponding author. Tel.: +39 3393742507; fax: +39 82445010.

E-mail address: gino.iannace@unina2.it (G. Iannace).

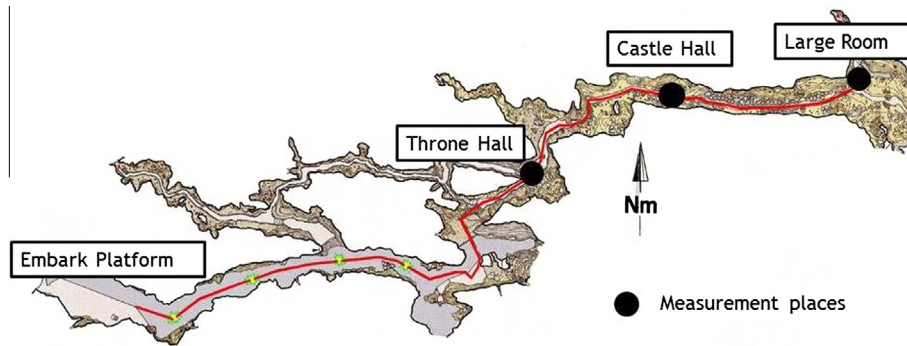


Fig. 1. Schematic plan of the caves of the angel (Pertosa) and its tourist itinerary and the points where the shows take place and where the acoustic measurements were carried out.

presence dating back more than 40,000 years ago. Fig. 2 shows a schematic plan of the caves of Castelcivita, in the parts of touristic path, and its tourist itinerary and the points where the shows take place and where the acoustic measurements were carried out. The caves of Castellana (in South of Italy near the city of Bari) are a complex karst, with stalactites and stalagmites, discovered in the last century, where in its places there are different events, at the entrance there are concerts throughout the year and the event “Hell in the Cave”, while inside are organized film festivals [6]. Fig. 3 shows a schematic plan of the caves of Castellana and the places where the acoustic measurements were carried out.

2. Acoustic measurements

Due to the impossibility to connect to the electricity grid the use of the whole equipment was not possible as recommended by ISO 3382 [7], and thus some rubber toy – balloons properly inflated have been used as a sound source. The impulse responses caused by the explosion of the balloons into the place, were recorded by an omnidirectional microphone type GRAS 40 AR ½”,

with 01 dB preamplifier PRE 12 H, connected to the interface, “01 dB Symphonie”, which is in turn connected to a portable PC. The use of the toy balloons as sound source and the analysis of the impulse responses have been previously tested with good results [8–10]. The following processing of the measured impulse responses gave the monaural acoustic parameters T_{30} , EDT, C_{80} , D_{50} . During the shows, the artists, for needs of the scene, do not occupy a fixed position and the spectators attend standing. This has imposed a certain randomness locating the source (blown-up balloon) and the receiver (microphone) at the height of 1.6 m above the ground, but the distance between the position of the source and the microphone was always not less than 3 m. Although the performances, for all three considered complexes, are winding along a path with a large number of rooms, the acoustic measurements were not carried out in all the places where the representations happen but the attention was for the largest cavities in which take place more articulated activities and for longer times. For each pair source – receiver at least three balloons were fired, the number of measurement points depended on the size of the rooms, giving six more acquisitions for larger places. For each place are shown the average values of the monaural acoustic parameters

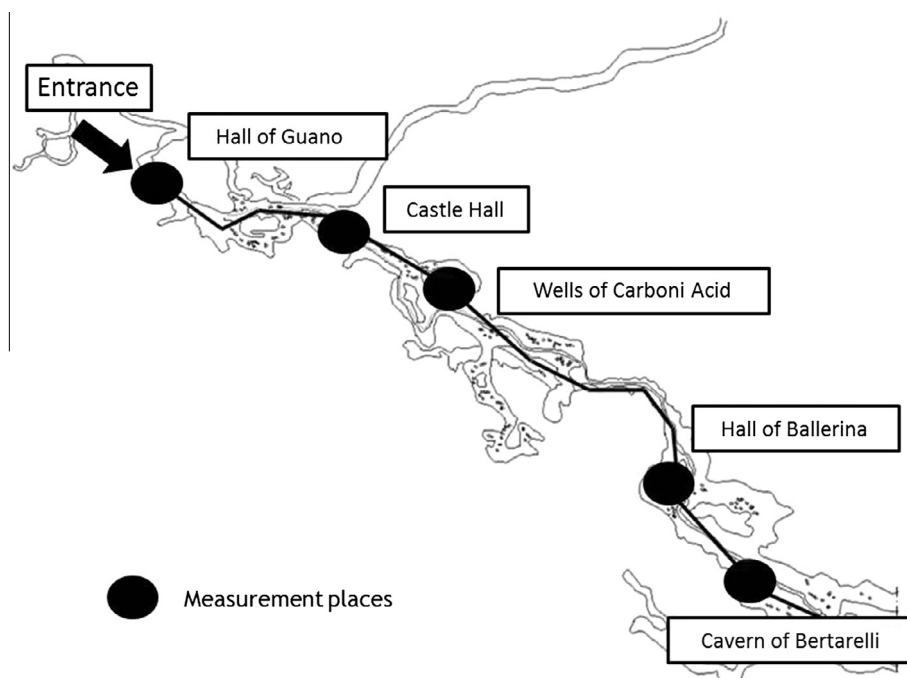


Fig. 2. Schematic plan of the caves of Castelcivita and its tourist itinerary and the points where the shows take place and where the acoustic measurements were carried out.

Download English Version:

<https://daneshyari.com/en/article/760908>

Download Persian Version:

<https://daneshyari.com/article/760908>

[Daneshyari.com](https://daneshyari.com)