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The assessment of ultrasonic tests as a tool for qualification and diagnostic study of traditional highly porous and soft stone materials used in the built heritage of the past.

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Ultrasonic tests are performing tools for the quality assessment and selection of stone as building materials, as well as for the detection of faults within architectural and structural elements. The use of the non destructive and non invasive diagnostic techniques has always advantages in the activities on pre-existing buildings, in terms of sustainability; moreover, it is a need with respect to the conservation constraints when we act on the historical-architectural heritage.
Ultrasonic technique is widely and successfully performed in the diagnosis and control of the restoration works on concrete and compact stone artefacts. Specific problems arise from its use with reference to highly porous and soft stones, in particular bi-component materials with grains-cement binder structure, such as calcarenites. Low ultrasonic propagation velocity, typically associated to the soft and porous materials can be easily affected by disturbing factors, in primis water (in vapour or liquid state), that can easily and frequently penetrates inside them and in significant amounts, due to their high open porosity. The analysis and interpretation of the data acquired by in situ investigations have to take into account this additional contribution. In the same way, on site structures and materials can be easily interested by salt presence and deposition within the pores, that can furtherly interfere on the data significance, as well as it is important to know the variability of data due to the different state of conservation of the stones.
The influence of all these factors on the response to the ultrasonic tests needs to be investigated by laboratory controlled conditions, preliminarily to the in situ application.
The present work refers to the experimental activity devoted to investigate the critical aspects that have been mentioned above and the results obtained. It is a part of a larger activity with the final aim to set up non invasive diagnostic procedures for the analysis and qualification of ancient masonries, realised with traditional soft stones, used as building materials in the Southern Italy. This activity is carried out within the AITECH network (Applied Innovation Technologies for Diagnosis and Conservation of Built Heritage), a regional research laboratory infrastructure (Apulian region, Southern Italy) funded within the FSE and FESR programs and realised by the contribution of the Italian CNR and Salento University.
In particular, ultrasonic velocity propagation have been measured on different petrographic kinds of calcarenitic materials. The influence of the sample size –the scale effect- has also been investigated. Velocity data have been recorded on the samples in the following conditions:
a) dry, wet and different rates of the humidity content
b) salt saturation
c) after ageing by salt crystallisation cycles.
Finally, ultrasonic tests have been performed on some samples treated by inorganic silica consolidant.
This experimental laboratory investigation is the preliminary activity to assess the performance potential of the ultrasonic tests as effective tool for the qualification and diagnosis before and after treatments, with reference to the specific critical aspects related to highly porous and soft stone materials, traditionally used in the built heritage of the past.