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Preliminary results from NDT-SPR survey on wooden beams

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Abstract –
A study on the wooden beams was undertaken inside the Palazzo Ducale of Carosino (Taranto, Italy). Non destructive measurement by using the Surface – penetrating radar (SPR) were performed in order to investigate the conservation state of wooden structures. The surface-penetrating radar analysis helps to better understand the complexity of the structure of the beams.

I. INTRODUCTION

The Palazzo Ducale, built in the 1400s by the Simonetta family, who in 1517 went to live in Carosino after having purchased a fief. In 1524 the building passed to the Muscettola, the Albetrini and the Maruli. It became the property of the knight Roberto D'Ayala Valva in February 1875. In 1894 the latter started a restoration to connect the original "palazzotto" with the nearby deposits. The reception rooms were built above the warehouses, raising the wall elevation and building the façade of the building A forepart was created with round arches decorated with ashlar work, to give the structure the appearance of a castle.The complex was connected with the church of Santa Maria delle Grazie through a portico on the first floor, then destroyed when Count Roberto donated that part of the building to the church for the sacristy, and in 1985 the heirs of the D'Ayala Valva family donated the castle to the Municipality, which is now used for cultural activities.

Surface-penetrating radar (GPR) is a very near-surface geophysical technique that allows analyze in the first centimeters of depth the buried defect inside the structures of pillars, beams, walls, etc. [1]. The distribution and orientation of electromagnetic energy subsurface reflections can be related to certain aspects of the investigated materials such as the presence of voids, defects, etc. Successively high definition three-dimensional maps and images of the investigated structures can be produced.

A growing community of engineering, architects, restorers has been incorporating surface-penetrating radar (GPR) as a routine field procedure for the degree of conservation of the structures analysis [1, 2, 3, 4, 5]. The SPR surveys were undertaken in some wooden bears inside the Palazzo Ducale in order to ascertain the conservation state.

II. Results and discussion

The SPR surveys were carried out with the IDS Hi Mod system with 2GHz antenna. Data were acquired in continuous mode along 0.01m spaced survey lines, using 512 samples per trace, 16 ns time range, manual time-varying gain function. In this paper the results of one beam were shows (Fig. 1).

The data were subsequently processed using standard two-dimensional processing techniques by means of the Reflex 8.0 software. On each SPR processed profile (Fig. 2) a hyperbolic shaped reflection events inside the white dashed circle are visible. This reflection event was interpreted as probably due to the knots. A relatively strong continuous reflections are visible on the Fig. 2. In this case the shape and dimensions allows to interpreted they as fractures.

III. conclusions

The presence, in the radar sections, of various anomalies of hyperbolic form, due to small inhomogeneities such as pebbles and pipes, has made possible a rapid and accurate analysis of the propagation velocity of the electromagnetic waves that allowed the transformation of the time axis in depth.

The analysis of the data has highlighted the presence of numerous reflections with the characteristic shape of hyperboles placed at depths ranging between 0 and about 2.5ns (0.0 - 0.15m); these anomalies correspond to the probable presence of knots inside the beam; the number of nodes is high and varies from a minimum of about 10 to a maximum of about 25. It is therefore possible to observe a linear density of nodes ranging from 1.7 to 4.2m^{-1}.

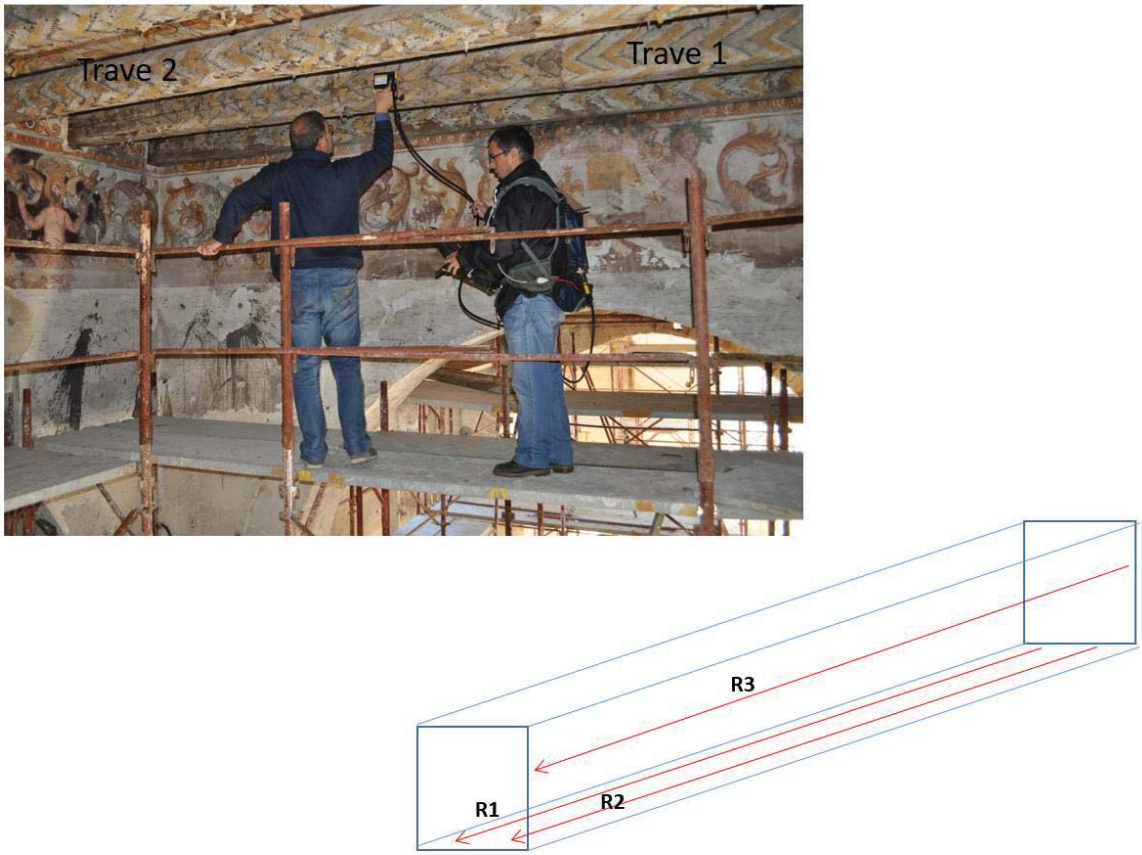

Fig. 1. The surveyed wooden beams

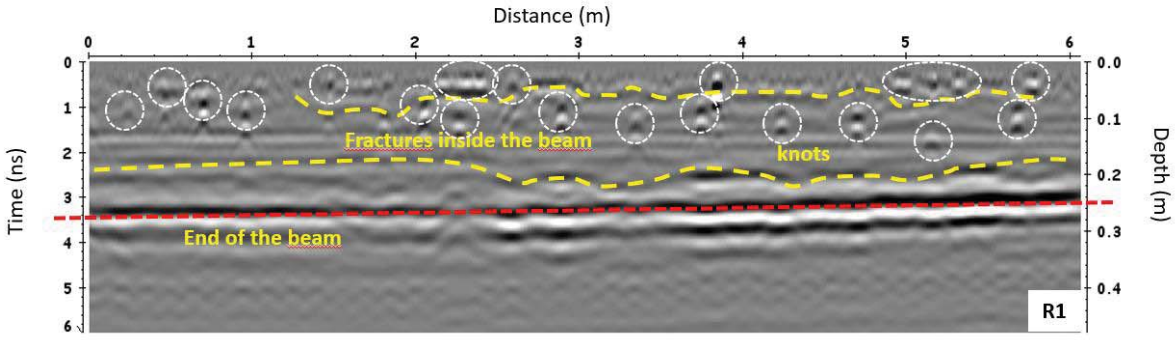

Fig. 2. GPR processed section.

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