

# Non-destructive testing to reveal the history of a 17th-century building

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## 1 Abstract

This paper describes the experience of a building contractor, who used non-destructive testing (NDT) to assess a 17<sup>th</sup> century residential building, and who, as a consequence, drew up a conservation and strengthening plan. The preliminary phase of the study involved an in-depth analysis of the historical and architectural context. This was based on the limited documentation available, such as historical maps and land registry records. Where the sources proved incomplete, a careful, close examination of the building was used to supplement them. Subsequently, a series of non-destructive tests (NDT) was carried out on both the vertical masonry structures and the horizontal timber structures, which led to the decision to preserve all the original structures. The interrelated results of the non-destructive investigations made it possible to reconstruct the major historical transformations that had taken place over the centuries – and there were many of them. Consequently, the building, with its frescoed rooms, was placed under a conservation order by the Ministry of Culture. Once again, non-destructive investigations proved to be an essential part of preserving historic buildings.

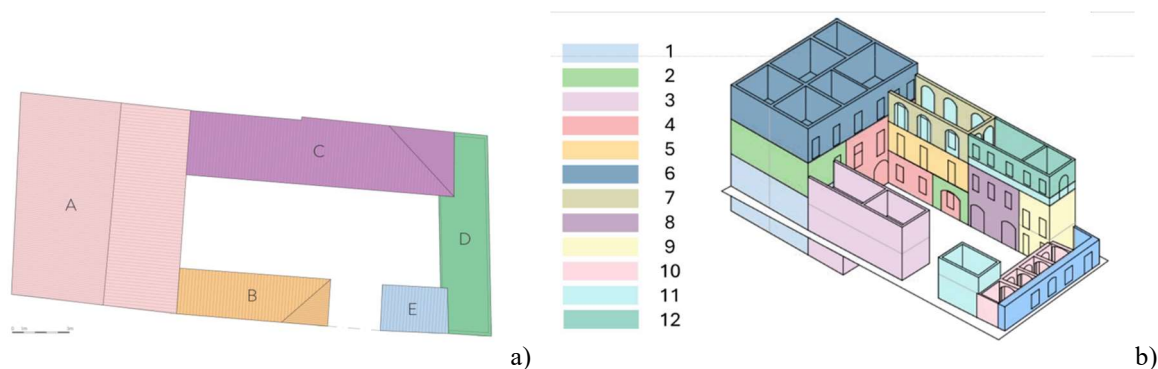
**Keywords:** NDT, historic building, masonry, sonic pulse velocity tests, drilling resistance.

## 2 Introduction

Studying the architectural heritage found in historic town centres is of fundamental importance for preserving collective memory and understanding a local cultural identity. This paper contributes to this area of research by providing an in-depth analysis of a residential house in Lodi's centre. This house embodies different architectural layers and is now subjected to rediscovery and enhancement. This is a building – probably dating from the 17<sup>th</sup> century – situated in the western part of the city of Lodi, near the ancient medieval walls, incorporating a section of them and following their original layout.

It is courtyard which, whilst maintaining a sense of unity as a whole, presents itself as a complex structure comprising volumes of varying heights and masses, organised around a quadrangular courtyard. The inner courtyard, enclosed on all four sides by wings of buildings from different periods, creates a sheltered and intimate setting, and serves as the central hub of the entire building. The building has a complex, four-storey structure with distinct functions. The basement in the northern section houses the cellars, the ground floor comprises service areas and the two upper floors are dedicated to living accommodation. The frescoes and paintings adorning the rooms appear to be the work of at least four different artists from various periods.





**Fig.1.** a) Roof plan showing the division into main sections and b) an isometric view of the complex development [1].

### 3 Diagnostic investigation

Both passive and active thermographic analyses were carried out, but the high level of relative humidity made it impossible to see the masonry behind the painted walls. On the other walls, it was possible to remove portions of plaster and expose the various types of masonry, all of which were documented and catalogued. Selected walls were then subjected to sonic pulse velocity tests by direct transmission determining the different construction technique present in the masonry walls [2]. On the same walls, penetrometric tests on the bedding mortars were carried out, with a special device that enables to reach up to 7 cm and so enabling, together with sonic tests, their different chronological dating (Fig. 1).

Finally, a series of georadar surveys made it easy to identify the many disused smoke stacks that could be reused to house new technical installations as part of the conservation restoration project.

A significant proportion of the investigations focused on the timber floors. These involved geometric surveys and drilling resistance tests. This made it possible to assess the floors' state of preservation and identify the construction techniques used for the various extensions added over time. All of the floors have been preserved and suitably reinforced using wood-on-wood techniques.

### 4 Conclusions

Minor architectural heritage, which is often overlooked, can reveal untold stories and offer new perspectives for understanding the urban landscape. To support this research, a well-designed and targeted diagnostic campaign [3] is certainly needed, even if it consists solely of ND testing, with the various useful results being cross-referenced.

### References

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