

# 3D Technologies for Protection and Exposition of Authenticity of Historic Building

## Tenement House at ul. Wroniecka 23 in Poznań

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## Introduction

Historic buildings are places that accumulate the memory of events, human accomplishments, technical achievements and aesthetic creations of our ancestors. The past, however, is also important as the foundation for the present and future. It is the key component of continuity of social and cultural environment that derives from the created heritage and thus, enriches contemporary culture with new, valuable elements. Responsibility for culture heritage of earlier époques means that architecture, which is revitalised and adjusted to purposes connected with today's needs of urban space and society residing in it, should be treated as a complex phenomenon whose value is defined by the synergic interaction of elements making up the whole. The relation between the past and the future requires analysis of history of the place and its impact on forming the interior but also allows to re-define approach to architecture for which a wider perspective of conditions and limitations becomes a rich source of creative inspiration.

## Integration of research structure: from design through renovation to building operation

Using new technologies in collecting and processing of data about historic buildings is nowadays becoming a standard. For several reasons, it is even more important for old buildings than those modern ones: if we want to use their potential and learn more about their history and uniqueness of their character and structure, we should apply modern solutions, such as 3D scanning and BIM modelling. A tenement house at ul. Wroniecka 23, located in the very heart of the Old Town in Poznań, excellently illustrates the aforementioned thesis. The building was raised in the 15th century and is now listed in the National Register of Historic Monuments. Its renovation was integrally connected with the research process. On the one

hand, the building plays the role of the historical background, component and limitation but on the other hand, it allows creation and innovative approach to new technologies whose aim is to improve durability of the structure and protect the historic matter. The house has gone a thorough transformation, from an abandoned ruin to a technologically developed centre of science, research, design, architecture, art and technology. This complex process was supported by technologies at every stage of works and now, when it functions day by day, the data is continuously collected to effectively monitor structural changes and daily operation.

## Research analysis

Revitalisation of Wroniecka 23 was not just a mere project of renovation of a listed building, as the process of recognising, forming and defining the scale of renovation interference was integrally connected with the research process whose goal was to look for elements of the primary construction purpose, diagnose characteristic features of consecutive periods of history and analyse a multidirectional strategy of the long-lasting and solid security of the building. New technologies as research tools have revealed data about the building, thus showing dynamic transformations it had experienced. The house was covered with multiple layers from past centuries, which had hurt the historic tissue. New technologies enabled researchers to gain new knowledge about the building and technologies applied in the past. This led to creating a link between the past and the present, allowed to work out more effective methods of protecting the monument and define options of future operation of the building. The essential stage of the process included the professional collection of spatial data about the as-is state, which was based on properly planned measurement cycles with the use of a 3D laser scanner. The data collected in the form of a point cloud became a starting point for preparation of advanced documentation in BIM environment, 2D documentation and various types of analyses which constituted the base of the project. However, the role of 3D scanning and its derivatives did not end at that stage. As the works connected with preparing the building for revitalisation continued, the point cloud was continuously updated, which allowed carrying out even more analyses.



*Fig. 1. 3D laser scanning of the tenement house, Poznań, Poland*

## Design

The main assumption of the whole project was to prove that a historic building does not have to be just a relict of the past but can pursue one of the primary purposes of the Venice Charter: to make the monument socially useful. Wroniecka 23 is not only a useful place; it is also a historic house that is modern and technologically advanced but, at the same time, it is environmentally friendly and meets requirements stipulated for nearly zero-energy buildings. Technology applied in the building helps to protect its historic value and, at the same time, conduct scientific research. The collected data allowed to define functions of particular rooms, design all details of their layout and arrangement, create the form and character of new elements, such as stairs, roof construction or location of installations. The constantly updated point clouds affected the designer's work, which can be felt in the interior of the house.

Using a laser scanner enabled the researchers to conduct the 3D examination of the detail with complex geometry – it broadened the knowledge about the structure of historic bricks and wooden beams, and facilitated designing and installing dedicated systems of technical equipment which, on the one hand, provide outstanding parameters of air quality, ventilation or thermal comfort and, on the other hand, they protect the historic matter better than ever before. They also pay respect to the authenticity of the place: the original brick walls, uncovered from several layers of past centuries, are the background for modern elements, such as intake and exhaust diffusers or ventilation pipes which are not hidden but exposed outside. They do not damage the historic matter, they co-exist with it.

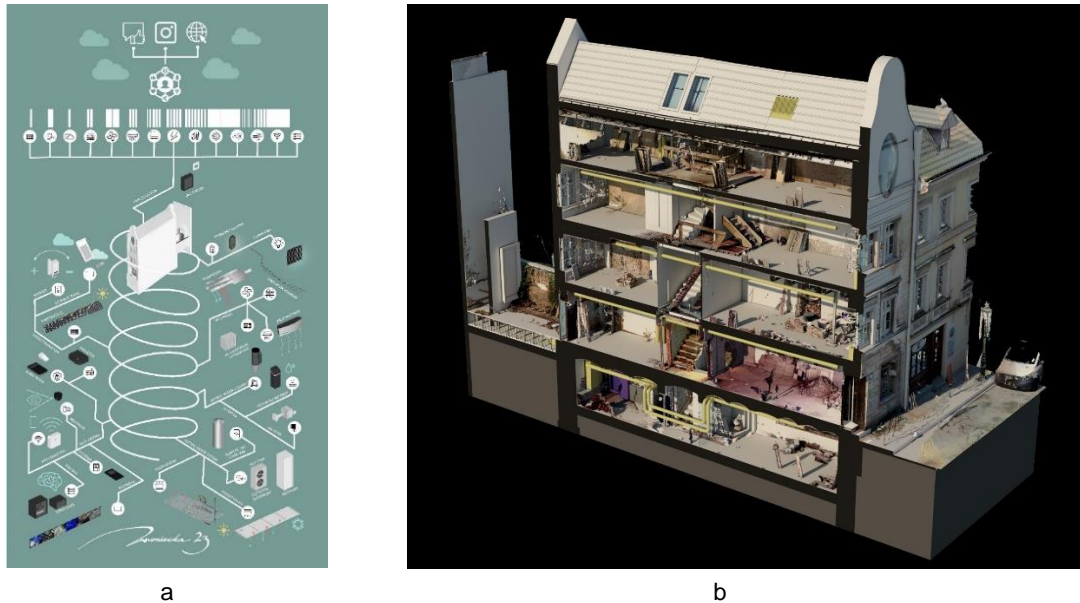


*Fig. 2. 3D examination of the detail with complex geometry; 2a. Examination of wooden beams, 2b, examination of brick structure.*

## Performance

3D scanning conducted during renovation works allowed the documentation of the actual location of elements which are not visible but are essential for the proper functioning of the building. (Fig. 3b). On the basis of the point cloud, the 3D model was made in Revit; it resembled the detailed structure of bricks, uneven walls and the structure of the whole, irregular fifteenth-century building, together with contemporary elements of the technical equipment. In consecutive stages of the renovation, when drilling was the necessary part of the installation process, the model enabled the proper installation of other systems without the risk of damaging the already existing systems which are invisible, hidden in the floor, e.g. BMS. Thanks to that, it was possible to define the location of invisible systems, e.g. those encased in ceilings, with precision up to 1 cm and avoid drilling through. This documentation is also

crucial from the historical point of view as it will facilitate future renovations. (Fig. 3b)



*Fig. 3 Wroniecka 23, Poznań, Poland; 3a. Schedule presenting the technical equipment in the building, 3b. Point cloud with technical equipment of the building,*

## Operation

The stage of building operation assumes modernisation of HVAC systems and another scanning of the house; this will facilitate precise monitoring of technical systems in the building and store data for future modernisations. The laser scanning of Wroniecka 23 inspired the Polish pianist and composer, Leszek Możdżer, to create a soundtrack to a video illustrating the scanning and a statement: this building produces more energy than it needs. His music serves as an example of how broad and interdisciplinary impact may 3D scanning have on various areas.

## Conclusions

3D scanning and other technologies applied in the tenement house at ul. Wroniecka 23 in Poznań have created possibilities to adjust the house at Wroniecka 23 to contemporary forms of operation without significant prejudice to its historic matter and identity. They have also contributed to upgrading energy efficiency of construction elements, technical equipment, inner and outer structures; all this has allowed to implement top standards of climate comfort inside the building and meet requirements regarding the minimum total cost in the building's LCA. In order to illustrate the condition of the building, the systems of monitoring, automated control and management of the house have been installed. Their purpose is to monitor values of essential environmental parameters and status of the systems, integrate technological devices, control the consumption and production of energy; they also record, analyse and present the obtained data. All the aforementioned activities have allowed obtaining and collecting data about the monument, broadened knowledge on its history and facilitated effective operation of the building in accordance with the standards of sustainable development.

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