# Using 3D Models for Conservation and Study of the Wooden Architecture Heritage in Lviv Skansen

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## The problems of preservation of the wooden structures in Lviv Skansen

The Museum of Folk Architecture and Rural Life is an open-air ethnographic museum located in the beautiful Shevchenkivskyi Hai (Shevchenko Grove) park in the northeast part of Lviv. It was established in 1971 for the preservation of some important specimens of wooden folk architecture, usually rural, such as farmhouses, workshops of craftsmen, mills, schools, barns, and churches. The museum conserves and displays wooden architecture and everyday life artefacts from all ethnographic zones of the Western Ukraine.

The museum possesses 110 folk architecture objects that have been collected and transported from their original sites since 1967. They include seven churches, two of which are especially valuable: St. Nicholas Church from Kryvka village (1763) and Holy Trinity Church from Klokuchka (a suburb of Chernivtsi) (1774).

The challenge of the open-air museum when preserving wooden constructions is their continuous exposure to the outdoor atmosphere. The wooden architecture objects require continual monitoring and repair—for example, complete replacement of the roof covering (shingles or straw) every 15–30 years. The maintenance depends both on the quality of the materials and methods of conservation.

Before 2007, most of the museum objects were in poor or very poor condition due to the lack of funding since 1990. Up until 2010, no repairs or renovations were undertaken. The resulting roof leaks caused serious damage to the building elements. When finally transferred, the objects were assembled with some mistakes that eventually led to their destruction.

## The experience of creating models by the museum architects

The decision to make 3D models of the museum objects was adopted as a result of the fact that their current documentation was in poor condition. Much of it was acquired during the time of transportation of the buildings from their original sites, and thus often was lost. The existing hand drawings of the museum objects were made by architecture students. They were of low quality and provided only a general impression of the objects.

Given the risk of destruction of the valuable museum objects and the desire to preserve

the maximum information about the authentic constructions, in 2007 the transition was initiated from the traditional drawings to the digital models of the buildings. For this, the ArhiCAD software was chosen. During the first few years (from 2007 to 2010), the museum architects acquired 3D models and documentation for seven large buildings, including the renovation project of the house from the village Gusnyi. This typical "long house" is a traditional type of dwelling from the Boyko ethnographic region and was 80% destroyed during a fire in 2005. The restoration project was based on the research of the archival material and the house remains that escaped the fire. It included stone parts of the building that were recorded only in the archival documents (the stone barn and cellar). They were not rebuilt after the transportation of the house to the Museum in the 1970s. As a result, the 3D model of the edifice was the only model that preserved an authentic
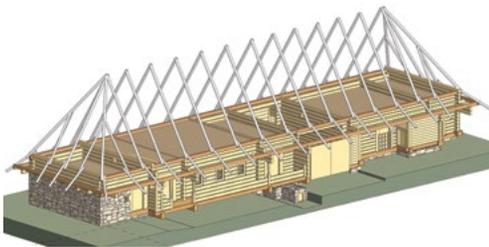
look of this type of house, which no longer exists in its native territory.

The project of creating digital models was presented in two international cooperation projects. From 2010 to 2015, the museum conducted restoration work in cooperation with its international partners from Norway and UNESCO. The first project was a result of collaboration with the Maihaugen Open Air Museum (Lillehammer, Norway) and was funded by Riksantikvaren (the Norwegian Directorate for Cultural Heritage). The Norwegian partners did not participate directly in the restoration work, but sponsored materials (wood, straw) for the restoration. As a result of this cooperation, the houses from the village Mshanets (early 20th century), the house from the



Fig. 2. The barn from Transcarpathia.

village Lybohora (1812), and the house and barn from the village Pylypets (1846) were restored.



Fig. 1. 3D models of the house from the village Gusnyi

The UNESCO project was called "A Revitalization and Collection Care Programme for the Museum of Folk Architecture and Rural Life, Lviv, Ukraine" and was sponsored by the Norwegian government. The Museum conducted the "Workshop on documentation of the houses" that covered both traditional and modern methods of documentation. The goal was to assess the quality of the documentation in the Lviv Museum and develop suggestions for improvement. The workshop was led by UNESCO consultant Jan Michael Stornes, who has technical expertise in documentation and condition assessment of wooden architecture in Norway. He has worked at the Norwegian Institute for Cultural Heritage Research (NIKU) since 1996.

The goal of the Ukrainian architects was to get acquainted with the modern European standards of documentation and assessment of the wooden structures and wood. The participants in the workshop shared their experiences and discussed the possibility of the practical implementation of the acquired knowledge. This workshop was useful not only as a practical measure; it was an important step in the development of cooperation between the folk architecture museums in Ukraine and Europe.

Another part of the UNESCO project was a restoration of the house from Shandrovets (1909). This "long house" was a complicated construction in very poor condition. The building consists of two parts (the house and the stables), joined by one large roof. The walls and beams that supported the roof were poorly collected and rotten. The large size of the log elements and lack of additional technical equipment, such as cranes, did not allow removing it for several times and adjusting dimensions on site. The 3D model helped to detect these defects, to determine the correct size of the elements that required replacement, and to construct the roof rafter system in compliance with its authentic project. All measurements were performed with a laser ruler Leica Disto and modelled accordingly.
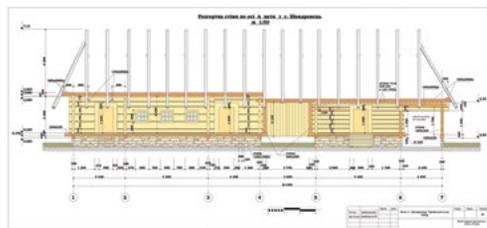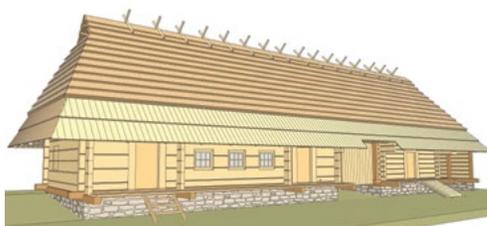




Fig. 3, 4. The "Long house" from Shandrovets (1909). (3D model and drawing)

The digital model also allowed testing of all repair solutions with high accuracy in the office.

The ArchiCAD software allows using existing library elements or making one's own. When needed, it is possible to create an additional library for modelling of individual elements and details. The elements of traditional wooden architecture are typical, and can even be similar in different countries.

## Practical use of the 3D models

Digital modelling is useful not only for studies of the wooden architecture, but also for creation and promotion of the museum collections. Among the main opportunities for this application are:

### Making architectural drawings based on the 3D model

The ArhiCAD software allows creating documentation and drawings of an entire building, separate walls or details. All changes in the 3D model are relatively easy made and are automatically transferred to the construction drawings. The 3D modelling allows creating a clear visual presentation of the object, changing the scale, adding de-

tails, creating intersections and 3D section in the axonometric projection at any point, and adding drawings and additional information (text, photos, archival materials).
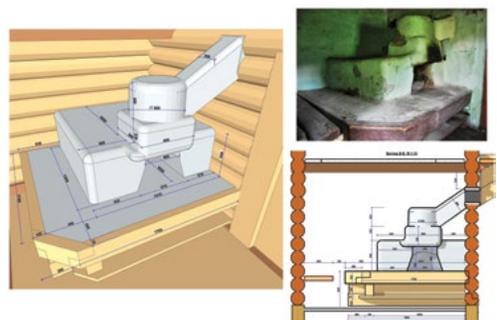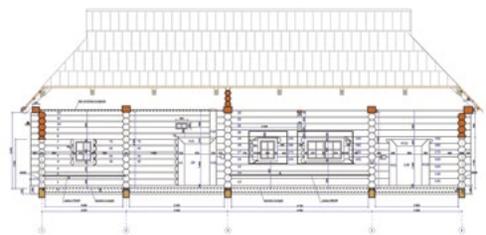






Fig. 5, 6, 7. The house from village Rivnia (1861), transferred to the Museum in 2013—3D model, drawing, 3D model and drawings of furnace

Documentation produced in this way is much more accurate than traditional documentation, and is of high quality.

Demonstration of the hidden structural elements of the building, mechanical parts of mills, thrashings, sawmills, etc.

The structure of the wooden constructions is quite complicated. It is often hidden under a high roof; some log cornering techniques can be hidden inside and invisible. These details are usually interesting for ethnographers, architects, conservators, scholars, and museum visitors. The technical facilities like water mills, threshing, sawmills, and so forth also have internal mechanisms. The bad working condition of these mechanisms often does not allow running them. In this case, the 3D animations can be used to demonstrate their work. This type of the 3D model has already

been made for the watermill from the village Lybokhora.

Creating and working with the general plan of the museum.

Unfortunately, during the 50 years of the museum's history, not all of the planned ethnographic zones have been built, and some are still unfinished. The goal is to build two ethnographic zones of Polissya and Volyn and an area of the handicraft town.

For such a global and complex work it is essential to possess digital models made on the basis of the ethnographic expeditions and archival research. A ready model can be placed on the landscape model in order to evaluate how individual objects will look from different angles or as a whole. It might also help to plan individual tourist routes and farmsteads.
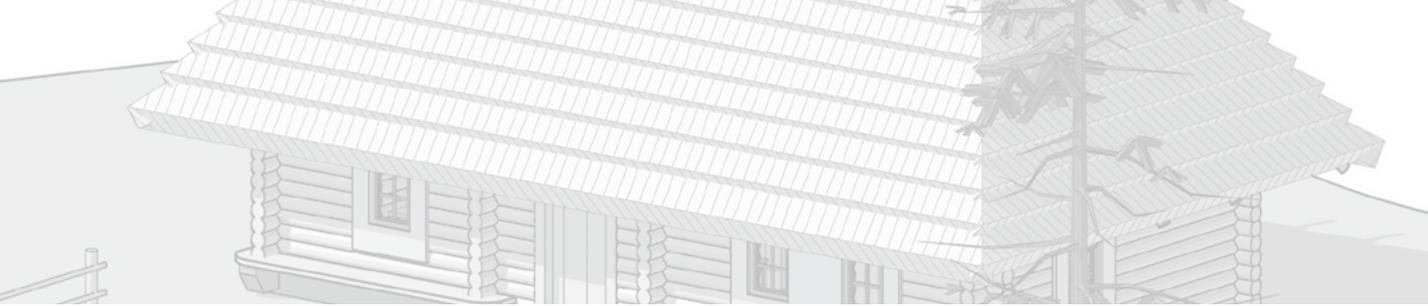


Fig. 8. The watermill from Lybokhora,  3D model



Fig. 9. The farmstead from the village Berezhonka

### Connection between the construction models and digitized base of the interior and exterior exhibits

The museum has a collection of 20,000 exhibit items including furniture, textiles, utensils, carpentry tools, musical instruments, farm tools, religious items, etc. Almost all of them have been included in the digital catalogue. The information from the existing digital catalogue can be linked with the digital models for creation of the exhibition plans.

### Demonstration of the different time layers and phases of construction

Throughout their existence, the museum objects have been often altered. They were remodelled while in their original sites. Sometimes they were transferred to a different place or rebuilt by the owners. When transferred to the museum, the wooden structures were assembled according to the reconstruction projects and could have undergone slight changes. Now a 3D model of the current situation is created, but information is also added about any previous phases of reconstruction. The digital modelling allows showing different time layers, and marks elements that have been restored or changed because of decay; it also allows monitoring the general condition of the object.

### Promotion of cultural heritage

Digital models can be used for promotion of the museum collections and various educational programs. Thus, they can help to attract a wider range of stakeholders through the modern means of communication. Virtual 3D tours are becoming increasingly popular. Digital models of the museum objects can be incorporated into computer learning games.

### Summary

Today digital technologies have become an integral part of our reality. In the museums, such technologies can completely transform the museum experience and help to overcome gaps between the museum, its content, and audience. Creation of the comprehensive construction database in the Museum of Folk Architecture and Rural Life not only has a wide range of applications—beginning with better management of its assets—but also improves digital access to its heritage and cultural activities, potentially reaching every adult and child.