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LA EXPERIENCIA DEL REUSO



*Propuestas Internacionales para la Documentación, Conservación
y Reutilización del Patrimonio Arquitectónico*

VIDA EN EDIFICIOS Y CASCOS HISTÓRICOS
●
ITINERARIOS Y PAISAJE DENTRO
DEL PATRIMONIO



Congreso Internacional sobre Documentación, Conservación y Reutilización del Patrimonio Arquitectónico

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The Pogost Complex on Kizhi Island, Karelia: laser scanner survey for the analysis of the structural assessment of the Church of Transfiguration

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The work of the project is on the Pogost Complex, with a precise detailed and accurate analysis of the architectural and static structure of the Church of Transfiguration for the study of methodologies for conservation and restoration. The survey focuses on general survey of the object through different methods: laser scanner survey, direct survey, general analysis, realization of a wide photographic and pictures, drawings for studies through the general to the particular analysis. Special attention was paid to the architectural structure of the wooden architecture in relationship with a second internal metal structure, inserted during the fifties because of the first signs of structural failure of the church. These two systems of structures over time have started to interact and rely on each other distorting the original architectural static system and producing significant deformations and static changes on the structure of the church, currently submitted on a delicate intervention of restoration. For all these reasons it was necessary to test the potential of a laser scanner survey planning stages of acquisition of the data, making critical evaluation of the information obtained and methodological procedures for the graphical restitution. To complete the first work step was conducted a study on structural details, intersections and wood elements assembling systems, in order to obtain a good knowledge of the features and issues about that architecture. The proposal for these operations is focused on choosing a type of survey performed by 3D laser scanner for three-dimensional processes that can be able to join a high degree of reliability and reduced time for data acquisition. The definition of related diagnostic situation of the church appears to be a fundamental activity to define concretely the state of deterioration and structural condition of the building.

DOCUMENTATION OF WOODEN ARCHITECTURE IN KIZHI ISLAND

The Pogost Complex: the Church of Transfiguration

The documentation activities on the study of wooden architecture in Karelia are included in a multi-year European Research Project entitled "Wooden Architecture. Traditional Karelian Timber Architecture and Landscape" developed by the Seventh Framework Programme, Marie Curie Actions aiming at the promotion of international Scientific Research and increasing scientific exchanges between universities in different countries. The Scientific Coordinators and Responsables are Prof. Stefano Bertocci, University of Firenze and Prof. Sandro Parrinello, University of Pavia in collaboration with the Petrozavodsk State University (Russia) and University of Oulu (Finland). The research and documentation are carried out through workshops and seminars organized on the island of Kizhi, which belongs to the larger islands in Lake Onega. Kizhi is part of the list of UNESCO World Heritage Sites, which is considered a

World Heritage site because of the presence of historic architectures, characterized by structural and technological systems typical of the Karelian territory. The measurement campaigns and documentation in this area helped to deepen specific methodologies for the representation and definition of systems of investigations and monitoring for the conservation and protection of these particular architectures. The Church of the Transfiguration is the main building of the Pogost complex. Built during the Northern War (1700-1721), the church became an expression of the great talent of its people. The consecration of the altar took place on 6th June 1714 as stated in the inscription on the cross of the altar of the church. The Church of the Transfiguration of Kizhi was erected on the site of the old church set on fire by lightning. Its height to the central dome is 35 meters. The church has an octagonal plant at multiple levels. For the material of construction were used the wood of pine, aspen and fir. It has a structure in eight levels. The eastern part of the altar is shaped pentagonal. From the west to the main fort attacking a fort down in the refectory (narthex), while lower octagon are placed one above the other two forts octagonal smaller.

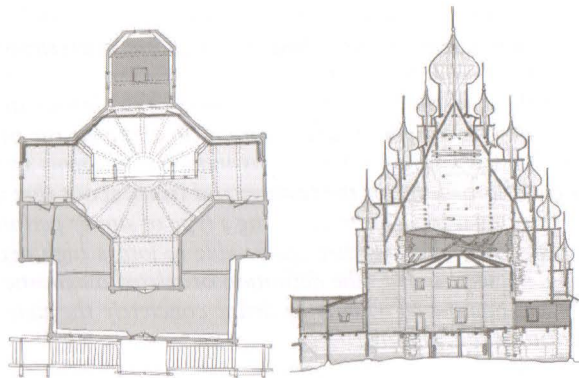


Figure 1. Plant of the access level and cross section of architectural structure of the church.

The church is crowned by twenty-two domes placed in tiers with pitched roofs and an octagon with a curved shape like a barrel vault. The shape and size of the crowns vary by reason of the level, giving a kind of particular rhythmic aspect of the church. In this temple functions were held only during the summer period. From the construction point of view, this means that within the individual sections of the structure is not present seal wool or birch, the church hasn't double doors or windows, floor or ceiling heating. The central volume is formed by three octagons of measures decreasing in height. The main particular things are related to technological solutions that can sometimes be considered as simple decorative elements, but they actually have first of all a protective function.

THE SURVEY PROJECT

Introduction

The Church of the Transfiguration must be interpreted as a large complex formed and composed of elements of different nature and generally connected to each other by technology nodes of multiple types. The purpose is to study the object through a scientific instrument that allows to understand exactly all the qualities and the physical, spatial, and technological elements present for understand the best solutions for conservation and restoration. The accurate and dependable drawing of a building is the basic tool for architectural restoration, for the knowledge of the state of conservation and for the definition of necessary interventions to improve. The survey proposed is based on a system of acquisition of the measures that sees integrate different analysis methodologies in order to ensure and guarantee the reliability of the measurement and the general descriptiveness of each element present in the component. The need for investigations of various kinds is fundamental in order to be able to formulate scientific considerations on the totality of the article; in particular the architectural survey premise and continuous verification and monitoring procedures of restoration, is intended to provide a display system of the state of the structure, together with particulars of the state of health of the individual architectural components, every consideration in addition to a thorough diagnostic importance. Careful survey operations are the fundamental base of knowledge for the exercise of critical and interpretive activities related to training and development of a specific emergency architecture, settlement or territory, as well as constant monitoring of the need for conservation, restoration and enhancement of site.

General methodology of intervention

The development of integrated procedures for the documentation of artistic and cultural heritage today uses advanced technologies to carry out surveys to date articulated in the morphometric characteristics of the drawings, as well as material and diagnostic devices. The result of the operations of survey assumes in this strategy a series of values: documentary and testimonial value for the description of the physical, material and conservation of the building and its context and a value representative model of the object investigated in which the thematic elaboration of the basic information is a critical aspect essential for the assessment of the architecture. The application of the relevant integrated and the preparation of subsequent investigations and critical issues has led to the structuring of a database sizeable quantitative and qualitative. The database has processed the purpose of obtaining consistently useful information for the design and construction of an integrated model of analysis on architectural system investigated. The preparation of drawings, vertical sections on each plate of beams, axonometric able to fully show the relationships between each groove present, represent the general objectives of the first phase and main knowledge-diagnostics of the project.



Figure 2. Sequence of the digital elaborations made for each part analysed: photo mapping of a façade, cross section with photo mapping and 2D redrawing.

The proposed designs are accompanied by a diagnostic framework and a mapping of the degradation that allows you to explore the most interesting geometric sections of each beam becoming real thematic maps where you can read a whole different characteristics which affect the product. The construction of three-dimensional models then completes the overall objectives of the project. These models do not have the purpose of being useful to graphic material representation of a complex state of affairs, but most want to be seen as dynamic database and always upgradable, integrating with modern management systems, GIS on which articulate throughout the insertion of diagnostic data. The three-dimensional model can become navigable and interrogated in each of their parts like a “virtual book or booklet graphic campaign” constantly consulted and updated

Architectural survey and structural properties of the Complex in 3D simulations

The 3D digital capture of the Church of the Transfiguration has requested the recovery of a large number of scans from different viewpoints then processed to return a comprehensive three-dimensional model not only the main subject but also the context in which it is included, along with other buildings nearby, such as to be faithful to the original and measured in detail. The scan tool 3D product output raw data appropriately revised: alignment of the shooting, merging into a single triangulated surface filming, editing surface to remove any small faults, simplify subsidiary or establishment of a multi-resolution representation, and finally mapping of color data. The advantages offered by such work arising from the use of laser technology are:

documentation of the architecture in terms of cataloging, presentation graphics, or for the management of geo-referenced documentation of the restoration; a better understanding of the work or its condition (simulation of static characteristics, structural analysis FEM (Finite Element Method) simulation of decay events, metrics analysis, etc.); better use, through new forms of interactive multimedia presentation or immersive and both local and remote access to the tools of visual analysis; the accurate reproduction material directly from the 3D model, which does not require therefore the

realization of casts. Finally, simulation and design of a system of documentation and communication of restoration through 3D GIS technologies and multimedia systems capable of implementing and further developing the three-dimensional representation.

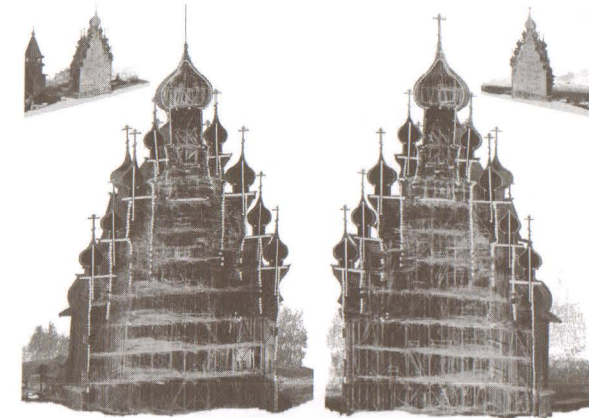


Figure 3. Isometric view from the point cloud for the understanding of the wooden structural system.

PHASES OF THE RESEARCH PROJECT: INTEGRATED 3D LASER SCANNER SURVEY

Procedure for create three-dimensional supports for scientific analysis and restoration of the Church of Transfiguration

The fact-finding phase of the building, part of the restoration process proposed is, together with documentation historical-critical operations in preparation for scientific analysis in the program.

These operations must provide the documentary basis for the preparation of thematic maps containing the results of studies on aspects of matter, the degradation, as well as on the chemical-physical and technological. To do this so expeditious in a preventive phase of the project are necessary survey operations aimed at the individual parts of it. The proposal for these operations is concentrated on the choice of a type of survey executed through 3D laser scanner for the preparation of three-dimensional substrates that combine a high degree of reliability and a reduced time of data acquisition. This choice is advantageous in view of having an as much as correct measurement and subsequent representation of each wooden element, both of the individual parts which make up the entire artifact, that any of the surfaces decorated timber.

Taking into account the characteristics of the object in question, in particular the decorative richness and compact size, it seems appropriate to use a particular type of scanner, specially designed for this type of survey. Associated with the given metric is also obtained the information on the type of material, since the instrument is able to map in real time the environment 3d generated from the point cloud with the colorimeters of the object. The operation, thanks to the characteristics of the scanner

in question, takes place with the use of a single operator, capable of simultaneously acquire data and have an almost immediate return of the three-dimensional model. A three-dimensional representation so obtained of individual boards that constitute the part of iconostasis examination, essential for the restoration of wooden supports and for the following reassembly of the whole, occurs so in time to leave room for the later stages of diagnosis and restoration. As regards the decorations also, this digitization of the measurements, it is useful for a possible reproduction of the shapes in a prototyping process with numerical control, which contributes to a more expeditious and flexible the integration phase of any missing parts being restored. That's the reason why, associating the data acquired from the scanner using a Prototyper can play and copy portions of decorum in series in which to assess time, cost and response of materials to any interventions.

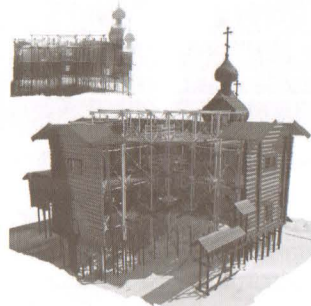


Figure 4. 3D model view.

Analysis of degradation and their mapping

The definition of diagnostic pictures about the church appears to be a fundamental activity to concretely define the state of deterioration and structural conditions of the building. It was drawn up the project of a database, through management programs as filemaker, can contain information about each piece of wood in the church. The database is designed to meet the needs of restorers, but also aimed at a subsequent proposal for the development of the restoration itself, will then be directly related to GIS the three-dimensional model of the church, allowing the preparation of thematic maps detailed structure. Operative Phases: definition and analysis of census card descriptors needed designing on-site support; definition of digital media; census of items, cataloging data; computerization of data; processing of the database; preparation and engagement of the database to the graphics system and the implementation of GIS upgradeable.

The creation of different keys to access the database will make it possible to build an archive that can tell after the restoration of the church made for individual pieces of wood, knew directly from three-dimensional model. In addition to the creation of the database is expected on degradation of the wooden structures within the developed CAD morphometric survey proposed by the church. Each degradation will be reinstated in special layer and re-affiliated with nets in the design and importance of the church.

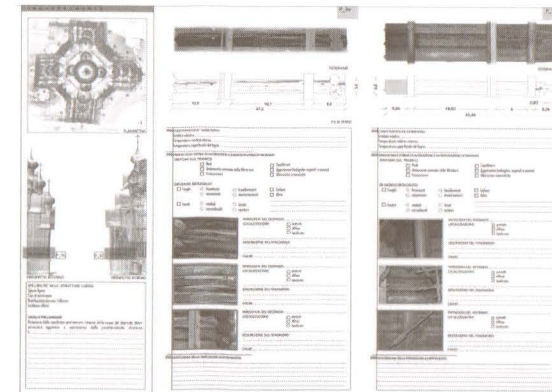


Figure 5. Example of a form of analysis of the state of conservation of the wooden structural element. The fields of the schedule can create the base of the GIS.

CONCLUSIONS

The digital technology of 3D solid modeling, photorealistic mapping of the models, the manipulation of chromatic aspects and the presentation technologies of virtual museums should be applied to the virtual reconstruction of the morphological complexity of the artifacts of historical and artistic interest. The technologies and rendering of virtual representation offer a rich range of possibilities for the representation of technical and analytical data for the construction of knowledge and experience useful in the field of conservation, monitoring, as well as the benefits, also for informative, realistic visualization of cultural heritage. The virtual representation then provides the ability to communicate and be able to convey deep, normally inaccessible to museum visitors (tourists) proposing significant experience in the field of museum display. The fundamental attribute of digital models is not so much being photorealistic simulation of the real, or foreshadowing or formal means of simulation structural and / or functional as being able to function as a true virtual prototypes with behavioral similarity and performance, primarily topological, geometrical and perceptive, able to allow us to simulate and analyze the project and observe his behavior so much better than analogue technologies allow both the display and the database. The commissioning a series of models then allows the construction of structures to illustrate an inherently spatial as architecture and landscape, with a three-dimensional representation.

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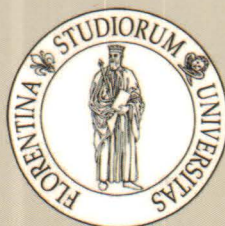
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ITINERARIOS Y PAISAJE DENTRO
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De forma conjunta, la Universidad
Politécnica de Madrid
(Escuela Técnica Superior de Arquitectura)
y la Universidad de Florencia
(Departamento de Arquitectura)
buscan intercambiar experiencias y
criterios desde un punto de vista actual.
El Congreso prestará especial atención
a la documentación, conservación y
reutilización de edificios y centros
históricos.

El objetivo de esta iniciativa es la
puesta en común de experiencias
vinculadas a aspectos profesionales y
académicos en el campo de la restauración
arquitectónica. El discurso puede
trasladarse al panorama internacional,
particularmente sensible con estos
temas hoy en día.



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