1. Introduction

The complete dismantlement of historic timber structures is a well-established restoration practice in Japan. Many conservation specialists hold the opinion that this restoration practice is the only reliable way to extend the lifetime of a historic building. Current dismantling methods and conventions evolved in accordance with the features and demands of framed timber structures that are predominant in Japan. Significantly less experience has been accumulated with horizontal log building types. Therefore, the ongoing restoration of the Church of the Transfiguration at the UNESCO World Heritage site of Kizhi Pogost, being at the center of international attention and attracting experts from around the world, is an important case study for expanding the theory of restoration through dismantling. This report is part of a larger research project dedicated to studying restoration and maintenance practices surrounding horizontal log wooden heritage in Eastern Europe.

2. History

According to the inscription on its altar cross, the Church of the Transfiguration was built in 1714. The church was built out of pine logs using a horizontal log construction technique and is 37 meters tall with a perimeter of 22x29 meters. Its basic structure consists of a three-level octahedral frame with four two-level side attachments. This structure collectively supports the weight of 22 domes of various sizes. The church’s dimensions and architectural design have only one known analogy - the 18-domed Intercession Church, which was likely built by the same team of carpenters in 1708 and lost to fire in 1963.

Views of the origin and nature of this monument evolved over time. Popular fable attributes the church’s construction to a legendary master-carpenter who swore that no building would ever match or exceed his masterpiece. However, recent research into building history and structure has exposed fundamental structural flaws that already existed at the moment of construction. Although the artistic sense, skillful craftsmanship, and deep wood material knowledge of the anonymous group of carpenters who built this church are undeniable, they apparently lacked experience working with tall structures and thus could not predict its long-term behavior.

The church’s most significant structural deficiency was in its foundation, a mere 80-cm deep trench containing boulders and gravel supporting a 600-ton structure. Moreover, the church was built at the location of a previous one and was larger than the earlier structure with its side extensions, causing severe structural deformation. Further complications were caused by steady northwestern winds in the area, the monument’s location on a slope, and the building’s dimensions exceeding the horizontal log building method’s structural capabilities. Restoration specialists working at the Transfiguration Church have observed that higher in the structure, carpenters laid logs in a manner lacking experience working with tall structures and thus could not predict its long-term behavior.

Photo 1 The Transfiguration Church with a dismantled third tier during the peak of the tourist season (August 2016, photo by Y. Uekita)
The church needed its first repairs soon after it was built, in 1754, and vertical binding posts were installed along the walls to help control log movement. These early reinforcements sustained the church for 200 years despite a visibly noticeable tilt to the structure.

From 1825 to 1879, the church’s exterior was refurbished with wall siding and sheet metal roofs replacing the original wooden shingles. Researchers still debate the effect of these interventions on the state of conservation. One opinion is that the external cladding helped prevent horizontal movement of the logs (1, p.11). However, on the contrary, Opolovnikov (2) observed that logs beneath the cladding deteriorated much faster because of a lack of ventilation. When the logs of the Transfiguration church were uncovered during the conservation work under his supervision in 1960s, he demonstrated that they were in a significantly worse state than similar uncovered logs in other timber structures (2, pp. 233-235).

The mid-20th century repairs were data-driven and conducted alongside considerable scientific debate. Nevertheless, those repairs possibly disturbed the fragile equilibrium that sustained the structure. Focus was placed on restoring the monument’s original look, so the cladding was removed, and aspen shingles were carefully restored based on images and remains of original pieces. During the conservation work, specialists concluded that the structure was stable and did not need immediate intervention (2, 250). However, during the next decade, the walls of the building began to move, leading to an emergency state in the 1980s. Two possible reasons for this movement are the increased weight of the cupolas under the aspen shingles and the removal of the supporting external cladding from the logs.

In the 1980s, in response to the emergency brought about by the monument’s wall movement, the interior was removed and an iron frame was installed to support the structure from the inside. This was an emergency measure that was never meant to be permanent.

Since the middle of the 20th century, restoration specialists were convinced that dismantling was the only comprehensive solution for rescuing the monument. The only question was when such a project would be attempted (2, p.255). Finally, the first stage of the complex restoration project began in 2009. We will describe this work in detail in the next chapter.

3. Current restoration
3.1 Process description

According to the restoration project developed by St. Petersburg Scientific Research Institute (Spetsproektrestavraitsiya), the Church of the Transfiguration is divided into seven restoration tiers, with each tier independently suspended using a specially engineered lifting system that allows dismantling of the logs from the bottom up. After dismantling the lowest tier, the logs are transported to a carpenter center built for this purpose on the island. There they can be safely stored and a team of experienced carpenters can work on their treatment year-round. The carpenters first reassemble the dismantled tier in its original state to observe how the elements inside the structure behave. After treating or replacing the logs, the tier is once again assembled inside the workshop to carry out a series of loading tests. Finally, the logs are dismantled and reassembled at the monument, and this process is repeated for the next restoration tier.

3.2 Carpentry work

The museum’s carpentry team consists of 15 experienced hereditary carpenters. The log treatments are done manually using of traditional carpentry instruments and joinery techniques. The team avoids artificial adhesives and non-timber insertions, and whenever replacements have to be made, the new timber elements are carefully selected to match timber density and resin and moisture content.

The carpenter’s work is directed by methodical guidelines developed by the Carpenter Center of the Kizhi Museum of Folk Architecture. These guidelines are designed to ensure the authenticity, construction capacity, and visual criteria of restored elements. The visual criteria are very precisely defined in the guidelines, which state that: a) regular logs showing volume or length deterioration of more than 40% should be replaced; b) prostheses should appear in the wall in a scattered manner; c) there may be no more than 20% of prostheses on any vertical slice and no more than 20% of the total length of the logs in any one wall panel; and d) each wall panel must contain no less than 30% of whole logs (with no additions), either new or original (3, p.21).

3.3 Foundation and wall reinforcement

To repair previous structural deficiencies, the current restoration project provided for a reinforced concrete foundation that lies deeper than the soil freezing level. Boulders from the original foundation were preserved in a visible part of the foundation and bound with a concrete solution. Their shapes were manually fitted to the church’s wooden underfloor to ensure even weight distribution.

However, even on a solid foundation, the restored portion of the church began drifting toward previous deformations. The drift became...
apparent after the third tier was restored and reassembled at the monument. In response to this, in compliance with the ICOMOS advisory mission recommendation, an early supporting system of binding posts was added to the building. These binding posts consist of two wooden planks - one on the wall’s exterior, and a matching one on the inside. The planks are bound together by metal bolts going through the wall. The bolt’s entry points have an elongated shape to allow the necessary vertical log movement in response to seasonal expansion and shrinking of timber. Such a system has traditionally been widely used in log buildings. Previously seen as additional support to be discarded after restoration, the binding posts were re-evaluated as crucial parts of the building, “because no log building of this size can be stable without such a system.” (1, p.9)

3.4 Current state and progress

The foundation and the four lower restoration tiers have been completed since summer of 2015, and one more restoration tier has been dismantled and is awaiting restoration at the Carpenter Center. There was a nearly two-year delay in the process because of the efforts to prepare a restoration project for the three remaining restoration tires and secure tenders for trusted contractors; and because of ongoing debates about an important structural component in the next tier - a quadrangle frame bearing the weight of top domes.

According to specialists at the site, most of the work in terms of volume and complexity had been completed. Presently, all movement in the walls has been stabilized and regular monitoring does not detect any additional deformation. A more detailed description of monument’s current state and its restoration process, containing measurement data and technical drawings, can be found in annual reports prepared by Kizhi museum staff members and available in English(4).

4. Discussion

4.1 Idea evolution

The method of repairing a log building by lifting it and replacing its lower logs is a well-established traditional practice across all regions where log buildings are common. From this point of view, the current restoration of the Church of the Transfiguration is a re-invented and technically enhanced version of an age-old practice. Complete dismantlement has also been practiced to relocate buildings. Evidence supporting this is presented in axe marks found on logs in building walls all over the country. In the modern age, dismantling has been employed by conservators to transfer monuments to open-air architectural museums. However, dismantling as a way of restoring important historic monuments remained taboo in expert circles, which are influenced by European heritage conventions.

When the first scientific debates began in the 1960s, one proposition that most experts could agree upon included lifting the top of the church and restoring only lower tiers using dismantling (2, p.253). Many preferred this option because the most valuable part of the church, its unique multi-domed structure, would remain intact. Later, evidence of the structure’s real technical state revealed the necessity of restoring the entire building. Consequently, plans evolved into a form similar to the present approach: lift the multi-domed top and restore the lower parts by dismantling, detaching each log starting from the bottom of the lifted part and placing it on the finished bottom part after appropriate treatment. An early proponent of total dismantling, Opolovnikov expressed concerns about such method, which he found to be equivalent to total dismantling, but unjustifiably more complex (2, p.254).

Despite showing no difference in principle from total dismantling, this innovative approach overcame national and international resistance to restoration through dismantling, at least for this monument. This collective change of heart can be seen in the contrast of the latest ICOMOS advisory mission reports, which are highly supportive of the process, and the expert resolutions in “Wood Structures: A global forum on the treatment, conservation, and repair of cultural heritage” (5) organized in 2000 to debate restoration strategies for the Church of the Transfiguration. The organizer of the forum, J. Kelly, calls the idea of dismantling of the Church of Transfiguration “the most controversial and radical solution” (5, p.x) supporting his argument with claims that the dismantled building will be difficult to reassemble, that restorers will be biased toward replacing old materials, and that the building will lose its authenticity.

4.2 Method strengths and weaknesses

At the current stage, restoration process at the Kizhi Church of the Transfiguration shows satisfactory results of the lifting method, which may be adopted for future restoration of various structures.

In this section we attempt to critically appraise possible strengths and weaknesses of the lifting method compared to conventional dismantling.

(1) Advantages of the lifting method:

a) Uninterrupted tourist activity. A thorough restoration using complete dismantling of a such a complex monument could last a decade. In the case of Kizhi Pogost, this would certainly affect the livelihoods of hundreds of people.

b) Warranty against accompanying uncertainties connected to funding, political turmoil, or human mistakes. In general, stakeholders feel much better about dismantlement when most of the monument is standing before their eyes throughout the process.

c) Sensible solution to a range of logistical problems connected to storing large volumes of material and seasonality of work.

d) Added possibilities for testing and prolonged observation. Current restoration showed that the behavior of such a complex monument cannot always be predicted, and empirical evidence from separate stages
of the process can provide important insights for handling the following stages.

(2) Disadvantages of the lifting method:

a) Possibility of discontinuity of expertise between different restoration stages. In case of the Kizhi Church of the Transfiguration, a separate restoration project is made for each tier, with contractors selected on basis of an open competitive tender each time.

b) Limited access to the building’s foundation. In contrast to the lifting method, complete dismantling allows specialists to conduct whatever foundation straightening is necessary without being restrained in techniques or equipment.

c) Discontinuity of environmental states between different restoration layers. Reassembling a monument at once has the advantage of operating with the elements in a more homogenous condition, whereas reassembling in stages carries the risk of conditions diverging when work is spaced over years.

d) Possible bias in favor of lower tiers. We previously mentioned that the top of the Kizhi Church of the Transfiguration is considered the monument’s most valuable part. However, while restoring the lower tiers, important decisions that will affect the upper tiers are made without having complete information about their state. An example of such bias is applying visual criteria for logs restoration, where the appearance of prostheses on the same vertical plane below the current restoration tier will affect log treatment choices.

5. Conclusions

This technical report reflected on the novel restoration method of gradual dismantling being conducted at the Church of the Transfiguration at the Kizhi Pogost UNESCO World Heritage site. The Church of the Transfiguration is a historic timber monument of unprecedented complexity and importance. The report presented an overview of the monument’s architectural history and the evolution of approaches to its conservation, along with explanations of the current restoration process.

Although any restoration of such scale becomes a valuable source of new ideas and approaches, the unconventional dismantling method adopted in this case opens a new chapter in ongoing general discussions of dismantling. As an alternative to a complete dismantling, which has been widely adopted for framed timber structures in Japan, the present case demonstrates a gradual dismantling by tiers from bottom to top, which is only possible in log wall structures, where structural elements are supported only by elements directly beneath them. In the case of Japan, where seismic hazards demand structurally sound architecture, restoration through dismantling has been an important part of the building tradition. However, this is not the case for log wall structures found in Europe, and dismantling options often raise concerns about authenticity among conservators.

In this view, the Church of the Transfiguration’s architectural history, the evolution of conservation approaches, and current results of the dismantling process have convinced the international community that restoration through dismantling is not only appropriate but unavoidable in this case. Moreover, the restoration technique adopted for the Church of the Transfiguration can be thought of as an extension of the traditional repair technique of replacing the lower logs of a building to prolong its lifetime. Consequently, this case opens a question of whether such a technique is preferable to complete dismantlement for log constructions.

To further guide the discussion, we presented strengths and weaknesses of the given method that we perceived at the project’s current stage. The listed advantages are more concerned with social aspect of the restoration, such as uninterrupted tourism activity and warranty against financial and political uncertainties, and is a more cautious process overall, which helps with stakeholder aversion to dismantlement. Meanwhile, the method’s disadvantages reflect the project’s increased technical difficulty, such as limited access to the foundation, discontinuity of expertise and decision-making between different stages of the restoration, and the divergence of structural elements in a lengthier reassembly process.

As the restoration of the Church of the Transfiguration is still ongoing, it is too early to draw conclusions about this new approach to dismantling. However, careful monitoring and critical evaluation of the results of this restoration in the coming years are certain to provide new insights for the theory and practice of dismantling of timber structures.

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References

1) Report on the ICOMOS Advisory Mission to Kizhi Pogost (C 544) 1st to 7th July 2014, available from <http://kizhi.karelia.ru/media/info/files/attached/1501_final_icomos_report_eng_1.pdf>
2) Opolovnikov A.V., Restavratsiya pamyatnikov narodnogo zodchestva, Moscow: Stroizdat, 392 p.,1974 – in Russian
3) Kovalchuk A., Metodichesoe posobie po restavratsii element istoricheskih derevyannih pamyatnikov, Petrozavodsk: Kizhi museum publishing house, 47 p, 2016 – in Russian
4) Kuznetsova K., Titova O., Report on the state of conservation of the WHS “Kizhi Pogost” (C 544) in 2014-2015, available from <http://kizhi.karelia.ru /media/info/files/attached/1512/pdf-en_soc_report_2014-2015.pdf>
5) Kelley S. J.: Overview, Wood structures: A global forum on the treatment, conservation, and repair of cultural heritage / Stephen J. Kelley et al. eds., Philadelphia, PA, pp. vii-xiii, 2000

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