



Wood Structures

A Global Forum on the Treatment,
Conservation, and Repair of Cultural Heritage

Stephen J. Kelley, Joseph R. Loferski,
Alexander Salenikovich, and
E. George Stern, editors



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Dedication

This book is lovingly dedicated to
Evelyn and Wendell Kelley
through whom all things have become possible for me.

—sjk

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Overview

The Fragile Wood Heritage

Wooden architecture is far more important in the built heritage of the northern European countries than in western Europe or in the Americas. Though wood was the primary building material in pre-medieval times in Europe, the establishment of a feudal society in western Europe brought the predominance of brick and stone construction. The Americas and Australia followed these traditions.¹ In the northern Slav territories, however, the tradition of wooden architecture rendered in logs predominated through the Middle Ages for the construction of monasteries, churches, fortifications, and palaces. This wooden church architecture continued into the 18th century and peasant home construction for some time thereafter. Until the beginning of the 19th century, whole towns and cities, including the greater part of Moscow, were of wood log construction. The paper by Foliente opens this book and places the history of the northern Slav wood-built heritage in a world perspective.

Today this precious and fragile heritage is on the verge of disappearing in Russia and the former states of the Soviet Union. Mikhail Miltchik of Spetzprojectrestavratsia in St. Petersburg recently wrote the following:

“The destruction of the monuments of wooden architecture has acquired the character of an avalanche. In 10–15 years to come they may completely disappear in [Russia] but for a few churches and chapels that are in a satisfactory state, and for those that have been transported to the open-air architectural preserves . . . More than 80% of [wooden] churches noted down before the 1930s do not exist [today]. It is during the latest years that in Arkhangelsk Region there have been lost such constructions as the nativity (Rozhdestvenskaya) Church in Bestuzhevo on the River Ustyia (1763), the Twelve Apostles (Dvenadsati Apostolov) Church in Pirinem on the River Penega (1799); there have been burnt down the ensembles of Ust-Koga and Verkhnyaya Mudyuga graveyards (*pogosts*) on the River Onega (17th–18th centuries). The churches of the famous Liada graveyard are in a state of emergency; the helm roof of the St. Nicholas (Nikolskaya) Church (1670) in Volosovo of Kargopol County has fallen down; the John the Baptist (Predtechenskaya) Church (1780) in Litvinov on the River Vaga stays roofless; the Our Lady (Odigitrievskaya) Church (1709) in Kimzha on the River Mezen is on the verge of collapse. Unfortunately, this mournful inventory is much longer. . . .²

The value of this heritage was recognized as early as the turn of the last century when the idea of the ethnological open air museum was germinated. This distinctly eastern European concept—wherein examples of regional wooden architectural styles were relocated to nature preserves where ensembles could be placed in village tableaux similar to their region of origin—could then be enjoyed by the population and given ready and standardized stewardship to prolong their existence. From the 1920s to the 1960s, numerous open-air architectural preserves were established. Among them, besides the Ethnographic Museum

¹ The Japanese, of course, developed their own traditions in wood construction that encompass 90% of their built heritage.

² Miltchik, M., “The Tragic Fate of Russian Wooden Architecture and the Problems of Its Preservation,” *The Actual Problems of the Unique Russian Wooden Architecture Monuments’ Researching and Saving*, M. Miltchik, Ed., Spetzprojectrestavratsia, St. Petersburg, 1999.

on Kizhi Island in Karelia, Russia, can be included: Maliye Karely, 24 km east of Arkhangelsk, Russia; the Open Air Museum at Kolomenskoye, on the outskirts of Moscow, Russia; the Vitoslavitzy Open Air Museum, on the outskirts of Novgorod, Russia; the Podmonastirskaya Sloboda by the Ipatievsky Monastery in Kostroma, Russia; the Shehelokov farmstead in the Shcholkovsky Khutor preserve near Nizhny Novgorod, Russia; the excellent Folk Architecture Open Air Museum near the village of Piragova on the outskirts of Kiev, Ukraine; the Museul Satului Village Museum in Herastrau Park in Bucharest, Romania; the Wallachian Outdoor Museum in Rožnov, Slovakia; the Museum of Folk Architecture in Sanok, Poland; the Vabahumuseum Ethnological Open Air Museum in Rocca al Mare near Tallinn, Estonia; the Ethnographic Open Air Museum near Riga, Latvia; and the excellent Rumšiskes Ethnological Open Air Museum near Vilnius, Lithuania. Among the papers discussed in this book regarding Kizhi Pogost (Miltchik, Kozlov et al., Vahrameeva et al., Piskunov, Mattson) is a fascinating paper regarding the Estonian Open Air Museum (Laht).

There are also numerous examples of wooden built heritage that exist in situ in this region: the Stavkirkes of southern Norway; the wooden residences in Göteborg, Sweden; the wooden suburbs—Kadriorg, Kalamaja, and Kopli—to the east and northwest of Tallinn, Estonia; the wooden Orthodox Churches in the Rzeszów region of southeastern Poland; the wooden heritage of eastern Slovakia; the wooden Rumanian villages in the Transylvanian region of Maramureș; and, of course, the wooden farm structures in Paezeriai, Lithuania, discussed in this book (Vilkonciene et al.) to name but a few.

These wood log structures (excluding the Swedish and Estonian examples which are wood frame), though diverse in character, share common pathologies. The most vulnerable parts of timber buildings are the logs closest to the ground, those below the windows, and the logs closest to the roof. These areas are exposed to more moisture than the rest of the construction, and, in the case of the ground plate, are subject to insect attack and decay fungi. These pathologies are discussed by Kozlov et al. and Mattson. The most dangerous and destructive enemy is fire.

Kizhi Pogost and the Church of the Transfiguration

At the request of our Canadian colleagues, Andrew Powter and Herb Stovel of the International Council of Monuments and Sites (ICOMOS), Professor Joseph Loferski and I went on a technical consulting mission to the Church of the Transfiguration (Preobrazhenskaya Tserkva) on Kizhi Island in Lake Onega in Karelia, Russia, in January of 1995. The Church of the Transfiguration is part of the Kizhi Pogost ensemble and is the jewel of the Kizhi Open Air Museum, a UNESCO World Heritage Site. The purpose of our visit was to assess and critique the methods, findings, and conclusions of the restoration team headed by Professor Yuri Piskunov of the Vyatka State Technical University, Center for Research, Engineering and Manufacture of Building Structures (CREMBS) at Kirov, Russia. Our translator on our two-week visit was an engineer and wood scientist, Alexander Salenikovich. Alexander subsequently did his doctoral thesis at Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg, due to an exchange program set up by Professor Loferski and his mentor, Professor George Stern, who established the internationally renowned Wood Science Program at Virginia Tech. Stern and Loferski developed a cruise conference that sailed from St. Petersburg via Kizhi to Moscow in August of 1997, where many of the papers in this book were presented.³

³ *Proceedings: Preservation of Russian Antiquities, Its Impact on Russia's Rejuvenation*, E. G. Stern, Ed., Virginia Tech, Blacksburg, VA, 1998.

At Kizhi we found an island where the snow was three feet deep and the temperature stayed less than 10°F, where skies were clear, stars shone undimmed by urban light at night, where ice crystals fell from the sky and grew into fine fingers inches long and tightly spaced on trees and shrubs, and where brilliant sunrises occurred at 10 o'clock each morning with the sun never rising high above the horizon and setting by 4 p.m. Because of the season, we had the tiny Island and Open Air Museum to ourselves; lived in a little wooden village; feasted on fish, root vegetables, and vodka with the villagers; and took a banya (sauna) at night that included jumping through a hole in the ice into the frigid waters of Lake Onega. We came to know a people who lived close to the land and whose ancestors constructed magnificent structures like The Church of the Transfiguration.

But just as important, we came to know an industrious group of professionals who had taken on the gargantuan technical and political problems of restoring the Church of the Transfiguration. Professor Piskunov was faced with the task of developing a restoration scheme after years of diagnostic procedures by an army of professionals, where the results of different diagnostic procedures would yield varied results (Miltchik, Kozlov et al., Vahrameeva et al., and Mattson). Yuri's analysis was state-of-the-art and his solutions were cutting edge. Loferski and I revisited a lesson that I have learned again and again in international preservation consulting in Russia, Lithuania, Ukraine, and Macedonia: these countries may have economic difficulties, but there is no dearth of technical expertise, that perhaps we can learn more than we teach. We came to know Tatiana Vahrameeva, who administers the Kizhi Museum and who struggles with the procurement of funding for the restoration of The Church of the Transfiguration, a struggle that, at the time of this writing, has yet to be won.

The Church of the Transfiguration, with its 22 onion domes, remains the sole example of the culmination of the development of the multi-domed wooden church. There is a poetic legend about the craftsman builder of the church. Having completed the edifice, he threw his axe into nearby Lake Onega, saying, "This church was built by Master Nestor; there never was, nor will be another one to match it." The Church has been cited by some historians as an example of an architects' extravagance and loss of control over materials and proportions. It is certainly an illustration of a carpenter pushing a technique to its furthest limits and a remarkable example of a particular climax in the formal development of a style. However, the key to its interpretation as an architectural masterpiece is not because of its sheer size, its magnificent form, the complex details of its construction, or the fact that it was built using only axes and adzes and without metal nails, though these issues are formidable. The Church of the Transfiguration is quite simply a masterpiece of log engineering. The building forms and structure are superbly integrated. This is why this structure is worthy of being the focus of this "global forum."

What Are the Proper Approaches to Restoration?

Structural Aspects

The single most problematic issue with the Church of The Transfiguration, as it stands today, is the "metal carcass" that was installed within the entire structure in the early 1980s in an effort to achieve stability and consequently rendering the interior unusable. The unheated wood log structure expands in the winter months due to an increase in moisture content. In contrast, the metal carcass, volumetrically insensitive to moisture, decreases in size due to the cold temperature. Therefore, in the winter, the Church structure would not be supported by the carcass when loads from snow and wind are at their greatest. In the summer, the wood structure shrinks due to lowered moisture content and the metal carcass

expands due to thermal expansion. This opposing behavior of the wood and steel due to these seasonal changes will damage the more fragile wood structure more and more unless the system is carefully and constantly monitored and some form of remedy is provided. The answer is to remove the metal carcass and re-establish structural integrity.

The most controversial and radical solution discussed has been the total dismantling and reconstruction of the Church, while replacing those wooden elements that are damaged and decayed. Dismantling could make a restoration project become much larger than previously envisioned. It is likely that the dismantled building would prove difficult to reassemble. It would also become too easy to replace parts of the original fabric for the sake of convenience rather than for purely technical reasons than would occur if the structure was conserved without dismantling. Consequently, the building would lose authenticity. Philosophically, the original wood structure should be considered the most reliable one. It was born in the creation process, works in complete harmony with the construction, and can only exist together with all original parts of the building. This brings to mind one of the parables of Jesus, "No one sews a patch of unshrunk cloth to an old coat; for then the patch tears away from the coat and leaves a bigger hole."⁴ Like the use of consolidant treatments on stone masonry, dismantling should be used only as a last resort and only if all other, less intrusive approaches have been exhausted. Dismantling has been ruled out as a possible treatment at The Church of the Transfiguration.

It has been agreed that structural intervention should be minimal and should not change the essence of the structure. Piskunov's engineering solution was summarized in the following fashion, "the principle . . . is, in our opinion, to insert additional engineering devices at the minimum and to use the potentialities of the original structure at the maximum."⁵ This approach is the same as has been reached by my colleague, Professor Predrag Gavrilović of the Seismology Institute (IZIIS) in Skopje, Macedonia, for restoration of Byzantine churches constructed of masonry, which he refers to as "the principle of minimum intervention—maximum protection."⁶ Of course, both of these principles reflect my own philosophy: "The goal of the conservation engineer is to stabilize the structure with the minimum intervention."⁷ It is apparent that this principle can hold true for all built heritage and not just that constructed of wood. The world community appears to be in harmony in this regard, as reflected in such conventions as the Venice Charter.

Material Aspects

The other problem, of course, is how to protect the wood material from decay caused by moisture, organic growth, and insect infestations. Here is where a look at the diverse cultural aspects of wood heritage come into play. First, the building typology of Russian wood architecture is distinct from that of the Norwegian Stavkirke, the churches of southeastern Poland, and Japanese temples and pagodas. Each building type has its own water shedding and moisture drying aspects that are defined by their evolved cultural forms. Second, different

⁴ Matthew 9:16.

⁵ Piskunov, Y. V., *Inspection of the Transfiguration Church and Analysis of Its Major Bearing Structures*, Kirov, Vyatka, Russia, 1994.

⁶ Gavrilović, P. and Zelenkovska, V., "Seismic Strengthening of Historic Monuments and Experimental Investigations," *Annali di Geofisica*, vol. XXXVIII, No. 5–6, November–December 1995.

⁷ Kelley, S. J., and Crowe, T. M. "The Role of the Conservation Engineer," in *ASTM STP 1258: Standards for Preservation and Rehabilitation*. Stephen J. Kelley, editor. Philadelphia, Pennsylvania: ASTM: West Conshohocken, PA (1995).

regions have unique climates that impact potential moisture and ecological “shelves” in which organic growths and insects can thrive.

Finally, every culture has developed its own maintenance and repair techniques. For instance, a way of protecting the timber used in Sweden was the paneling of the timber facades with thin planks or boards. Oil paints made from linseed oil and turpentine are also used extensively in Sweden. In Norway, wood tar has traditionally been used in the treatment of the Stavekirkes, though this treatment has darkened the appearance of the wood. In Japan, the dismantling repair of wooden temples occurs every 200 to 300 years, and this “radical” technique is itself regarded as an important part of Japan’s cultural heritage, so much so that the World heritage convention and ICOMOS met in Japan in 1994 and drafted the *Nara Document on Authenticity*. These maintenance techniques have been successful based on the fact that the Heddal Stavkirke is between 650 to 750 years old and the Horyu-ji Temple complex, near Nara, Japan, believed to be the oldest wooden structure in the world, is more than 1300 years old. At The Church of the Transfiguration, the approaches of boarding, painting, and dismantling are not in keeping with their traditions. As Laht tells us, “wooden buildings can not be preserved forever . . . all that can be accomplished is to slow down the process of decay.” In the paper by Miltchik, we are told that the Church was once covered with vertical boarding. This was done at a time when Russia was looking westward and emulating her western European neighbors. The boarding was removed in the 20th century to express the true folk craft and architecture of the region and, consequently, exposing the logs to weathering from rain and ultraviolet rays. Though boarding would provide long-term protection from the elements, there seems to be no turning back.

Craft techniques themselves pose their own problems, as is exemplified in the Kudrjavitseva et al. paper. Here the author is critical of a restoration and partial reconstruction where traditional techniques were abandoned and the appearance of the restored structure was altered. In contrast, the Kairamo paper suggests that appropriate crafts persons can be located and trained.

Currently, conservation treatments of wooden elements of building generally entail the use of chemicals. With the use of chemicals over time, one must consider the possible consequences of their use. In particular, toxic chemicals could conceivably affect the environment as well as the health of the conservator and the unknowing public that visits the heritage site. An honest assessment of this eventuality is given by Laht, where a dizzying array of chemicals used at the Estonian Open Air Museum over a period of many years is now discussed in the terms of pollution. Vilkonciene gives a description of traditional regimen of chemical conservation treatments on a Lithuanian Garner. Sheetz discusses the avant garde use of borate pellets on totem pole conservation in Alaska. Munck et al. describe wood treatments using radio waves, microwaves, and heat treatments in Denmark where the use of chemicals is no longer allowed.

The Wood Frame Heritage

The majority of the remaining papers from western Europe and the United States stand out from the previously discussed papers in that they deal with braced frame and balloon frame structures rather than structures composed of logs. Framed structures vary from log structures because, in most cases, the framed structure is covered with a protective cladding that bears the brunt of the weather. Therefore the cladding can become decayed without loss of integrity to the protected frame. The Church of the Transfiguration has no such sacrificial layer.

What can the West learn from this exchange on wood log heritage in northern Europe? All of the pathologies discussed with wood log heritage will one day be the problems we

face with our much younger heritage in North America. A review of the discussions in this book on the older frame heritage of western Europe will bear out this fact. We learn that problems are often very complex and that solutions are often elusive. We learn that there are consequences to our actions each time we intervene, even with the best of intentions. We see that some of the most challenging problems are the direct result of previous interventions.

Munck et al. describe pathologies relative to wood decay that are similar to those experienced with wood log buildings. However, in the “environmentally conscious” society of Denmark, new techniques are described to treat fungal growth that do not use chemicals. These environmentally friendly techniques will no doubt catch on in other countries in the future. Palaia-Pérez offers a fascinating case study from the city of Valencia. She describes a methodology that uses the medical terminology of anamnesis, diagnosis, treatment, and control—a way of thinking that I adopted myself several years ago. Yeomans et al. describes the thought process behind the restoration of a medieval braced frame barn structure. This case study is distinct because the issues discussed deal with structural rather than material aspects.

Lewandoski offers a methodology for the diagnosis and treatment of framed structures based on his extensive experience with this topic. O’Bright and Drone offer case studies that deal with the environs of presidential homes—the Ulysses S. Grant Homestead and the Abraham Lincoln National Historic Site. *Foster* gives us a case study of restoration of a wood frame house of “blue collar” origins. The American examples of wood-built heritage stand apart from their European counterparts because they are smaller, less complex, and more humble. This is not surprising of a young nation with transplanted building traditions that did not come into its own until the turn of the last century and has as its architectural icon the skyscraper rather than the log cabin.

Two papers stand apart from the others. Sheetz discusses the preservative treatments used for the totem poles of Sitka, Alaska. Here the log itself becomes important as an object to be conserved rather than just an element of a larger whole. Hughes presents an intriguing paper and deals with the abandoned wood heritage in Antarctica left by numerous national research missions. New decay problems that are unique to this region of the world are described. Hughes shows us that there are new frontiers in this field and, at the beginning of the 21st Century, we still have our work cut out for us.

Conclusions

Have we achieved a true global forum in the preparation of this book? A book of this kind, which tries to equally represent the world view, will always fall short of its goal. I regret that there is not a Japanese paper in the book, nor is there a contribution from Sweden or from our Canadian colleagues to the north. The archipelago of Chiloé off the Pacific Coast of Argentina with its collection of ancient wood frame churches is not mentioned, nor is any of the wooden heritage on the continents of Africa, Asia, and Australia. I am convinced there are stunning examples of wood-built heritage that could have been included in this publication. But I believe we have succeeded in sharing ideas from northeast Europe and North America.

I would like to heartily thank the International Council on Monuments and Sites for the opportunity we received to consult on a once-in-a-lifetime venture. Thanks to Andrew Powter and Herb Stovel for inviting us along on this journey. A thank you to our hosts in the Russian Ministry of Culture for sponsoring us during our stay in Petrozavodsk, Moscow, and Kirov. A gracious thank you to Tatiana Vahrameeva and Yuri Piskunov and their friends and colleagues for their hospitality. Thanks to each and every author for his or her con-

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