22nd IIWC International Symposium Wooden Heritage Conservation: beyond disciplines

30th September – 2nd October, Bilbao

Proceedings Editors: Dr Tanya L. Park , AUS & Teresa Artola-Guijarro ,SP

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INTERNATIONAL WOOD COMMITTEE

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Preface and Acknowledgements

Since the ICOMOS International Wood Committee, IIWC, was established in 1975, the need for a set of conservation principles has been a continuous theme in the Committee's ongoing discussions and activities.

In a session of the of the 19th General Assembly of ICOMOS held in Delhi on 15th December 2017 the new IIWC 'Principles for the Conservation of the Wooden Built Heritage' were adopted as ICOMOS doctrinal text. These new 'Principles' replace those adopted previously in 1999.

After the success of the 2018 symposium organized in York (UK), the challenge was to take a step further with the organization in the Basque country of a symposium and a course intended to amplify the effort in order to give a focus of a holistic approach to wooden heritage conservation that extends beyond structures to include together with the materiality of wood construction, its complex intangible side. Its scope included the diversity of professions involved, possible approaches and processes, from a global perspective and their adaptations to the conservation of local wooden heritage.

This document is the publication, result of the papers presented at the 22nd IIWC International Symposium, held in Bilbao between September 29 and 2 October 2019, under the umbrella of the Summer Courses of the University of the Basque Country.

This Symposium wouldn't have been possible without the support, help and involvement of many people and organizations. Their invaluable help has been crucial not only to make a success of participation, both in number and in quality of international experts, but to raise awareness among local Institutions, and professionals. Thus, together with the rich scientific exchange among participants, the event has helped to connect also with locals. The event begun with a day-excursion to visit wooden heritage of Bizkaia and Araba, and specifically, the extraordinary Añana Salt Valley Cultural Landscape, and two also extraordinary wooden vaulted churches: Sta. María Goikouria in Orozko and S. Andrés in Ibarrangelu.

Especial thanks to the following institutions for their help, support and economic contribution:

- Bizkaia Regional Council – Diputación Foral de Bizkaia, and its Director-General of Culture, Andoni Iturbe who introduced the Symposium in Bilbao.
- Gipuzkoa Regional Council - Diputación Foral de Gipuzkoa, and its Director of Culture, María José Telleria, the Chair of Heritage Conservation Gabriela Vives, and Heritage Conservation Architects, Josu Maroto and Ainara Iroz, who also accompanied us during the whole both events in Bilbao and San Sebastian.
- Araba Regional Council – Diputación Foral de Álava, and the Deputy of Basque Language, Culture and Sports, who welcomed us in Añana Salt Valley, and Chair of Heritage Service, Txema Villanueva who also attended both Bilbao and San Sebastian events.
- Baskegur. Basque Wood Association, and its CEO Oskar Azkarate, who welcomed us in both Bilbao and San Sebastian events.
- ICOMOS. Spanish national Committee, with its President Alicia Castillo, that also joined us in Bilbao.
- Fundación Valle Salado de Añana, for their welcome to the, so-special site, for their help, and specifically to the General Manager, Andoni Erkiaga, and the Director of Culture, Alberto Plata.

The Symposium and Course wouldn't have been possible without the help, organization and hosting of:

- GPAC. Grupo de Investigación del Patrimonio Construído-Built Heritage Research Group. UPV/EHU.
- Unesco Chair on Cultural Landscapes and Heritage - Cátedra Unesco Paisajes Culturales y Patrimonio.

With thanks to its chair, Professor Agustin Azkarate, and to Architect María Peraita for her coordination work.

- UPV-EHU, Cursos de Verano, Summer Courses, and the work done by Aintzane Gereñu and Ainhoa Urbieta.

Thank you to the organizations and institutions that helped with the visits and welcomed us to the sites:

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- Albaola Itsas Kultur Faktoria – The Sea Factory of the Basques, and its Director Xabier Agote.
- The community of Orozko, for the visit to Santa María de Goikuria, and the lunch outside the church.
- La Antigua Hermitage and Raquel Moreiro for the guided tour.
- Pamplona City Council for welcoming us to the Condestable Palace, and to the Conservation Architects Jesús Leache and Fernando Tabuenca, the latter having attended both Bilbao and San Sebastian events.
- Igartubeitia farm museum farm for the quick visit to the wooden cider press.

And last but not least, thank you to the team that made this possible: Teresa Artola, for her irreplaceable and intense work, and to Alazne Ochandiano and Iker Gómez Iborra.

Thanks to Tanya Park for the work of collecting and publishing of this proceedings.

The experience, continues the long tradition of Symposia organized by the committee. May the contacts and exchanges that resulted in the event serve to raise interest in the conservation of wooden heritage, and in to increase of the community interested in it, here and elsewhere. This is one of the main goals of the International Wood Committee of ICOMOS.

I hope the content of this proceedings are of interest to the reader.

Mikel Landa

President of the ICOMOS International Wood Committee
Bilbao, August 2020.[1]

[1] Front cover photograph, M. Landa

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Wooden churches in the Basque Country: barrel vaults roofs

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Abstract
During the 15th and 16th centuries, dozens of small churches and parishes in the Basque Country were renovated thanks to a previous improvement of the techniques of wood scaffolding that prefigured a space modulation and an empirical knowledge of the (load and tensions) forces calculation with greater difficulty than the stonework. In this region with important forest resources and a municipal property regime that protected its communal goods, the wood builders maintained a natural dialogue with their resources and devised original and economic solutions for these unusual carpentry roofs that are developed in a very limited geographical area, of just 2000 square kilometres. Its 3 typologies (vaults, trusses and rafter/purlin) were limited to the construction of the roof structure and were the result of its ability to synthesize various cultural and economic factors. Through the presentation of 3 examples located in Orozko (Bizkaia), the structure of its wooden vaults and the intervention techniques used during the recent conservation processes will be analysed.

Key words: *wood, church, Basque Country, intervention, methodology*

INTRODUCTION: DEFINITION AND CONTEXT

The Basque woodwork achieved a remarkable degree of improvement during the sixteenth century due to a sudden increase of new wooden buildings that flooded the valleys and coasts of this region of northern Spain. Thousands of farmhouses were rebuilt in those years at the same time as in urban areas, where houses were built only in wood and due to that were whipped again and again by fires.

Ships were assembled on riverbanks, complete fleets arose from Basque shipyards where an army of carpenters, unparalleled in another corner of the continent, struggled to launch new naos for Atlantic merchants and the Royal Navy (Santana 1996).

Religious architecture was never outside this expansion, there was a great renovation of dozens of churches and parishes also in these years thanks to a previous improvement of the technique of wood scaffolding that prefigured a space modulation and an empirical knowledge of the (load and tensions) forces calculation with greater difficulty than the stonework.

Our wooden Basque churches are parishes buildings constructed with thick masonry walls and a wooden roof structure. The peripheral location of the Basque Country seems to be the cause of traditional typologies having little or no representation at all in our territory despite the fact that the Iberian Peninsula is one of the places in Europe with the greatest variety of wooden roofs.

It is important to emphasize that there is no specific model of recognizable and distinguishable Basque carpentry but rather a synthesis made by the Basque builders.

The analysis of its context will show us the main characteristics of these particular building types.

- Geographically speaking it´s a phenomenon that appears concentrated in a very homogeneous area of valleys, distributed in the 3 current provinces of the Basque Country, and also match with an old religious demarcation called Diocese of Calahorra (between Burgos and Pamplona) (Image 1)

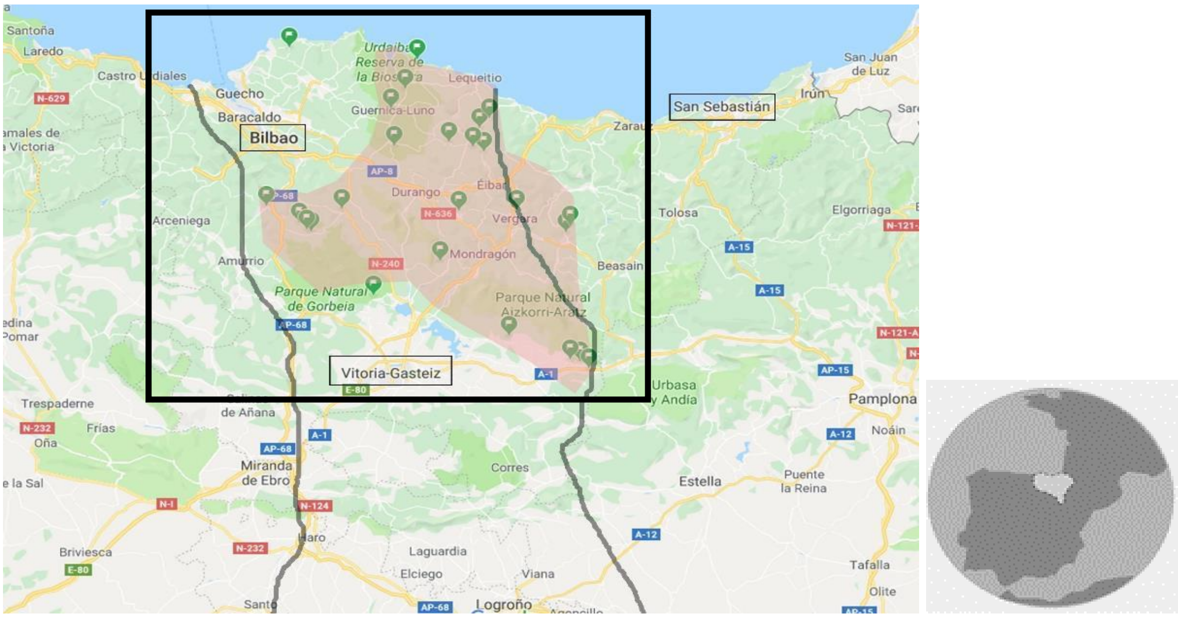

Image 1: Boundaries of the diocese and the area of diffusion of wooden churches in the Basque Country. Source: author

- The social context brings us in a territory where wood was in abundance and there were many skilled carpenters who were not organize in any guild nor governed by ordinances, just the opposite to what was happening in other nearby areas like Castilla. Basques were well known for being commercial navigators, and the main destinations were Flanders, northern France and England to transport iron weapons. (Santana, 1996).

Another special treat of these years was the civil society, because it was organized by the Fueros, a Spanish word meaning Rights, which refers to a special agreement between the monarchy and the Basque and Navarre territories. Since its birth, it was decisive in defining a specific political way which implied shared sovereignty, limitation of the real power, tax exemption and military benefits, universal nobility and local administration by their own institutions. The bishop here lacked of any direct power. To understand the technical background we must recall that this period is known as the Great Reconstruction, a period of massive renovation of the Middle Age buildings. The most active villages were renewing their churches and the final act was to provide a roof with a stone vault as the fashion model in Castilla. These renovations were known and admired by modest local parishes with limited economic resources (tithe basically). Also were constructed in sloping plots.

The environmental context shows us an abundant and homogeneous oak forest which developed rapidly without seasonal variations. Only a small part was privately owned by farmhouses, the rest was communal mount property owned by local councils that exercised protectionist legislation and were on demand for neighbours. That is the reason that our art historians believe in, the solution of exchanging stone for wood due to economical reasons (Santana, 1996) (Ayerza, 2019).

ARS LIGNEA

Nowadays[1] we only have around 61 buildings that can be included in this group of wooden Basque churches. In fact, very sadly, only one publication made in 1996 show us this heritage. It is called Ars Lignea and was part of a traveling exposition sponsored by the three local governments and directed by art history expert Alberto Santana which also had the collaboration of the architect Enrique Nuere among other Spanish wooden specialists.

Even after 23 years no further studies have been made and this book is no longer available.

In this catalogue one can distinguish 3 different typologies of wooden churches:

1) The oldest one is a Post and beam construction, of which "La Antigua of Zumárraga" is one of the best examples.

2) Flat structure roof with exposed beams, which is "techo plano a cinta y saetín" in Spanish San Miguel de Elexabeitia is a good example of it.

3) Wooden vaults, which are exempt structures that do not generate lateral tensions on the masonry walls, usually without foundations, absorbed by different elements on case by case basis that can be: hidden bracings in the sinus of the vaults, exempt posts attached to the inner side of the walls, stone brackets or hang the boss to the roof by nailed sticks to the rafters.

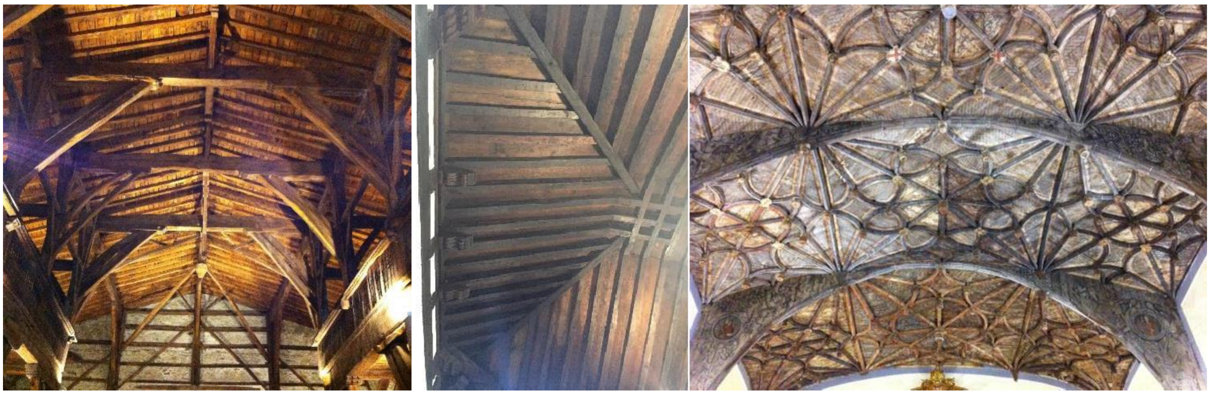

Image 2: From left to right, La Antigua, San Miguel de Elexabeitia and San Andrés de Ibarrangelu. Source: author

BARREL VAULT WOODEN CHURCHES

This article will focus on the wooden barrel vaults and 3 of the remaining churches with this type of roof that can be found in the surrounding valleys of Orozko (Bizkaia). This is a perfect example of different states of conservation among these churches.

These three constructions are really close to each other, less than 5 km, and two of them (Olarte and Zaloa) were made probably by the same carpenters.

Image 3: Location of the three churches. Source: author

The oldest one is San Bartolomé de Olarte a church with a single nave, built after 1500 A.D reusing the elements of a previous construction. The original cover is from 1520 A.D with four open trusses reinforced with bracing laying over stone brackets in the walls. Fifty years later the barrel vault was completed for the nave and a rib vault was constructed for the presbytery. The eight arches were made by four curved elements that support a longitudinal beam. Between the arches there were wooden boards with plaster to simulated stone. This building also has an elevated choir and a porch. (Santana, 1996)

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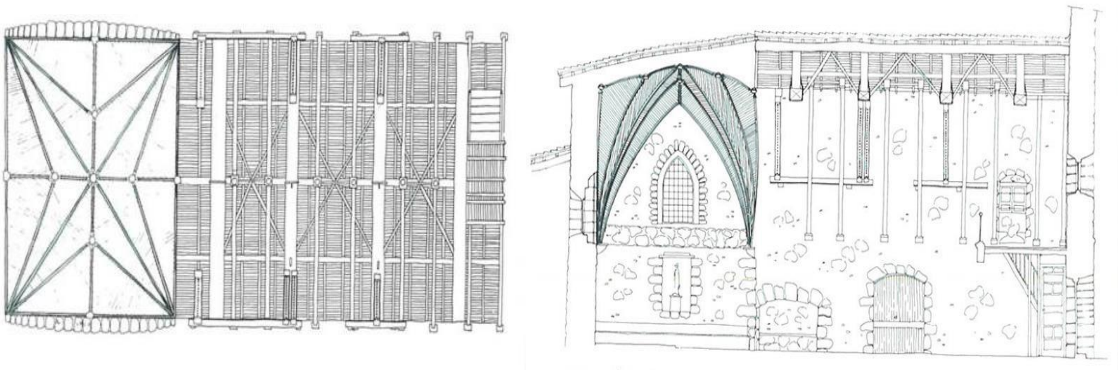

Image 4: Plan and longitudinal section of the church. Source: Ars Lignea (Santana, 1996)

But in 1987 a controversial intervention was made by the neighbours and the wooden boards covering the barrel vault were stripped away exposing the ribs. In the presbytery, they removed the plaster.

[1] At the end of 2019 a new book has been published related to wooden churches in Gipuzkoa (Ayerza, 2019).

Image 5: San Bartolomé de Olarte nowadays. Source: author

Three kilometres away we can find San Pedro de Zaloa from 1530 built in a similar way. As you can see in the axonometry view below eleven curved arches support a central beam to which they are fixed by carved bosses (six still original).

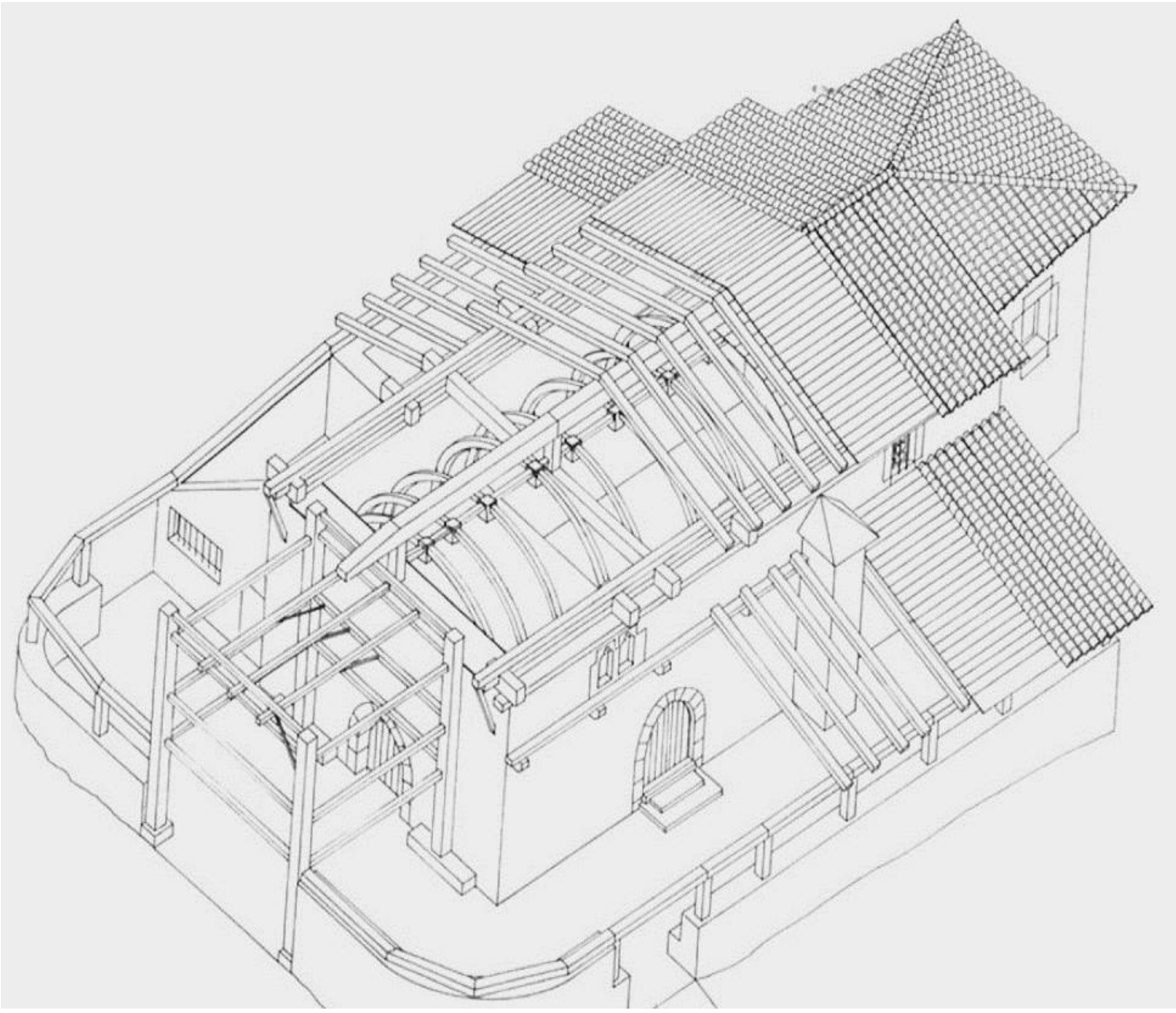

Image 6: Axonometry view of San Pedro de Zaloa. Source: Ars lignea (Santana, 1996)

In 1660 the whole structure was reinforced by two bracings with vegetal foundation which formed the structure of the belfry which can be seen nowadays without any board panelling. There is also an elevated choir where the original purlins with red and black polychrome of the XVI century stands. (Santana, 1996). At the end of 2015 the entire tiles of the roof were removed.

Image 7: San Pedro de Zaloa nowadays. Source: Mikel Landa

Sta Maria de Goikouria is only 4.5 km away from San Bartolomé. This is an anachronic design, a copy of Olarte´s ceiling made in 1770 commissioned by a neighbour who made money in South America and sent it from Mexico. (Historic church archive of Bizkaia. Account books 1766-1959). It was located in slope and its masonry walls haven´t had any foundations. Since they already had the money the construction was finished in just one year. Again, the same scheme, barrel vault with 9 curved arches made with oak wood and covered with oak and chestnut boards (Santana, 1996).

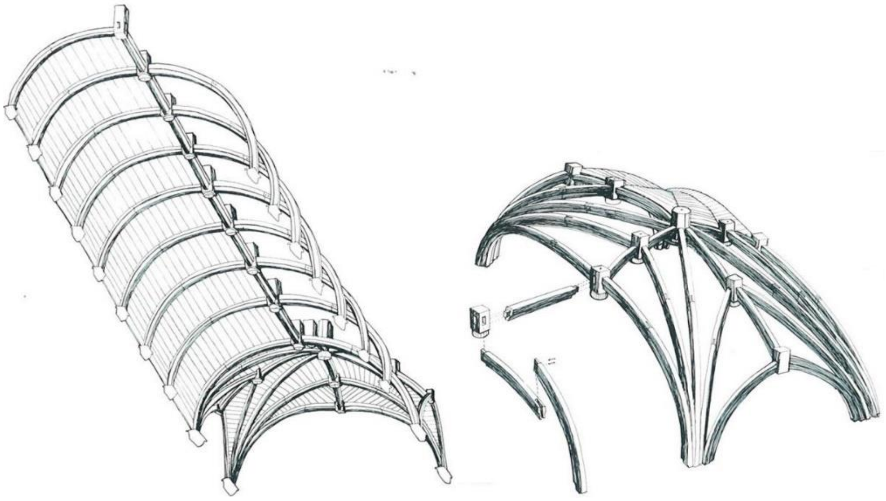

Image 8: Santa Mª de Goikouria, details of its roof structure. Source: Ars lignea (Santana, 1996)

The singular thing this time are the paintings, a tempering technique with vegetal motifs. In 2013 the painting was restored by a private company designed by the Cultural Council of Bizkaia. We knew that the neighbours had to pay for at least half of the arches and that costed around 20.000 €.

Image 9: Detail of the paintings in the barrel vault. Source: author

In the previous examples we find an irreversible intervention made without having collected the previous state in a rigorous way (Olarte), another intervention in which the tempera paintings have been kept (Goikuria) but with an unspecified architectural intervention of the building to future interventions and finally another specimen (Zaloa) in which only a re-roofing has been made that does not affect the architectural elements that already have a lot of pathologies.

The analysis of the current state of the churches, brings us to a conclusion that when it comes to intervening in a historic building it is desirable to have a previous methodology that helps us not to forget or neglect any step.

This script was perfectly described in the Icomos principles of 2017 that can be summarized in the following steps:

- Inspection, survey and research
- Analysis and evaluation
- Intervention
- Present-day materials and technologies
- Recording and documentation
- Monitoring and maintenance
- Historic Forest reserves
- Education and training

FUTURE RESEARCH STEPS

As mentioned in the beginning, the appearance of these Basque wooden churches has been explained by the intervention of shipbuilders, believed by some people that the relative formal similarity of a wooden vault and the hull of a ship turn them into even works.

But this reflection does not seem to attend to the historical reality that shows us that both the techniques are themselves sufficiently complex that a shipbuilder would hardly dare to design a roof for a church and vice versa. (Nuere, 1996)

However, it seems feasible that the people who served as intermediaries between the two professions when supplying them with wood could have taken advantage of these curved pieces for both shipbuilders and our barrel vaults.

The forester was a specialized craftsman who was hired to examine and choose the most suitable trees for construction, and to supervise the task of turning the logs into lumber and boards. It was ensured that hackers and sawmills took advantage of the appropriate parts of the trees to obtain specific timber needed in the construction of a ship, apart from the planking. They were also required to calculate the timber that would be obtained from standing trees when they were to be sold, for measurements of timbers and tables at the time of final payment of a contract, as well as to act as judges or arbitrators in the differences that they were raised on timber issues. There is evidence of them in the wood supply deeds of the Zumaia shipping sector in 1589 AD. (Itsasoa, 1980)

Most of the “carpenter masters” of the riverbank can be considered as foresters, since their technical knowledge was not limited to the design and construction of ships but also included familiarity with the preparation of timber for them. But, while the carpenter masters sometimes worked as foresters, it seems that they were mostly engaged in shipbuilding

In a further research for my thesis I´ll try to demonstrate if my hypothesis is correct through the comparison of the standard measure used in the construction of the ships 1590 AD onwards, the river bend, 0.574684 m, and the dimensions of the curved pairs that form the vaults of the Basque churches.

The typological study and the dating of the roof structure of the churches of the Basque Country remains a pending task that should be addressed as soon as possible, since the programs of restoration of the historical heritage undertaken by public administrations in the last 2 decades are particularly affecting in the renovation and replacement of these structures without attending to any historical evaluation criteria.

That is why I consider it important to be able to contribute with my research to fill this gap in the knowledge of our heritage.

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NON-DESTRUCTIVE TECHNIQUES (NDT) FOR THE STUDY OF WOODEN STRUCTURES IN HISTORIC BUILDING

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Abstract

The aim of this paper is to gives an overview on various non-destructive techniques (NDT) used to study wooden structures in historic buildings. The high cultural value of historic buildings and the necessity to preserve them as intact as possible, make NDTs to gain importance when selecting the method to preserver and assess a historical structures in order to survive damages arising from several reasons including damaged by time. The selected techniques concern the measurement of some physical/mechanical properties and condition. The NDT analyses have been grouped under four major: visual inspection, optical, ultrasound, and electromagnetic. The measures was taken at the surface and inside of the wood. For analysis was used: Rinntech Resistograph model R650-ED, FLIR System model T420 for Infrared thermography (IRT), ARBOTOM for tomography, Electrical Resistance Measuring (ERM) with DELMHORST BD-2100 pin moisture meter (Protimeter) and MASTERGRIP Digital Thermometer with Laser for superficial temperature. In conclusion, the benefit to used NDT is that can applied “in situ”, do not require to take big samples to destroy and to obtain such information. Also, are the most appropriate tool for the evaluation of the external and internal structure and materials quality of cultural heritage.

Keywords: *Non-Destructive Techniques, wooden structures, resistography, thermography, tomography.*

INTRODUCTION

Non-destructive techniques (NDT) methods are used to assess the quality of wood and include a variation of testing like: visual inspection, photographic documentation, ultrasonic and sonic testing, electromagnetic and optical among others. Those methods are widely used in the wood industry for mechanical grading of lumber, timber structure inspection, and property assessment of standing trees. The aim of this investigation is to apply various NDT to diagnose wooden structures in historic buildings.

A methodology for evaluate wood structure was published (Sotomayor & Cruz, 2003) which proposes that three components should be taken into account: diagnosis, evaluation and restoration treatments. Another author also proposes, visual recognition techniques and other NDT and pseudo non-destructive methods were used (Basterra et al, 2009) such as microphotography, xilohigrometry, ultrasound velocity measurements, screw extraction and resistography. The structural assessment begins with the identification of the original wood specie, the characterization of the structural timber and the identification of diverse types of damages and lesions present.

Analysis of resistography profiles obtained from wood samples and extraction of pieces of wooden structures with an age of 80-120 years were performed, and the close relationship between the resistography variables and the density of the wood was observed (R2> 90%) (Acuña 2011). Also, some researchers (Lopez et al. 2013) have used infrared thermography (IRT) in the inspection of historic timber structures to analysis the thermodynamic behavior of timber as a function of its density.

These technological advances are being integrated into the analysis of materials in historic buildings, hence the aims of this paper is to give an overview on various non-destructive techniques (NDT) used to study wooden structures in historic buildings.

Case Study

The Badden Leroux family house, is located in the heart of the city of Sanchez, province of Samana, in Dominican Republic. In 1879 Sanchez became a very prosperous city with the construction of the port. Many transatlantic ships arrived with merchandise that were traded throughout the island. The distribution of the merchandise was carried out by land, through the railroad or carriage, and by sea, by small vessels such as schooners, sloops and cayucos among others. The economic impact generated by the port and the railroad stimulated the migration of nationals and foreigners people. In 1886, the city had 1,000 inhabitants and 180 homes, and by 1887 there were about 2,000 people, not taking into account the Scots and English employees of the company that administered the railroad. For decades Sanchez was one of the most cosmopolitan centers in the country and the region, it was the presence of so many foreigners.

The Bodden Leroux family house (fig.1) is one of the wooden houses ordered by catalog, imported from the United States. The building was built at the end of the 19th century, on a sloping terrain, so it rose on wooden piles, which makes it look bigger. It’s a rectangular plan, divided into rooms that communicate by a central corridor and has a perimeter gallery where all the doors and windows open. The structure is made of wood, the sheathing and the floor are made of 13.97cm wide (51⁄2 inches) pinewood boards. The metal cover is hipped with four gabled dormer windows. The house has been modified and expanded. However, its appearance has not changed much. Is currently abandoned (fig.2).

Figure.1. House of the Bodden Leroux family (Prieto, 2018)

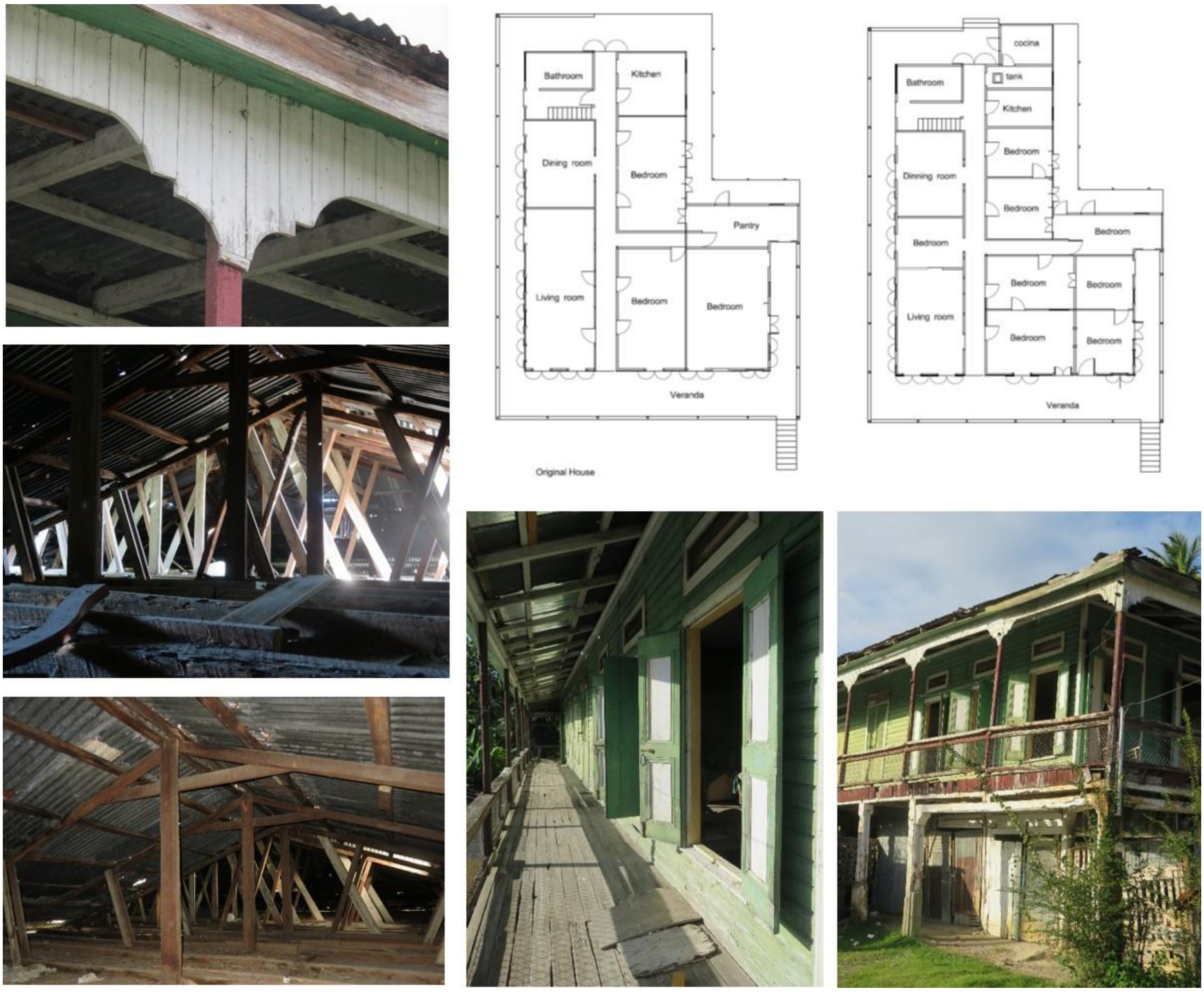


Figure.2. House of the Bodden Leroux family (Prieto, 2018)

Methods

The NDT analyses have been grouped under four major studies: visual inspection, ultrasound, electromagnetic and optical. The visual inspection was in situ and provides an initial indication of the condition of the wood and the degree of damage (Table 1). The inspection includes, photographic documentation of the house, the history of the structures, the current and past use, the condition of adjacent structures, and environmental condition.

Ultrasound. To detect and quantify wood internal decay was used the Rinntech ARBOTOM, an impulse tomography unit that enables an inside view of condition of timbers and trees and round wood. A series of sensors are placed around the structural elements, each one connected to the next and then to a computer. Each sensor is tapped, which sends a stress wave across the wood to the other sensors, and produce an image (fig.3).

Table 1. VISUAL INSPECTION OF THE DEGREE OF DAMAGE IN WOOD

DEGREE OF DAMAGE IN WOOD	Sheathing	Rafter beam	Joist	Post Column	Brace	Floor	Ceiling	Pile	Door	Window	Veranda
Decay / Rotting	II	N/D	N/D	N/D	N/D	II	I	N/D	I	I	II
Crack or Split	I	N/D	N/D	N/D	N/D	II	I	N/D	I	I	II
Deformation	I	I	I	I	I	III	II	N/D	I	I	III
Knot or knothole	I	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	I
Bending	I	N/D	N/D	N/D	N/D	II	I	N/D	I	I	II
Swelling/ dryness contraction	I	N/D	N/D	N/D	N/D	I	I	I	I	I	I
Shrinkage/ moisture growth	I	I	N/D	I	N/D	N/D	N/D	N/D	N/D	N/D	I
Soft and spongy	I	N/D	N/D	N/D	N/D	II	N/D	N/D	I	I	III
Moisture	I	I	N/D	I	N/D	I	III	I	I	I	III
Dry rot	I	N/D	N/D	I	N/D	I	N/D	N/D	II	II	III
Broken member	III	N/D	I	N/D	I	III	II	N/D	II	II	III
Improper repair	II	I	I	I	I	III	III	I	III	III	III
Loose joints and connection	I	I	I	I	I	III	III	N/D	I	II	III
Missing wood	II	I	I	I	I	III	III	N/D	II	III	III
Presence of xylophage insect	I	N/D	N/D	I	N/D	N/D	N/D	N/D	N/D	I	II
Vegetation, Fungi and lichen	I	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	I
Color loose or change	II	I	N/D	I	N/D	I	I	I	I	I	III

Degree I: Poor presence or area of deterioration. No danger of falling.
Degree II: Medium presence or area of deterioration. Danger to falling.
Degree III: Large presence or area of deterioration. Danger to falling.
N/D: No sign of damage or presence.

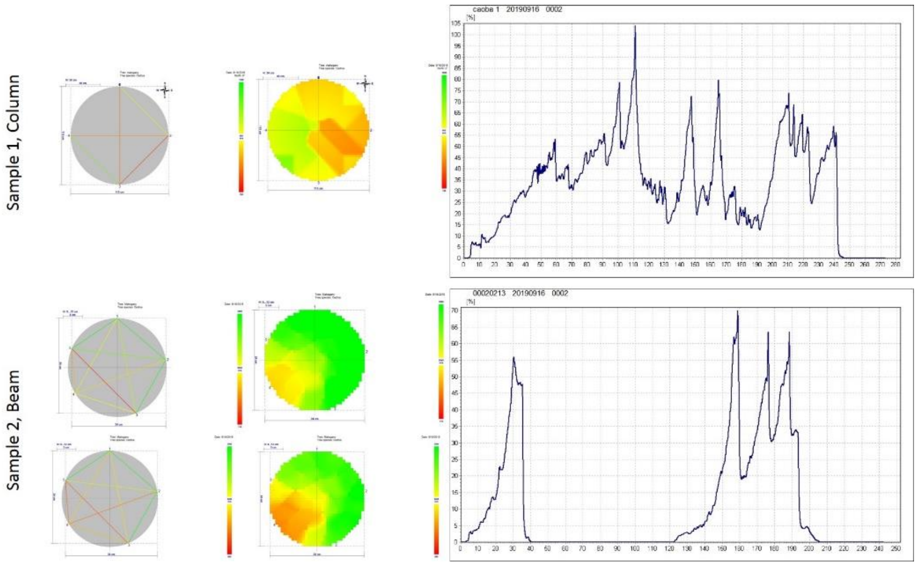
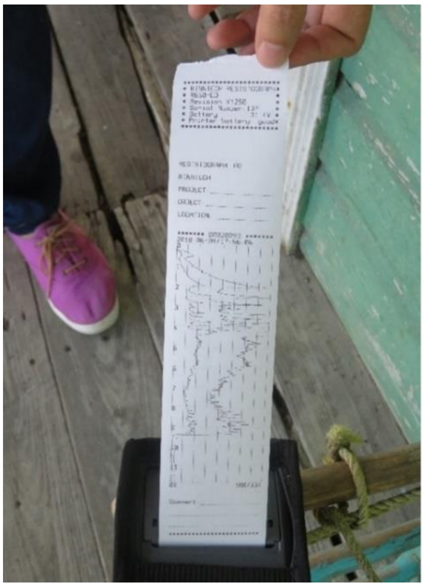


Fig.3. Diagrams an ultrasound images in S-1 column and S-2 beam.

The Image analysis software was used to quantify the proportions of undamaged and damage wood, with Species- specific algorithms, and optional color schemes allow for detailed analysis of decay data. The structural pieces were measured different heights and width. Tests were performed on different structural elements as: bean, column, board, post and piles.

Electromagnetic. Rinntech Resistograph model R650-ED, is an electronically controlled, drill that provides unsurpassed accuracy in measuring the relative density of wood in trees and timber structures. Use DECOM software to analyses the data and produce credible charts that properly reflect actual wood conditions (fig.4).



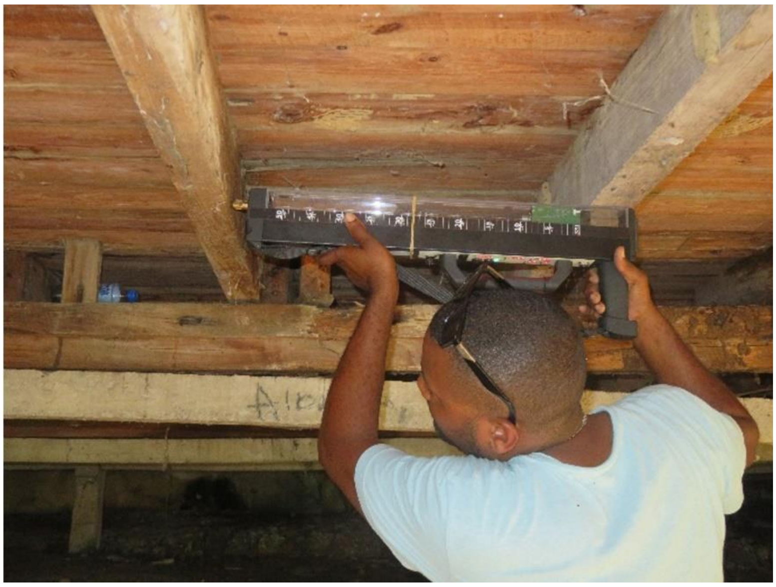


Fig.4. Using the resistograph (Flores, 2018)

Electrical Resistance Measuring (ERM) with DELMHORST BD-2100 pin moisture meter (Protimeter), is used to assess and monitor the relative moisture level of timbers. MASTERGRIP Digital Thermometer with Laser for superficial temperature, is used to assess the material external temperature.

Optical. FLIR System model T420 for Infrared thermography (IRT), The IRT identifies the temperature of the material and offers a thermal image with different temperatures that is interpreted as moisture area, and with that can detect levels of moisture content in wood. This analysis is very important because humidity is one of the factors that most affects wood.

Conclusions

Through visual inspection it was determined that the general structure of the house is in good condition. The main injuries are in the enclosures, floors, ceilings and veranda, which show an advanced deterioration, and are mainly caused by moisture. There is also indications of improper repair, loose joint and connection, missing wood and color change are some of the damage that are appreciated by sight.

Ultrasonic tomography, coupled with image analysis and the resistograph provides an efficient, noninvasive approach to evaluate the condition of the internal decay of the timber and the structural. In general, the Arbotom indicated that some structural elements had internal lesions although they were not visually appreciated. Gaps and soft areas were detected in some columns while in others can observed the good state in which they are. The resistograph affirmed the data obtained with the ultrasound and also indicated the resistance of the samples. The thermographic inspection allowed to know the presence of moisture on the pieces, detect insects and anomalies. The moisture level was tested with thermohygrometer.

In conclusion, the benefit to used NDT is that it can be applied "in situ", it does not require big samples that destroy the building to obtain important information. Also, these instruments are the most appropriate methods for the evaluation of the external and internal wood structure and materials quality in cultural heritage.

Acknowledgment

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Traditional timber roof structures in Albania through the analysis of the Albanian ethnographic sources

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Abstract

In this paper, I will shed light on a less-known Albanian legacy in the main framework of historic timber roof structures. During the wide and impressive study campaign and survey of traditional architecture carried out by the main Albanian scholars in the field of ethnography and architecture studies throughout the Socialist regime (1944-1992), the less studied structural and architectural components turned out to be the timber roof structures. Among the many ethnographic sources produced by Albanian ethnographers during the dictatorship, I will especially focus on and analyse the archival materials provided by the ethnographer Ali Muka. During the last decade before the collapse of the regime Muka, by means of the diffusion of 3 detailed questionnaires and many ethnographic expeditions, aimed at investigating rural settlements, traditional dwelling houses typologies and the building technology of masonry walls and timber roof structures. According to the published results of Muka's investigation, all over Albanian territory the most common type of roof was the so-called *stropil* roof. Some notable exceptions include the examples in the Albanian Alps, such as the village of Theth, and the case of Gjirokastër's traditional timber roofs identified, studied and classified during my PhD research. Woodworking procedures and techniques, construction process details and related popular beliefs, left behind in handmade graphic representations and technical drawings realized by the professionals of the *Instituti i Monumenteve të Kulturës (IMK)*, where collected and reported by the ethnographers of the *Instituti i Kulturës Popullore (IKP)*. Nowadays, archival sources preserved at the archives of the *Instituti i Antropologjisë Kulturore dhe Studimi të Artit (IAKSA)*, together with the many testimonies of Albanian traditional architecture throughout the territory, constitute an important and fundamental key-part in retracing and recovering the knowledge about material culture and traditional building techniques in Albania.

Keywords: *Historic timber roofs, Ethnography, Architectural Heritage, Material Culture, Archival documents, Albania*

Introduction

My contribution origins both from my previous doctoral research on Albanian traditional architecture, particularly focussed on the identification of the peculiar Gjirokastër's timber roof typology and building technology[2], and my recent postdoctoral research on traditional timber roof structures in Albania as visiting researcher at the *Instituti i Antropologjisë Kulturore dhe Studimi të Artit (IAKSA)* in Tirana.

The latter has been held through an in-depth historical analysis of the ethnographic reports preserved at the IAKSA's Arkivi i Etnografisë (AE), i.e. Ethnographic Archive, still in process, that would support a possible forthcoming survey campaign. Consequently, the article should be considered as a first preliminary attempt in framing the Albanian local building technique concerning traditional roof structures starting by analysing the historic documentation produced from the first research campaigns, about the rural and urban traditional architecture, which began during the Communist Regime within the ethnographical studies context. In fact, since the establishment of the *Instituti i Studimeve*, later renamed *Instituti e Shkencave*, Albanian ethnography institutionally began its activity within the Department of History, Sociology and Economy of the abovementioned Institute (Bardhoshi & Lelaj 2018: 17) carrying out intensive research works on albanian material and immaterial culture. The importance of studying and documenting the *arkitektura popullore* was a crucial point since the beginning of the dictatorship. The aim was to demonstrate the creative mastery of Albanian people rooted in its material and immaterial culture, on which the national identity had to be built. In this sense, *arkitektura popullore* was among the most representative sources of inspiration, being thought and created by the *mjeshtri popullor*, i.e. people craftsman or master (Adhami 1958: 3).

I will therefore focus my attention especially on the analysis of the published research work produced since the late 1970s by the Albanian ethnographer Ali Muka who tackled local building techniques of traditional architecture in rural contexts. The studies carried out by Muka mainly focussed on the rural areas of central Albania, especially on roofs' structure of *banesa me shtëpinë e zjarrit në qendër* also known as *banesa tiranase* architectural dwelling typology and its variations (Muka 1999:101), based on his direct fieldwork experiences[3]. However, in 1983, he published and extended his attention on other bordering rural areas by means of the diffusion of 3 detailed questionnaires aimed at investigating rural settlements, traditional dwelling houses and the building technology of masonry walls and timber roof structures. Those questionnaires were addressed to the *Instituti i Kulturës Popullore (IKP)* collaborators' network on the territory. Thus, starting from Muka's published sources where different rural areas where cited, I have tracked down and analysed the IKP collaborators' file on which Muka based part of his considerations by processing the ethnographic data acquired and delivered by the collaborators (fig. 1).
Since the processing of the consulted archive data is still ongoing, I will focus only on the ethnographic reports based on the Muka's 1983 questionnaire concerning the roofs' building techniques, omitting the ethnographic data relevant to the early IKP ethnographers' fieldworks which have not been analysed yet. Despite the fact that the wide architectural and ethnographical survey campaign was facing out, in a more deepen way issues related to the traditional building techniques generally, more attention was paid to the architectural aspects of Albanian traditional architecture and its plan-type and volume development.

[2] The studies on traditional timber roofs in Gjirokastër, of which a very brief overview is presented in this article, have been supported by an extensive fieldwork preliminary survey campaign, which aimed at identifying the different roof structural morphologies, their main carpentry and bearing elements, as well as by an in-depth archival research held in 2015 at the *Instituti i Monumenteve të Kulturës "Gani Strazimiri" (IMK)* in Tirana.

[3] Despite the 30 years of Muka's research activity, it must be pointed out that during the archive research none of his personal ethnographic reports has been available to consult at the AE. Although this inconvenient, I have been able to meet and interview Ali Muka.

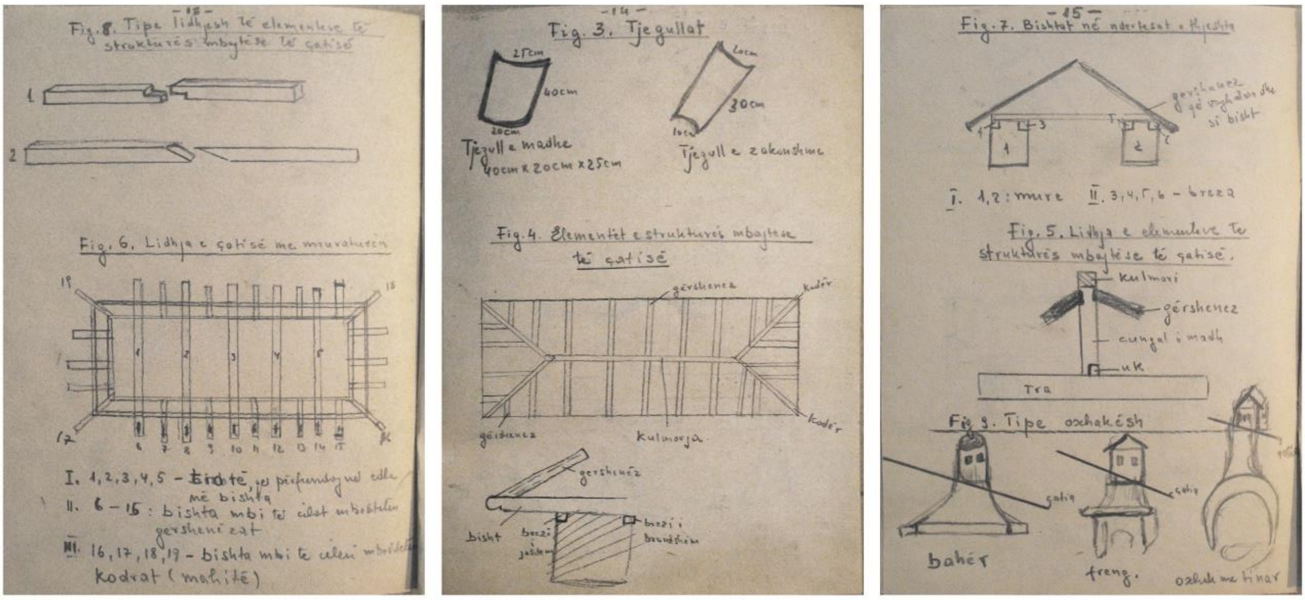

Figure 1 – Example of the sketches made by the IKP collaborators in compiling the Muka's questionnaire about traditional timber roofs. (Source: (Source: IAKSA, Arkivi i Etnografisë (AE), Dos. no. 1256/3 (D77), Doc. no. s.d., dt. s.d.1985)

This reflected in the high number of articles concerning the traditional dwelling typologies published on the main scientific journals of that time, such as *Monumentet, Etnografia Shqiptare, Kultura Popullore, Studia Albanica, Studime Historike.* Particularly, concerning roof structures and their construction process:

"[...] despite many studies have been carried out on our traditional dwelling houses, both in number and variety of faced issues, and although there is not a lack of information, among them, roofs have not been considered, not even in a specific case, as subject of a particular study."(Muka 1999:123)

It must be noted that this article on Albanian traditional timber roofs should be considered as a first step in defining a wider knowledge framework on Albanian traditional building techniques, that need to be further implemented and addressed. To this end, a further, systematic analysis of the big amount of ethnographic documents preserved at the AE would help in tracking and mapping what have been done during the dictatorship. In fact, more than the specific literature published during the regime, that often have to be purged from the dictatorship ideology, the archival sources are of primary importance for the reinterpretation of those researches. Moreover, their analysis will help in planning further fieldwork activities addressed to the investigation of the remaining significant examples of traditional timber structures. Finally, to define and placed the Albanian case within the framework of the traditional building techniques in Europe, a more extensive research project aimed at developing a dedicated Database should be envisaged.

1. The *Pyetësor* series on *Arkitektura popullore*

In 1983, the Albanian ethnologist and ethnographer Ali Muka, member of the Institute of Folk Culture (*Instituti i Kulturës Popullore (IKP)*), at the *Akademia e Shkencave e RPSSH*, prepared 3 questionnaires, focussed on traditional architecture in rural areas: *"Vendbanimet dhe banesa fshatare", Muret dhe* *tradita në ndërtimin e tyre”* and *“Çatitë dhe tradita e ndërtimit të tyre”*. The questionnaires were addressed to the external collaborators of the former Department of Ethnography and aimed to support the ethnographic research by documenting, recording and studying the Albanian traditional architecture in rural areas through the answering to different specific questions. The questionnaire titled *“Roofs and their building tradition”* (*Çatitë dhe tradita e ndërtimit të tyre*) was conceived as a supporting tool to investigate the construction and building technology of the Albanian traditional timber roofs in rural areas (fig. 2). The questionnaire articulated in two parts: the introduction and the specific section *“Çatitë”*, i.e. roofs. The introduction contained information on the general methodology to be used during the interviews, also indicating the most suitable research participants to question:

> *“In addition to interviewing the older inhabitants of the village, it is also proper to consult the craftsmen who built the rural dwelling house and take advantage from the most of their experience and knowledge, to answer to the requests of this questionnaire.”*(Muka 1983: 1)

Moreover, it underlined the need to both write-down and sketch the information gathered from the interviewees, clarifying the importance to frame the data within the suggested historical parenthesis (19th century-1912; 1912-Liberation (1944); Liberation-present).

The complete paper containing the answers to the questionnaire had to be mailed to the former IKP, Department of Material Culture. The section *“Çatitë”* was divided into two headings. The first was composed of 12 questions concerning the building materials supplying and their characteristics; the second was composed of 23 questions on the roof construction work organization and its building technique. In the end of the section *“Çatitë”,* was attached an annex containing a few representative sketches on roofs’ common structural elements and joints’ details.

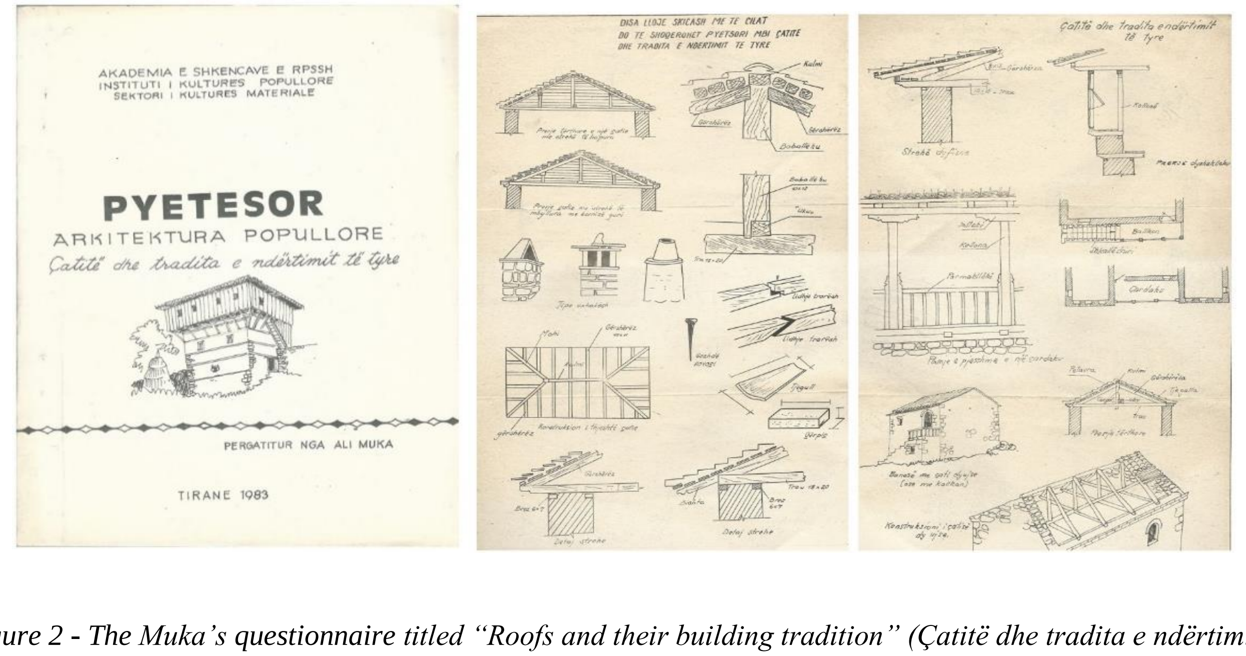

Figure 2 - The Muka’s questionnaire titled “Roofs and their building tradition” (Çatitë dhe tradita e ndërtimit të tyre) and its graphic annexes (Source: Muka, 1983).

2. The common Albanian traditional roof structure according to Muka' studies

The configuration of an ancient timber structure is often the result of the skilful hands of workers, craftsmen and carpenters who did not base their work on scientific knowledge but on their empirical experience. Albanian traditional roofs were built with structural elements obtained by the woodwork processing of lumber locally available and, usually, the common roof was a pitched roof *(çati me kullime* or *çati me flegra)* having the shape of a gable roof and hip roof (Muka 2001b: 62, 64; Muka 2007: 373). According to Muka (1999: 102; 2001b: 64; 2007: 373), the Albanian traditional roofs in rural areas could be divided in domestic and auxiliary constructions' roofs and dwelling houses' roofs. The latter were more complex and accurate because were built by carpenters or skilled builders. Muka, basing his investigation on the plan arrangement of the pitches from the outside, identified 3 possible roof morphologies. The first two, arranged to cover a rectangular shape plan, had a span usually not exceeding the length of 4 ÷ 5 m. The simplest could be found in distinct types of dwelling houses and was called two-pitched roofs (*çatia me dy kullime*) or gable roof. Carpenters used to call it "roof without hip and/or valley rafters" (*çati pa mahi*), or also gable roof (*çati me kallkan*). The structure was quite simple and, besides the missing of the hip/valley rafters, the main vertical posts and the horizontal or inclined jetting beams forming the eaves were also missing. In some cases, when thin collar purlins belt was transversely put in place under the hip/valley rafters or under the common rafters at about 1/2 or 1/3 of their length, the ridge beam was missing too. Consequently, the common rafters were joined together at their top by means of a half-lap joint. This simple roof structure was diffused both in the North and in the South of the country (Muka 1999, 104; Muka 2007, 375). The second one was similar to a gable-hip or half-hipped roof (*çati me tri flegra*, *çati me dy mahi* or *çati me tri faqe*). According to Muka (1999: 104; 2007: 375) this type was common in the rural mountainous areas of Elbasan province, central Albania. The last roof morphology was the most consolidated and diffused in the Albanian countryside (fig. 3). It was the typical hip or cross-hipped roof (*çati me katër flegra*, *çati me katër kullime*, *çati me katër faqe* or *çati me katër mahi*) (Muka 1999: 104; Muka 2001b: 69; Muka 2007: 376). In this case, the total span to be covered was wider than the previous ones (Muka 2001a, 247; Muka 2001b, 70). The number of intermediate spans and supports could vary along the transversal and longitudinal axis or both, always maintaining the rectangular shape of the overall plan. The inner wooden structure was always the same, allowing simple partial modifications and new additions when needed. Thus, to an articulated plan scheme corresponded a more complex pitched roof shape but the same wooden structure and structural members.

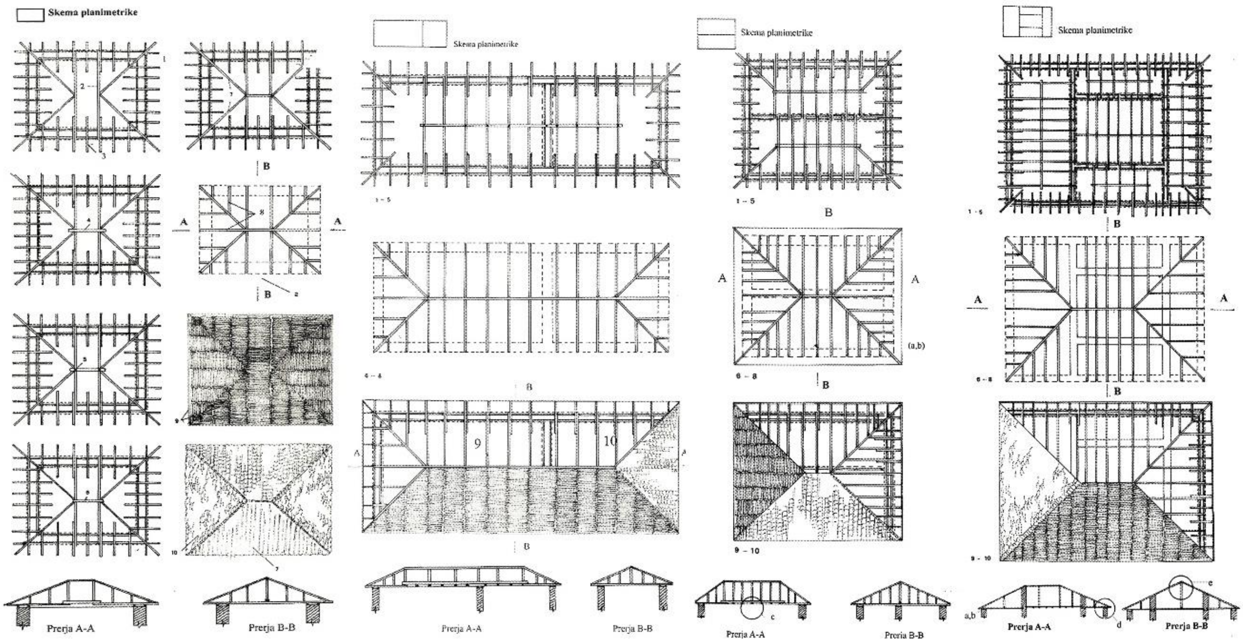

Figure 3 – The common Albanian traditional timber roof and its development according the spans increase (Source: Muka 2007).

3. The structural elements and the construction process[4]

The inner wooden structure of the common Albanian traditional timber roof identified by Muka was composed by the following structural elements (fig. 4): 1) horizontal timber ties system (*brezi i çatisë* or *brezi i trenëve*); 2) horizontal main beams (*trarët* or *trenët*); 3) horizontal beam orthogonal to the *trarët* (*ura e trarëve*; *ura e trenëve* or *uk*); 4) horizontal dragon beam (*mahi të vogla* or *këlyshë të mahive*); 5) vertical main posts (*baballëk* or *cungal*); 6) ridge beam (*kulmor*); 7) hip/valley rafters (*mahi-të*); 8) common and jack rafters (*ballsëore* or *gërshanëz-at*); 9) horizontal or inclined jetting beams (*bishtat e strehës*); 10) secondary horizontal beam orthogonal to the *trarët* (*urat e vogla* or *uqët e vegjël*); 11) secondary vertical posts (*baballekët e vegjël* or *këlyshë cungjelash*) (Muka 2007: 377).

[4] According to the Muka published literature and the following consulted IAKSA archival sources: Arkivi i Etnografisë (AE), Dossier (Dos.) no. 1226/3 (D77), Documents (Doc.) no. 3, date (dt.) 23.III.1984; AE, Dos. no. 1231/8 [1232/9 (s.d.)] (D77), Doc. no. 8, dt. 8.V.1984; AE, Dos. no. 1244/21 (D77), Doc. no. 21, dt. 12.IX.1984; AE, Dos. no. 1245/22 (D77), Doc. no. 22, dt. 12.IX.1984; AE, Dos. no. 1254/1 (D77), Doc. no. 1, dt. 5.I.1985;v AE, Dos. no. 1256/3 (D77), s.d., dt. Sd.sd.1985; AE, Dos. no. 1260/7 (D77), Doc. no 6, dt. 3.VI.1985; AE, Dos. no. 1280/11 (D77), Doc. no. 9, dt. 20.V.1987; AE, Dos. no. 1288/2 (D77/1), Doc. no. 2, dt. 8.sd.1988; AE, DOS.no. 1315/1 (D77), Doc. no. 1, dt. 17.VIII.1994.

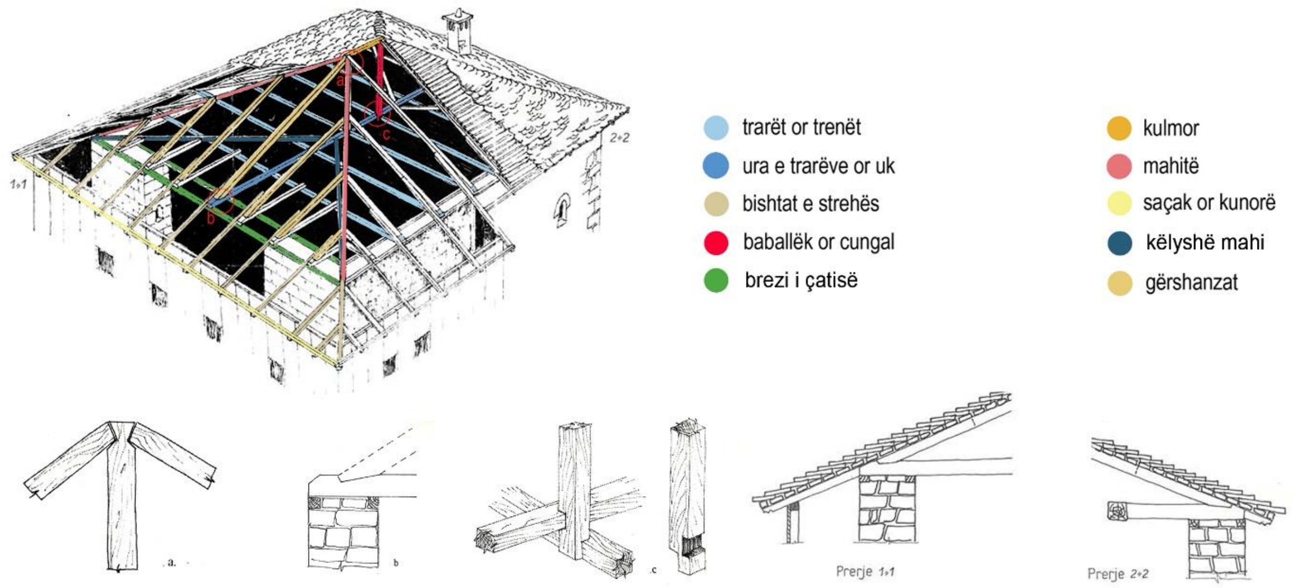

Figure 4 – Structural timber elements identified by Muka and few joints details (Source: Muka, Riza & Thomo, 2004; Graphic processing: Pompejano 2018)

The construction process started with the placement of the thin plates composing the horizontal timber ties system (*brezi i çatisë*), which were lengthways positioned on the top of the stone masonry bearing walls. Usually, there were 2 lengthways positioned elements, but when the wall thickness was greater a third one was added in the middle. These elements created a sort of horizontal wooden belt, embedded in the masonry, where each element was tied to the next one to guarantee stability to the entire timber-tie system. Joints between two consecutive thin plates were usually ensured by means of nails. Horizontal main beams (*trarët*) were put in place directly on the masonry timber-tie system along the span transversal direction. Then, horizontal or inclined jetting beams (*bishtat e strehës*) were nailed on the external thin plate of the timber-ties system (*brezi i çatisë*), to create the eaves. The distance between these elements depended on the distance between the *trarët*. Muka noted that the projection and the length of those elements with respect to the external face of the bearing masonry wall, was as much at least as the thickness of the wall itself (65÷75 cm). On the *trarët*, an horizontal beams (*ura e trenëve*) is orthogonally placed, parallel to the longitudinal axis of the roof plan. Carpenters paid attention to shaping and levelling this element in correspondence of its points of contact with the *trarët*. Often it was composed of two nailed elements to extend its length throughout the longitudinal direction. The extension joint was realized in correspondence of one of the below-placed horizontal beams by means of a simple scarf splayed joint. This structural element is present within almost all Albanian traditional roof morphologies.

The role of the *ura e trenëve* was to ensure and tie together the *trarët* while transmitting on them the loads transferred by the main vertical posts (*cungal* or *baballëk*), which were directly insisting on it. The main vertical posts (*baballëk* or *cungal*) were directly connected to the *ura e trenëve*. Their placement and height, as well as the rise of the roof, were influenced by the span of the building, calculated comprising in it the thickness of the perimeter bearing walls. Since the most diffused plan scheme had a rectangular shape, the minimum number of *baballëk* was equal to two. In case of more articulated plan, composed by series of minor secondary spans not exceeding a width up to 4 ÷ 5 m, shorter vertical posts (*baballëkë të vegjël*, *këlyshë baballëku*, *këlyshë cungali* or *dajusha*), were placed and nailed at their bottom on the secondary *ura të vogla* and at their top to the *brezin e mahisë*, a sort of collar purlins' belt. The ridge beam (*kulmor, kulmi, ura e sipërme* or *zinxhiri i sipërme*) was supported by the main vertical posts. Usually, in correspondence of the contact surface between the main vertical posts and the ridge beam, the bottom face of the ridge beam was roughly shaped and levelled to guarantee a better stability. The hip or valley rafters (*mahitë*), extended in diagonal upward direction from the corner, formed by two bearing walls, up to the ridge beam. The top of the hip or valley rafters was shaped and nailed on the top face of the ridge beam in correspondence of the supports offered by the main vertical posts. The bottom end of the hip and valley rafters was roughly shaped and nailed to the external thin plate of the *brezi i trarët* system, or more often on the *këlyshë mahi*, a sort of dragon beam diagonally placed across the *trarët,* along the projection line of the hip rafters, joining the *ura e trenëve* in proximity to the *ura e trenëve-baballëk union* (Muka 1999, 110). This sort of dragon beams extended outside, beyond the outer edge of the wall, in correspondence of the corner between two perimeter walls. The inclined plane of the pitches was formed by the series of common and jack rafters (*gërshanzat* or *ballësore*). The distance between the common rafters depended on the distance between the horizontal beams (*trarët*). The bottom end of rafters was approximately shaped and nailed creating a very rough single step joint. The cross section was a little bit smaller than the one of the *mahitë* but are not rare cases where it was the same. In case of considerably wide inclined span of the pitches, both common and hip/valley rafters could be formed by 2 timber elements joined together. In this case, more than one collar purlin belt (*brezat e mahisë*) were transversely placed under their bottom surfaces at about ⅓ of their total length. These common rafters' belts were composed of supporting thin purlins (Muka 1999, 111; Muka 2007: 383).

Once the wooden structure was completed, the arrangement of the roof covering started with the placement of a series of rectangular cross-section battens forming a belt (*saçak* or *kunorë*) that was nailed at the end of the jutting out elements forming the eaves (Muka 1999: 112). Then were placed the boards (*hartosat*, *petavra*, *flashka* or *kona*) forming the planking (Muka 1999: 112; Muka 2001b: 71; Muka 2007: 384). The arrangement of the boards nailed on the rafters, formed the roof planking (*dyshemeja e mbulesës*) on which in some case was laid-out a thin layer of clay. The boards were nailed one next to the other, but if there was no clay layer on the planking, then the boards were arranged leaving a distance of about 4 fingers (Muka 2007: 384). The last phase of the construction process was the placing of the tiles that usually started positioning the first course of tiles jutting out 10 cm from the eaves edge. The construction principle was the same for tiles as well as for stone slabs mantle: to put every two, the third one above in a staggered position (Muka 1999: 113; Muka 2007: 384). The first course of tiles and the last course at the ridge beam level were ensured by a little of mortar made of clay to guarantee their stability and avoid displacements (Muka 1999: 113; Muka 2007: 385).

4. Traditional roofs in Gjirokastër: a brief overview

Gjirokastër traditional timber roofs constitute a peculiarity if compared to the main framework described by Muka' studies, as well as the specific case of the Alpine region of Theth (Shkreli, 2018). The structural framework complexity of these wooden roofs increases depending on the number of minor spans to be covered and accordingly to the number of available supports. The greater the total transversal span to cover, more articulated is the wooden roof structure. According to the number of supports available and the spans to be covered, I have identified 4 timber roof frameworks. These roof frameworks have in common the large number of timber elements placed at a close distance and cooperating to support the heavy roof stone slabs covering. The arrangement of the members reflects the spatial structural behaviour of these timber roof frameworks (fig. 5).

Figure 5 – Traditional timber roofs in Gjirokastër, Albania (Source: Pompejano, 2018)

The roof structure is composed of a series of primary bearing timber elements that turned out to be common to all the identified roof frameworks. The local popular terminology used to indicate the structural members differs from the one reported by Muka. For instance, the *trarët* or *trenët* are called *tabanët e çatisë, ura e trarëve* is called *lumi,* the word *mahi-të* indicate the common rafters and not the hip or valley rafters which are called *angonaret.* The main evident difference with the roofs described by Muka consists in the arrangement of the secondary posts (*këlyshë baballëku*), which in Gjirokastër's roofs are called *pajanta* and are placed inclined, supporting the systems of collar purlins (*zinxhir*) nailed at the bottom face of the rafters. The eaves are also known as *sprethë* and varied in length according to their placement along the building perimeter. The eaves on the main facade were composed by structural inclined posts called *testekë të gjatë,* i.e. long *testekë,* and had a projection of about 160 ÷ 175 cm from the external surface of the wall. The eaves along the lateral facades were formed by *testekë të shkurtër*, i.e. short *testekë* and had a projection of about 110 ÷ 120 cm. In both cases these inclined posts are nailed to the thin outer plates of the timber-ties system inserted in the masonry. The planking, made of timber boards (*petavra*), is directly placed and nailed on the upper face of the rafters. The *petavra* were always arranged at 5÷8 cm distance between one from another. The heavy black limestone slabs, called *dërasa guri*, were offset arranged starting from the eaves up to the ridge beam. No nails, hooks or metal connectors and mortar are used to tight and fixed the slabs.

5. Conclusion

Trying to reduce the gap between the reasoned analysis of the built environment and the complexity of human works, in 1983 the Albanian ethnologist Ali Muka drafted 3 important questionnaires aimed at investigating rural settlements, traditional dwelling houses and the building technology of masonry walls and timber roof structures. Those questionnaires were addressed to the IKP collaborators' network on the territory that, after having fulfilled them, returned the written answers to the IKP in Tirana. Thus, at the dawn of the collapsing of the dictatorship and in the first two decades after it, Muka published a series of articles and monographs dedicated to his intensive fieldwork research about Albanian traditional rural architecture. Among those contributions, only two articles were entirely dedicated to the description of what he found to be the common traditional timber roof type widely diffuse on the Albanian territory.

At the same time, he also declared the need to better address and deepen the research on Albanian traditional building techniques, pointing out how the majority of the Albanian professionals' efforts had been addressed to the description of the architectural features and components, as well as to the definition of the Albanian traditional house's architectural types. Starting from the analysis both of Muka's published literature and of the archival sources preserved at the IAKSA archives, I tracked down precious information about woodworking procedures and techniques, construction process details and timber elements terminology that where collected and reported by the ethnographers of the *Instituti i Kulturës Popullore (IKP)* retracing Muka's important contribution.

The intermediate results of the ongoing research demonstrated how his first studies on Albanian traditional timber roof, although very detailed and holistic under many aspects, did not include the outstanding exceptions of traditional timber roofs of the Albanian Alps areas and South/South-East regions, focussing the attention on and describing only the examples from Central Albania. In order to contribute and pushing forward the knowledge on traditional timber roofs in Albania, my doctoral studies focussed on the Gjirokastra traditional timber roof structures, revealing a very local peculiar roofs typology that seemed to be limited to the citadel and its surroundings. However, expanding the research perspective on a more general level, the lack of a systematic analysis of the materials produced both from the IKP and the IMK and the daily disappearing of many outstanding examples of the Albanian traditional architecture, urges further and better addressed fieldwork, studies and contributions. A future historical-typological classification of the Albanian traditional building techniques needs to be based on a multidisciplinary approach able to rediscover and document the local technical material culture that used to be orally and practically transmitted by craftsmen. In this sense, the critical and interlaced critical and historical analysis, both of the archival documents and of the traces embedded in the still existing testimony of the Albanian traditional architecture, will allow to gain a full knowledge of the Albanian case study and place its legacy within the major research field of the traditional building techniques in the Mediterranean countries.

Acknowledgment

This paper contains partial results both of my PhD thesis defended in September 2018 at the *Politecnico di Milano* (Italy), and my recent archival research carried out at IAKSA, Tirana (Albania). I would like to remark that the processing of the archive sources consulted at the IAKSA Archives is still ongoing and thus, the research. Consulted archival documents and main literature are in Albanian language. English translation provided within the text was prepared by me, the solely responsible for any error and/or inaccuracy.

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Experiment in the Desert: the Investigation and Assessment of Frank Lloyd Wright's Dining Room at Taliesin West

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Abstract

Taliesin West, located in Scottsdale, Arizona, served as Frank Lloyd Wright's winter home and studio from 1938 until his death in 1959. Through the Taliesin Fellowship, Wright trained hundreds of apprentices who helped him build and continually alter the site. The complex has continued to evolve since 1959 and currently operates as a school and museum that maintains both the architect's pedagogical legacy and built fabric. This paper documents the investigation of the architectural wood in the Original Dining Room, one of the remaining early structures built at the site, central in the plan and of primary heritage significance. The project, led by the University of Pennsylvania's Center for Architectural Conservation in partnership with The Frank Lloyd Wright Foundation, merged archival research and building archaeology to establish a chronology of Wright's many modifications to the space. This was accompanied by an assessment of the wooden elements and related building forensics including wood identification, paint analysis, and environmental monitoring to record conditions and related pathology. This data has informed current conservation and preventive maintenance strategies for the Original Dining Room, with potential application to Taliesin West as a whole.

Key words *Frank Lloyd Wright, Taliesin West, Wood, Documentation, Assessment*

1.0 History and Site Background: Frank Lloyd Wright, Taliesin West and the Dining Room

1.1 Wright and the Materiality of Wood

As an architect, writer, and educator, Frank Lloyd Wright's career spanned seven decades to yield some of the most seminal works of the modern movement. Wright cultivated design philosophies which are embodied in his architectural vocabulary, most notably "organic" architecture, or the belief that forms and materials should be used in harmony with nature. He had a fondness for wood, expressed in his 1928 Architectural Record essay that wood "is universally beautiful to man - it is the most humanly intimate of all materials."[i] Wood's natural form, he believed, is best shown in simple, rectangular shapes, like those created by a machine. The linearity of milled wood allowed the architect to achieve expansive horizontal volumes as well as to craft intricate decorative repeating ornamental units. Embracing the natural textures and surface qualities of wood often meant refraining from painting or coatings[ii] Wright wanted neither for wood to fully weather as that could diminish its beauty, nor did he wish to use preservative coatings that obscured the natural identity of the material. Herein lies opposing paths of design intent and the prevention of destructive weathering that remain challenges for the interpretation and conservation of his works. As Wright's vulnerable wooden elements continue to age and evolve as significant heritage, methods for intervention and prevention of deterioration have progressed as a priority in conservation management. Taliesin West serves as an ideal laboratory for the study of Wright design principles that have advanced problems of wood deterioration. As the natural behavior of wood has influenced the growth and character of the built-landscape, the assessment of the history, value and pathology of the material will continue to shape the compound from ephemeral student-built experiments to sustainable, more permanent monuments.

1.2 The Taliesin Fellowship

With his commissions destroyed by the Stock Market Crash of 1929, Wright turned to teaching in 1932, founding the Taliesin Fellowship in Spring Green, Wisconsin. Twenty-three men and women enrolled that October. Apprentices learned by taking part in Wright's few commissions as well as through the hands-on construction and maintenance of the Wisconsin property, Taliesin. [iii] The Fellowship thrived, but Wisconsin was too cold during the winter months, forcing the Fellowship to spend less time building outdoors and more time keeping warm. By 1937 Wright wished to return to Arizona, where he had worked on the Biltmore hotel during the previous decade. As his rate of architectural commissions improved and his income began to grow again, Wright had the means to return to Arizona with his family and the Taliesin Fellowship in search of a location for a new desert camp. He chose a site below the McDowell Mountain 26 miles northeast of Phoenix and named it Taliesin West. [iv] (fig.1). The first structures at Taliesin West were tent-like in form. All the buildings were constructed by apprentice hands of the Taliesin Fellowship. Cement, redwood, and canvas were brought in by car, and stone was sourced from the land.[v]

Figure 1 - Exterior View of the Original Dining Room from the southeast ca.1939, featuring an early version of the decorative "icicles.", The Frank Lloyd Wright Foundation, Taliesin West Archives, Scottsdale, AZ.

Figure 2 - Exterior view of the Original Dining Room ca.1939, The Frank Lloyd Wright Foundation, Taliesin West Archives, Scottsdale, AZ.

Figure 3 - Interior view, ca.1946, Parker, Maynard L, Taliesin West. Dining room. Scottsdale, AZ. The Henry E. Huntington Library, San Marino, California.

1.3 The Dining Room: History of Use, Description and Features

The Original Dining Room (fig.2-4) was constructed between 1938 and 1939 to serve as a dining space for the Wrights and the Fellowship. It served this function until 1948-1949, when it was converted into a private dining room for the Wrights. Fellowship enrollment had increased after World War II, and a larger space than the Original Dining Room was needed to accommodate them.[vi] The Original Dining Room underwent multiple campaigns of change during Wright's lifetime, for both aesthetic and functional reasons. The space continued to undergo changes following Wright's death in April 1959, and today serves as a classroom and a board room.

The Original Dining Room is located on the southwestern edge of Taliesin West. It is bound by the Dishwashing Area to the north, which was constructed along with the Original Dining Room, with the two spaces divided by a frame wall with a masonry fireplace in the center. A Conference Room, which originally functioned as bedrooms for Wes and Svetlana Peters and Gene Masselink, boarders the Original Dining Room to the east. The south wall of the Original Dining Room features double glass doors in its center. Three steps on the exterior side of the door lead to a small landing, with two additional sets of steps down to the lawn on both the east and west side of the landing. A short wall separates the steps from the lawn. On the western side of the Original Dining Room, a platform of thirteen steps rise along the masonry wall and lead to the Drafting Room. A shallow triangular pool resides at the base of the steps, beginning near the southwest corner of the Original Dining Room.

The one-story structure is primarily constructed of battered "desert masonry" walls which rise approximately 8.5 feet from ground level. Clerestory windows are situated directly on top of the desert masonry walls, running along the west wall, south wall, and southern end of the east wall. Two rows of alternating fixed wooden panels and operable wooden shutters with piano hinges cover all but the first 3 feet of clerestory windows on the southern end of the west wall. The north wall features a fireplace in its center, with a geometric Gene Masselink mural painted on plywood (fig 5) above built-in coves to the fireplace's west, and a door and built-in shelving to its east.

Four beams spaced approximately 8 feet apart serve as the primary support system of the roof. Each consist of one continuous 2-by-12-inch board which runs from north to south the entire depth of the Original Dining Room and extend 8 feet out from the clerestory windows on the south wall. On the exterior, two decorative wooden icicles hang from the center of the overhanging part of the center two beams. Near the southern doorway on the interior, two desert masonry columns situated approximately 3.5 feet from the door serve as additional supports for the two center beams. Wide decorative boards and cove lighting sit beneath the two center beams.

The ceiling between the westernmost two beams and between the easternmost two beams consists of plywood with recessed lighting. The two center beams form the frame of a 7.5 foot wide skylight composed of ten fiberglass panels, beginning at the fireplace and spanning for 17.5 feet towards the southern door. A laylight consisting of twenty triangular panels (tri-panels) connected to thin diagonal wooden members hangs beneath the skylight. Small decorative wooden pyramids adorn the skylight frame below the laylight, above the dentils and lighting.

Figure 4 - Exterior view, ca.1947, Parker, Maynard L, Taliesin West. Architectural detail. Scottsdale, AZ. 1940s. The Henry E. Huntington Library, San Marino, California.

2.0 Project Overview: Partnership, Methodology, Assessment and Documentation

2.1 University of Pennsylvania and Frank Lloyd Wright Foundation Partnership

The Center for Architectural Conservation at the University of Pennsylvania is a division of the Historic Preservation Program within the Weitzman School of Design that is devoted to the training and research in the technical conservation of the built environment. The Center provides the opportunity for graduate students to explore various dimensions of professional practice alongside faculty in partnership with entities of heritage stewardship such as the US National Park Service and the Getty Conservation Institute. As part of a five year agreement with the Frank Lloyd Wright Foundation to explore various aspects of the architect's built legacy, the first of the collaborative activities has focused on Taliesin West, recently designated a UNESCO World Heritage Site along with a group of Wright's buildings.

Figure 5 – Mia Maloney annotates HABS drawings of the north wall and mural with their present conditions.

2.2 Objectives and Methodology

On-site investigation occurred January 7-12, 2019. During this time, a wide range of diagnostic tools were implemented to confirm the archival information for the chronology, as well as to assess the condition and integrity of the space. The primary goal was to provide recommendations for the immediate and long-term conservation of wooden elements of the Original Dining Room. To meet this objective, the current conditions and associated pathologies were documented and described following an on-site investigation and analysis of the environment. Appropriate interventions were then identified, informed by the Frank Lloyd Wright Foundation's preservation philosophy, the integrity of the wooden features, and the intended use of the space. An integral part of this process was understanding the context in which the structure developed and the creation of a building chronology, derived from archival research and building archaeology.

HABS Measured drawings of the structure were provided in the form of CAD files.[vii] Because the drawings did not include the entirety of the Original Dining Room, the provided drawings were modified as needed and additional drawings were created post-site-visit. These drawings, supplemented by photographs, then served as a base for a three-dimensional model of the Original Dining Room created using Rhino. Each wooden member was individually formed in the model, with the goal of representing how each piece fits together rather than only representing their combined massing. An alphanumeric naming system was derived to label the majority of the visible wooden elements to aid in clarity when referring to parts of the Original Dining Room, particularly for the elements which repeat throughout the space.

2.3 Assessment and Documentation: Project Scope

While the findings and recommendations may be applicable to multiple structures at Taliesin West, the scope of the project was limited to the Original Dining Room with a focus on the wooden architectural elements. The building chronology encompasses all materials found in the space, but only the wooden elements have been included in the condition survey. Because the conservation of the wooden architectural elements is dependent on the function of the structure as a system, non-wooden elements are included in the recommendations.

2.4 Application

In 2015 a Preservation Master Plan for the site established Taliesin West's period of significance as 1938-1959, the era associated with Wright.[viii] A brief condition assessment was included in the Master Plan, noting the most pressing issues. A project for the space grew out of the Preservation Master Plan and began in Spring of 2019 shortly after this research was completed. While the Preservation Master Plan laid the groundwork for the project and provided a great overview of Taliesin West's preservation needs, the large, site-wide scope meant that an in-depth analysis of each space could not be included. Because the Original Dining Room has a high level of significance and integrity, with much of the present wood dating to Wright's period, additional information and recommendations for the space were requested. It was the intention of this research to answer some of the remaining questions about the wooden architectural elements of the space, including its construction chronology and current conditions, and to provide recommendations for its conservation in regards to both the project and its long-term maintenance.

3.0 Archival Research / Documentary Records Describing Chronology / Previous Studies

3.1 Building Chronology Explored and Documented

A combination of archival research, personal testimonies, and building archaeology was used to form a building chronology of the Original Dining Room. Historic photographs, most of which were taken by apprentices, illustrated the major campaigns of change, and interviews and memoires by apprentices provided insight into why these changes occurred.

Photographs by apprentice Robert Carroll May and photographer Pedro E. Guerrero documented the alterations to the Original Dining Room which began only a year after it was constructed. Taliesin West was Wright's own home and he could afford to alter the site to his pleasing. Some changes were made for the sake of design, while others were repairs made as a result of experiments in construction combined with the limited skill set of apprentices who were still learning. Lapped boards were added to the ceiling in the winter of 1940-41 to combat an especially rainy season and the space between the center beams was transformed into a skylight.[ix] The beams were strengthened with the addition of flush lapped boards to support the added weight. Fascia boards, covered with shingles, were added to the southern end of the structure, and the decorative hanging boards were replaced with wooden "icicles."[x] Major changes occurred in 1946, including the insertion of an opening in the center of the masonry of the southern wall of the Original Dining Room to create a doorway. The lapped ceiling boards were returned to canvas, and the roof was extended over the southern entrance.[xi] Glass was added to the clerestory opening by 1947, with dentils put in place on the South wall above this.[xii]

During the winter of 1948-49, a new Dining Room was formed on the site to accommodate the increasing number of Fellowship apprentices and the Original Dining Room was converted into a private Dining Space for the Wrights.[xiii] This was followed by alterations, many of which increased the privacy and formality of the space. The fireplace in the northern wall was added by 1949.[xiv] Rafters were added over the joists to change the skylight's roof from flat to gabled, and glass replaced the canvas by 1950. Two boards, decorated with dentils, were mounted at the base of the skylight. The early 1950s also saw the addition of two desert masonry columns inserted near the southern door under the center two beams. By 1955, the door opening in the south wall was lowered to the grade of the interior floor, with steps built down to the exterior lawn. Shutters were added to the clerestory windows, and the mural painted by Gene Masselink on the west side of the fireplace was present by this time. The projecting boards with dentils on the interior of the skylight were lowered to their present location at the base of the beam.

Changes continued follow Wright's death in 1959. The glass of the skylight was replaced with fiberglass during the 1960s. The terrace to the east of the space was enclosed in 1971, resulting in the replacement of the glass in the shuttered portion of the clerestory window on the east wall with mirrors.[xv] Alterations have also been made to suite the room's current configuration as a board room and classroom. This includes the addition of shelving and a heating unit between the northern doorway and fireplace, and the addition of a series of bulletin boards on top of the chair rail along the eastern interior wall. Below the mural, two cubbies are the only remaining elements of the built-in buffet that was present in 1958.[xvi] Additional wiring has been added for internet and electrical updates.

3.2 Chronology Mapped and Modelled

To illustrate the complex building chronology, each element in the Rhino model has been color-code to the period in which it first appeared. The coloring of an element means the specific feature first appeared in that location at that time, but it does not mean that the present fabric of that element dates to that time period. A board may be color-coded to a year even though the element was recycled from an earlier period or replaced at a later date. The process of digitally reconstructing the structure piece by piece meant that the interior structure had to be carefully considered. Photographic evidence of the structure's earlier forms helped to inform what exists beneath the surface, and consequently led to a better understanding of how and when elements were added, removed, and altered (fig.6).

4.0 Physical Investigation / Condition Assessment Description

4.1 Mapping of Moisture Content and Fungal Decay

To better understand the extent of the moisture infiltration and risk of fungal decay, between 2:00 and 3:00 PM on Wednesday, January 9, 2019, moisture content readings were taken along the roofline of the east and south elevation and on four of the eight exterior eastern and western faces of the beams using a pin-less Wagner MMC 210 moisture meter. The temperature during this period increased from 67.2 to 67.7°F, and the relative humidity decreased from 30.8 to 30.4%.[xvii] No rain events were observed on site within 48 hours prior to obtaining the readings. The results of these moisture readings were mapped on drawings using a gradient to represent the percentages (fig. 7).

Readings were taken along the lapped boards on the exterior elevation of the easternmost beam, which is original to the 1938-39 construction. The highest moisture content was found at the beam's south end, with readings up to 31.0%. This puts the member at a significant risk of decay and insect infestation. Though it is not unusual for a board's moisture content to be higher near the end grain where moisture is absorbed most easily, the increased moisture retention in this portion of beam may also be caused by the lapped structure of the beam trapping moisture and restricting evaporation, particularly because this area is directly exposed to precipitation. Readings decreased to 10.8% where the roofline begins, but rose to 23.0% at the end grain of the next board. Most of the remainder of the measurable area of the board was dry, having a moisture content between 5.7% and 4.0%, except for where the beam comes into contact with the roof support element approximately 6' 8" from its southern end. Here, the moisture readings increased to 20.0%, nearly as high as the readings at the end grain. Additional readings were taken on of the three easternmost beams. The moisture content of these members ranged between 12.4% and 32.0% with no consistent pattern. Each of these boards were found to be wet, with nearly all of the readings taken of these boards being greater than 15.0%. Measurements were taken on the fascia boards along the south elevation. Except for the westernmost end of the facia board where it meets the westernmost beam, all readings for the southern fascia boards were below 12.8%.

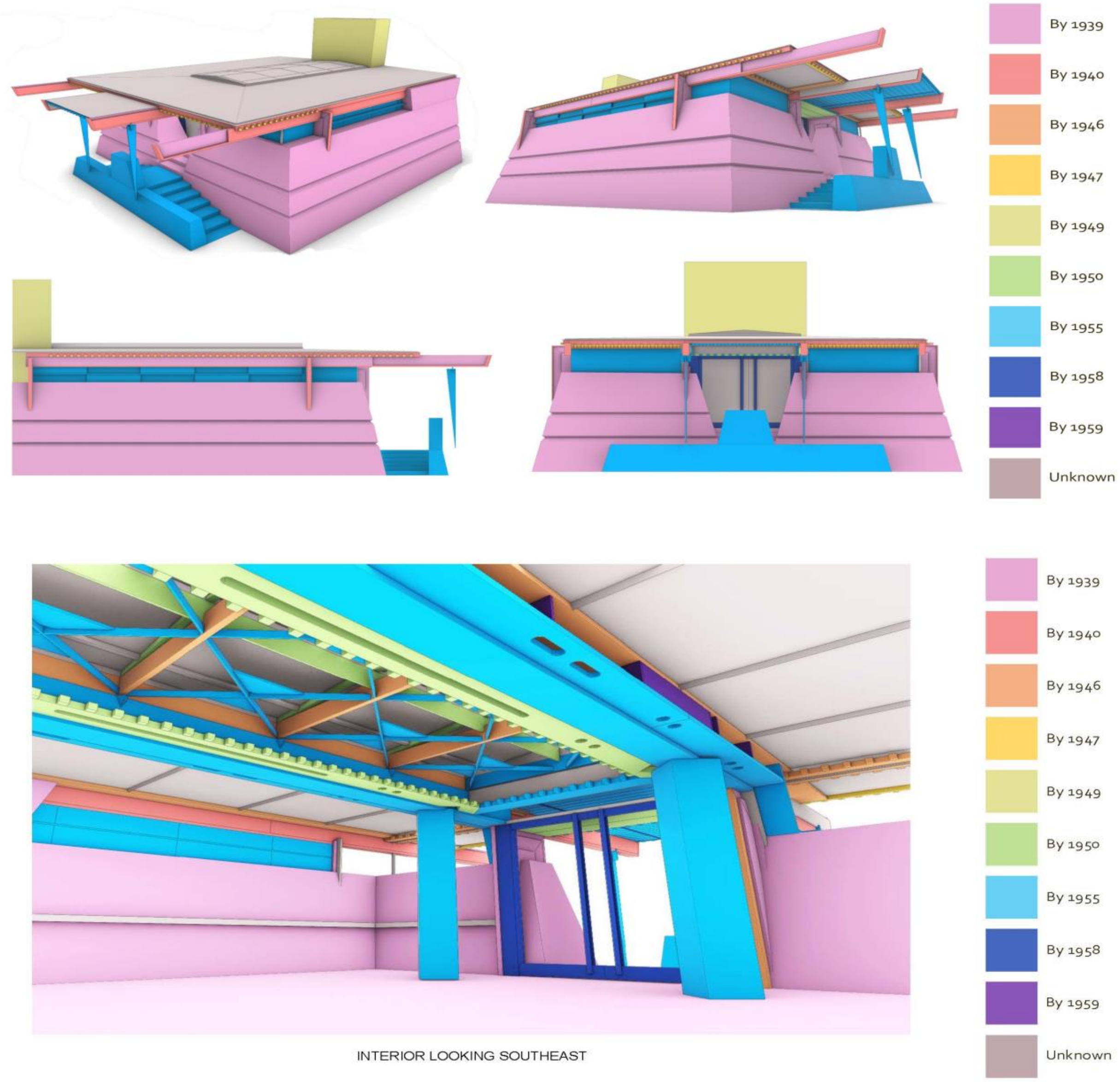

Figure 6 – By creating a three demensional model featuring every individual wooden member used to construct the Original Dining Room, each element could be color-coded to the period in which it first appeared in the space.

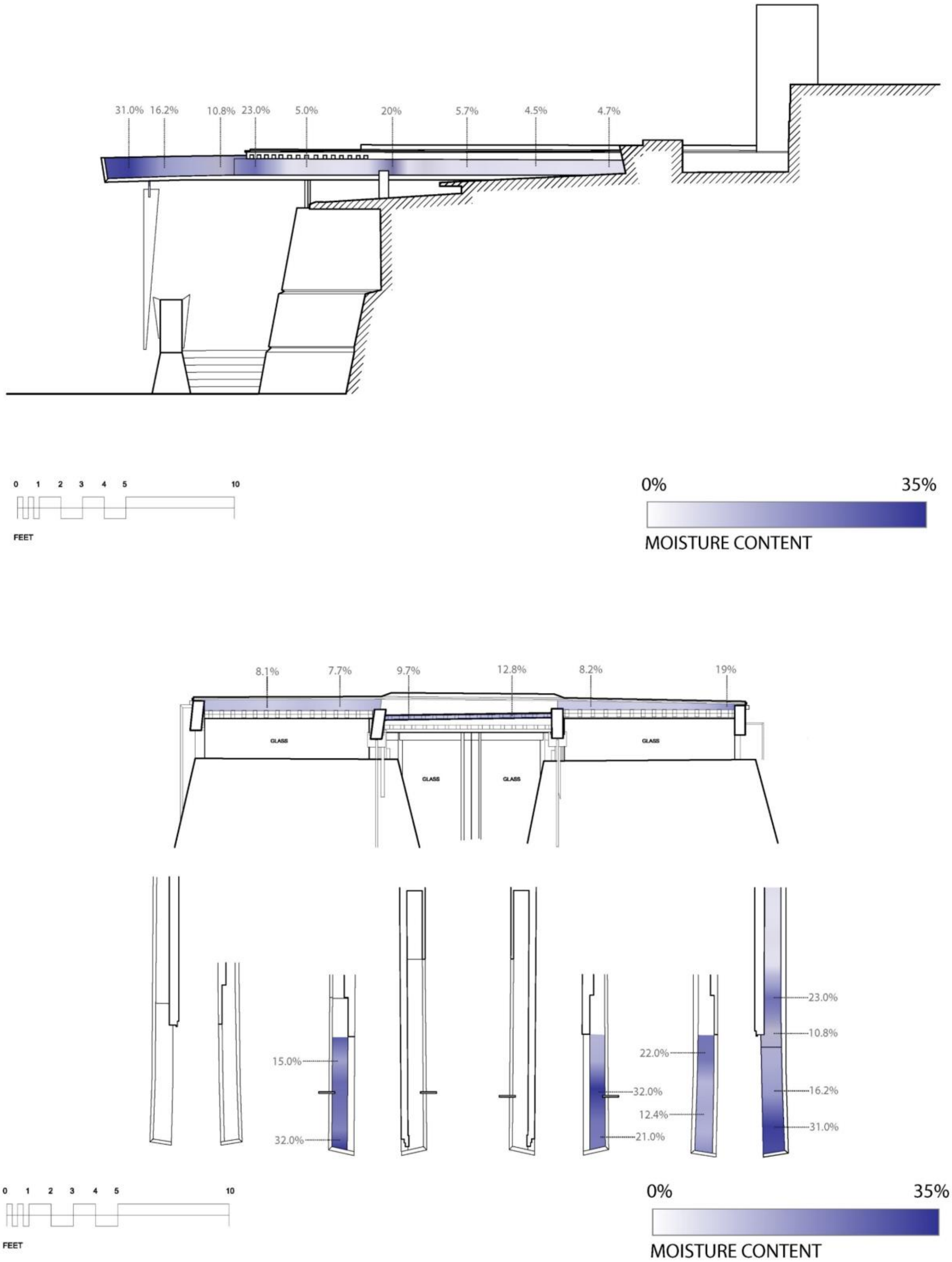

Figure 7 – High levels of moisture were found in nearly every exterior member tested with a moisture meter, revealing a signifcant risk for insect infestation and fungal decay.

4.2 Thermography

Using a FLIR C2 camera, infrared thermography was used to map temperature and moisture patterns of wooden members of the Original Dining Room. This was especially helpful in investigating the inner members of the exterior beams where decay was present but measurements could not be taken with a moisture meter due to size restraints. Thermographic images of the tops of the outermost beams showed that the areas of severe decay had temperatures as far as 15°F below that of surrounding wood, confirming that moisture is still a severe issue in the inner members of the beams (fig.8).

Infrared thermography was also use to document decayed members of the roof overhang directly below an area of high decay of inner members of the second-easternmost beam. Though there was only a 2°F temperature difference between the area of decay and surrounding wood, it is clear that moisture penetration is still an ongoing process and that there is likely additional decay below the surface in the areas surrounding the visible damage. The less drastic temperature difference in this area than on the top of the beams is likely partially a result of the ceiling not having direct sun exposure which would increase the temperature in surrounding wood.

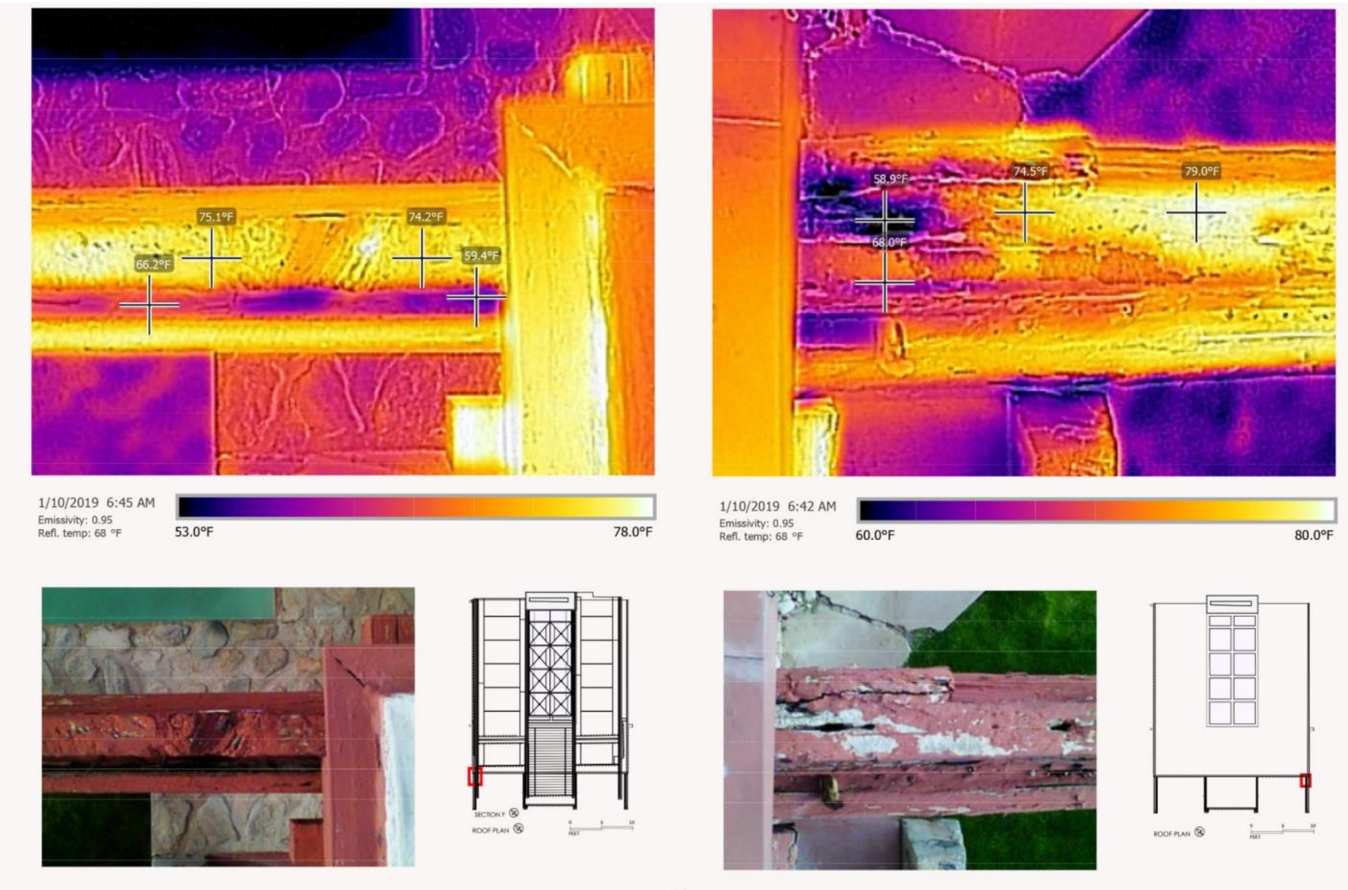

Figure 8 – Infrared thermography revealed areas of high moisture on the tops of the beams, suggesting that moisture-related decay was still and ongoing process.

On the interior, thermographic image were taken on the skylight's northeast corner where signs of termite activity and fungi decay were present. Here, the surface temperature of areas of high decay were up to 10°F below the temperature of surrounding wood. This confirmed that moisture is still entering the structure in this area, meaning that the extensive visible deterioration may still be ongoing.

Figure 9 – Andrew Fearon replaces a tri-panel that was removed during investigation.

4.3 Physical Probes, Selective Disassembly and Surface Probes

Probing and limited disassembly was done on site to better understand conditions beneath the surface. Probing was done across the exterior portions of the beams, revealing severe decay beneath the surface. Disassembly occurred on the exterior beams along the eastern elevation. The enclosure of the terrace to the east of the Original Dining Room in 1971 lead to alterations to the elevation, including additional framing around the roof support and modifications to the shutters. Plywood was added on the easternmost beam where it meets the roofline of the enclosed terrace, and microbiological growth and insect activity was found here, likely sustained by water runoff from the abutting roof. On the interior, dentils and a tri-panel of the laylight were removed to observe fastener types and look for any evidence of earlier finishing campaigns (fig.9). A lack of paint behind the elements and the absence of earlier nail holes suggest that both were in place before the structure was painted in the late 1950s and have not undergone changes since.

4.4 Previous Repairs / Modifications / Elements from Period of Significance

Most of the fabric in the space likely dates to the 1938-1959 Period of Significance. The hands of the apprentices and eye of Wright can still be observed in the crafted woodwork, as nearly all of the material that survives dates to Wright's period. Among the remaining fabric is the core member of each of the four beams, original to the 1938 constructions. The only areas which likely do not derive from Wright's period are the northern doorway, bulletin boards, shelves to the east of the fireplace, skylight's fiberglass and plywood ceiling members. The present icicles likely are also not original to Wright's period, though they are similar in design. Two features which are no longer present include the built-in to the west of the fireplace and portions of the chair rail.

Few previous repairs are evident in the structure, though a major intervention did occur on the second-West-most beam in the form of additional boards lapped on the east and west sides, secured by bolts. This intervention was likely in response to the severe decay of as well as to stabilize the deformation of the beam which appears in the form of a clockwise twist.

4.5 Bio-deterioration, Weathering, Structural Conditions. Biotic and Abiotic Agents

The interior is in overall good condition, with water staining and cracks being the most prevalent concerns (fig. 10) both conditions are found primarily on the mural, ceiling and cove lighting. Because moisture appears to be entering across a wide area of the elevated portion of the skylight, the moisture is most likely a result of precipitation. However, a series of mechanical systems run across the roof near the chimney, and water has been observed to pool on the northwest corner of the roof. Fungal decay and pest activity accompany the moisture infiltration near the fireplace. Though the damage resembles that of subterranean termites, drywood termites are most likely responsible for the deterioration, as they can survive with no access to the ground and require as little as 13% moisture content, which is less than that of subterranean termites. While moisture content readings were not taken in this area of the Original Dining Room, infrared thermography suggests that the affected areas are holding more moisture than surrounding members.

UV damage was also a concern on the interior, particularly on the plywood mural. Damage was worse closest to the clerestory window, where UV energy readings were 550 µW/Lm, and less severe near the fire place, where readings were 286 µW/Lm.

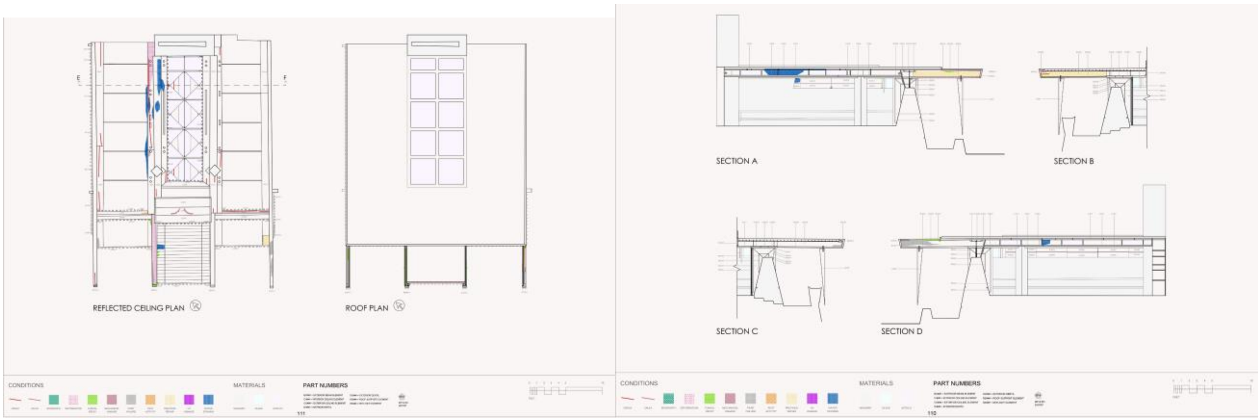

Figure 10 – The majority of the conditions observed on the interior were concentrated near the skylight and along the second easternmost beam. On the exterior, the worst conditions were found on the overhanging portions of the beams.

Wooden fabric from 1938 has survived on the exterior, likely a result of the dry climate. However, the structure is not free from moisture-related decay mechanisms such as fungal decay, biological growth, and weathering. The exterior wooden elements of the Original Dining Room are in worse condition than the interior elements. All of the conditions noted in the interior occur more severely on the exterior. Additionally, paint failure was observed on the exterior wood on all elevations at the time of the assessment. Fungal decay was observed beneath the overhang, near the second-westernmost beam. In all four beams, the boards immediately to the left or right of the center members were found to have areas of advanced fungal decay, particularly near the roofline. This was accompanied by ant activity in the easternmost beam.

Severe deformation and cracking was observed in the two westernmost beams. Both of these beams have a counter-clockwise twist and downward slope, as well as cracks. Though cracking is widespread on the interior, with approximately half of the ceiling boards and cove lighting members having one or two cracks which run parallel to their grain, most are likely a result of the wood shrinking and swelling rather than a structural issue. Apparent structural issues on the interior are primarily manifested in the downward deformation of the second-westernmost beam near the mural.

5.0 Wood Species Identification

5.1 Areas Sampled

Six wood samples were taken from the Original Dining Room and analyzed, including two exterior samples and four interior samples. A sample was taken of the exterior of the easternmost beam beneath the plywood which was removed during the investigation. From the second-easternmost beam, a sample was taken of the lapped member directly east of the center, main member of the beam. Samples on the interior were concentrated around the skylight. One sample was taken from a dentil, and one from a tri-panel on the laylight. A pyramid was sampled, as well as the framing member of the skylight to which it was mounted. Samples were prepared for analysis by wetting followed by slicing with a platinum coated double-edge razor. Each of the sampled areas were believed to have dated to Wright's lifetime.

5.2 Results / Redwood / Properties / Pathology

All six samples were determined to be redwood (*Sequoia sempervirens*). Redwood, also referred to as coast redwood, California redwood, and sequoia, grows primarily in California. Old-growth redwood, which is moderately strong, stiff, and hard, has highly decay resistant heartwood. Second-growth heartwood can have a much lower decay resistance. Redwood lumber is typically used for building, with its potentially high durability making it ideal for outdoor construction.[xviii] Old-growth redwood has a specific gravity of .40 SG. Green old-growth redwood has an average moisture content of 86% in the heartwood and 210% in the sapwood. As it dries from green to ovendry, old-growth redwood typically shrinks 2.6% radially, 4.4%, tangentially and 6.8% volumetrically.[xix]

Characteristics which can be used to identify redwood include its course texture, generally straight grain, and lack of odor. Growth-rings vary from narrow to moderately wide. The transition between latewood and earlywood is abrupt. The heartwood ranges from red to mahogany in color, while the sapwood is nearly white. Redwood is also characterized by large taxodioid cross-field pitting, a lack of ray tracheids, and abundant and diffuse longitudinal parenchyma.[xx]

Taxodioid cross-field pitting was the most defining feature of the samples. When a sample is viewed radially, cross-field pitting is visible as the area of intersection between ray parenchyma cells and the axial tracheid walls. There are five types of cross-field pitting which may be used in wood identification: fenestriform (or window-like), pinoid, piceoid, cupressoid, and taxodioid.[xxi] Taxodioid cross-field pitting appears in several species other than redwood including Japanese Cedar (*Cryptomeria japonica*) and bald cypress (*Taxodium distichum*).[xxii] The presence of taxodioid cross-pitting in conjunction with other characteristic anatomical features confirmed that the samples are all redwood.

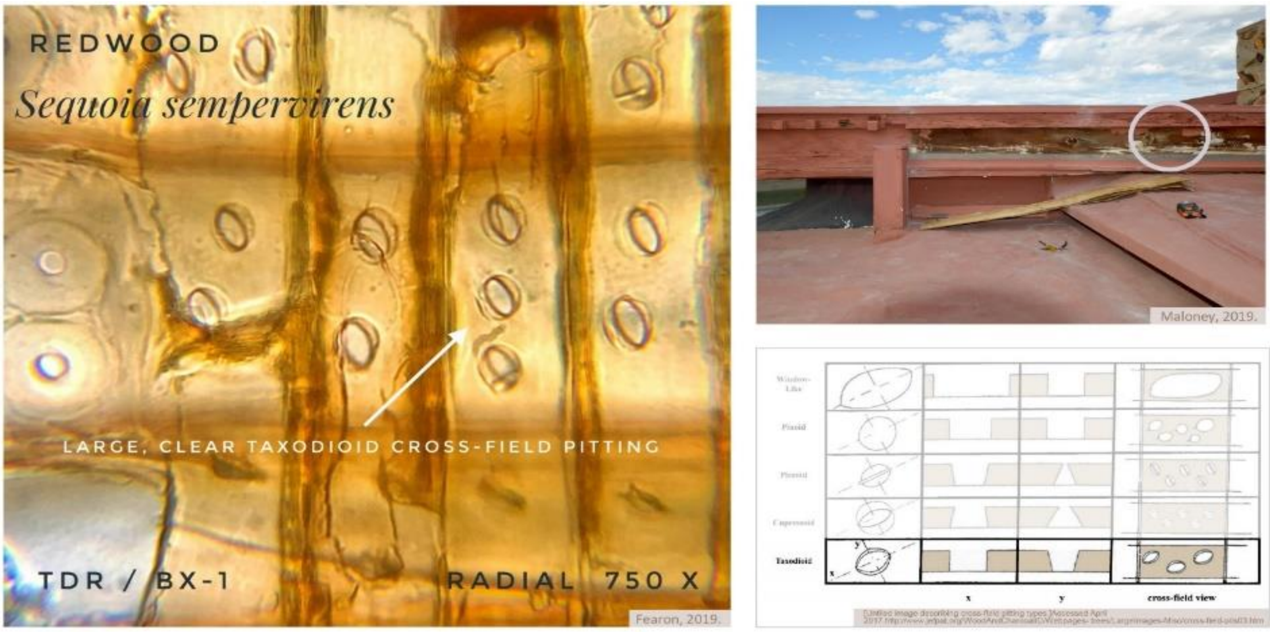

Figure 11 : Photomicrograph of wood sample taken from location of beam identified with taxodioid cross-field pitting.

6.0 Finish Investigation

6.1 Site History Records and Current Practices

The Original Dining Room remained unpainted until near the end of Wright's lifetime in the late 1950s. Most of the wooden elements of the Original Dining Room are painted Taliesin Red, though details such as shutters, the tri-panels, and doorways are a brighter Mandarin Red. The concrete floor is the darkest color, Maricopa Red.

6.2 Paint Sample Areas

Samples were taken from 15 different elements for finishes analysis. All but four samples were taken from the interior. Samples were taken with two goals. The first was to understand how the structure had previously been treated. This included the investigation of how the structure appeared during earlier periods for use in later interpretation, as well as to document what treatments had been implemented in the past. The second goal of the finish analysis was to confirm the chronology that was developed using archival documents by comparing the stratigraphy of elements from different periods. It was recognized before the sample process that the use of paint analysis to meet this goal would be limited as the structure was not painted until after the majority of the present elements were added.

In addition to samples, color readings were taken on site using a spectrometer. Readings were taken primarily within the southern doorway where there was a lack of soiling and fading. Color readings were compared to Benjamin Moore's Classic Color Collection. The closest match determined using the X-Rite CAPSURE color meter was Seminole Brown 1183 for all three samples. Data was also collected using both CIE L*a*b* and L*C*h color space coordinates.

6.3 Results / Conclusions

Because color discrepancies occur when photographing samples or analyzing them with a computer monitor, all samples layers were observed and documented directly through the microscope, rather than through the photographs. While an effort was made to document the observed colors from the samples as accurately as possible for the purpose of comparing the stratigraphy of the samples, the noted observed colors should not be taken as a true representation of the finishes.

The stratigraphies of the fifteen samples can be divided into two categories based on the colors found. The first includes samples with stratigraphy's limited to colors resembling Taliesin Red, which includes the exterior portions of the easternmost beams, the icicles, and boards near the ceiling found along the plywood or at the base of the beams. The second category includes samples with stratigraphies that include Mandarin Red, a shade which is brighter and closer to orange than Taliesin Red. This color was found in all of the skylight elements and shutters. Of these, the pyramids had the most layers (up to seven), suggesting that they were often repainted as a result of changing aesthetic desires.

The finish analysis helped to confirm the building chronology of the covelighting boards of the second-easternmost beam, as well as the nearby board over the south wall's easternmost clerestory window and along the plywood where the ceiling meets the easternmost beam. Each of these five boards had the same first layer, a slightly darker shade than the present finish color. This shade likely dates to the late 1950s when the structure was first painted as there is no evidence or record of that any stripping of paint occurred which would have removed the original layers. The second layer of one of the boards in the covelighting of the second-easternmost beam is a red-brown color which does not appear on any of the other samples taken. This layer may date to the insertion of the cove lighting, as the cutting of holes into this board would have likely been followed by its repainting. The next layer on three covelighting boards is a brighter shade of red than the present finish. It is suspected that this finish was added to unify the boards around the cove lighting as the darker shade used after the holes were added likely did not blend with the surrounding boards. The theory that these layers are related to the insertion of the cove lighting is supported by the evidence found on the boards near the window and eastern beam. Both contain only two layers; the same shades as the first and last layers of the boards in the cove lighting. Because these boards did not undergo changes after they were first painted like the boards around the cove lighting, it was not necessary for them to be repainted as often.

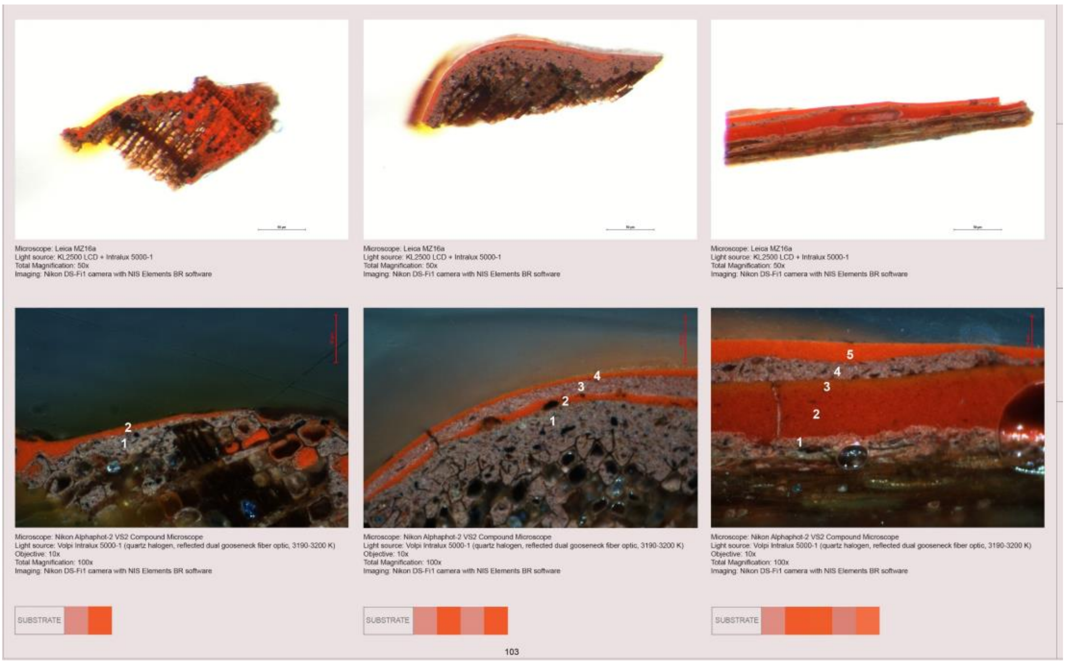

Figure 12- Photographs of finishes samples taken from tripanels (left and center) and a pyramid (right). Microscopic analysis revealled differeing stratigraphies of Taliesin Red and Mandarin Red in each.

7.0 Environmental Assessment: Light, Temperature and Relative Humidity

7.1 Light, Visible and Ultra-Violet

UV and visible light level readings were taken in eight areas of the Original Dining Room using an ELSEC 765C UV+ Logger between 2:28 and 2:35 P.M. on January 10, 2019. Measurements were recorded for UV light by proportion, measured in microwatts of UV radiation per lumen of visible light. The recommended standards for UV exposure in museum settings is below 75 µW/Lm. The appropriate level of visible light is dependent on whether the space is to be used for work, exhibition, or storage. Finished wooden objects should typically not be exposed to light levels over 200 Lux.[xxiii]

Visible light readings were high in the skylight, ranging from 1290 to 3175 Lux. However, the highest UV reading in this area was 3 µW/Lm, showing that the skylight's fiberglass is blocking nearly all UV radiation. This indicates that the UV radiation measured in other areas of the Original Dining Room is originating almost exclusively from the southern doorway and clerestory windows. The highest levels of both UV and visible light in the Original Dining Room were recorded in the southwestern corner near the clerestory window, with a maximum reading of 4350 Lux and 600 µW/Lm. UV and visible light are of special concern in the northwest corner of the space, as the paints of the mural between the clerestory window and fireplace are susceptible to photo-degradation in addition to the plywood substrate. Readings in this area ranged from 95-800 Lux and 286-550 µW/Lm. Except for the UV readings in the skylight, all areas measured within the original dining room had readings outside of the recommended ranges of UV and visible light.

7.2 Temperature and Relative Humidity

Scottsdale, Arizona is located in a hot-dry climate zone. The region is characterized by a monthly average outdoor temperature over 45°F throughout the year and less than 20 inches of precipitation annually.[xxiv] The Original Dining Room is not airtight, with openings present where glass meets masonry or wood. Heating and cooling is achieved using a mini-slit system located between the fireplace and northern doorway.[xxv]

Four SensorPush Humidity and Temperature Smart Sensors were placed in the Original Dining Room to monitor temperature and relative humidity on January 10, 2019.[xxvi] Data was analyzed using 15 minute intervals starting at noon on January 11, 2019 to noon on April 26, 2018. Monitoring for this research was limited to 106 days. For consistency, all four sensors were installed along the second-westernmost beam. On the interior, SP-1 was installed near the doorway and clerestory window, SP-3 near the fireplace and mural, and SP-4 near the skylight. SP-2 was placed on the exterior between the door and clerestory window.

Expectedly, the datalogger that experienced the greatest daily variation in temperature and relative humidity was the exterior logger, SP-2. It was not unusual for this logger to undergo temperature changes of 60°F or more throughout the day. With the temperature changes came the largest fluctuations in relative humidity. Because SP-2 was located in an area that receives shade for most of the day, the highest temperatures recorded were those during the evening when the sun was low enough to shine directly on the sensor. The hottest day recorded occurred on April 19, where temperatures reached 106.71°F at 8:45 PM. The exterior wood is likely to reach much higher temperatures during the warmer months and in areas where it is exposed to direct sunlight for a longer period.

Overall, SP-4, located in the skylight, had the greatest daily changes of temperature and relative humidity of the interior dataloggers, though the three interior loggers followed similar patterns. Each had an average relative humidity of around 33%, with a range from about 10% to 60%. This range in relative humidity was not just seasonal, as it changed by approximately 20% throughout the day, instigated by the changing interior and exterior temperatures. Such changes in relative humidity can cause rapid cycling in the moisture content of wood, causing it to shrink, swell, and crack. Though the average falls near the recommended 35-40% relative humidity range for wood in the southwestern United States, each interior logger was only within the 35-40% relative humidity range for 13-14% of the time data was collected.[xxvii] Only a tenth of the exterior data collected fell within this range. A relative humidity fluctuation from 10% to 60% at great frequencies can result in splitting and related deformation. Just over a third of the readings from each monitor fell well below 30% relative humidity, which can cause adhesives to desiccate and finishes to become brittle. As temperatures increase in the summer, the wood is likely to be further exposed to a relative humidity below 20% for an even greater period.

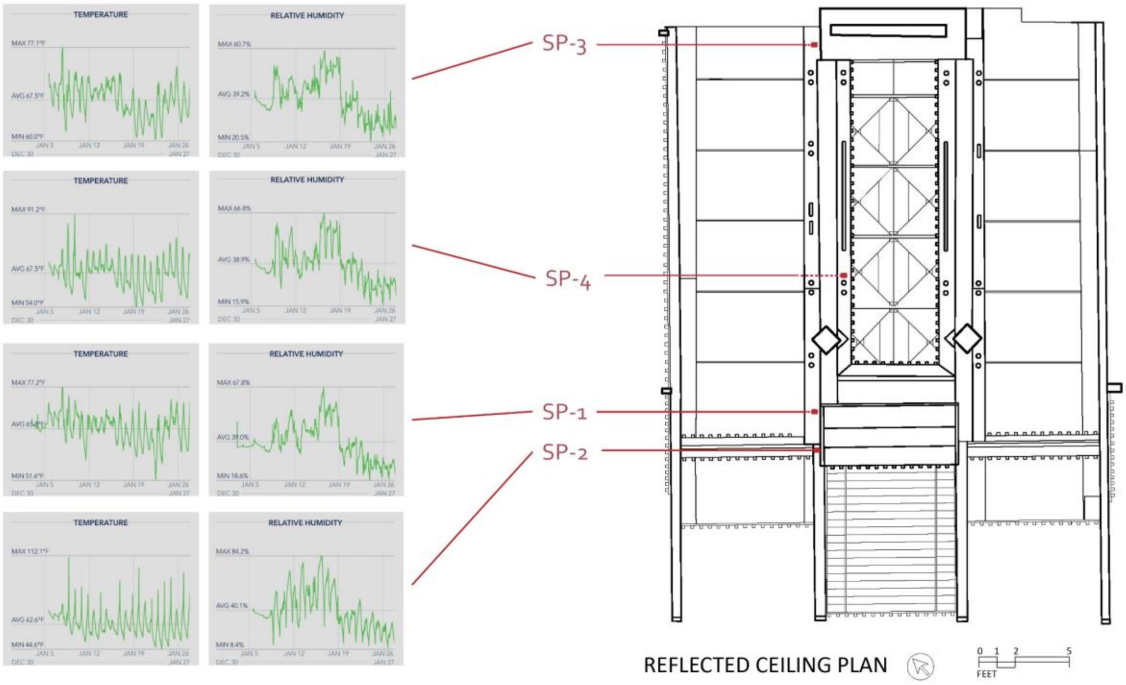

Figure 13 – For SensorPush data loggers were placed along the second easternmost beam, where rapid and extreme daily fluctuations in temperature and relative humidity were observed.

8.0 Conclusions: Recommendations for Future Work

As a result of the combined investigation that converges documentary records, archaeology and building forensics, an understanding of both the integrity and heritage value of the physical fabric may be established. Most notably, the Original Dining Room retains a high level of integrity with eight identifiable modifications made within the period of significance between 1939 to 1959. Based upon site records in relation to the greater population of buildings, the Original Dining Room represents one of the last surviving original redwood structures of the compound. It is situated at the center of a network of buildings as a repository of chronological evidence of a construction that was designed by Wright and transitioned into his private space. As Taliesin West served as a laboratory to incubate and foster the expression of his principles, one may view this one intimate room as reflection of the core of his architectural ideology. The students built the wood structure in a series of modifications though an experimental process rather than a pragmatic program to sustain the harsh desert environment long term. A series of vulnerabilities to environmental agents have affected the current conditions documented, among them water infiltration, UV/ solar damage and extreme heat that fluctuates interior relative humidity from 10% to 60% with great frequency. Based upon site records, the exterior and interior was left unpainted, and pathology related to this history may be inferred. As ultraviolet light and solar damage combined with aqueous exchange for the exterior surfaces, slow but significant degradation related to de-lignification occurred over a period of nearly twenty years. The performance of redwood species is also a known variable and indicates density, decay resistance and porosity and although robust in some respects is eventually susceptible to the aforementioned agents of deterioration. Furthermore, the flat roof that replaced an almost temporary tent-like structure became an inherent design problem for water infiltration. It is clear from thermography, moisture content readings and physical probing that severe decay has consumed central members of the four ganged cantilevered beams and require further structural assessment and intervention. Repair and some replacement with a decay resistant species should be anticipated. Disassembly is necessary however should be minimized where possible following detailed labeling of all members following those provided on AutoCAD documents. Currently the pitch of the flat roof does not adequately divert water away from the beams and as a result has created saturated moisture conditions where the roof spills water between the beams causing decay, negative deflection and deformation. Previous repairs are evident and should be reversed and corrected with better detailing to address water management particularly where the roof and beams meet. This work shall be implemented at the time of the roof replacement currently scheduled for the summer of 2019. Upgrades to the glazing that will entail removal of the later fiberglass panels and new replacement panels similar to the originals will be installed. These new panels should be paired with a UV blocking film or factory coating that will eliminate UV and reduce solar damage. To address the adverse conditions of interior temperature and relative humidity the site should continue to monitor for seasonal cycles with anticipation to upgrade the current heating and cooling systems to provide a more stable environment with acceptable temperature ranges between 65 to 75 °F and relative humidity between 30% to 55%. The interior painted surfaces finishes are in a good state of preservation and require only a light cleaning. The exterior painted surfaces can be continued to be maintained using the same products, potentially with some adjustments to the Taliesin Red color based on spectrophotometer readings of paint exposures conducted during the investigation.

Acknowledgements

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Timber Frame Conservation: Keeping the Traditional Craft Alive

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Abstract

While it is certainly important to conserve the building as an artifact, it is equally important to keep the practical knowledge of the particular craft alive. By employing trades people that work with raw materials, tools, and techniques as evidenced by the old work, we further our understanding of the craft that produced the artifact. The trade or craft is then preserved along with the artifact.

Approaching the Work

When we approach the repairs to a timber framed building, there are the obvious considerations of minimizing disturbance to the original fabric, maintaining the structural integrity of the building with the repairs, and of course keeping as much original work as practical. However, if we are preserving the artifact, shouldn't we also be preserving the craft that created it? In my opinion, preservation of the craft is equally important, if not more important.

There is a tendency in repairing timber framed buildings to use the latest, high technology fixes such as adhesives, epoxy resin fillers, steel fastenings, and the like. They are after all, what is being marketed to those architecture and engineering professionals involved in the repairs of those buildings. We all know how important advertising and promotion are in dictating outcomes. If there is no vested interest, there is no promotion. No industry is promoting a simple carpentered solution using locally obtained wood. Thus, highly engineered products, shipped thousands of miles is what we are offered. I can't deny that there are times when those products may be the best approach to meeting the above mentioned criteria, in some cases they may the only approach. (Figure 1) They don't however, further our understanding of the carpentry craft that created these wooden structures originally. Use of these new products creates a new class of technicians, chemists, and mechanics that become involved in the repair work rather than carpenters. The high tech solutions should only be the last resort, after the carpenter or craftsman has exhausted all the usual, time tested possibilities within his scope. After all, timber framed buildings have been traditionally repaired primarily by carpenters for a thousand years or more. If a carpenter couldn't make it work with wood alone, a local blacksmith would be brought in to fashion some ironwork.

The Design Professionals

To resurrect, and preserve the carpentry craft as well as the actual building, there first needs to be a better understanding of traditional carpentry by the professionals: the architects, engineers, and building officials. All those professionals involved in preservation of timber framed buildings should have as a minimum, a basic introduction to the history of the craft and its development across both time and space, and guided tours of their local timber framed buildings representing various periods. Learning the nomenclature of the various components and different framing systems is essential for communicating with others involved in the work. There should be in addition, practical "hands-on" courses on the use of traditional hand tools, on working with new, freshly felled timber of different species, with layout and cutting of wooden joinery, shaping of pins, and erecting the frame using traditional methods. (Figure 2) Lastly, they should execute some of the common, traditional repairs using wooden joinery secured with wooden pins. As seems to be typical today however, these professionals rarely have any practical "hands-on" experience. This needs to change. In the United States, continuing classroom or on-line education is required of architects, engineers, and building professionals periodically in order to renew their licenses. Courses of this type could easily be certified towards that continuing education. Armed with this basic knowledge, they are better able to understand an old timber framed structure, how and when it was originally built, how it was modified, added to, what types of timber were used, how they were converted from the log, and most importantly, how best to specify the repairs. They will also be on a more even footing communicating with the craftsmen that will carry out the actual work and gain their respect.

The Craftsmen

The craftsmen (I don't intend to be gender specific here) should also have a basic introduction to the history of the craft and its development across both time and space, and guided tours of local timber framed buildings of various periods, also learning the nomenclature of traditional building components. The "hands-on" courses in timber building with new material and repairing old, are even more essential to the craftsmen for they are the ones to be carrying out the actual repair work. And, as nothing impacts the quality of traditional timber joinery more, a thorough course on sharpening of edge tools is critical.

If a carpenter has constructed new timber framed buildings using traditional methods and tools of the particular period, he is in a good position to work on a historic building of that period. He will recognize the layout marks, level marks, the numbering of components, etc. on the old work, thus understanding the particular layout methodology that was used. This will be to his advantage for the laying out of the repairs and new components. He will recognize the earliest phases of construction and how the building was modified, repaired, or shored up throughout its life. He will identify important artifacts and remnants of materials that give clues as to how it was constructed and used. The species of wood, where in the tree it comes from, and its proportion of sapwood and heartwood will be identified. How it was converted from the log, ie. hewed, sawed, or riven will be evident to him. This will be used to guide the selection of the replacement materials and matching the replacement section to the existing one. He will be able to examine tool marks on the old surfaces and readily understand how the original tools were positioned and wielded to produce those particular marks. A competent craftsman will likely build up a collection of historic tools or modern reproductions of them that he can use to create new replacement sections, modifying the tools' cutting edges as necessary to match the marks on the original work. While he is free to use modern tools to perform some roughing out tasks, the tools that leave the finish marks should be the traditional ones.

Since the carpenter will likely spend far more time in the historic structure than all the other professionals combined, he could be a valuable asset to those professionals, guiding them, offering advice, and helping with specifications on the actual work. While many architects and engineers are reluctant to accept advice from any workmen, I feel they would likely listen attentively when they realized the extent of a particular craftsman's knowledge. Over time, their attitude would begin to change, developing a greater respect for the craftsman. I have noticed that when I am working as an architect on old buildings with craftsmen educated as mentioned above, they will bring to my attention interesting construction anomalies, deficiencies in the structure, or other items I might have missed. I am thankful to have them involved and respect their opinions. They are a pleasure to work with and can be better counted on to do a proper job. (Figure 3) The competent craftsman will also be of great value to the preservation of the building itself. A fully knowledgeable craftsman will produce far better and more lasting work than one who is just a workman blindly following an architect's specifications.

The dichotomy that has existed with design professionals on one side and the craftsmen on the other does not produce the best results. Having design professionals produce copious drawings and specifications to enable bidding by multiple contractors creates a "race to the bottom" effect. The least competent contractor will often get the work! However, this dichotomy has begun to be blurred over the last few decades. Many structures are being built today by design-build firms where all work from the client meeting to the finished building is done in-house. This is somewhat similar to the ancient approach where there was a Master Builder who was as good at geometry, design, and ornament as he was at selecting stone in a quarry, picking out timber in the forest, or showing a workman how to properly use a tool. It is a good model to return to. Pick the design professional team and the contractor simultaneously, then amongst them, work out the specifications and negotiate the cost.

Figure 1. Modern high-tech materials may have their place in repairs to timber framed buildings, but only after all other traditional carpenter's techniques have been considered. The decayed eave end of this early nineteenth century roof truss required some custom fabricated steel reinforcing to make the wooden repairs structurally sound.

New Traditional Work

Because of his skills and understanding in working with historic construction, it is likely that a significant portion of a craftsman's work will be creating entirely new, but traditional structures using period tools and techniques. It is almost inevitable that his curiosity and understanding of the old will prompt him to delve into this new work. I received my initial hands-on training dealing with stinging insects, hay dust, and animal excrement while repairing centuries old timber framed barns. It wasn't long before I was dreaming of working on freshly cut, new timber. After working by hand in new wood, using only traditional hand tools, I soon found that I was gaining extra insight into understanding the old work that I saw. By working with both old and new buildings, the two approaches complement each other.

There is a growing market for such new "historic" structures to stand along with other truly historic ones both in the private sector and in the public (museums). (Figure 4, 5) While these new structures aren't historic, they serve as examples of how the historic ones might have appeared when they were new, in their pure, original form. The built environment will improve overall when there are more traditional, vernacular structures in a given area, even if some are newly built. As old ones are lost, the newer ones keep up the vernacular appearance of the area. Working in both preservation and reproduction of historic work should be encouraged and perhaps even required, as it will keep the craftsman in his best form.

Figure 2. "Hands-on" courses should be required for all professionals involved with repairing old timber framed buildings as well as constructing new ones. Here at Jamtli Museum, Sweden, students with a variety of professions and trades are learning the timber framing craft. The long plate timber is being raised using an efficient and safe traditional technique called "parbuckling".

Figure 3. Rather than blindly following an architect's specifications, a well-trained craftsman can better interpret the structure, its needs, and the approach to repairing it. He can bring this knowledge to the architect's attention and improve the project's overall outcome. This craftsman is fashioning a scarf joint on an existing sill timber, a traditional carpentry repair.

Preserving the Craft

The above recommendations will better preserve the buildings and at the same time, *keep the craft alive*. The artifact (the building), with time will eventually wear or degrade to a point where the layout markings, the individual tool marks, or the conversion methods are no longer discernible. It will just be some rough, fuzzy old wood thing without much story to tell. Maybe the last original section of a building, the only part that hasn't been replaced, now needs replacement. While the new work replaces the old, at least the original form of the building is preserved. Or, perhaps a building is lost completely to fire, flood, or some other natural disaster. The artifact is gone completely! If the craft that created it is preserved, the building can be reconstructed. The trees are once again felled and hewn to size, the carpenters then frame them up with mortises and tenons, and the building's framework is raised up again. The knowledge is still there, as are the professionals and craftsmen skilled in doing the work. The craft has been preserved and will hopefully outlast any one building.

Figure 4. This New York State Dutch barn is a reconstruction of the original 18th century barn that graced this historic farm property. Many of the original barn's timbers survive re-framed in an adjacent mid 19th century barn and were documented for the re-construction.

Figure 5, Virtually all of the timber, siding, and flooring for this barn was harvested out of the farm's woodlot, matching species as much as practical. Traditional scribing methods and hand tools were used to fashion the joinery.

"HISTORIC"VERSUS"IN HISTORY": A TREATISE OF REFELECTIONS ON THE REGENERATION AND CONSERVATION PLAN OF EN'NING ROAD HISTORIC DISTRICT OF GUANGZHOU， CHINA

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Abstract

In conservation of built heritage, how to properly deal with the huge amounts of vernacular buildings in urban historic districts is still in a vague area in urban planning design and whether to "preserve" or "dismantle" concerning culture continuation is the core issue in the process of urban sustainable development and evolution while the pattern of conservation involves the comprehensive roles of society. This paper focuses on the various stages of the reconstruction city plan of En'ning Road historic district of Guangzhou, the process of urban planning concerning conservation and the regeneration plan of Yongqing Block and then combines the international conservation principles and the theoretical context on "historic" versus "in history" to obtain a preliminary analysis and reflections on the regeneration and conservation issue of En'ning Road historic district.

Keywords: *historic district; En'ning Road; Valletta Principles; Historic; in history*

Introduction

En'ning Road is one of the oldest historic districts in Guangzhou. It retains the typical characteristics of a vernacular settlement dating to the late Qing Dynasty and the early Republic of China, dominated by a Guangzhou Xiguan great house and zhutong houses (i.e., bamboo-shaped houses with narrow façades, but long in depth). Between 2006 and 2019, En'ning Road evolved from a local livelihood renovation project to one of the 26 historic districts within the Conservation Plan of Famous Historical and Cultural City of Guangzhou. However, when 'En'ning Road Historic and Cultural District Conservation and Utilisation Plan' (the En'ning Road Plan) was completed, the first phase of the En'ning Road renovation had been finished and the second phase was already in progress. Through this case study, the article reflects on the maturity of the concept of historic environment conservation and development in China, and provides a reference for appropriate interventions in the follow-up phase of the renovation of the En'ning Road renovation.

The evolution of En’ning Road and the compilation process of the conservation plan

Guangzhou's city site has never experienced changes since it was built over 2,000 years ago. Under the impact of market forces, the process of hollowing out traditional villages and gentrification of historic districts has gradually emerged.[5](Fig.1)

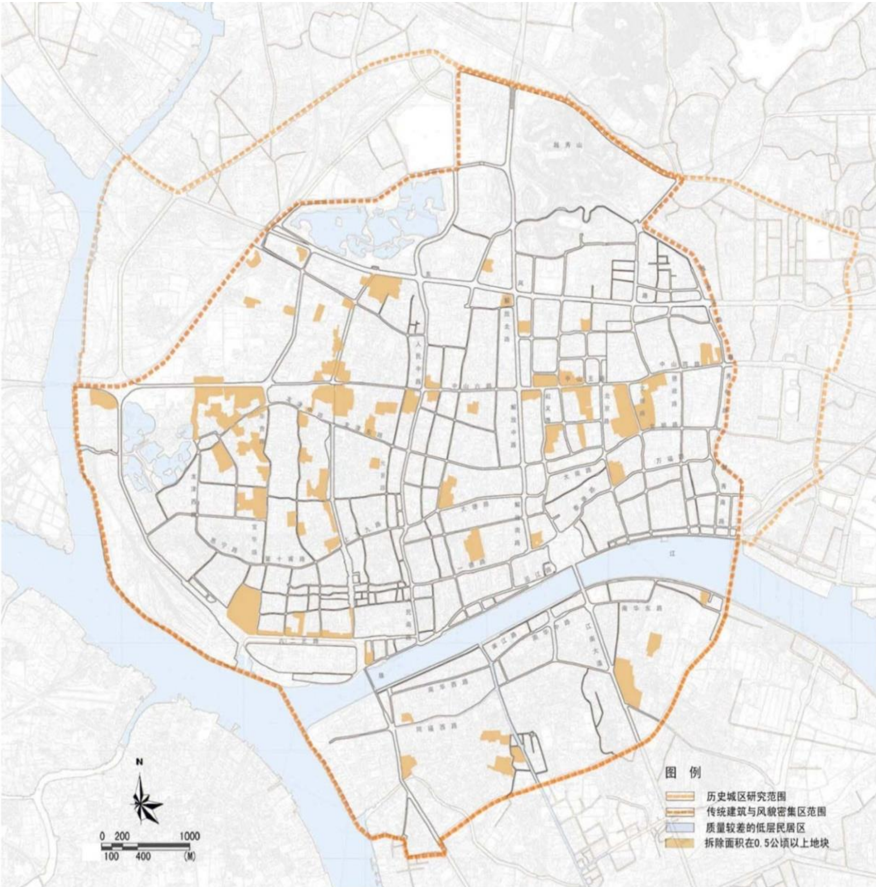

Fig.1. Schematic Diagram of Demolition Area in Historic District.

En’ning Road community is located in a representative area of Guangzhou’s local Xiguan culture. In the Ming Dynasty, En’ning Road was the 11th Street of the Shibafu Commercial Streets. In the Qing Dynasty, a settlement layout dominated by Xiguan great houses and zhutong houses gradually took shape. In 1931, the qilou (arcade house) building type appeared, and the main body of En’ning Road’s historic fabric was formed in this period. The overhead promenade of the building could shelter people from rain, sun and shade. It could also facilitate shops to open their doors and recruit customers. It well combined the arcade of western classic buildings with the local climate characteristics of Guangzhou.

The historic fabric of En’ning Road still exists, which is mainly characterized by a high density and parallel connection, and retains the zhutong houses and qilou buildings. Most of the buildings in this historic pattern were built in the period of the Republic of China. The history is not very long, but it contains tangible texture and intangible cultural fabric.The important value lies in its unrepeatable sense of belongings to the place of residence.[6] (Fig.2, Fig.3)

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5 Feng Jiang, Wang Tian, 2014.

6 Twombly R, 2009.

Fig. 2. Historic Information Map of Guangzhou City Layout-The red area is En-ning Road Historic and Cultural District.
Fig. 3. Photo of En-ning Road in 1960s.

From 2006, the reconstruction of Guangzhou involving En’ning Road has been intermittent, and the dispute over the preservation and abolishment of historic district gradually intensified.

(1) 2006: Guangzhou Rebuild Housing Plan on En’ning Road

In 2006, Guangzhou Municipal Government suggested the promotion of the old city’s transformation through the renovation of dilapidated houses, proposing to "completely demolish" the buildings within the planning scope based on the regulatory rules, and then to carry out the "in-situ relocation "after renovation. This plan has been jointly opposed by local residents, the building texture of En’ning Road was partially destroyed in this round of demolition. [7]

(2) 2007: Old City Reconstruction Plan of En’ning Road

In 2007, Guangzhou launched a real estate project to promote the transformation of the old city, and local residents launched an anti-demolition rights movement. En’ning Road became a pilot project to introduce real estate developers to renovate the old city.

(3) 2009-2011: Old City Renewal Planning of En’ning Road

In 2011, the " Old City Renewal Planning of En’ning Road " proposed the principles of renovation and restoration, such as "restore the old, integrate with the new" and "preserve the original street fabric".

[7] Guangzhou Municipal Planning Bureau, 2014.

According to the idea of "government leading, enterprises undertaking and residents participating", the real estate developers are still responsible for investment and operation.

(4) 2012-2019: Conservation Plan of the Famous Historical and Cultural City of Guangzhou

In 2014, the Conservation Plan of Guangzhou as Historical and Cultural City was completed, and En'ning Road was admitted as one of the 26 historic and cultural districts on the initiative of local residents. In 2016, Vanke Real Estate completed the first phase of renovation, including the Yongqingfang Community on En'ning Road. In January 2019, the En'ning Road Plan was approved by Guangzhou Municipal Government. [8](Fig.4)

The problems in the first phase of the En'ning Road renovation and the difficulties in the second phase

From 2007 to 2016, the original fabric of the buildings in the northern part of En'ning Road has been destroyed due to improper demolition, which needs to be repaired urgently. The fabric of the southern part of En'ning Road is still relatively preserved. Comprehensive evaluation of buildings in the En'ning Road Plan is divided into:

Category I: immovable cultural relics;
Category II: historic building clues;
Category III: traditional architectural clues;
Category IV: architecture compatible with traditional style and features;
Category V: architecture incompatible with traditional style;
Category VI: buildings that conflict with traditional styles.

The En'ning Road Plan established design principles for the renovation of vernacular buildings that under Category III as 'buildings for restoration' and Category IV as 'buildings for renovation' to prevent similar failings in the second phase of renovation. (Fig.5, Fig.6)

The difficulty in the second phase mainly lies in whether the vernacular buildings and the lives of the residents can be preserved under the intervention of market forces. The living patterns of the Fengqing Area's residents in the southern part of En'ning Road are relatively intact, and it has been suggested that they are retained in their entirety, but the conservation of other vernacular buildings is still inadequate. The important part of the urban texture which as the large number of vernacular buildings are still classified under Category V as 'buildings incompatible with traditional style' in the current evaluation map for the conservation of architecture according to the En'ning Road Plan. Attention has been drawn to this discrepancy by one expert as public opinion in the notice period, but it has not been absorbed by the En'ning Road Plan at present for various reasons.

[8] Guangzhou Municipal Planning Bureau, 2019.

Fig.4 –Review of Conservation Planning for En-ning Road Historic and Cultural District and fabric Comparison

Fig.5, 6–Photo of the current situation in the southern part of En-ning Road

Article 7 in the En’ning Road Plan stipulates "the historic and cultural characteristics and values of the historic and cultural district of En-ning Road" as follows:

<<(1) the inheritance place of Cantonese opera and martial arts crafts; (2) the living museum street full of Xiguan atmosphere; (3) the starting area of Xiguan cultural and creative brands." It already contains representative traditional cultural heritage, such as cantonese opera, wing chun quan, Xiguan copper

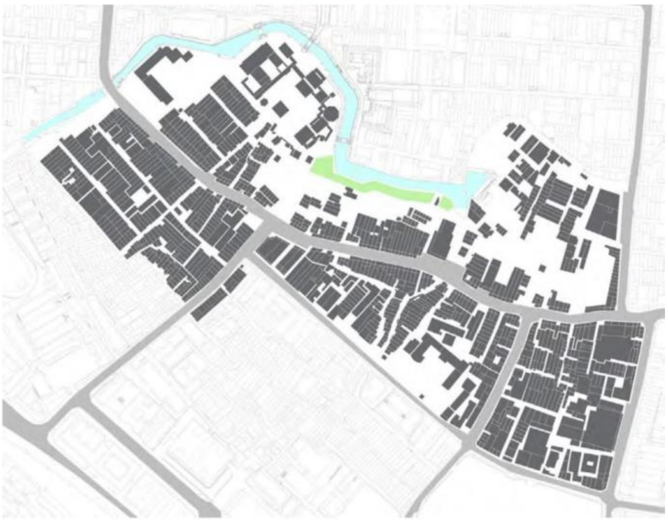

Fig.7. Present Building Fabric of En-ning Road Historic and Cultural District

technique and Xiguan bone-setting. However, due to various values and limitations of the existing system, there is still no clear content to preserve the daily life of the aborigines.[9]

The first phase of the En'ning Road renovation was completed prior to the compilation of the En'ning Road Plan, and the renovation design of a vernacular building called Vanke Cloud in Yongqingfang Community lacked sufficient control. The transformation of the roof changed the traditional urban

Fig.8. Photo of the current situation in En-ning Road

[9] Guangzhou Municipal Planning Bureau, 2019.

texture and replaced the original openings of the gable wall with closed commercial bay windows, losing authentic historical details. (Fig.7, Fig.8)

The Valletta Principles and their references to dealing with large numbers of vernacular buildings in historic urban districts

The International Council of Monuments and Sites (ICOMOS) promulgated "The Valletta Principles for the Safeguarding and Management of Historic Cities, Towns and Urban Areas" (The Valletta Principles) in 2011 as follows:

The globalization of markets and methods of production cause shifts in population between regions and towards towns, especially large cities.

Another important modification, particularly in fast-growing cities, takes into account the problems of large - scale developments, which alter the traditional lot sizes that help to define historic urban morphology.

The loss and/or substitution of traditional uses and functions, such as the specific way of life of a local community, can have major negative impacts on historic towns and urban areas. If the nature of these changes is not recognised, it can lead to the displacement of communities and the disappearance of cultural practices, and subsequent loss of identity and character for these abandoned places. It can result in the transformation of historic towns and urban areas into areas with a single function devoted to tourism and leisure and not suitable for day - to - day living.

It is important to recognise that the process of gentrification can affect communities and lead to the loss of a place's liveability and, ultimately, its character.

New architecture must be consistent with the spatial organisation of the historic area and respectful of its traditional morphology while at the same time being a valid expression of the architectural trends of its time and place. Regardless of style and expression, all new architecture should avoid the negative effects of drastic or excessive contrasts and of fragmentation and interruptions in the continuity of the urban fabric and space.

The authenticity and integrity of historic towns, whose essential character is expressed by the nature and coherence of all their tangible and intangible elements. [10]

In reviewing the spirit of The Valletta Principles and their references to dealing with large numbers of vernacular buildings in historic urban districts. It is possible to identify the inspirations for the second phase of the En'ning Road renovation from other related theories. The Valletta Principles address the need to face up to the increasing interference of market forces in conservation practices, reaffirming the right of residents to live in historic districts and advocating attention to the continuity of architectural character in renovation to show understanding of and respect for the historic urban context.

[10] ICOMOS-CIVVIH, 2011.

The correlations and contradictions in the conservation of 'historic' heritage and the requirements of people 'in history'

The turning point of the preservation of En'ning Road Historic District is a mixture of "top-down" and "bottom-up" decision-making modes. Without rejecting the influx of external market forces, it also tries to reverse the preservation jointly promoted by "local people". Under Guangzhou's high economic development policy, it can be understood from this complicated operation that under the impact of

Fig.9. The poster of "Turning Over En-ning" released during the public participation activities in En-ning road in May 2017

modern commercial civilization, people's common sense of deep feelings for their hometown still exist, and their action for historical protection is still strong.

In fact, the discussion of the international conservation context respect for the spontaneous choice stem from the recognition that compliance with the moral standards in the community, which is a measure that can truly realize sustainable intervention. In the famous case of Tsumago-juku in Nagano County, Japan, local residents voluntarily chose to sacrifice the convenience of modern life and pass on the complete preservation of residential buildings and ancient life style of Edo period to future generations. The proposal of the international context for community conservation of vernacular architecture heritage is reflected in Charter On The Built Vernacular Heritage (1999) Ratified by the ICOMOS 12th General Assembly, in Mexico which clearly states:

<<The built vernacular heritage is important; it is the fundamental expression of the culture of a community, of its relationship with its territory and, at the same time, the expression of the world's cultural diversity.>>

<<The conservation of the built vernacular heritage must be carried out by multidisciplinary expertise while recognising the inevitability of change and development, and the need to respect the community's established cultural identity.>>

<<Adaptation and reuse of vernacular structures should be carried out in a manner which will respect the integrity of the structure, its character and form while being compatible with acceptable standards of living. Where there is no break in the continuous utilisation of vernacular forms, a code of ethics within the community can serve as a tool of intervention.>>

<<Changes over time should be appreciated and understood as important aspects of vernacular architecture. Conformity of all parts of a building to a single period, will not normally be the goal of work on vernacular structures.>>[11]

In the practice of preservation involving many stakeholders, the wisdom provided by the Chinese lies in "expedient". For example, Chen Duxiu pointed out in "Reconciliation Theory and Old Morality" how "radical" and "conservative" in the cultural transformation "wrestle": "For example, in bargaining, the price A is 10 yuan, the price B is 3 yuan, the final result is 5 yuan, if the price A is 5 yuan, the final result is 2.50 yuan. The same is true of social inertia. " At the present stage, the real situation of "stalemate", various "dilemmas" and "bargaining" is common in the conservation. The renovation process of En’ning Road reveals that we need a more diversified, open and humane attitudes in the disposal of vernacular heritage.

The conservation consciousness gradually aroused by the stakeholders of the En’ning Road historic district under the influx of external market forces shows an expedient method with Chinese characteristics in the face of the dilemma between conservation and development. This case shows that conforming to and stimulating the moral standards of the local community is a conservation method that could actually realise sustainable intervention, and the impulse of Chinese historic conservation would thus be kept alive. (Fig.9)

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Securing system of wooden materials for preservation in Japan

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Abstract

My topic is the securing wooden materials for preservation and the present project about corporation of wooden architecture and forest in Japan. Ancient wooden architecture is constructed with huge members comparatively and for replace of members, it needs long diameter materials which are difficult to bring up. Furthermore, other things such as thatch and cypress bark for roofing, bamboo for wall structure and Japanese Lacquer for painting should be secured. For securing these materials, the Agency for Cultural Affairs of Japanese government promote project.

To bring up forest to secure materials is historical way in Japan. *The Ise Jingū* which has unique rule "*Shikine-Zōtai*", the repeated reconstruction of a shrine on a ceremonial cycle, is a case of local production for local consumption. The members of *the Ise Jingū* are huge, so *the Ise Jingū* is bringing up forest in its complex to secure wooden materials for future "*Shikine-Zōtai*". Historical speaking, the member of "*Shikine-Zōtai*" were secured in its complex and this is the usual way to inherit wooden architecture to next generation. But harsh environment of forest made the securing system impossible from Medieval age and especially long diameter logs are difficult to secure.

My main topics are as below. 1) the definition of large diameter and long members and the parts made with them. 2) historical cases of procuring large diameter and long members at the case of *the Ise Jingū* and *Tōdaiji temple.* 3) the trial project to secure wooden replacement materials for cultural properties in present Japan. Lastly, I will talk about culture of Japanese wooden architecture from the view of the harmonious coexistence of architecture and forests.

Key words…*Diameter and long members / Securing wooden materials / Forest / the Ise Jingū*

1. Introduction

Almost all Japanese Historical architecture before 19th century is wooden architecture and preservation work needs new wooden materials to replace decayed members. Replacement member should be same size, species and grade as original member. It is usually said that size of members of ancient buildings is comparatively large and became smaller as time progressed. Therefore it needs huge wooden materials to maintain ancient buildings but huge tree in Japanese forest gradually decreased. In such difficult situation, it is necessary to secure wooden materials for future preservation. To solve this problem, Japanese government select some forest to secure wooden materials for historical buildings.

2. Purpose and definition of diameter and long members

The important thig is that to obtain huge members immediately is difficult on the market. Thus, based on standard sizes of the present timber market, we can take items over 45 cm as large diameter logs, and those over 6.0 m[1)] in length as long logs, with items fulfilling both conditions as large diameter, long logs. For future replacement of huge members, we have to ascertain the current size and species of members used for important cultural properties by investigating previous preservation reports.

To talk about parts made with large diameter, long logs, it depends on the characteristic of Japanese historical architecture. It is usually said that the size of building members become gradually smaller through the Medieval era. Then large diameter, long logs were often used in the Ancient period for many types of members, such as the pillars of temple main halls, the central pillars of pagodas, beams, bracket arms, and so on. For example, the central pillar of the five-storied pagoda of *Hōryūji temple* is 82 cm in diameter and 32 m long. Its bracket arms are 68 cm high and they required logs over 80 cm in diameter for the standing tree (Fig.1). In addition to this, storehouses surviving from the ancient period are made of logs piled in the manner of a log house. The length of logs which was fixed by the size of storehouse are over 6 m long. In addition to such structural members, the door panels of *the Hōryūji temple* main hall are made of solid timber 102 cm wide which would require logs over 180 cm in diameter at the bottom of the standing tree.

In contrast to this, the development of structural technology also made members smaller, so large materials become limited to a few particular types of structural members, mainly pillars and beams. This tendency depends on some possible reasons. One is a high level of accessibility of timber, depending on how close the location of a building is to a forest. Another involves characteristic features of Japanese architectural culture, that is massive wooden materials are regarded as something precious, and sometimes importance is indicated by likening other things to key elements of Japanese architecture. This is collateral evidence for the significance attributed to large wooden materials. Such a trend leading to the use of huge materials can also be seen in modern wooden buildings.

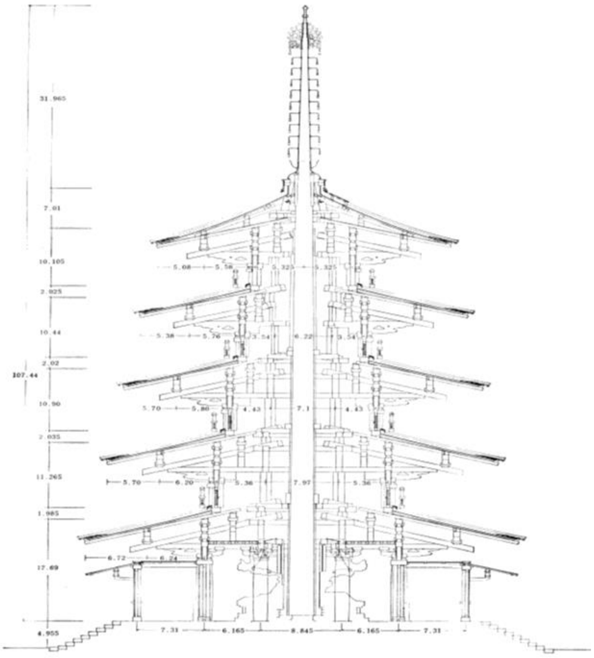

Fig.1. Five-storied pagoda of Hōryūji temple (Ōta1984)

The purpose of this survey is to estimate the amounts of huge members of important cultural properties. Based on this information, we prepare huge wooden materials for future preservation. Because it takes long time to develop huge wood, we make long term plan for securing wooden materials as below.

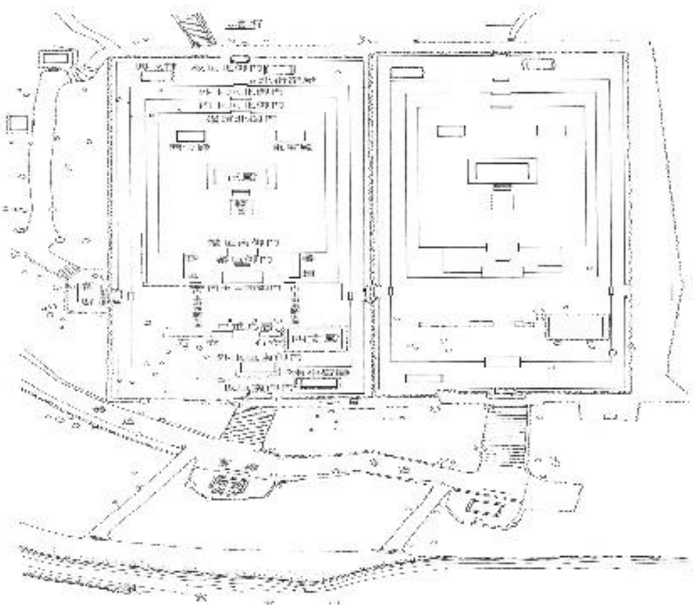

Fig. 2. Two places of the Ise Jingū (Ōta1998)

3. History of securing huge wooden materials

Japanese Shrines have a unique system "*Shikinen-Zōtai"*, which is the repeated reconstruction of a shrine on a ceremonial cycle. This rule makes shrines difficult to survive before the 10th century. The most famous example of this rule is *the Ise Jingū* which buildings are rebuilt every 20 years as part of *Shinto* beliefs about death, renewal, and the impermanence of all things. This rule makes it possible to inherit architectural techniques from one generation to the next. This rule of *the Ise Jingū* is especially called "*Shikinen-Sengū*". So *the Ise Jingū* has two places for its main buildings and one of these places is usually vacant for next *Shikinen-Sengū* (Fig.2). But at reconstruction time, two sets of main buildings exist side by side. The repeated reconstruction rule, *Shikinen-Sengū* is characteristic of Shrine, but there are few shrines continuing reconstruction cycle. Some shrines treat re-roofing as *Shikine-Sengū* instead of reconstruction. In this situation, *the Ise Jingū* is the only remaining shrine which retains the custom of *Shikinen-Sengū* in its fully intact form.

Because the buildings of *the Ise Jingū* inherit the ancient shape with huge members, this *Shikinen-Sengū* requires about over 10,000 Japanese cypress trees at one time. To talk about securing members, it is usually said that *the Ise Jingū* brings up forest in its own district to use for *Shikinen-Sengū* until Medieval age, but after this period, the forest of *the Ise Jingū* was devastated and it could not supply huge wooden materials to reconstruction. Then at *Shikine-Sengū* in 1380, the forest outside of *the Ise Jingū* supplied wooden materials for the first time and the forest in *Kiso* district located in the middle of Japan has been supply area from 1709. In 1798, t*he Ise Jingū* designated the *Kiso* forest as *"Misoma-yama"* which means great mountain for supply wooden materials. This forest was supervised and controlled under the *Owari Tokugawa* clan and the governor protect the forest not to cut down in surplus. After *Meiji* restoration in 1868, the administration of this forest was transferred to Japanese government. In 1906, *"Misoma-yama"* was changed to "*Jingū-birin*" which means forest for securing materials of *the Ise Jingū*. After WW2, "*Jingū-birin*" was incorporated to the national forests because of the principle of separation of government and religion. In "*Jingū-birin*" area, trees were systematically planted so that it would be possible to provide 200 - 300 years old tree stably. For this purpose, *"Jingū-birin"* area was divided two. One is region in which trees were prohibited to cut down for 100 years to product huge wood for *the Ise Jingū*, the other is region for wood of *Shikinen-Sengū* in these 100 years. In addition to this, *the Ise Jingū* has brought up own forest to secure wooden materials for "*Shikine-Sengū*" after 1923. This is 200 year project to bring up huge Japanese cypress with periodic thinning. Thanks to this project, lumbers from thinning were partially used for *"Shikinen-Sengū"* members in 2013. This is the first time to provide members from its own forest in about 700 years.

Fig. 3. Transportation of huge beams (Nara National Museum 2005)

I would like to talk about history of securing huge members of *Tōdaiji temple*. *Tōdaiji temple* is a famous Buddhist temple complex located in *Nara* and its main hall is *the Great Buddha Hall* which is one of the largest building made of wooden framework structure. *The Great Buddha Hall* has suffered fire twice and its beginning dates to the middle 8th century. This first *Great Buddha Hall* was destroyed by war in the 12th century and was rebuilt in the end of 12th century with Chinese techniques, newly brought to Japan owing to the difficulty of this construction. This second *Great Buddha Hall* was also destroyed by war in 16th century and a reconstruction project was delayed because of domestic conflict. So it was organized by the *Tokugawa* shogunate, but structural difficulties caused the newly built *Great Buddha Hall* to be reduced in size. Although the current building, completed in 1709, is still immense at 57 m long by 50 m deep, it is about 30% smaller than its predecessor.

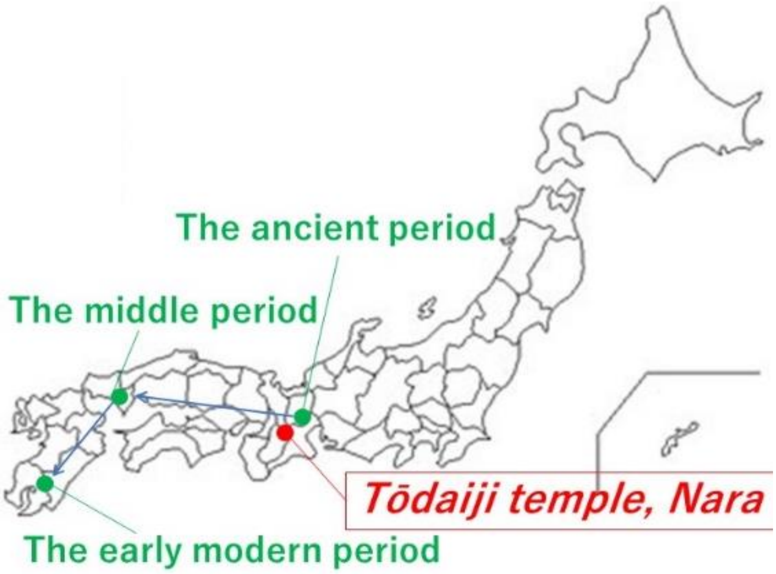

Fig. 4. The location of mountain area to fell the wood

Each *Great Buddha Hall* were also grand in scale and were made of many large diameter, long logs. In the case of 8th century structure, we can obtain information about the log size from historical documents. These indicate that the pillar size was about 1.2 m in diameter, and 20 m long. In 8th century, there was generally a considerable amount of wood in the mountains, because human construction was still not very active. Accordingly, it was easy to obtain large members from mountains close to *Nara*. So historical documents show that members of fist *Great Buddha Hall* were obtained from the forest of *Shigaraki* area, 40 km away from *Nara*. But large trees became fewer until 12th century then to secure members of second *Great Buddha Hall*, carpenters had to search far and wide for forests that could supply the pillars, procuring trees from the ancient province of *Suō* in southwestern *Honshu*, 500 km away from *Nara*. For the third version, the Buddhist monk *Kōkei* started the construction project in 1684, and ground was broken for the current *Great Buddha Hall* in 1688. But *Kōkei* was unable to obtain one of the most important types of members, 23.5-m long beams[2)]. Eventually in 1702, he found huge trees at *Shiratori* shrine in *Hyūga* province, southeastern *Kyūshū*, 900 km away from *Nara (Fig.3, 4)*.

As above, the district to secure wooden members was changed farther and farther away from *Nara* for each reconstruction. That is to say, it indicates that the environment of wood was rich with huge trees in ancient period, but their numbers of huge trees decreased after the Medieval period.

4. Securing wooden materials in present Japan

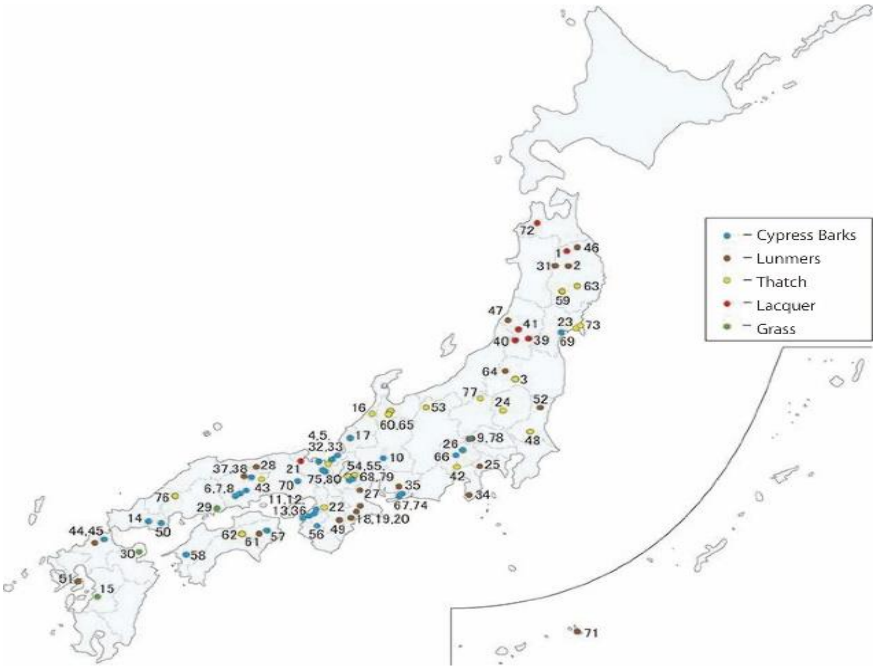

Fig. 5. The location of "Forest of Cultural Properties" (the Agency for Cultural Affairs HP)

Historically speaking, securing huge wooden members was important elements for Japanese architectural culture. In addition to this, the consumption of wood decreased after WW2 with change of Japanese construction industry. The forestry industry gradually degenerated through lack of wood consumption and it is becoming difficult to secure wooden materials such as Japanese cypress barks, thatch, lacquer. In such situation, it is important to secure wooden materials for preservation of important cultural properties and to train craftsman with traditional skills to secure. So, the Agency for Cultural Affairs set up forest development project to secure wood for preservation from 2006 as below. The Agency for Cultural Affairs has set up "Forest of Cultural Properties" that serves as supply forest and training forest for materials necessary for preservation of cultural properties. The purpose of this project is provision of chance to train of collection materials. In addition to this, dissemination and awareness are another purpose. In present, there are 80 places designated as "Forest of Cultural Properties".

Focused on cypress barks, its problem has two aspects, one is decrease and aging of craftsman, the other is decrease of Japanese cypress forest. Fundamentally, collection and roofing of cypress barks were completely separated. Conventionally, in trust relationship between collection craftsman and forest owner, the collection of cypress barks had been carried out integrally with the management of the forest. However, in the change of forest management, it becomes difficult to maintain such relationship, and some problems appear; such as the case of being cut down before cypress collection and tendency that forest owners avoid collecting cypress. In the present training, roofing contractor began to train collection of cypress barks themselves, that is collection and roofing craftsman is to corporate each other.

Today some wooden materials produced in "Forest of Cultural Properties", are supplied to preservation field, but the amount is very few. Based on market principles, these wooden materials are not necessarily supplied for preservation work except for some case. In future, we hope the amount of supply would increase properly. I think this harmonious coexistence between wooden architecture and surrounding environment is characteristics of Japanese architecture and this problem is very common around the world.

1) On the traditional Japanese scale, 6 m is 20 "*Shaku*" which is one of standard size for span length between beams in the early modern age.

2) In Japan, there is a custom of celebrating the transportation of large trees. The famous example is *"Okihiki festival"* for *"Shikinen-Sengū"*.

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Challenges in the Relocation Process of Conserving the Vernacular Architecture of the Negeri Sembilan Traditional Malay House

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Abstract

Relocation is considered as one of the conservation approaches in vernacular architecture under threat for various reasons. Although some of the international charters are not preferable towards this approach, some see it as the last solution. In Malaysia, this approach seems to be well accepted to protect them from being abandoned. Two cases were chosen to identify the challenges posed by this process on the vernacular architecture of traditional timber Malay houses in the Negeri Sembilan area, by studying the relocation of *Rumah Tukang Kahar* and *Rumah Maimunah Yaakub*. On-site visual observations and photographing documentation were used to explore how the dismantling and the reassembling process was implemented. Major findings indicate that inappropriate changes affected the characteristics of the house and its traditional value as a result of reinterpreting and inexperienced house owners, contractors and local authorities in addition to lack of socio-cultural awareness and appreciation.

Keywords— *Challenges, Changes, Relocation.*

Introduction

The vernacular architecture of the Negeri Sembilan Traditional Malay House (NSTMH) is one of the traditional dwellings that were constructed by villagers which forms part of the valuable architectural heritage in Malaysia before the modern technologies influences arrived (Sulaiman, 2014). It is commonly known as the *rumah kampung* or 'village house' (Lee, 2003) which made from timber construction. This house has a distinctive architectural quality and a diversity of styles and houseform that reflects the creativity and aesthetic skills of the Malays. NSTMH is also designed adapting to the climate, flexibility in design and construction, and to suit the lifestyle and the economic status of the owners (Sulaiman, 2014). The characteristics of the NSTMH can be seen through in its layout and houseform such as built on stilts, elevated floor, straightforward timber post and beam structure, full-length louvered windows, high roof with ventilation openings and low thermal conductivity material. Most of the NSTMH can be seen in rural areas and now, facing new challenges in order to survive for future generations. This paper is structured based on the challenges in the relocation process of conserving the house that focuses on the two case studies, discussing the findings from on-site visual observation and photographing documentation.

The Relocation Concept

According to Gregory (2008) that various ICOMOS Charters are against this relocation concept, and some sanction it as the last solution, as stipulated in Article 7 of the Venice Charter (1964):

> "A monument is inseparable from the history to which it bears witness and from the setting in which it occurs. The moving of all or part of a monument cannot be allowed except where the safeguarding of that monument demands it or where it is justified by national or international interest of paramount importance"
>
> (ICOMOS Venice Charter (1964), p.3)

As suggested in Article 10, ICOMOS New Zealand's Charter for the Conservation of Places of Cultural Heritage Value (2010), a more pragmatic approach was considered:

> "In exceptional circumstances, a structure of cultural heritage value may be relocated if its current site in imminent danger, and if all other means of retaining the structure in its current location have been exhausted. In this event, the new location should provide a setting compatible with the cultural heritage value of the structure"
>
> (ICOMOS New Zealand (2010), p.4)

The Burra Charter (2013) also highlighted that an appropriate location and use should be considered in the case of relocation. While, Articles 5 and 6 of the ICOMOS Principles for the Conservation of Timber Structures (1999) considered an intervention made to the original fabric of a building only if it follows reversible and traditional methods. In this context, a NSTMH might require complete or partial dismantling and subsequent reassembly with minimum alterations. Article 9 of the Burra Charter (2013) also asserted that relocation may be acceptable if it is 'the sole practical means of ensuring its survival', designed for (removable) and with a history of relocation. Relocation of historic buildings should be viewed as a last resort, as mentioned in Article C, Appleton Charter for the Protection and Enhancement of the Built Environment (1983). With exceptional views from all the other charters, this ICOMOS Canada Appleton Charter focuses on intervention is one charter that accepts the possibility of relocation, as stipulated in Article 3.17, where:

> "Dismantling and reassembly should only be undertaken as an optional measure required by the very nature of the materials and structure when conservation by other means impossible, or harmful"
>
> (ICOMOS Appleton Charter (1983), p. 36)

Example of the relocation concept on a bigger scale that was first established in Scandinavia in the 19th century is the open-air museum (OAM) in Skansen, Sweden and the relocation of Abu Simbel in Egypt (moved in 1968 from being flooded by the waters of the Nile) (Sulaiman, 2017). However nowadays, a TMH were transferred anywhere in Malaysia, often out of its original context and setting, especially with a different use and function. For example, boutique resort (Terrapuri Resort, Terengganu; Bon Ton Resort, Langkawi) and gallery or museum (Malay Heritage Museum, UPM) that become an established practice in Malaysia. The authenticity of the house's place, location and setting has become secondary to preserving the fabric, even in a different context. The adaptive-reuse approach of adapting the original design of the house into more 'usable' functions has proved valuable for the survival of a house from abandonment.

The Challenges of Relocation Processes

Referring to the National Heritage Department's website, only two (2) relocated traditional houses (timber building) are gazetted under the heritage list set by the National Heritage Act 2005 which is Ampang Tinggi Old Palace; built in the 1860s, has been dismantled and relocated several times, resulting in much alteration (Waterson, 1990) and the Negeri Sembilan House Model (now as a gallery). One of the most significant features of the NSTMH is it can easily be enlarged and moved from place to place (Hilton, 1956). The practice of lifting (*usung rumah*) through mutual cooperation (community self-help) or'gotong-royong'and moving the whole house to another site within the same or different village demonstrates the flexibility of this type of dwelling (Carsten and Hugh-Jones, 1995) and Sulaiman, 2014). Although the house is physically re-sited, the context of the *kampung* will be lost especially when transferred to a different area. In the past, the house may be transferred either by river or land, the fact that it is taken down part by part means that the condition of the house is not guaranteed when it is reassembled. It will creates a traditional impermanence of the house structure itself and lose its connection.

Observation on the Case Studies

Two case studies of historic 19th century houses in the region of Negeri Sembilan were selected due to their unique characteristics, having similar issues towards conserving the house. Both case studies are an empty abandoned houses. The findings will also explain the relevant challenges processes that may reflect to the connection of these case studies.

Case Study 1: *Rumah Tukang Kahar*, Kuala Pilah, Negeri Sembilan, Malaysia

Rumah Tukang Kahar was built in the 1880's (fig.3). *Tukang Kahar* was a well known craftsman completed the house all by himself. He had a very fine craftsmanship skills and was also the man who built Istana Seri Menanti in 1902 (Rasdi, 2012). The house was built for the people of high status and wealth position besides designed based on the Kitab Tajul Muluk (full of symbolic meaning on the traditional rules and building the house). The special characteristic of this house can be seen from the intricates carving techniques applied especially at the head of staircase, beams and rafters, wall panelling, columns, door and etc. (Sulaiman, 2014). The house was quite difficult to find as it had already been transferred. The chronological events to the house are shown in Figure 1.

Figure 1 below - The Chronological Events to the House

Dates	Events
1880's	House built
1910s	The house first moved to the new site (Not known when the house reassembled). Taken down bit by bit (not lifted up).
1969	The deterioration of Pangkal Serambi and Hujung Serambi.(due to not reassembled during the transfer process) Some parts were kept underneath the house. Replaced kitchen with concrete block and timber plank. Replaced of the wall type on left elevation with additional small window.
1970	Rumbia Attap was taken down and replaced by zinc roof. Wall partition built (Rumah Ibu) due to the marriage of his adopted child.
2010	Abandoned

2013	Sold to the Negeri Sembilan Museum (a gallery) and moved from the site.
End 2014	Pending for budget to re-assemble the house and Reassembled
Early 2015	Completed Reassembled (without original *Pangkal Serambi* and *Hujung Serambi*)
Sept 2019	Continue works (to complete the house) by Universiti Teknologi Malaysia

(Source: Adopted from *Sulaiman, 2014*)

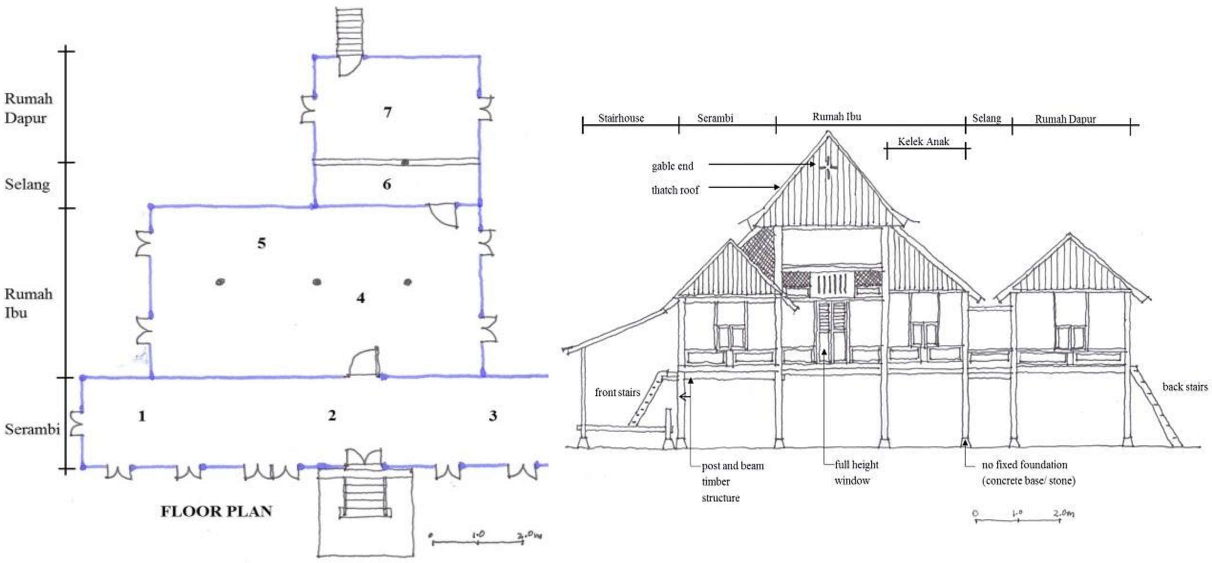

Figure 2. Original layout plan of Rumah Tukang Kahar, Negeri Sembilan (1-Serambi Hujung, 2-Serambi Tengah, 3-Serambi Pangkal, 4-Rumah Ibu, 5-Kelek Anak, 6-Selang, 7-Dapur)-(left) and side elevation (right)(Source: Sulaiman, 2014)

Figure 3 below: The Dismantling and Reassembling Processes

Dismantling Process	**Reassembling Process**
The lack of proper tagging (documentation-only used white marker to mark) of the components as it was supposed to be (before works, during the works and after works) by producing HABS (Historic Architectural Buildings Survey) as required by Heritage Department of Malaysia (HDM).	No documentation was done according to HDM requirements.
No temporary roof installed before work start (requirement by HDM).	A temporary roof was not used to protect the house (requirement by HDM)
Conservator was not appointed to consult the conservation works that were carried out (contradict with normal practice required by HDM)	Conservator was not appointed to consult the conservation works that were carried out (contradict with normal practice required by HDM).

Workers without proper attire or healthy and safety precautions.	Workers without proper attire or healthy and safety precautions.
	The works were handled by unskilled Indonesian workers, not locals, and no experienced *Tukangs* or even modern carpenters were employed.
	The workers used the original material (timber floor or structure) as a temporary structure while doing the works. No scaffolding was used.
Although the measured drawing report was produced by university, it was never used for guidance. The house was not surveyed prior to the start of the project.	Do not refer to the measured drawings.
The house being taken down part by part instead of lifting it all up	Orientation: Normally faces the river or a paddy field with its background a hill, and *Serambi Pangkal* or *Hujung* will face *Qiblah* (Makkah). The current orientation is quite awkward probably due to site constraint.
The location of the storage, exposed directly to the weather especially hot and wet condition is not suitable and storage for quite some time (more than a year due to no budget).	New location: In the same compound with the Old Palace of Seri Menanti (OPSM) that has been gazetted as National Heritage is questionable.
Many parts or elements of the house are missing and should be replaced accordingly especially the *Rumah Ibu* door.	No ritual ceremony was done for its re-erection as normally house used to.
	The traditional method of constructing the house does not apply to this house as *Tiang Seri* is not being erected as it was before. The placement of *Tiang Seri* on the right position is also questionable.
	Misplaced the position of the carving beam in the *Serambi* area (original facing inside, currently facing outside).
	The original *Serambi Hujung* and *Serambi Pangkal* were once again not reassembled and no reason was given.
	The use of red zinc material for the roof is also questionable.
	New paint/lacquer was applied to give a new look to the house including original coloured carvings.

Source: Adopted from Sulaiman (2017)

Figure 4. Rumah Tukang Kahar, Negeri Sembilan before dismantle (left) and after reassembled (right) (Source: Negeri Sembilan Museum)

3.1.2 *Case Study 2: Rumah Maimunah Yaakub, Rembau, Negeri Sembilan, Malaysia*

The *Rumah Maimunah Yaakub* was built in the 1920s by a benefactor. The background of the previous owner was as a Muslim scholar. From 1721 to 1826, this *kampung* was the site of the coronation of *Raja Rembau 1* (Raja Melewar) were local rulers originally from Pagarruyung, Sumatera Barat. This house was built from the highest-quality local timber called *Chengal* and was one of the most lavish houses in the *kampung*. The special characteristic of the house can be seen through dragon head features at the end of roof ridge and 20 pieces of intricates decorative timber panelling separating the *Rumah Ibu* and *Seramb*i areas (10 panels right, 10 panels left) with different patterns and designs. The chronological events to the house are shown in Figure 5.

Dates	Events
1920’s	House built
2000s	Owner passed away
	Abandoned
2010	Rented by Indonesian workers
2013	Bought by the founder of Yayasan AsSofa
2014	The house was dismantled and left the *Rumah Dapur(kitchen)*built on the ground
2015	The house was reassembled at new site at the Islamic High School (*Yayasan AsSofa*)

(Source: Author, *2019*)

Figure 5: The Chronological Events to the House

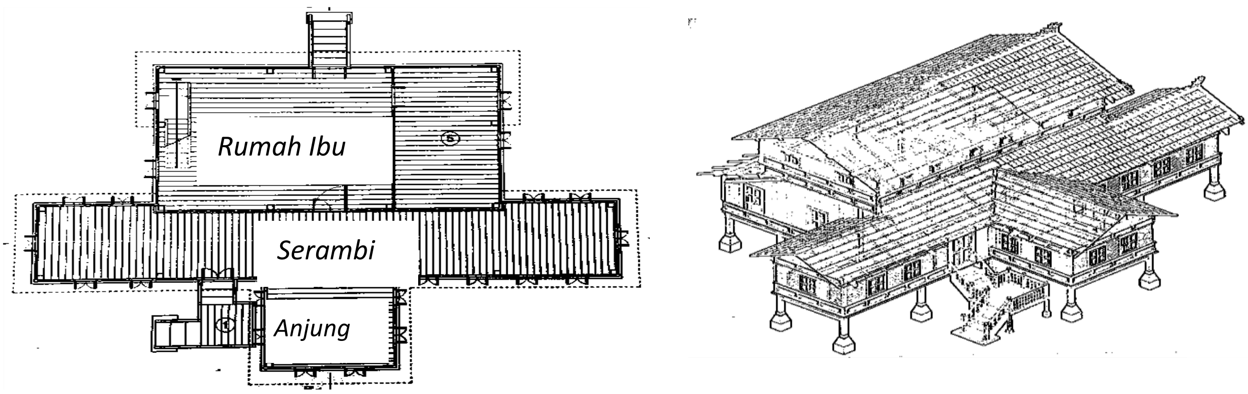

Figure 6: The layout plan and perspective of Rumah Maimunah Yaakub without Rumah Dapur based on measured drawing produced by university.Source: KALAM (2014), Sulaiman (2017)

Figure 7 below: The Dismantling and Reassembling Processes

Dismantling Process	**Reassembling Process**
No documentation was done to record all the processes. Only sketch plan was used at the site to guide them through the dismantling process. (drawn on A3-size at the back of calender paper).	No documentation was done according to HDM requirements.
A temporary roof was not used to protect the house (requirement by HDM)	A temporary roof was not used to protect the house (requirement by HDM)
Conservator was not appointed to consult the conservation works that were carried out (contradict with normal practice required by HDM)	Conservator was not appointed to consult the conservation works that were carried out (contradict with normal practice required by HDM)
No proper working attire or healthy and safety precautions.	No proper working attireor healthy and safety precautions.
Although the measured drawing report was produced by university, it was never used for guidance. A black marker was used to tag all the structural elements.	Do not refer to the measured drawings.
All the roof structures, roof beams (9 metres), walls, window panels, decorative timber panels, fascia board, door, timber floors, floor beams, columns and beams were taken down (*Rumah Ibu* and *Serambi*) (from top to bottom).	No ritual ceremony was done for its re-erection as normally house used to.
All the decorative features of dragon head (roof ridge*)* were demolished due to the need of lifting down the roof tiles. Many sizes of nail were found.	The suspended column (*buah butun*) of *Rumah Ibu* was reassembled, still in its original colour, prior to being repainted with shellac.
Original timber was used as a tool to loosen the wall.The existing fabric was nailed by the	The original column structure was reconfigured to increase the height of the

workers with temporary new timber to tie them up from broken.	underneath space about 10 feet (out of proportion)
The original fabrics sustained damage as a result of improper dismantling.	*In-situ* alterations of the new timber joint (column)
The rope was used to hold the structure from falling directly to the ground to avoid more members cracked or damaged.	A concrete platform as a base for the front staircase was built later. It was probably a last-minute decision where to put the staircase
The *Tiang Seri* was the second to last structure taken down. It is supposed to be the last structure but it was not happening.	A process of trial and error was followed to install the new staircase by putting in too many columns to support
All the material was stored temporarily in open storage under fruit trees within the house compound. All the materials were not covered with plastic and exposed to the rain	The existing materials were not covered throughout the project (and were thus exposed to the rain).
All the timber floor was nailed and manually done using a crowbar.	The perimeter wall of the house was painted (shellac) in timber colour.
The toughest job was lifting up the main columns of *Rumah Ibu*. It was quite a heavy structure and only few of them were involved. The structure warped and almost broke as they could not manage to hold them up correctly. The workers did it the wrong way when dismantled the first part of the column.	The strength of the column extension is questionable in terms of distribution of the jointing patterns
	Erection of the main structure (column), starting with the front side of the *Anjung* area. Not in a traditional way of erecting the house (*Tiang Seri* is the main column and should be erected first, with others following afterwards).
The location of the 'time-capsule' was found underneath the *Tiang Seri* column. The 10 cent coin stated *"STRAITS SETTLEMENTS TEN CENTS, 1919*" indicated the birth date of the house.	The new design of the staircase in timber was installed, totally different from the original (quite at odds with the character of the building).
	The roof tiles of *Rumah Ibu* were completely reassembled without the original cement roof ridge (dragon pattern).

Source: Adopted from Sulaiman (2017)

Figure 8: Original condition before (dismantle-left) and after (reassembled-right) where the height of underneath was increased to 10ft, features of dragon head at the end of roof ridge was not constructed (red circle)and new staircase (red rectangle)Source: Sulaiman (2017)

Discussion and Conclusion

Both case studies shows similar issues and challenges in dismantled and reassembled the houses which includes poor record and documentations, no appointed conservator, various unconvincing methods and techniques applied, unskilled worker and no proper storage for materials.

Apparently, some of the changes that were effected during the reassembly process could have been avoided at an earlier stage. In the case of *Rumah Tukang Kahar*, the main mistake involved the placing of the carving elements in the wrong position. This should be avoided by referring and adhered to the recording and documentation processes as stated in the ICOMOS Principles for Recording of Monuments, Group of Buildings and Sites, 1996. Not only that, the house was painted (shellac) including all decorative element that resulted in the loss of their original colours. *Rumah Maimumah Yaakub* can be considered as a new transformation from its original height of the stilts being increased to about 10 feet. The height was extended on top of the existing column with a new jointing system that is quite a risk. This seriously affected the scale and proportion of the house which lost its character as a result. It also led to the misinterpretation of the NSTMH, especially for the future generation.

Also, these issues highlighted how we are able to interpret that as part of the challenge of conserving the house in order to find the best way to undertake the move, especially with regard to the joining elements and the sequence of construction. These are the things that we can learn from other people (lead by example). The fact that *Rumah Tukang Kahar* has an educational value that can be expanded by correct conservation practices how to appreciate this heritage in the right way. It has to be done effectively, with knowing how to maintain it for long-term benefit and in a sustainable way.

Unfortunately, in both of these cases, despite the best intentions, correct procedures were not followed (traditional methods, wrong materials were used and wrong type of connection) and there is need for guidelines. This happened to *Rumah Tukang Kahar*, where the house was not reassembled back to its original design due to dismantling process probably missing or degraded parts, sustained damage or even been extensive destruction during the transfer process. Furthermore, the *Tukang* or carpenter may not possess the appropriate traditional skills required to reinstall the house, including no system of part identification and tagging applied. Again, in both cases, it is evident that no one with any specific conservation knowledge was involved including owners and contractors. So, perhaps they never thought about it. In order to do this, the implementation of proper conservation works need to be clearly done through establishing guidelines etc. to relocate them.

Currently, there is no form of regulation about the historic environment and even no specific guideline to maintain historic timber buildings specifically in Negeri Sembilan. The Negeri Sembilan state government could consider by having its own provision act one. Instead, the National Heritage Act 2005 also has no specific provision for the traditional timber house.

This observation has told us something about how things happen in terms of the changes in form, fabric and function that affected the relocation approach involving a dismantling and reassembly process. It will also involve what we can learn about it, so that other people having to carry out repairs might learn from it in the context of relocation, sense of place and responsibility as well as the house owner's involvement. But, none of the processes are similar due to not been properly done by the contractor as well as the owner. The contractor involved should be registered under Malaysia Construction Industry Development Board (CIDB) with BO3 license. Owners also should know their role by preserving their house accordingly. Due to the limitation reference on the relocation processes and the lack of knowledge in heritage has also become the barrier for them to help conserve the house.

Above all, realization of what they have to conserve might drive the owners, contractors and local authorities to utilize it in intelligent way which will help the Negeri Sembilan's people to protect their heritage where the nation will be benefited on the whole especially for the future generation as it is an indication of the country's distinctive material culture

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Architectural Historic Wooden Preservation in Japan: Documentation and the Dissemination of Knowledge

Dr Tanya L. Park

Abstract
This paper outlines the process surrounding the preservation of historical wooden architecture in Japan, highlighting the reciprocal correlation between the preservation of significant wooden structures and the associated preservation of traditional techniques**.** Historical overviews highlight legal transformation representative of societal changes and refinements to the training systems for the preservation of Important Cultural Properties within Japan. Centralisation of knowledge and governance provides a constant authority from which Cultural Properties are protected and are a strength of Japanese protection structures. Traditional knowledge pertaining to techniques of craftsmanship is an essential element of the communication process both now and into the future.

Key Words: *Cultural Properties, Legal Structure, Agency for Cultural Affairs, Protection*

1. Introduction

Japan's recognition of the instability and danger from the disappearance of traditional skills culminated in 1975 with legislative protection as the government introduced *"Protection of Traditional Techniques for Conservation of Cultural Properties".* Legal protection of traditional techniques officially recognises the persons who possess the knowledge pertaining to specific techniques. To date, Japan is unique in its endorsed acknowledgment of the dualistic nature of preservation of cultural properties, by the protection of the associated indispensable skills. The legal transformation is representative of societal changes and refinement of the training systems.

2. Historical Overview of Legislative Cultural Heritage Protection in Japan

Legislation, as it pertains for the Protection of Cultural Properties includes a number of significant historical events influencing contemporary legal guidelines. The Meiji Restoration, from 1868, was a significant turning point signalling the end of military governance by the Tokugawa Shogunate, who had reigned for 250 years from 1600. Meiji Restoration implemented a new system of government with the Emperor (from the Imperial household) as the new leader and a parliamentary system was employed.

The two observed forms of religion, each meeting different ritualistic needs within society, were Shinto and Buddhism. There had been a long history of peaceful co-existence, both religions strongly placed within Japanese society. During the Restoration, in 1871 Shinto was declared as the state religion, leading to an anti-Buddhist movement. Additionally, in 1871 and 1875 legal ownership of lands previously granted in the Edo period [c.1600-1868] including Buddhist temples and Shinto shrines were seized by the government under the Confiscation Law [Agechi-rei], resulting in demonstrations and subsequent violence. A direct result of the conflicts between the two religions was a substantial loss of important cultural properties.

(a) 1871 Preservation of Ancient Objects Decree

In 1871 the government issued a decree for the protection of antiquities, prefectures were ordered to submit inventories specifically identifying objects of significant cultural importance from their region. From 1880 the government provided substantial funds for the preservation of ancient shrines and temples and by 1894, 539 shrines and temples had received subsidies for preservation.

When the Tokugawa Shogunate was defeated in 1868, the new government formed under the Emperor, the central power, and the seat was moved from Kyoto to Tokyo. International trade began again in several major ports, new relationships with America, the Netherlands, Russia, Britain, France and other European countries were established. In 1889, a modern constitution based on German models was enacted.[1] A new government replaced the Han system, with the prefectures, and consolidated the administrative structure. In 1889, the cities, towns and villages were ordained as the basic administrative unites. These had generally larger areas and populations than the previous villages and towns and were placed under the supervision of the prefectural government. Thus regional hierarchy by now had five levels;

(i) The prefecture
(ii) The city or the county (many traditional counties were clusters of towns or villages)
(iii) The newly agglomerated town or village
(iv) The local community unit (based on former town or village within a city)
(v) The subdivisions (minor places within a community unit)

This system has remained virtually unchanged, and is still in practice today.

(b) 1897 Law for the Preservation of Ancient Shrines and Temples

In 1897 the Ancient Temples and Shrines Preservation law was decreed. This law covered 'buildings and artworks possessed by shrines and temples'.[2] The law declared that any ancient shrine or temple finding itself financially unable to maintain or repair its buildings, or any other treasure in its possession, may lobby to the government for a financial aid to assist it to meet the associated expenses. The law also directed that a register of buildings under special protection should be kept and maintained, recording name, ownership and location, origin and history, construction and architectural style and detailed measurements.

(c) 1919 Historic Sites, Places of Scenic Beauty, and Natural Monuments Preservation Law

This law incorporates wide-ranging areas, from historic sites to animals and plants considered of high scientific value. Historic sites category includes important ruins. Places of Scenic Beauty are the places of exceptional landscapes and natural sites, such as those included in classic Japanese poetry and paintings. Interestingly Natural monuments now include rare animal plants.

(d) 1929 Law for the Preservation of National Treasures

The law of 1929 for the Protection of National treasures was enacted to circumvent the transfer of proprietorship and in numerous cases the export of national treasures abroad, often traded due to financial hardship by the owners. By the enactment of the law in 1929 for the Protection of National Treasures, permits for alterations were introduced as well as increased funding. By now approximately 70% of associated costs were covered by the government.

(e) 1933 Law regarding the Preservation of Important Works of Fine Arts

This was a measure to ensure that precious artworks did not leave Japan. The previous law of 1871 was cumbersome due to lengthy procedure, and often resulted in time delays leading to the designation of a national treasure, resulting in the loss of precious works of art. The new law prohibited the exportation of any kind of art object for one year in order to give time in assessing the objects value.

In January of 1949 a fire broke out during preservation of Kon-do Buddhist temple Hōryū in Nara. Hōryū-ji is of notable cultural significance as the temple's pagoda is commonly acknowledged to be one of the oldest wooden buildings in the world, underscoring Hōryū-ji's place as one of the most celebrated temples in Japan. Preservation of Hōryū-ji was during a time of war and the threat of destruction was an impetus for partial dismantlement and storage off-site. Thus, when the fire started a significant proportion of the structure was not damaged. Damage was confined to the first (ground) floor and the murals. The charred wooden members were moved to a separate fireproof warehouse for future investigation and research. Through a recent dendrochronological analysis of the wooden materials preserved during the restorations done in the 1950s, it has been determined that some of them were felled prior to 670 AD. [3] The Hōryū fire was the motivation for the enactment of the 1950 law which combined a unified legal framework expanding previous existing laws, and reinforced the protection system.

(f) 1950 Law for the Protection of Cultural Properties

The Law for the Protection of Cultural Properties replaces the previous three laws, of 1919, 1929 and 1933, with the aim of achieving a more encompassing, overarching legal protection. The law provides a clearer view surrounding the responsibilities of the owners of cultural properties, expected to take a more active role in their protection. The law provides three categories of "Important Cultural Properties";

- (i) Tangible cultural properties
- (ii) Intangible Cultural Properties
- (iii) Historic sites, places of scenic beauty and natural monuments

The properties considered the most significant are defined as "National Treasures". The term "Special Historic Sites" were further classified into two categories "Special Places of Scenic Beauty" and "Special Natural *kinen-butsu*".

There have been a number of amendments since the 1950 Law for the Protection of Cultural Properties [herinafter referred to as LPCP].

In 1954 'Tangible cultural properties' were re-categorised as "important tangible cultural properties" and an amendment took place around eligibility for related subsidies. Revision established a "custodial body" in charge of the management of cultural properties without an owner, or with multiple owners. The previous law provided for protection of cultural properties at a national level, whereas the 1954 amendment provided for the provision of protection at local governmental level, who could take measures for the protection of cultural properties within their own jurisdiction. An amendment in 1968 resulted in the Council for the Protection of Cultural Properties being established. The Agency for Cultural Affairs [ACA] was also established, under the guidance of Minister of Education, Culture and Sports, Science and Technology [MEXT]. In 1975, the government amended the Law for the Protection of Cultural Properties to include a new category of Important Preservation Districts for Groups of

Traditional Buildings. Property ownership was extended from individual, to include proprietorship of more than one individual, small groupings and organisations.

As of October 2010 there were 87 designated districts. There is an important difference at this point when considering cultural property, the difference lies in ownership. Over 70% of nationally designated structures are religious structures, making the proportion of private ownership low. This is not the case when considering Preservation Districts. Private ownership rights are strong in Japan, some owners view designation as a restriction to individual rights, whilst others are more accepting due to the opportunities that often arise from designation. In some cases, designation has meant the survival of remote towns threatened due to rapid modernisation and industrialisation in the 1950's and out-migration by young people from rural areas to large metropolitan cities of Tokyo and Osaka.

Townscape preservation (*machinami hozon*) and environmental protection first came into public awareness in the late 1960's due to modernization. Local movements began trying to preserve historical buildings groupings. The subsequent introduction of "selected conservation techniques" ensures the traditional techniques associated with the preservation of cultural properties and is an important step in acknowledging the skills and techniques associated with preservation as being an essential part of preservation.

In 1996 a system of Registration of Cultural Properties was implemented. By this time Registered cultural properties, having fewer stringent rules to be adhered to by the owners, generating a wider appeal to a broader range of people. Through the registration system a significant number of buildings have been identified that were previously unable to be protected as important cultural properties, now numbering over 25,000.

In 1999 allocation of authority to the prefectures and the designated cities was put in place by ACA. Soon after, in 2004, we see the establishment of a selection system of Important Cultural Landscapes. The definition states "Landscape areas that have developed in association with the modes of life or livelihoods of the people and the natural features of the region, which are indispensable for the understanding of our people's modes of life and livelihoods". Selection is dependent upon general consensus of local governments and citizens. It must be pointed out that at times consensus has not been reached and at times the policy of local governments is not receptive to historic heritage conservation.

The amendment of 2004 also saw the expansion of the system of Folk Cultural Properties, referring to production technology related to tools, utensils and other articles for daily life and manufacture. Additionally, the expansion included Works of Fine Arts and Crafts, Tangible Cultural Properties, Tangible Fold Cultural Properties and Monuments.

Fig. 1. 祇園祭 Gion Matsuri. Annual Festival Kyoto. [Photographs by Author]

3. Definition of Cultural Properties in Japan

Diverse cultural properties have been created and developed throughout Japan's long history. Cultural properties include tangible structures such as shrines or temples, Buddhist statues, paintings, calligraphy and other skills such as per forming art and craft techniques, traditional events and festivals. Natural landscapes unchanged by time are also included as cultural properties in Japan. Under the Law for the Protection of Cultural Properties, these cultural properties are divided into the following categories.[4]

- Tangible Cultural Properties, including structures, paintings, sculptures, crafts, calligraphic works, classical books, and ancient documents which are of high historical or artistic value, as well as properties such as archaeological artefacts and other historical materials of high scientific value.
- Intangible Cultural Properties, defined as those of high historical or artistic value, such as drama, music, and craft techniques. They are embodied by individuals or groups who have mastered the relevant skills
- Folk Cultural Properties, defined as items indispensable for understanding transition in the daily lives of the people, such as manners and customs, folk performing arts and folk techniques that are related to food, clothing, housing, occupation, religious faith and annual events, as well as clothes, tools and implements, houses, and other objects used in connection with the foregoing. (see for example Figure 1).
- Monuments, include shell mounds, ancient tombs, sites of palaces, sites of forts or castles, monumental dwelling houses, and other sites which possess a high historical or scientific value. They also include gardens, bridges, gorges, seashores, mountains, and other places of scenic beauty which possess a high artistic or scenic value, animals, plants, and geological and mineral formations possessing high scientific value.
- Cultural Landscape, defined as landscapes that have evolved with the modes of life or livelihoods of the people and the geo-cultural features of the region, which are indispensable to the understanding the lifestyles and/or livelihoods of the people of Japan. Groups of traditional buildings are buildings of high value which form beautiful historical scenery in combination with their surroundings.

Of these cultural properties, the government designates, selects, and registers important items in categories such as Important Cultural Properties, National Treasures, Historic Sites, Places of Scenic

Beauty, and Natural Monuments, and gives priority to their protection. In addition, cultural properties that are underground (Buried Cultural Properties), and traditional techniques and skills that are necessary for the restoration and preservation of cultural properties (Conservation Techniques for Cultural Properties), are also protected.

4. **Japan: Legal protection of traditional skills**

Japan's acknowledgment of the problem concerning the disappearance of traditional skills also resulted in the Japanese government, in 1975, including a new chapter (Chapter V-3) in the Law providing for "Protection of Traditional Techniques for Conservation of Cultural Properties". Legal protection of traditional techniques officially recognises the persons who possess the knowledge pertaining to specific techniques. To date Japan is unique in its endorsed acknowledgment of the dualistic nature of preservation of cultural properties, by the protection of the associated indispensable skills. [5] Table 1, Protected Certified Techniques owned by individuals, are periodically referred to as "Living Treasures" alongside Protected Techniques owned by associates.

Certified techniques owned by individuals

Sterotomy [modern stereotomy] wooden construction.

Tiled roof

Cypress bark harvesting

Persimmon roof

Thatched

Plaster [painted plaster]

Joinery production

Casting production

Gold printed paper manufacture

Plaster [Kyoto traditional wall]

Metal joinery blacksmith

Tatami production

Stone tablet roof

Certified techniques owned by associations

Monuments repair: The Japanese Association for Conservation of Architectural Monuments

Monuments Woodwork: as above, Traditional Japnese Architecture Technology Preservation society.

Coloured monuments: Nikko Cultural Assets Association for the Prservation of Shrines and Temples.

Tiles roof: Preservation Society of Japanese Traditional

Bark roof, persimmon roof, thatched roof: Company National preservation Scoeity of shrines and temples roofing technical work

Plasterer [Japanese wall]: National Cultural Heritage Preservation Association of wall technologies.

Joinery manufacture: National Preservation Society of Joinery techniques

Monuments decoration: Japan Association for Historical Art and Architecture.

Cultural Heritage Preservation Association of Tatami

Cultural Heritage Preservation Association of Stone Wall Techniques

Table 1. Protected Certified Techniques owned by individuals and associations.

Nobuo Kamei,[6] discusses the necessity of preservation techniques and associated preservation outlines. The industrial revolution and associated industrial production methods, along with the increased use of glass, iron, steel and concrete led to the erosion of traditional techniques and associated knowledge and skills. Subsequently, the transmission of traditional techniques and repair materials became increasingly difficult.[4] As a solution, the Cultural Properties Protection Law selects preservation techniques that are essential for cultural property, and certify the individual or association holder of the selected preservation technique. Each individual receives governmental subsidies and is requested to generate accounts of the preservation technique and strive to train successor a for the said technique.

Along similar lines, so called Behavioural Traditions provide minimal written documentation, meaning that there is very little available pertaining to the preservation and history of Japanese architecture. William H. Coaldrake noted,[7] following numerous observations on preservation sites within Japan, that many of the architects, carpenters, roof-tilers, and other craftsmen engaged in these projects have family traditions reaching back into the Edo period. Today, study of their professional skills affords unique opportunities to understand their respective customary traditions.

But what is actually known of the construction techniques and associated carpentry tools during the Edo period? Very few of the actual tools used by the carpenters during this period remain and so historical documentation and illustrations are an important source of information. One of the best compilations is the Sino-Japanese illustrated Encyclopaedia from 1713, which gives pictures of contemporary carpenter's tools together with explanations. Most of the tools depicted have changed very little in their basic construction and shape during the subsequent centuries and continue to be used, with minor improvements, by carpenters today. What is also understood through the historical texts is the significant skill and labour involved by the craftsmen who worked on such structures of the Edo period, and periods prior.

Concerns in Japan surrounding preservation and the succession of the associated conservation technologies are due to two main factors. The social demands for restoration work and other work that requires the deployment of traditional techniques is low, and the repair materials and tool production materials are often difficult to obtain. Offered solutions are;

- to ensure work by selecting non-appointed important cultural properties (nationally)
- regional (prefectures and municipalities) culture being promoted
- increase listings of cultural properties within the registration system, ensuring a higher quantity of cultural properties

5. Conclusion

Typically, the repair of historic wooden structures in Japan has involved respect for the preservation of existing, and in particular orginal, materials in the sense that carpenters have reused as much as possible of the original fabric. Replacement of members must be considered as an integrated part of the history of timber structures, a rational response. One could argue that replacement of structurally deficient materials is, in fact, the only way to preserve their authenticity as timber structures. This article has focused upon the actualities of preservation in Japan, methods and operations via practical applications of the processes. However, international discourse pertaining to Japanese methods of preservation frequently highlights the concept of Authenticity, often quotes the Nara document on Authenticity, more recently Nara +20: On heritage practices, Cultural Values and in particular the concept of Authenticity. It is of paramount importance to note that Japan has been putting in place systems to protect its heritage for centuries. Japan has always iterated these systems and undoubtedly will continue to do so. This is all in an effort to be practical, far reaching, inclusive and efficient at the preservation of its heritage, both tangible and intangible. Historically, Japan has recognised the mutual protection of tangible and intangible cultural knowledge and how one is unable to exist without the other. Interestingly, Nara +20 places emphasis on stakeholder involvement with communities of interest and indicates a diminishing role for the State in the heritage and even of the expert.

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Towards a sustainable wooden heritage without designated by the Government
Actual conditions of Buddhist temple and their repair technicians in Japan

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Abstract

In Japan, there are approximately 76,000 Buddhist temples with a long history. In the complexes of temples, the main hall is the central architectural structure, and many of them have continued as wooden structures through the cooperation of generations of believers and followers, and the techniques of craftsmen such as temple and shrine carpenters. The fact that the basic building use of a main halls is unchanged and rotting parts can be replaced are believed to be the factors that led to the permanent use of traditional wooden main halls. However, the situation is changing recently because of urbanization or the decline in followers and the rural population.

After the Act for the Preservation of Old Temples and Shrines was enacted in 1897, 60 buildings were newly designated as national treasures annually. However, there have been several cases such precious buildings being reconstructed due to fire and the national treasure designation being cancelled after being completely burned down.

Currently, the temples subject to preservation only account for a small part of the total number of temples in Japan. In fact, there are relatively many undesignated main halls that were completed during the *Edo* period (1615-1867) or earlier.

In this paper, I tried to clarify the relationships between construction year, period of use, rebuilding factors, and average usage period of main halls by region of Buddhist temples other than those designated by the national government. I also tried to clarify the existing areas where the survival of long-used main halls is threatened in the event of a huge earthquake such as the 2016 Kumamoto Earthquakes because there are no or insufficient craftsmen in the vicinity to repair historical buildings.

Key words *Buddhist Temple, Main Hall, Repair work, Repair technician*

Introduction

Wooden buildings are susceptible to fire, and old shrine and temple structures were lost in frequent major fires in urban areas during the *Edo* Period. Even after the Act for the Preservation of Old Shrines and Temples was enacted, nationally designated cultural properties burned down in the Great Kanto Earthquake (1923) and the Second World War. In order to ensure that historical wooden structures susceptible to fire are sustainable in the future, even now it remains important to implement disaster prevention in case of disaster and also repair for preservation, and the same also applies to undesignated wooden structures.

Old buildings of the *Edo* Period or earlier include main halls not designated as national cultural properties in Japan now. Main halls designated as national cultural properties (hereinafter referred to as “nationally designated”) receive fire disaster prevention equipment and the necessary repairs mainly through subsidies, but some wooden main halls are left in disrepair if not designated as national cultural properties (hereinafter referred to as “nationally undesignated”). During the period of rapid economic growth (1955-1973) in Japan, there was an increase in the number of cases where temples with ample funds in urban areas, etc. rebuilt their main halls instead of repairing them, and it is very likely that they included some old main halls with cultural value at that time. Because these nationally undesignated old main halls include buildings susceptible to disasters such as earthquakes due to structural deterioration, ongoing repair works similar to the steps taken for nationally designated buildings is necessary to ensure that they are passed on to the next generation.

In order to repair old main halls and prepare for disaster, it is preferable that there are skilled craftsmen such as *deiri-daiku* (regularly hired carpenters near-by) in the neighborhood. In areas such as *Nar*a prefecture where there are many historical buildings nearby, an environment where it is easy to perform repairs is comparatively well maintained because there are still many skilled craftsmen in the neighboring areas. However, local traditional skilled craftsmen are decreasing nationwide due to the aging of society and the worsening shortage of successors, and repair works for passing on value are no longer easy to perform. If nationally designated, large-scale repairs are carried out by gathering together skilled craftsmen from throughout the country, but there are concerns about the decline of the local succession of skills in many local regions because there is no such surplus of funds if nationally undesignated. In the 2016 *Kumamoto* earthquakes, many *machiya* (two-storied wooden row house) built in the castle town more than 120 years ago were damaged, but the *machiya* that underwent repairs in advance using *Kumamoto* City’s cityscape conservation subsidy system clearly suffered less damage. However, after the disaster, the residents of many other *machiya* made the choice to demolish them without performing repairs due to a lack of connections with *deiri-daiku*.[1] One factor thought to have contributed to the shortage of traditional skilled craftsmen is the exclusion of traditional wooden construction methods and the spread of modern wooden construction methods using many nails, metal fittings and plywood when the Building Standards Act came into force in 1950. Due to these conditions, it is hoped that the “culture of repair” will be rebuilt nationwide in order to pass traditional architecture such as wooden main halls to the next generation. In the present era of the environment, manufacturing with high durability and the culture of continuing to use things for a long period by repairing them are required for a sustainable contemporary society.

Repair for preservation of designated and undesignated main halls

When the Act for the Preservation of Old Shrines and Temples was initially enacted in 1897, 60 buildings were newly protected as national treasures every year. The number of designations later increased, and there are currently 5,033 buildings designated as national treasures and important cultural properties, including 1,226 Buddhist temple buildings and 303 main halls.

An exhaustive study of nationally undesignated main halls throughout Japan was conducted from 2007 until 2012, and responses were received from 2,661 temples. The following figures and analysis on nationally undesignated main halls are based on this study.[2]

There are presently approximately 76,000 temples in Japan, and designated 303 main halls account for just 0.4% of all temples. Nationally undesignated main halls include many temples with a long history, and those temples founded prior to the *Momoyama* Period (until 1614) when many castles, temples and shrines were built account for more than 60%.

There is regional discrepancy in the timing of completion of main halls, with 58% of main halls being completed in the *Edo* Period or earlier in *Kyoto*, *Nara* and *Shig*a prefectures currently existing, while only 8.8% currently exist in *Tokyo*. The national average was 25%. Some nationally undesignated main halls have been designated as cultural properties by prefectural governments (hereinafter referred to as "prefecturally designated") or are registered cultural properties, but these only account for 3% of the total. Repair subsidies are limited for prefecturally designated properties and there are no repair subsidies for registered cultural properties. For this reason, the understanding and financial support of followers and believers are essential for the repair of undesignated main halls. (Figure 1)

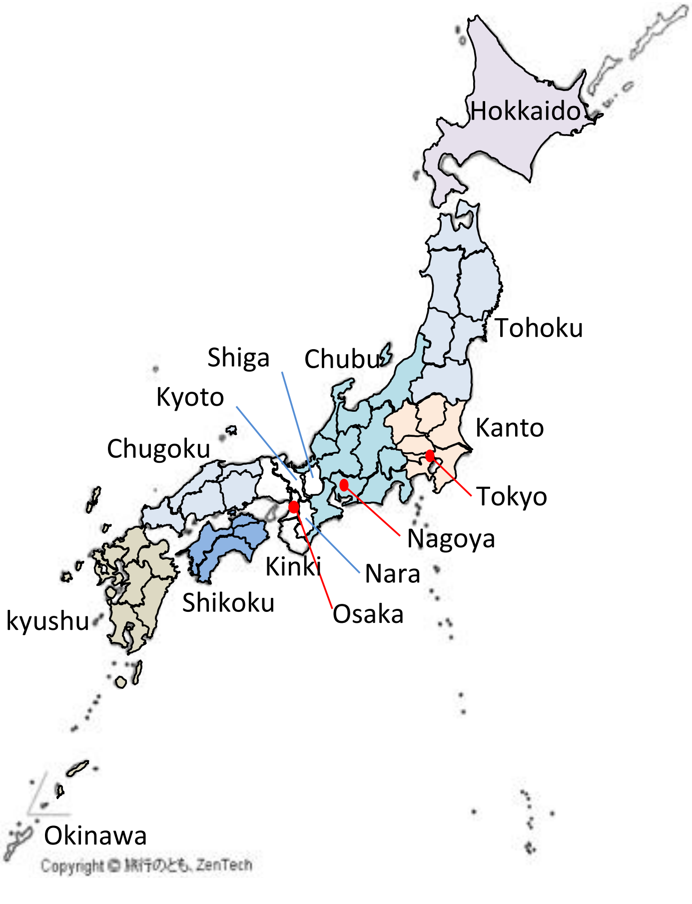

Fig. 1. 8 Regions, 3 prefectures and 3 cities of Japan

Meanwhile, in a study of the period in which the previous main hall (main hall that existed before the current main hall), there was a range from new main halls build after the end of World War Ⅱ (from 1945 onwards) to old main halls build in the *Momoyama* Period or earlier, and approximately 60% of these previous main halls are rebuilt after the war.

The main causes of reconstruction of these previous main halls include aging, natural disasters, renewal of functions and war. Aging of wooden structures includes deterioration and rotting of structural materials, and disasters include fires, earthquakes, typhoons and floods.

Here, there are 36 main halls where the previous main hall was completed in the *Edo* Period or earlier (until 1660) was used for a long time, and 119 main halls where the previous main hall was completed after the war was rebuilt in a short period. The average number of years of use of the previous main hall being 411.6 years and 33.6 years respectively. The main cause of reconstruction was aging in both cases with a 378-year difference in average years of use. It is presumed that the former were used while repeatedly performing maintenance and repairs, but the latter indicate that aging occurs in even 30 to 40 years unless repairs are made. It is very likely that the 36 main halls that were completed in the *Edo* Period or earlier included main halls with cultural property value, and many of these were in major cities such as *Tokyo*, *Osaka* and *Nagoya*.

Newly creating high quality buildings that are representative of each era also has cultural value, but the loss of nationally undesignated old main halls due to the lack of skilled craftsmen able to repair them is an issue that should be resolved in terms of the succession of cultural value. In addition, the continual decrease of old buildings causes a vicious cycle by reducing opportunities for the successors of skills to perform traditional repairs.

Meanwhile, there was a period (1961-1980) in which non-wooden main halls such as those with reinforced concrete (RC) structure accounted for 60% of reconstruction of main halls after the war (wooden structure was reduced to 40%), and the timing is similar to the period of rapid economic growth in Japan. It was also a period when it was believed that RC could be used semi-permanently in non-flammable structures like masonry. However, many construction examples indicated to temple stakeholder like chief priest later that RC does not provide the flavor of change over time like wooden main halls, and that it does not necessarily have a long life due to cracks appearing in walls. For these reasons, non-wooden main halls rapidly decreased from the 1980s, resulting in wooden main halls regaining a share of more than 70%. Two-decade blank from 1960 dramatically reduced to the new construction and repair work available to *domiya-daiku* (carpenters specializing in temples and shrines), and also led to the reduction of successors to skilled *domiya-daiku*.

Fig. 2. Senso-ji

Early examples of non-wooden reconstruction of a main hall are the main halls of *Otani Hongan-ji Hakodate Betsuin* and *Tsukiji Hongan-ji*. After the previous wooden main hall of *Hakodate Betsuin* burned down in 1907, it was reconstructed in 1915 as the first main hall be of RC structure appearing to have a traditional wooden structure, and was nationally designated in 2007. Furthermore, the previous wooden main hall of *Tsukiji Hongan-ji* burned down in the Great Kanto Earthquake (1923) and was rebuilt with non-wooden (RC) structure in 1934, and was nationally designated in 2014 for its ancient Indian appearance that indicated traditional Buddhist roots.

Meanwhile, although not an early example, the main hall of *Senso-ji* (early *Edo* Period, national treasure) (Figure 2)[3] was burned down in the war and lost its national designation, and was later rebuilt using RC. In this way, major fires have repeatedly occurred in urban areas, and the reconstruction of main halls using non-wooden structure (RC) is inevitable in ways due to the progress being made with the increase of non-flammability in urban areas.

The current state of burned down nationally designated cultural properties and prevention of disasters involving wooden main halls

Fig. 3 Kinkaku-ji

After the Act for the Preservation of Old Shrines and Temples was enacted, nationally designated wooden cultural property buildings that have burned down include 61 castles, 47 temples, 23 shrines and 115 tombs, residences and other structures, and the oldest of these was the three-story pagoda of *Horin-ji* built in the early *Nara* period (710-729) and burned down in 1944. Furthermore, *Kinkaku-ji* (national treasure built in 1397) (Figure 3)[3] was completely burned down due to arson in 1950 and was removed from the designation list.[3]

Disaster prevention equipment for nationally designated cultural properties is implemented using subsidies. Following the burning of the roof of *Notre-Dame de Paris*, the Agency for Cultural Affairs in Japan conducted an urgent study on April 22 this year, and as a result, it was reported that there were some defects despite firefighting equipment such as fire hydrants and water cannons being used in some main halls designated as national treasures.[4]

Meanwhile, installation of fire hydrants and water cannons was limited to 30% of undesignated temple main halls, and 80% only used simple equipment such as fire extinguishers.[5] Numerous fires simultaneously break out when widescale disasters such as major earthquakes occur, and fire services lose the ability to perform their functions. Because of this, ongoing maintenance of hardware using equipment and the creation of human resources to improve the effectiveness of operation of firefighting equipment by voluntary firefighting organizations are vital for wooden main halls, and this applies regardless of whether they are nationally designated or not.

Preservation of wooden main halls and skilled repair craftsmen

Temples in the past had skilled craftsmen such as *deiri-daiku* (regularly hired carpenters nearby), and the traditional skills for maintaining local wooden main halls were passed on. In the *Edo* Period, in addition to *machikata-daiku* (carpenters living in the same town), influential shrines and temples utilized *monzen-daiku* (carpenters located outside the temple gate), and castle towns had carpenter districts (*daiku-machi*). *Monzen-daiku* also handled requests from other temples in the suburbs.[6] At present, there are many old main halls in *Shiga*, *Kyoto* and *Nara* prefecture including those that are undesignated, and the succession of skills is comparatively well maintained in many surrounding areas.

Meanwhile, when looking at temples nationwide, the shortage of traditional skilled craftsmen makes it particularly difficult to maintain and preserve undesignated wooden main halls (such as repair of damage to roofs and walls and replacement of rotting material). It has become common for wooden buildings today to be assembled on site by widely using metal fittings, nails and plywood to put together timber processed with joints, etc. in factories in advance. Opportunities to use traditional tools such as chisels, saws and planes in traditional joinery have decreased except in temple and shrine construction and traditional Japanese rooms, which has made it difficult to develop successors for traditional skilled craftsmen. This environment is also an issue for the repair of traditional wooden main halls.

Domiya-daiku decreased during the period of rapid economic growth when many of main halls built with non-wooden structure, and this later led to a nationwide decrease. Although there are comparatively many main halls from the *Edo* Period also outside the *Kinki* region, many temples without the necessary *domiya-daiku* nearby were located in *Hokkaido*, *Tohok*u, *Kyushu* and *Shikoku*, and *domiya-daiku* were requested from far away such as *Kinki* region. There is a high proportion of temples without the necessary *domiya-daiku* outside of the *Kinki*, *Chubu* and *Chugoku* regions, and local succession of skills is becoming difficult.

Meanwhile, two preservation organizations were certified for "selected preservation techniques" based on the Act on the Protection of Cultural Properties, and there is a system for granting qualifications to people who pass when training is provided for skilled personnel. The total number of people with upper and mid-level qualifications in the two organizations includes around 430 *domiya-daiku*. The important thing here is that it is vital for carpenters in regional areas who do not have the opportunity to work on the repair of nationally designated temples to learn techniques of *domiya-daiku* through the repair of undesignated properties in regional areas.

As an example, a *domiya-daiku* company building shrines and temples in *Osaka* handled work nationwide centered on *Osaka* and other parts of the *Kinki* region, repairing and building a variety of large and small shrines and temples including not only nationally designated properties, but also nationally undesignated properties. According to master carpenters of this company, students from five traditional architectural schools nationwide seek to work for *domiya-daiku* like his company because they are unable to do carpentry work at ordinary construction companies now.

Conclusion

The scope of subsidies is limited considering that there are many old main halls completed in the *Edo* Period or earlier. Fundamental repairs including disassembly are difficult when not nationally designated, but the succession of skills is also difficult due to the limited opportunities for skilled craftsmen to perform repairs if there is a small number of historical buildings to repair. In order to revive the "culture of repair" in each region, it is also important to appropriately perform repairs of nationally undesignated properties and to pass on values and skills to the next generation.

In particular, in regions where there is a lack of funding due to the declining population, it is necessary to ensure traditional skilled craftsmen are sustainable in local communities by expanding the scope of repairs from the limited number of nationally designated main halls to nationally undesignated properties. In addition, preparations should be made for the risk of losses of local cultural properties including those that are undesignated which are caused by large-scale earthquakes.

Acknowledgement

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The temporary architecture built with wood and the property of land and urban real estate development.

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Abstract

The temporary architecture built with wood and the property of land and urban real estate development. The awareness of the city of Villa de Álvarez, Colima, on the importance and need of conservation of the Petatera in this community has influenced the local authorities to decide on the allocation of the plot where the plaza is built, as exclusive for the construction of this building made from wood and petates. This recognition of the ownership of the land is a mature decision of the government to protect the temporary architecture and the traditional techniques with which it is built every year. It presents the whole process of government decision and the participation of the community in the defense not only of the construction of wood and mats but of the defense of the land where it is built.

Keywords: *intangible heritage, real state, community*

Context

The bullring "La Petatera" of Villa de Álvarez, is a monument of great intangible value built from wood and fibers. Originally it had a religious purpose, and over the years that has been combined with modern culture to become an intrinsic part of the identity of the villalvarense people. The cultural importance of this historical monument has been ever growing, becoming part of the history of each person who lives through the traditions: both its annual construction and the festivities that it is part of. According to records, “La Petatera” has been in different places and has changed dimensions, but has always maintained its structural essence: the use of materials and their arrangements, while also adapting to the needs of the inhabitants.

Image 1. construction of the structure of the bullring “La Petatera”, 2016.

Image 2: spectators inside “La Petatera”. Source: Villa de Álvarez Historical Archive, 2015

Materials and components

The entire structure is built with materials from the region where the “petate” stands out the most. Common materials are pine, otate, bamboo, tepehuaje and white cedar. The ring is made up by tree trunks, metal cans, screeds, brackets, wooden boards and the structure to give shadow and its supports. All these are fixed in place with ixtle ropes and nails.

Image 3. View of the lower part of the walkways and stands. February 2017

Image 4. View of the shadow structure. February 2017

Image 5. Bullring “La Petatera” on J. Merced Cabrera Avenue: Historical Archive of Villa de Álvarez, 2015

It is composed of 70 sections, each with 7 trunks, 4 cans, 56 squares, 7 brackets, 2 platforms, 16 wooden poles and 3 veils, with all structural elements made from different woods. It also contains 36 petates, ropes, otates (type of bamboo), 2.5 kg of nails and 8 hooks. In total, this structure contains 490 trunks, 630 cans, 3,920 squares, 490 brackets, 70 platforms, 1,120 wooden poles, 2,520 petates, and 576 hooks.

Historic locations of the petatera

In its origins, the bullring was a small structure without stands that was built on the main square of Villa de Álvarez. In the 1930s, it was relocated a few blocks to the south, in the area that is now occupied by the Enrique Andrade primary school. By 1940, the bullring and accompanying structures were built in “La Frontera”, a nearby meadow some 300 meters to the north of the main square. The festivities were celebrated there for two consecutive years. It was in 1943 that Isabel Toscano, widow of Gutiérrez, donated some land on the outskirts of the urban area, on the road to Minatitlán, in front of what was then known as the pens of “La Haciendita” and served as a casino. Today, that site is where the municipal Cultural Center and headquarters of the local DIF stand. Sometime later, the ferial grounds were relocated some 200 meters to the west, on the terrains that are now occupied by the municipal sports complex. The bullring was to be built on that same spot for 25 years. In the year 2001, it was once again moved a bit further out from the city, some 300 meters to the west, but remained on the same street. During this period, the construction effort was headed by Ramón Cervantes Gómez, who had built it for 8 years on the previous sites. In 2002, the figure of Desiderio Contreras comes into play once again (Tortajada Rodríguez, 2003, p. 63).

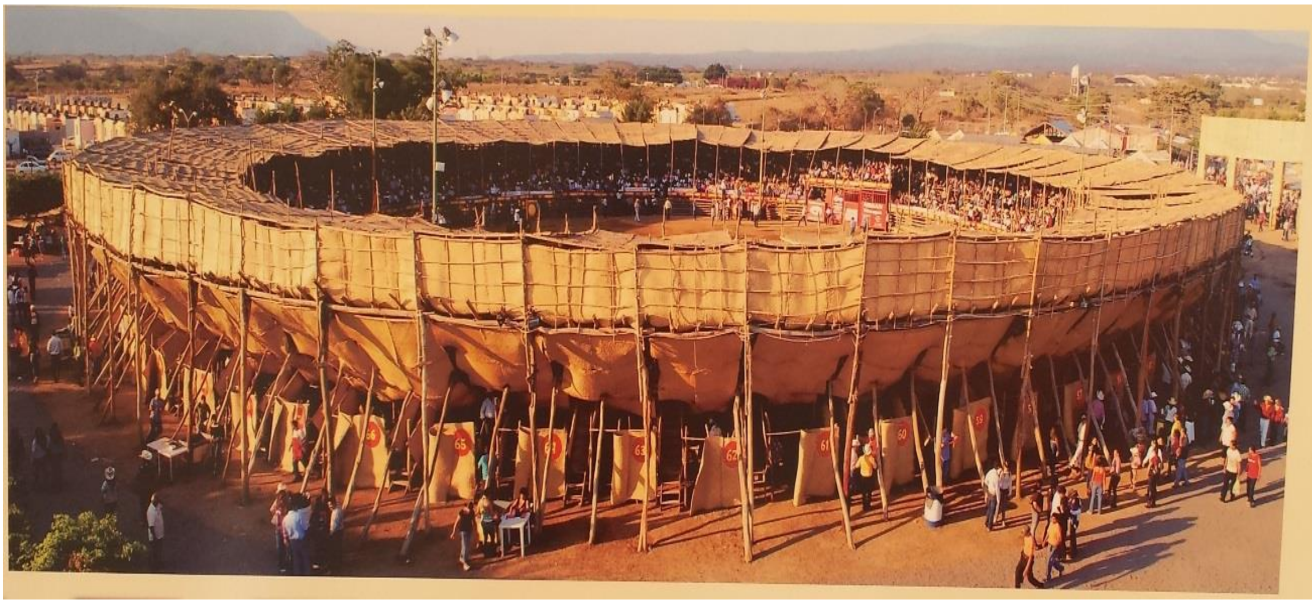

Image 6. Bullring “La Petatera” as it is built today. Historic Archive of Villa de Álvarez,

Today, this cultural symbol is built near one of the main ring roads of the city, near its modern limits. It maintains the traditional structure, shape and size and previous years, as well as the construction process involving wood, “Y” shaped tree trunks and metal cans that support all of the weight of the seats and walkways above.

Conservation history

On December 15th of 2017 in New Delhi, India, and within the General Assembly of the 21st ICOMOS symposium, the general principles regarding the conservation of architectural heritage built with wood were adopted. Thanks to the presentation of this cultural heritage from Villa de Álvarez, Colima, our county now formally inaugurates a new chapter in the protection of heritage made from wood. Dr. María Guadalupe Zepeda assumed the commitment of communicating and spreading the principles within the Americas for the next 3 years. A proposal was made for the inclusion of the principles from the Scientific Committee for Wood Conservation from the 20th International ICOMOS Symposium that are defined as follows:

- For Centennial Heritage, **Temporal and Modern Heritage** is added
- For Immovable Architectural Heritage, **Movable Architectural Heritage** is added
- For Permanent Architectural Heritage, **Periodic Architectural Heritage** is added

Another action undertaken by the municipality in honor of this monument was to rename one of the main roads in the city from “Libramiento Gobernadora Griselda Álvarez Ponce de León” to “Avenida La Petatera”, through official statement SE. No 90/2017. With record number 064 from the 3rd of February of 2017, the City Council approves and verifies that in the year of 2017, the official name of the road “Libramiento Gobernadora Griselda Álvarez Ponce de León” changes to “Avenida La Petatera” in the section between roads “Avenida J. Merced Cabrera” and “Avenida Pablo Silva García” in the city of Villa de Álvarez, Colima on the following grounds:

“The year 2017 marks the 160th anniversary of the charrotaurino* festivities in Villa de Álvarez, and the importance of the preservation of such a significant cultural and historical event is more than evident. Many awards have been received for the construction of such a peculiar structure, and the Petatera has been declared a National Artistic Heritage asset by the National Institute of Anthropology and History (INAH) since 2009. February marks the start of the largest festival in the city, and thus the 50th Legislature of the Honorable State Congress decreed on the 21st of January of 2016 that the Charrotaurino Festival, and all and any traditional activities that are part of them are to be considered cultural state heritage from that date onwards. Renown architects have also acknowledged this traditional structure, such as Carlos Mijares Bracho through his book “La Petatera”, a work published by the University of Colima and also illustrated by Roberto Huerta San Miguel.”

During the closing ceremony of the festivities “Festejos Charrotaurinos de la plaza de toros La Petatera de Villa de Álvarez” in 2019, a special acknowledgement was made for the people that make this special structure possible through their knowledge and effort, and the bullring received the honorary title of “Exemplary Wooden Architectural Heritage”.

As a result of all of this, an initiative was made by the mayor to designate the current build site as exclusive for the wooden bullring and the accompanying municipal fair.

CURRENT LOCATION OF THE FAIR GROUNDS

This plot of land is located to the west of the city of Villa de Álvarez, on Avenida La Petatera in the neighborhood of Villas Providencia, 28987. Detailed information on the plot:

- Cadastral record: 10-01-90-A29-567-000
- Type of property: RUSTIC
- Owner: Municipality of Villa de Álvarez

- Location: Av. La Petatera, Villas Providencia, Villa de Álvarez, Col.
- Surface area: 90,000 m^2

Image 7, 8. Current location of the fair grounds for the "Petatera": Av. La Petatera, Villa de Álvarez, Colima. 2019.

URBAN PLANNING

Process for the regularization of the property

Image 9. Property as stated in the current UDP (Urban Development Programme) of Villa de Álvarez, zoning areas.

Image 10. Property as stated in the current UDP (Urban Development Programme) of Villa de Álvarez, urban structure.

As per stated in the Urban Development Programme for the Urban Area of the Municipality of Villa de Álvarez, Colima, published in the Official Gazette of the State on December 19th of 2015, the noted property is zoned as Special Equipment area (EE) on a controlled access road (VAC-1).

Because of this, a special urbanization programme is needed, in which all scenarios for the use of the land and accompanying restrictions or limitations are properly defined, all in conformity with the law as stated in articles 256, 275, 276, 277 and 278 of the Law on Human Settlements of the State of Colima.

The proposals detailing the solutions and feasibility of providing the property with potable water, handling and treatment of waste waters, electricity, handling and disposal of solid waste and other urban services will be presented in due time, as well as the construction of proposed roads and consolidation of existing ones as per stated in the Urban Development Programme and other authorized partial development programmes. All in conformity with the Environmental Law of the Sustainable Development of the State of Colima, chapter V, article 45, fraction IX that states that the project must obtain the environmental impact resolution issued by the Institute for the Environment and Sustainable Development of the State of Colima (IMADES).\\

Distribution Project:

The architectural proposal will be developed accordingly, the main objective being the improvement of the distribution of spaces to ensure proper operation of the facilities while also emphasizing the protection of the Petatera.

Incorporation into municipal management:

In conformity with article 263 of the Law on Human Settlements of the State of Colima, the incorporation of plots of land into municipal management refers to the procedures that declare the change of state from a rustic or non-incorporated plot that make up the urban reserve to a fully functional area, according to the specified use in the Urban Development Plan.

In relation to properties that are already within city limits, and that their partial urbanization plan dictates improvements or modifications to their urban designation, the incorporation into municipal management refers to the procedures that allow for the change in official uses, densities, intensities and other specifications.

DESCRIPTION OF THE ADMINISTRATIVE AND POLITICAL PROCESS TO RENDER THE PROPERTY AS EXCLUSIVE FOR THE USE CASE OF THE FAIR GROUNDS AND FOR THE ANNUAL CONSTRUCTION OF THE PETATERA

1. The mayor, along with the administrative personnel of the Department of Urban Development prepare and develop the proposal to safeguard and grant exclusive rights of the area for the construction of the monument.

2. Initiate the project and create a partial plan to present to the corresponding departments for consideration and potential approval.

3. Inform the Human Settlement Commission for the preparation of an opinion on the partial plan for the development of the area, with noted emphasis on the conservation of the property for the continuity of the Cultural Heritage.

4. Do the necessary tasks to obtain commitment letters from the Department of Urban Development, board of trustees and councilors involved to safeguard the property from any future modifications that go against the intended purpose.

5. In a council session the following is requested: approval of the zoning as stated in the partial plan and the proposal of the initiative to safeguard and give exclusivity of use to the structure that is already recognized internationally.

6. Once approved by the council, the secretary of the municipality of Villa de Álvarez will inform the General Secretary of Government for its publication in the official gazette of the State of Colima and thus its officialization.

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WOLLATON HALL – PROSPECT ROOM FLOOR

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Abstract

Wollaton Hall (1580-88), built to the design of Architect, Robert Smythson (Longleat and Harwick Hall), is one of the most important Elizabethan houses in England (figure 1). The Prospect Room rises above the house to provide outstanding views over the parkland, and contains a 'Chinese lattice' floor structure (figure 2), where no beams clear span across the width of the room. Each main beam is tenoned into its reception beam at rights angles, which are then tenoned into further beams or bear onto the external masonry walls. This paper will look briefly at the history and possible reasons for this unusual form of construction, the defects found and the conservation repairs undertaken.

Key words: *Oak, Lattice, Serlio, Wollaton, Smythson*

History of the House, Floor and Alterations

Wollaton Hall is situated to the east of the City of Nottingham and set in 500 acres of parkland. It was built for Sir Francis Willoughby, a Scholar and Entrepreneur, whom inherited the estates from his father whom made their money from coal mining, as well as holding significant land holdings and was well connected to the Court.

Master Mason John Smythson, designed the house and was one of the first in England to be described as an 'Architect'. It was based on a Medieval plan but with the symmetrical elevations typical of the period, and with the entertaining rooms at first floor and the living and service quarters at ground floor. The Prospect Room sits over the Great Hall, and had lead covered flat roofs around the periphery.

The Prospect Room is rectangular in plan and around 20m long and 10m wide, with stairs in corner towers which continue to the roof over. It has large windows to the sides and ends to allow the owner and his guests to see the 'prospect' out over the Parkland and wider estate.

The 'Chinese lattice' floor is thought to be the earliest example of such a structure which are very rare. So where did the idea come from? An Italian Architect, *Sebastiano Serlio* published a book titled '*Serlio's L;Architettura*' in 1545 which included a drawing and description of such as structure (figure 3). The book is known to have arrived in England by 1566, so could well have been in the Scholar Willoughby's library. Of course it could have been his Architect whom owned the book. Of course the practical benefit of the design was that shorter beams could be used.

The Great Hall below the floor has large decorative hammer beam trusses, however these are in fact 'dummies', hollow and formed of boards, and thus perform no structural function. The floor structure over is completely independent.

As with most structures the floor had suffered over its life and repairs at different times undertaken. Four corner buttresses were added in the C17th, presumably die to concern about outward movement, and in the early C19th Architect Jeffry Wyatt (or Wyattville) was engaged in repairs which included re-levelling the floor by the addition of additional joists above the existing and the Great Hall ceiling added.

The house and Estate was sold to the City of Nottingham in 1925 whom subsequently moved its Natural History Collection to the Hall, which along with the Parkland was opened to the public, and continues in this use today. The second world war saw the building and estate requisitioned and used as a US Military Base, and a German Prisoner of War Camp respectively

Following the war the floor was inspected by a specialist Timber Consultant and Surveyor whom reported in 1953 on extensive timber decay, death watch beetle attack and pulling of the beam and joist tenons. He concluded that '*the safety of the floor is, however, so questionable that removal of the floor must be faced*'. Thankfully, this did not occur, but deep steel trusses were introduced with associated structure with hangers to provide support to the floor (figure 4). Whilst saving the floor this rendered the room unusable which was still the situation when we were appointed in 2003.

Previous Repair Proposals

Due to uniqueness of the floor a number of options for repair had been put forward prior to our involvement. Amongst others these included a new raised floor over the existing with an external stair though one of the windows! A further option was suggested in 1999 in a paper in 'The Structural Engineer' by C Jolley and K Brown of The University of Southampton which suggested continuous steel angles on the top and to the sides and then with matching tension cables to the underside to take the tension. These were suggested to the three 'continuous' lines of beams (beams 2 and 3, 5 and 6, and 8 and 9 – see figure 2).

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Figure 1. Wollaton Hall (by author)

Description

The Hall is of masonry walls with floor and roofs mainly of timber. Some movement was obvious but was not progressive in nature and this structurally not of concern. The 'Chinese lattice' floor comprises twenty-seven main beams varying between less than 2.0m and up to 6.5m. The timber is oak and approximately 370mm wide x 340mm deep. Each beam is jointed to the next with double tusk tenons and between each set of beams are oak floor joists of matching depth to the beams and between 50-75mm wide and also with double tusk tenons. The overlying 'Wyatville' levelling joists varied significantly both in size and quality with timber wedges used off the original floor members. The added steel lattice girders were buried in concrete within the masonry piers between the main windows.

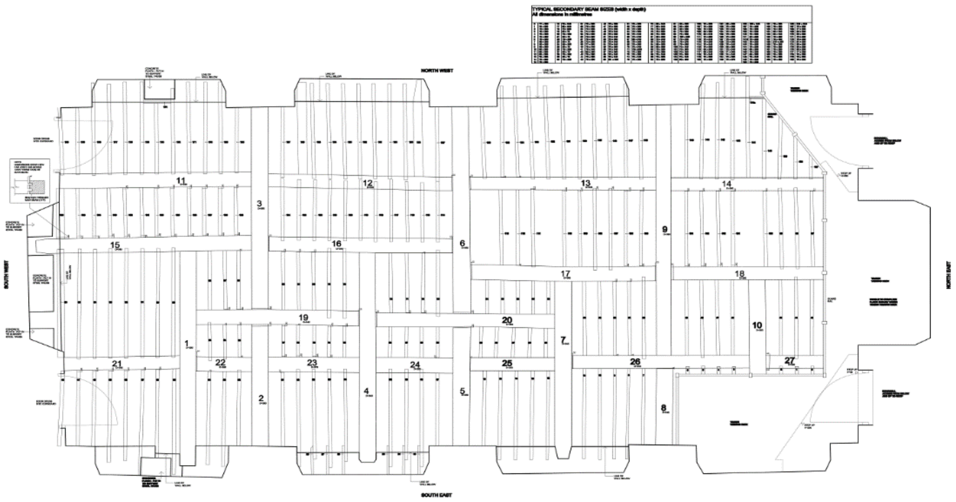

Figure 2. Survey plan of Prospect Room floor showing main beams marked 1-27 (The Morton Partnership Ltd.)

Investigations and Understanding

Following a successfully grant award from the Heritage Lottery Fund, The Morton Partnership Ltd. were appointed as Structural Engineers as part of a multi-disciplinary design team. As well getting the Prospect Room back into use and other fabric repairs to the House, the project included improved access for all, repairs to the stables and 1813 cast and wrought iron Camellia House, and within the landscape.

The 2002 published Conservation Management Plan provided important historic information on the hall and site as well as setting out clear issues and policies to guide us and against which our proposals would be assessed.

We inspected the floor visually, and commissioned measured surveys to accurately record positions, member sizes and deflections, as well as timber a decay assessment for moisture content, and insect and decay using micro-drills. This noted severe decay to main beams and 'hacking off' of assumed decayed timber, we assume as part of the Wyatville works (figure 5). The opening up confirmed the ceiling and 'false trusses' below to the Great Hall were separate.

The measured survey established the maximum deflection at the centre of the room was approximately 232mm to the original floor beams. Ridout Associates were appointed for the timber decay survey[2] and confirmed there was no current insect or fungal activity. The moisture content measured revealed these to be between 9.5 and 13.5%. This is too low for either fungal growth wood boring beetle activity[xxviii]. Importantly the decay to the beams was identified as likely to have pre-dated the Wyatville works as the added ceiling below showed no signs of damaged.

Figure 3. Sebastiano Serlio Book 1 – Serlio's L'Architettura (1545).

Assessment

In considering the deflection of the floor, it is likely that the oak was installed 'green' and would have suffered from shrinkage in its earlier life. This, along with the decay that has occurred, would clearly have reduced the integrity of the joints. Of course this could have been aggravated by any movement to the external walls. We had always known that the integrity and stiffness of these joints was the key to the strength and stability of the floor.

We considered that the restoration of the stiffness of these joints was critical to the reinstatement of the strength of the floor, and thus the removal of the steel lattice girders.

From an imposed loading perspective, the limiting factor was actually the size of the access stairs which allowed a maximum of 50 people in the room for fire safety reasons. The size of these also meant no large displays or furniture could be brought in. This allowed us to agree, with both the Client and English Heritage (now Historic England), the imposed loading at 1.5kN.m^2, which is equivalent to domestic loading. We did include some additional imposed loading to allow for the construction works to repair the floor.

The floor was structurally modelled, and with the critical beam identified as beam 9, one of the longest beams, but assessed as being adequate with the joint integrity reinstated.

Figure 4. Steel lattice trusses introduced in the 1950's (by author)

Figure 5: Hacked main beam (by author)

Solution

The floor had worked from 1580 through the 1950’s, over 370 years, successfully and despite the deflection and decay which had occurred, the Wyatville levelling timber were still reasonable true suggested that not much additional movement had occurred since that time. So simplistically we considered the key was to improve the integrity of the joints to allow the original structural intent to be reinstated.

We also took advantage of the three lines of beams (beams 2 and 3, 5 and 6, and 8 and 9 – see figure 2) which are in line and continuous across the building, where we built up layers of Kerto plywood over the beams, being glued and a screwed down, essentially increasing the effective depth and using the depth of deflection which had occurred. Plywood was used over the small section levelling joists, but with numerous inspection hatches, and floorboards over.

The actual improving of the integrity of the joists was simply by using bolted angle cleats to either side of adjoining beams (figure 6).

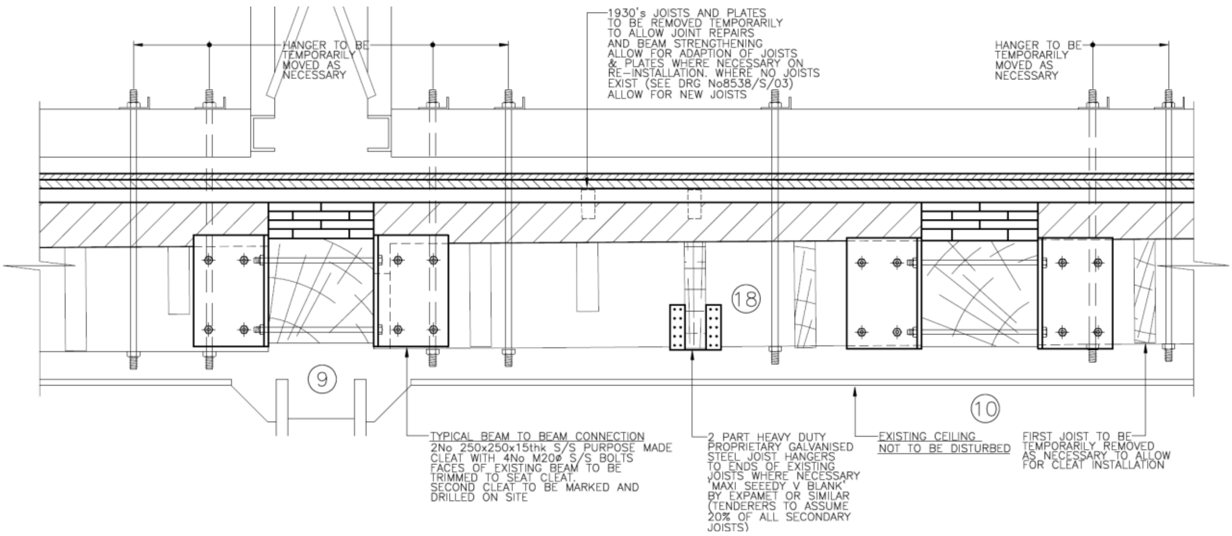

Figure 6 – Repair details for floor (The Morton Partnership Ltd.)

Figure 7 – The completed Prospect Room (courtesy Liz Hirst)

Buildability

Of course, key to the success was the sequence of work to allow the repairs and removal of the steel trusses. We required the steel to remain in place until the works were complete, but still with a crash deck formed below, and then the levelling joists were recorded and removed, but tagging to allow them to be replaced in their original positions as they were now an important part of the 'story' of the floor.

Once the cleats were installed, the hangers from the steel trusses were loosened and the floor monitored, and only once no movement was confirmed were the hanger completely removed. The steel was then removed by unbolting each individual member in turn. The remaining concrete was carefully cut out of the walls and the final floor repairs undertaken. The methodology allowed the Great Hall to be retained in public use for the duration of the works, except when the scaffold crash deck was being installed. This was designed to clear span between the Great Hall windows, cantilevering out to support external perimeter scaffold for masonry repairs.

The works were completed to the floor in around 12 weeks and at a cost of approximately £130,000 (at 2005 prices).

Conclusions

The main conservation structurally engineering logic adopted for the works to the 'Chinese lattice' floor was that it worked for over 350 years successfully, and thus with a little help should be able to be used for many years more and in to the future.

This was supported by the understanding of the history, investigations and structural analysis. Of course the real test is once the works is complete, and it is tested by actual use.

In this respect the results of the repair work far exceeded our expectations being inherently stiff with no signs of reverberations or deflections (figure 6).

Of course it would be intriguing to know why this design was adopted originally, and if it was a Client or Architect led, or indeed a practical decision based on timber procurement and difficulties for the obtaining long lengths of oak.

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Historic Carpentry Art in The Diocese of Lund

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Abstract:
The project *Historic Carpentry Art in The Diocese of Lund* started in 2014. By making a full inventory of the historic wooden constructions in the nearly 350 churches with medieval origin in the diocese we believe that what is known can be valued and what is valued can be saved. The general aim is to preserve by enlightenment and cooperation. The priority of the project are churches that are about to be restored. Cooperation with restoration planners, entrepreneurs, engineers, heritage officers, caretakers and authorities are of great importance to direct and limit actions to what is necessary in order to save the church´s heritage and reduce costs. Another aim is to make the carpentry art available to the parish members and to the public. Roof trusses and attics are 3D-modelled and published on Sketchfab, while papers and reports are published on the blog timmermanskonst.se. Seminars and lectures are held in the parishes. The regional medieval carpentry art is also seen in a larger European context. The accumulated knowledge is finally used in a PhD project that focuses on the carpentry art in the 12th century and its connections to the zeitgeist of the period.

Introduction

The medieval archdiocese of Lund consisted of Scania, Blekinge, Halland and Bornholm. This region was a large part of medieval Denmark and Lund was the seat for the archbishop. In 1658 Denmark lost all of the diocese of Lund to Sweden. Later Denmark got the island Bornholm back. The diocese of Lund was reduced and also lost Halland to the diocese of Gothenburg.

The contemporary diocese of Lund consists of 109 congregations and about 560 churches. Of these nearly 350 churches are of medieval origin and another great part of the churches are built in the 19th centuries. From previous research it is known that the diocese has many fragmentary high medieval wooden constructions and some intact late medieval constructions (Jansson 1987, Sundnér 1988 & 2005). How many roof trusses with medieval origin and of which different types had never been compiled, neither how many medieval doors that are extant, how many in masonry window frames that exists, how many churches that had free standing belfries or what other types of wooden constructions that could be found in the diocese. It was also evident that it was common that more intrusion than necessary were done on the medieval constructions during restorations because the knowledge of how they work or should be restored sometimes did not exist at the companies that did the planning or that the craftsmen doing the repairs only were familiar with modern craft techniques. To raise awareness, it was decided to start the project *Historic Carpentry Art in The Diocese of Lund* with the specific aim to make an inventory of the historic wooden constructions in the diocese and to obtain knowledge about how to best preserve and, when necessary, conserve this cultural heritage. A number of interesting churches were selected in a first phase, it was also decided to prioritize churches that were planned to undergo work that might affect historic wooden constructions. Since the project started in 2014 over 100 churches have been visited. In this paper only examples of what have been examined, done and are planned can be presented.

Historic Carpentry Art in The Diocese of Lund

In the diocese there are some quite intact roof trusses from the 12th century, the best preserved is the nave roof truss in Lyngsjö church that were built in the 1140s after a fire that burned down the predecessor. Examples of other well preserved 12th century roof trusses can be found in the chancel in Norra Åsum church dated to 1185, in the apsis in Tåstarp church dated to 1160s, and the chancel in Färlöv dated to 1160s. Well preserved roof trusses in the chancel of Perstorp church is from the 1250s and, as in Lyngsjö, the extant construction replaced an older one after a fire. In an earlier inventory 6 churches with in masonry wooden window frames were mentioned, now we have documented these in 34 churches. They were all, with one possible exception, built in the 12th century.[12] Hitherto unknown reused timbers that might come from the wooden churches, predecessors of the current built in stone and masonry, have been found in a number of churches and some of these timbers have been dated. During the investigation of the rooftrusses in the chancel of Färlöv church runes were found on one of the original rafters from the 1160s. The placement suggests the runes were inscribed before the roof truss were put in place. Most probably the runes were inscribed by one of the carpenters who built the construction. The diocese has 17 old extant freestanding wooden belfries, of which three are of medieval origin: Norra Mellby 1480s, Brönnestad 1490s and Perstorp 1503. Investigations on attics and in archives have so far increased the number of known medieval churches with free standing wooden belfries to 184. Reused remnants from torn down belfries are documented in 29 churches. This makes it possible for new research on the belfries of the diocese and their distribution over the landscape over time. The diocese have at least 40 medieval wooden doors, so far 5 of these have been analyzed with dendrochronology. A door from Skanör church is the only known counter rebated door outside England. The rare construction of the door, not noticed before the start of the project, has been discussed and compared with the English examples (Melin 2018).

Cooperation

One of the goals with the project is to raise consciousness about the cultural heritage in wood and through more awareness protect these constructions. During the project hundreds of people with different competences have been approached: decision makers, craftsmen, heritage officers, architects, conservators and dendrochronologists to name a few. But most important are the parishioners and the local caretakers. They are the ones that are in most contact with the churches and therefore are very important as defenders of their historical wooden constructions. The project is now, after going on for five years, well known. Parishes, and the competences mentioned above, contact us and cooperate when churches are about to be worked on. The project also have exchange with projects in other dioceses, institutions and researchers. By understanding the old constructions better the results also can be used in the maintenance of them. Cooperation with the Craft laboratory, a part of the University of Gothenburg, makes it possible to try different hypothesis about the medieval constructions as experiments that can be evaluated and finally implemented in restorations and maintenance. Examples of questions that can be evaluated are: tar recipes, wood quality and use, maintenance intervals and types of wood joints to use where and when. International exchange includes exchange with researchers from Denmark, England,

[12] A paper about the in masonry windows, with focus on the diocese of Lund, is to be published in the Danish journal Aarbøger for Nordisk oldkyndighed.

France, Finland, Belgium, USA, Norway, Italy, Canada and Germany. Especially the exchange with the National Museum in Copenhagen is important. Experts from Denmark are in our reference group and recently we have been invited to participate in a project concerning Danish golden altars. The Golden altar from Lyngsjö church in Scania has a wooden frame of oak under the gilded copper plates. And the plan is to bring it to the National Museums facilities and do transdisciplinary analysis of it and to compare it with the other Danish extant examples. The Lyngsjö golden altar will be investigated from a craft research perspective were the traces of production will be evaluated against and compared wih the written descriptions made by the 12th century monk Theophilius (Theophilius 1979). The analysis will further be the basis for a new conservation of the rare golden altar, not examined by conservators since 1954.

Synergies with projects in the Diocese of Lund
Historic Carpentry Art is not the only project in the diocese of Lund. Since 2016 a project about medieval mural paintings and plaster on the attics is ongoing. This project collaborate with the Carpentry Art project, something that facilitates the knowledge building. Another project is making an inventory of the church bells in the diocese, they are also examined and documented. A side project about the roofing materials used in the diocese over time has started this year by archaeologist Mattias Karlsson at Kulturen in Lund together with Karl-Magnus Melin. This project is funded by the Marcus & Amalia Wallenberg foundation. The roof trusses were part of a composite construction and to fully understand them it is necessary to know what roofing material they were built to carry. The roofing project will use surplus information from the Carpentry Art project, make more focused investigations in attics and museum´s collections and combine these results with archive research. In the diocese of Lund the church accounts are in some cases preserved from the late 16th century and onwards. In these documents there are among other things descriptions of the work performed on the wooden constructions, roofing materials, regional names for different timbers and the use of tar. Material specifications for no longer existing wooden belfries can be used to reconstruct them theoretically with quite good accuracy. Many of the maintenance plans for the churches in the diocese were made ten years ago or more. It is now regulated that they should be revised after ten years. Even if this is not a ”diocese project” the cooperation with the people doing these updates is vital in order to reduce costs and make the new maintenance plans as up-to-date as possible. Some of the results from the inventory, the craft research documentation and the dendrochronological analyses are used in a PhD project, that mainly focus on the 12th century carpentry art in the diocese of Lund. A further goal is to put it in a wider European context and try to understand it from a medieval contemporary perspective with the help of medieval literature, illustrations and the extant 12th century constructions (Melin 2017 & 2018, Almevik & Melin 2016).

Sustainability
We document the constructions carefully and make action plans based on their cultural value and long vitality instead of making plans from a modern ”rational” way of thinking. By this way of thinking less intervention can be applied. For example we might suggest a surgical repair of a wall plate, a cost much higher per meter than if the whole wall plate is changed, but much less than a total renewal and much more of the cultural value stays intact. Important ICOMOS charters behind these action plans are *Principles for the preservation of historic timber structures* from 1999 and the *Principles for the conservation of wooden built heritage* from 2017.

Availability
Most of the medieval wood constructions are to be found in the attics in the stone and masonry churches of the diocese. The attics are usually hard to enter and not accessible for the public in a way modern regulations allow. It is also often an environment with insulation and dust that is not healthy. So making the attics available for tourists is in most cases not possible. Instead the wooden constructions can be made available with modern digital technologies. Photo scanned 3D-models are uploaded on the internet

and make them available for the public and the research community.[13] Reports with descriptions, drawings and photos and papers are uploaded on the blog www.timmermanskonst.se. The diocese of Lund plans together with the local parish to create a restoration lodge when the renaissance church in Kristianstad is to be restored. The lodge would also include several exhibitions fcusing on ongoing and completed projects in the diocese of Lund.

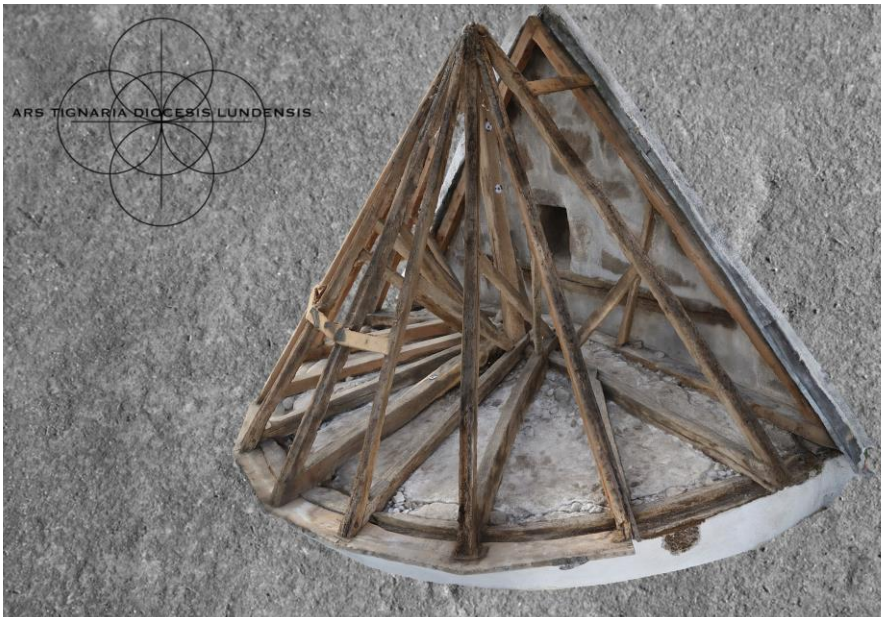

Fig. 1. Apsis roof truss in Tåstarp church. 3D-model produced with photo scanning by Camilla Melin. The 3D model is uploaded on sketchfab.

Installations

Electrical installations, and other installations as well, are unfortunately often installed by craftsmen that have no understanding of cultural values and worse is that the installations too often are done without a permit and surveillance by heritage officers. It is a priority for the project to raise awareness in these matters. We have been involved in some installation projects, discussing with the electricians and planners how to best install new wires. To the astonishment of all involved our interference resulted in less wiring, less intrusion on the historical constructions and also at less costs. In attics there are no use of the same amount of light as in a warehouse or in an office. When it is time to inspect the attics and search for leakage or inspect and document roof trusses a rechargeable LED lamp is of a much better use. A portable LED lamp is also of minimal cost compared to fixed light with wiring that is a potential risk for fire. It is essential to talk and discuss not only with a planner but also with the electricians that are going to do the work and that this meeting is held in the place where the wires are to be installed. It is also a good idea to install electrical plugs in the attic for a temporary work light or other tools that may have to be used during work or inspections.

[13] For examples see https://sketchfab.com/timmermanskonst

Fig. 2. A decorated plank from portal on a wooden church, reused in Brågarp church and now on display in the Historical museum in Lund.

Fig. 3. The old church in Stora Hammar has the only other known decorated plank reused from a presumed wooden church. Contrary to the plank from Brågarp this plank has not been valued but instead used by electricians to install electrical wires. In cooperation with the parish we removed the wires and it could be done with minimal harm to the invaluable plank.

Craft research

Traces of the used wood working techniques, tools and used quality of wood have been thoroughly documented. The oak used for constructions in the 12th century were generally of a quality only to be found in a forest that had not been affected by human intervention for hundreds of years. The preferred oaks were slow grown, straight and long with branches only high up on the stem. This quality of oak was suitable for cleaving and many of the oldest roof trusses were constructed with rafters with a trapezoidal cross section indicating they were cleaved radially (Melin 2017). We have also noticed that the oldest timbers and tie beams are hewed very smooth with a broad axe with single bevel, and also that the beams were prepared with the Nordic technique of *sprätthuggning* first were a double beveled axe was used.[14] The mix of two traditions can be interpreted as local carpenters first blocked the timbers and then the timbers were hewn by foreign carpenters, but more research has to be done before this hypothesis can be proven (Melin 2017a). It is very rare to find traces from the felling of trees and the transport of timbers. The only known example of 12th century felling traces was documented on an oak that was put in masonry over an opening in the church in Norra Åsum dated to 1185.

Traces from the felling have usually disappeared when the logs were hewn or when the timbers were shortened to their final length. In the churches of Särslöv and Bodarp we have found traces of transport, the roof trusses in those churches are most probably contemporary and Särslöv roof trusses were built with timber felled in the winter 1464/65 (Melin 2018a).[15] Carpentry marks made as a help when doing the joints and constructions are quite common from the earliest preserved examples to the latest. Assembly marks, which often are in form of additive scratched or carved lines or Roman number are common over long periods and not so helpful in the dating of constructions. But there are other types of marking that exists only for a short period in a more restricted region. These special markings, that we think in some cases are made by the same carpenter team, are only documented on late medieval constructions. We have so far identified three different carpenter teams that each are represented in at least two churches.[16] As a result of the project we have also been involved in the planning, the conservation and the documentation of probably the oldest extant lead roof in Scandinavia from 1770 on Bodarp church.

Fig. 4. Carpentry marks, in Särslöv church, on reused timber. Dendrochronological dating 1470s. The marks were made with a stamp and the system is additive. The same stamp has been used in Bodarp church by the same

[14] With the technique sprätthuggning the axe remove wood chips in the direction of the wood fibres and with continental technique the broad axe removes wood chips transverse the fibres.

[15] The roof truss in Bodarp is undergoing dendrochronological analyse after craft research investigation and sampling.

[16] In Melin 2012 and 2019 the roof trusses from Dalby and Gödelöv churches are described and they are most probably built by the same carpenters. The timbers from Dalby are dendrochronologically dated to 1503. The roof truss in Farhult church, dated to 1520-21, and the roof truss in Veinge church, dated to 1517 are very similar, and have the same type of marking. They are discussed and interpreted to have been built by the same carpenters (Melin in press).

carpenter team. The roof trusses in Bodarps church were sampled for dendrochronological dating that now are under analysis.

Dating of the roof constructions and the churches building phases

Since the 1970s there has been more focus on the roof trusses mainly in order to use them as objects that can be dated through dendrochronology. The sampling for the analyses was for a start done by dendrochronologist looking for timbers that they thought were good to date in order to build up reference curves to improve the science of dendrochronology.[17] In the late 1990s it became more common to first do a building archaeological examination before taking the samples.[18] With the current project the craft research perspective has led to focus more on the ocular examination before taking samples. Tool marks, traces of reuse, colour of the wood, type of joints and many other things have been observed and hypothesis about age and which parts that are reused or later additions have been crucial when it was decided which pieces to sample and analyse.[19] Next after this the dendrochronologist were involved and while taking the samples the timbers were examined to answer also silviculture questions. To evaluate different dating methods we have in some churches combined; ocular craft research dating, dendrochronological dating, mortar dating,[20] style historic dating of architectural features and of murals.

[17] Bartholin 1988.

[18] Building archaeologist Barbro Sundnér worked with combining building archaeology and dendrochronology, see for example (Sundnér 1988 & 2005).

[19] In Almevik & Melin 2016 craft research and conservation is further discussed.

[20] In Ranta et al 2009 mortar dating is described. The mortar datings done in the diocese of Lund is under analysis.

Fig. 5. A counter rebated door from Skanör church during dendrochronological sampling. Non- invasive methods were used where only a minimal amount of wood were removed on end grain in order to use a USB microscope to document the year rings for later analysis.

Fig. 6. Mortar sampling in Norra Åsum church. The church was first investigated thoroughly before dendrochronological sampling and analyse. In connection to dated beams mortar sampling were done to calibrate the two methods of dating. The samplings weres documented by video and photography.

Archaeological cleaning

It is quite common, in connection to work on church roofs, that the attics get cleaned from organic material. One of the reasons is that organic material can get wet and be a place for unwanted fungus to grow. Unfortunately this cleaning in some cases has been done with powerful vacuum cleaners and by workers without any knowledge about cultural heritage values. The cultural layers on the top of the masonry walls and in the pockets of the vaults usually have deposits that have been accumulated for centuries. In these layers garbage from the craftsmen can be found, their lost or broken tools, archaeobotanical material that is of great value for archaeobotanical and archaeogenetic researchers, pieces of off-cut material from the roof constructions that can be used for dendrochronological dating, coins and much more. The accumulated deposits have a great potential of giving information about the surrounding land, the craftsmen, the medieval building techniques, the use of the church attics for storing and the attics use for liturgical purposes.[21] If this source of information is cleaned away it is lost forever. To avoid this the project has initiated and cooperated on a number of archaeological cleanings where the waste is documented and removed in a controlled way by building archaeologists who work together with craft researchers. In a controlled archaeological cleaning the cultural layers give information and medieval murals, plaster and wood constructions do not risk to be harmed or destroyed by the vacuum cleaners hoses.

[21] In Melin 2016 the use of medieval attics, in the diocese of Lund, for liturgical purposes is discussed.

Fig. 7. Powerful vacuum cleaners erase everything. By chance the heritage officer Petter Jansson salvaged the only known rule for shingle roofers. Everything else was swallowed by the vacuum cleaner, and knowledge about the church and the building techniques were erased forever.

Fig. 8. Archaeological cleaning and documentation in Tåstarp church. The cleaning was done by archaeologists from Kulturen in Lund in cooperation with the project.

Church fires

In the 1980s an inventory of known church fires in Sweden was made (Midbøe 1985). In the inventory 16 churches from the diocese of Lund were presented. The current project has searched both in archives for mentions of fire and in the attics after traces. So far 82 churches from the diocese that have burnt totally, partly or had minor incidents with fire or lightning have been recognised. The reason of documenting church fires is not only of historical interest, it also has a practical reason. Strong fires often make cracks appear on the masonry. Cracks that can be mistaken for recent and also might be interpreted as caused by weak foundations when they might have been stable for hundreds of years. With the knowledge that the church has burnt the cracks can be interpreted with this in mind. In some cases it is not necessary to do drastic and costly investigations. Instead a gypsum telltale can be placed over the crack to decide if it is active. Increasing the knowledge about the history of each church might as in this case be used to save money.

Fig. 9. Taper burn marks on a reused, now vertical, oak timber from the 12th century. Notice the carpenter markings on the same timber that also is secondary but older than the current construction. The horizontal beam is of pine and probably from the 19th century. Before taking dendro sampling it is essential to do ocular dating in order to have a hypotesis before sampling.

Fig. 10. The church in Gumlösa burned 1904, photo taken by architect Theodor Wåhlin)

Taper burn marks

Taper burn marks used to be explained as the result of accidentally burning by candles. But scientific experiments in England have shown that these marks were made by deliberate intent as it takes a long time to produce them and that the candle has to be held in a sloping degree to make them have the characteristic shape that reminds of a light low on a candle (Dean and Hill 2014). In the diocese of Lund burn marks have so far been documented on roof trusses, church doors and other inventories in 15 churches. One hypotheses is that the burn marks were made to prevent that the church would burn, like the old saying fight fire with fire.

Conclusion

The extant carpentry art in the diocese of Lund consists of: 60 more or less fragmentary roof trusses from the 12th century, 34 churches with documented traces of in masonry window oak frames from the 12th century, 60 well preserved late medieval roof trusses, 40 medieval doors, reused timber from wooden 11th century churches, 17 wooden belfries and many more types of wooden constructions. The still working constructions consists of wood with tool marks and joints that can be analysed and interpreted to gain knowledge about the woodworking techniques, the carpenters, the patrons, the changing medieval minds of how carpentry should be performed and not at least which techniques that worked well over hundreds of years and which were failures from the start. This information can be shared and used during maintenance and restoration to preserve, use and develop this cultural heritage. To secure and spread the accumulated knowledge papers are written, presentations are held, 3D-models are put on display on internet and the new information is included in the updated maintenance plans. Many of the churches are only documented during a short visit so there is much left to explore in the future. The decision to prioritize churches about to be restored has been very fruitful. In many cases a restoration gives a good opportunity to document and investigate a church attic. The project has in some occasions been involved from the start in the planning and during the restoration so that an inventory of the wooden constructions and a plan could be worked out with the aim to interfere as little as possible with the constructions of highest value. This involvement has led to cooperation with decision makers, heritage officers, craftsmen, architects, engineers and parishioners. Awareness of the ancient wooden constructions and the fragileness of this unique heritage among all those involved in the management of the churches are vital and at least as important as any legislation. To make the wooden heritage available for future generations, to explore and enjoy, it is essential that sharing of knowledge continues after the project ends and the people involved in the management of the churches are replaced.

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First all the parishes and the generators that help us to visit their churches. The project has had tremendous help by PhD Barbro Sundnér and heritage officer Petter Jansson that have shared their research archives and results accumulated since the late 1960s and late 1980s. Petter Jansson is an active part in the project and also in the diocese project about murals and plaster above the vaults. Dendrochronologist Hans Linderson at University of Lund who has done most of the dendrochronological analyses in the project. Phd Federica Pompejano, PhD Mattias Karlsson and conservator Richard O. Byrne for proofreading.

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THE ROLE OF THE STAKEHOLDERS IN THE RECONSTRUCTION OF THE WOODEN ELEMENTS OF FUADIYE MOSQUE

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Abstract

Fuadiye Mosque is the only mosque in Fuadiye Village of Yozgat Province, Turkey. The mosque, built-in 1910, has the 19th-century First Turkish National Style masonry walls. It has a unique wooden roof with the wooden overlapped ceiling, a continuous tradition adopted since the 13th century.

The mosque caught fire in Jan 2014, which destroyed the wooden elements, pillar, beams, roof, overlapped ceiling, and stairs completely. As a caretaking authority of the cultural heritage in the region, Sivas Regional Directorate of the Foundations initiated a project to reconstruct the damaged mosque. ART-DEM Restoration-Architecture Company, a private firm, together with the technical expertise of the Foundations, utilized, traces on the structure, old photos, and modern 3D Laser-scanner for taking the measurement and conducting surveys for the restoration of the mosque. Most importantly, the roof with overlapped ceiling is reconstructed with traditional methods combined with modern joints for strengthening.

This paper intends to present insights into the reconstruction process of Fuadiye Mosque, especially on the use of wooden elements. The architect, the art historian, and the engineer, who are also authors of this paper are involved in the restoration project at different stages, will highlight the crucial roles of different stakeholder involved in the reconstruction process according to their experiences. The question of the effectivity of the different majors in different stages of the process is the fundamental question of the paper.

Keywords: *Reconstruction, wooden mosques, fire, interdisciplinary works, wooden overlapped ceiling*

Introduction

The wooden overlapped ceiling culture with locally called "*kırlangıç* (swallow) in Anatolia," which is a regional ceiling form, is the product of a millennial tradition that Turks carried from Central Asia to Anatolia. Overlapping ceilings are formed by overlapping wooden beams to form single-centered, stepped square or polygonal surfaces that gradually dwindle from outside to inside. It is an economical cover type due to the use of beams shorter than the length of the wall (Önge, 1975). One of the most developed examples of this form of the ceiling is seen in Erzurum Ulu Mosque (1179), and its simple forms are applied in the domes in front of the mihrab in Bayburt Ulu Mosque and Ispir Tugrulshah Mosque and the middle of the ceiling in the Ozbeyli Village Mosque in Kelkit District of Gumushane.

Fuadiye Mosque is the only mosque in Fuadiye village of Çekerek District of Yozgat since the civilization of the village. The ceiling covering in the mosque, built-in 1910, is an overlapped ceiling, dating back to the 12th century, over the masonry walls. In terms of design, exterior walls are arranged very merely and unpretentiously, except the northern façade. The mosque does not have a portal, which means there is no monumental entrance arrangement. The mosque has typical 19th-century First Turkish national architectural period features in terms of facade features, such as acanthus leaves and volute-curved leaves used in keystones on the facades, round-shaped windows, the capitals in the Ionic order, and ornamental elements on the mihrab. The interior architecture is particularly interesting in terms of wooden craft, overlapped ceiling, mahfil, minbar, and sermon chair, which carry the regional features of the wooden craftsmanship (fig 1).

Though the mosque was built in 1910, it has undergone several repairs in the 1960s and the most recent one in 2012. From the documents and traces in the building, in the 1960s, a concrete garden wall, woodshed, toilet, storage, and ablution place were added to the surrounding area, and the last prayer hall was closed with glass windows, and concrete and metal stairs were built instead of wooden stairs. In 2012, the minaret was added, and the roof was repaired, and the landscaped floors were covered with paving stones. During both repair periods, only maintenance works were carried out on the facade and wooden elements.

Figure 1. The mosque before the fire (SRDFA)

On 15 January 2014, the mosque suffered a major fire, and all the wooden elements from the floor to the ceiling were burned after the fire (fig 2). The villagers communicated the situation in the mosque to Sivas Regional Directorate of Foundations and placed cement finish on the floor in order to protect the structure. Sivas Regional Directorate of Foundations has appointed architect, civil (structural) engineer and art historian experts to conduct on-site inspections. As a result of the pre-fire situation of the building and the data that emerged during the fire, it was proposed to register the building and conservation works were initiated as soon as possible. As per their suggestions, firstly the burnt timber was removed in a way that would not damage the structure, and then the structural strength was tested by core sampling from the walls. Upon the registration of the structure by the conservation board, the Sivas Directorate of Foundations started a tender for the building's survey, restitution, and restoration projects and electrical and machinery projects of the mosque. The firms or companies who want to participate in the tender need to have experience in this particular field, and they need to have experts on their team. The documents related to these conditions were specially requested for participation. As a result of the tender, ART-DEM Restoration Architecture awarded the project design work. The team consists of three architects, including one restoration specialist, one expert art historian, one construction technician, and one restorer. Electrical and machinery projects were carried out jointly with the experts of the other companies. After obtaining documents and photographs from the Sivas Regional Directorate of Foundations, the structure was visited for measurement. 3D laser scanners and traditional methods have been used as a measurement technique. Eleven sessions, four in the interior of the building and seven in the exterior were established, and measurements were carried out. Traditional methods have been used for decoration details, window details, wooden seating, and provisioning. In addition to scanning, photographs were taken with high-resolution cameras for documentation from inside, outside, and minarets. Other than that the team interviewed local villagers and the headmen to collect data about the original condition of the building and the repairs it underwent.

Figure 14. The mosque after the fire (SRDFA)

While preparing survey projects according to the data obtained, the expert art historian has started researching for the determination of structures of the same period and structures of similar typology in the region. The researches include the literature and archival research along with the interviews with the local community. The smallest hints and data were evaluated until the approval of the project from the Conservation Board. All kinds of visual materials obtained during the researches, information describing the structure and repair information have helped to shape the survey projects and the restitution projects that reflect the original status of the building. In the literature research, not so much information was found about the mosque, which had not previously been registered. The drawings of the disappeared ceiling system and the ceiling decorations and the destroyed door could be made with the help of the old photos obtained from the local community. After the documentation studies, all the information and obtained findings were reported. The reporting work, like the project work, consisted of three phases. In the first part of the report; the current structure was described with the help of current photographs, and the problems were mentioned. In the second part, the restitution report, which includes the historical status of the building, was mentioned. In the restitution report, the information found in the archives and literature studies were mentioned, and the traces coming from the structure, especially the old photographs of the building, evaluations were made on comparative studies and typology. Finally, the procedures to be carried out within the proposed project are explained in detail.

Accordingly, the planning scheme shows similarities with the mosques in the other villages of Yozgat and Tokat in terms of both the planning scheme and the using of the wooden pillars and wooden ceilings

(Erdemir, 1987). In terms of the ceiling and roof system, the overlapped ceiling, the oldest known example in Erzurum, and also seen in nearby provinces such as Kırşehir and Yozgat in the 19th century, was used. It is similar to many mosques in the region in terms of having a women's section on the upper part of the last prayer hall. The last prayer halls generally have triple entrances with wooden or stone columns, and the upper part is covered with a wall, and windows number varies between three and four. Two-story window system and similar forms of windows are conventional among contemporary examples of the mosque. More elaborate materials and craft can be seen at the corners of the walls. On the other hand, the women's section was gone beyond the last prayer hall to the harim, carried by two independent pillars and two pillars lean on the walls. Again, this type of practice is frequently encountered in mosques in the region. Although it is the only mosque in the village, it shows typological similarities in terms of plan, façade, top cover and ornamentation with the mosques in the region and built in this period.

Figure 3. 15 The mosque during the repair (SRDFA)

The ceiling and roof system solution in consonance with the traces of the missing wooden elements is the essential point that needs to be analyzed in the structure. First, the positions of the struts and beams were determined in line to the traces in the structure. According to the comparisons made with the old photographs, the height of the facade was calculated, and the amount of stone wall to be built, and the seat of the wooden beam was determined. After fitting the main beams, the size and location of the beams to be used for the overlapped ceiling must be determined. The mosque is covered with an internal overlapped ceiling and externally hipped roof covered with tiles. The ceiling of the women's section is flat. Both the entire roof and the interior ceiling require a mutual solution. For this purpose, the middle point of the rectangle obtained by excluding the women's section was found, and at the same time a roof solution was made, and the ridge position and height were compared with the highest point of the ceiling. It has been deemed appropriate to obtain the wooden ceiling core by hanging it on the ridge post, both technically and as a technique observed in similar structures previously, and beam analyzes have been made in the light of this information. First of all, 30x30 cm beams placed on the wall and 30x30 cm beams are connected at a 45-degree angle, and the transition from rectangle to octagonal form was made. However, since the main form is rectangular, the edges of the octagonal form are not equal. Then a smaller rectangle was obtained with 25x25 cm beams placed from the middle of these diagonals. In the middle of this rectangle, 250x250 cm in size with a square space of 10x10 cm beams are placed at 50 cm intervals. At the edges of the square gap formed, eight ridge purlins sitting from the main post was placed, and the gap between the post and the truss were formed with a horizontal element. All these beams were covered with a bottom covering board (fig. 5). The ceiling rose is suggested to make by nailing. It has been proposed to use bolts in the combination of beams of 30x30 cm and 25x25 cm for both the difficulty of finding the carpenter who knows the traditional techniques and to strengthen.

Figure 16. The mosque after the repair (SRDFA)

The projects prepared were also examined by the Sivas Regional Directorate of Foundations, after determining other interventions to the structure. After reaching a common view, the projects were sent to Kayseri Cultural Assets Conservation Board for discussion. The proposal and the project prepared were deemed appropriate by the board after the experts visit the mosque on-site. After this stage, as the owner of the structure, Sivas Regional Directorate of Foundations went to the tender for the repair works. As in the tender for the project, a document indicating that they have done similar work before and documents indicating that they have the necessary experts are requested. Başaran Architecture awarded the tender. In the firm where the architect works as the site chief, two experienced carpenters from Tokat, masons, plasterers, painters, and fitter have been employed for this structure. First, a static examination of masonry walls was made. It was observed whether there was crack development due to the heat effect. Cavity ratio was calculated by local drilling. The hydraulic lime-based liquid injection is used to strengthen it statically. Besides, internal and external walls were plastered with hydraulic lime mortar.

The ceiling and roof system was implemented one to one in the details described in the project (fig 6). The first-class pine timber from the Samsun, where is the neighboring region to the village, was used as the wood material. Due to the bearing characteristics of the wood, the attention was paid to obtain large size wood from one tree. The woods were impregnated before use, and water-based preservatives were applied. Water-based varnish, which has been tried and determined successful before, has been applied to the woods exposed to weather conditions on the exterior façade to protect from the effects of cold and rain. The wooden elements in the structure, especially in the pillars and beams bearing the women's section, dovetail technique were used for joints (fig. 3). Modern techniques have been used to cut wood ornaments in the wooden ceiling core; parts are cut out on CNC instead of hand carving and nailed. Also, bolts shown in the project were used in joining large wooden beams. All these applications were carried out under the supervision of civil engineer from Sivas Regional Directorate of Foundations at every stage. After all the applications were completed, experts from the Sivas Regional Directorate of the Foundations (architect, civil engineer, art historian, electrical engineer, mechanical engineer) examined the implementations in line with their expertise, and after approving, the building was put into use (fig. 4).

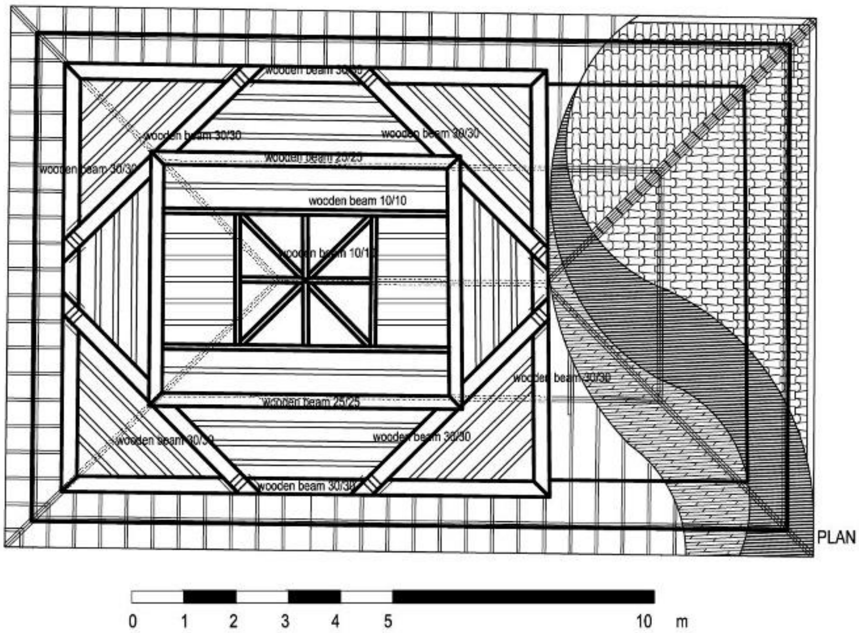

Figure 17 The suggested overlapped ceiling and roof solution (ART-DEM Archive)

During this whole reconstruction process, different experts from different institutions worked together. The institutions and different occupational groups involved in this process are shown in the graph (fig. 7). Thus, the stakeholders involved in this process are the local people, Sivas Regional Directorate of Foundations, Kayseri Cultural Assets Conservation Board, Art-Dem Restoration, and Basaran Architecture. A total of seven architects, three art historians, one civil engineer, one archaeologist, two electrical engineers, two mechanical engineers, one lawyer, one restorer, one technician and carpenters, masons, painters, plasterers, electrical technicians, and machine technicians were employed in the project and implementation process. The local community has been actively communicating with Sivas Regional Directorate of Foundations and ART-DEM Restoration Company during the project design phase. The experts involved in the project and implementation process outside the local community differs in every stage. In the project phase from Sivas Regional Directorate of Foundations, electrical and mechanical engineers, especially architect, civil engineer and art historian are active; in the implementation stage, the civil engineer was in the foreground, and the architect, art historian, electrical engineer, and mechanical engineer have also approved the implementation. Kayseri Cultural Assets Conservation Board incorporates different professional groups consisting of academicians and experts. These are two architects, art historian, archaeologist, lawyer, board director, Sivas Regional Directorate of Foundations director, Yozgat Governor's representative. The experts from the Foundations and the Board represent the state sector and include the Academy. ART-DEM Restoration-Architecture, which is in the project stage from the private sector, has three architects including one restoration expert, one expert art historian, one construction technician and one restorer, and BAŞARAN Architecture, which is in the implementation stage as the private sector, has the architect as the construction supervisor, carpenters and other masters for the implementation works. People from a different educational background, different vocational education, and different world-views gathered for the reconstruction of the ceiling and roof system and preserving the structure of a single mosque in the village of Fuadiye in Yozgat. While art historian is trying to capture traditionalism in typology and decoration, the architect aimed to protect the technical details and the perception of space in this process while building the ceiling with its original details. The civil engineer, on the other hand, tried to ensure the methods of obtaining the wood, brought together, and then protected. Likewise, other professional groups not mentioned here have tried to fulfill the requirements of their respective fields of expertise. However, the common aim was to preserve the mosque with its authentic architectural features, decorations and function and providing the continuity of the tradition. It was essential to making a joint decision for each solution proposal, which resulted in a successful project and implementation process. Also, while the most enjoyable part of the project has been researching work, such as combining pieces of an unfinished puzzle, for the art historian; the analysis and resolution of the roof and ceiling system have been the most enjoyable part for the architect. The adaptation of the project one to one to reality has been satisfied the civil engineer.

Figure 6. The implementation of overlapped ceiling (SRDFA)

In this paper, it has been tried to determine which stakeholders, which occupational groups are active at which stages. The local community, in the meantime, the users of the mosque, has been effective both in determining the original state of the structure and the user needs during the project design process. While the private sector is the project planning and implementation units, as the owner of the mosque, the Sivas Directorate of Foundations Regional Directorate is the most active institution. In particular, control and supervision are provided by experts within the state. The Academy is a function that has received more opinions and does not intervene actively. Although the field of expertise and perspective of each occupational group is different in this application, it has been found out that since the idea of conservation is based, it is a success to cooperate in the whole process and to give equal rights to each occupational group and stakeholder. In the project and implementation phase, notably the architect, the art historian, and the civil engineer also played an active role, while the absence of an expert civil engineer member in the conservation board could be considered as a weakness in this point. Two crucial factors draw attention to the success of this practice; the documentation made by laser scanning enables the application to be performed one-to-one, and the experience of the masters, some details not shown in the project or the problems arising during the application have provided the correct solution on-site.

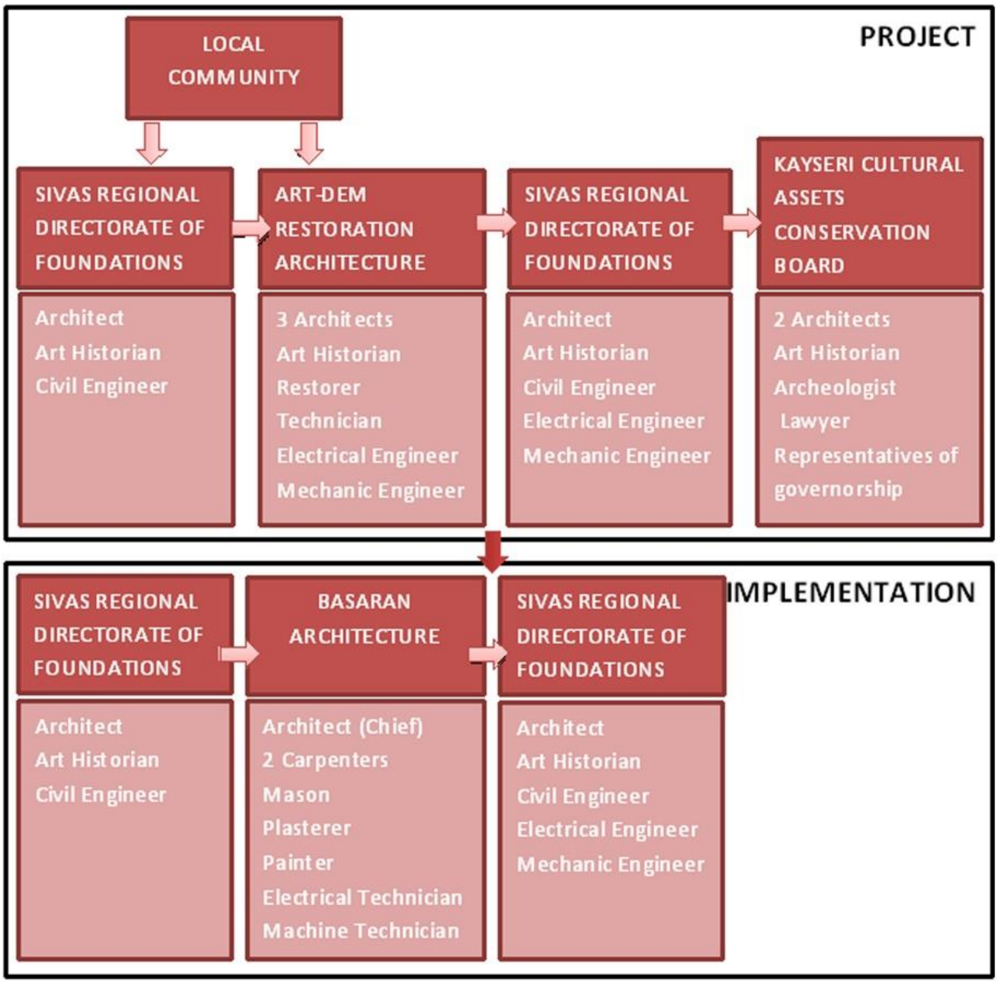

Figure 7. The stakeholder involved the project and implementation process

As a result, the experts working in the state institution are in charge of the control and supervision, and the experts in the private sector are the practitioners. In order for the projects and implementations to be healthy, to carry the conservation principles and to continue the traditional methods, the masters and experts involved in all these processes must be trained to be sensitive to the basic principles of conservation and to master the traditional techniques.

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Sivas Regional Directorate of Foundations Archive (SRDFA)

The roof of Skokloster House seen through a carpenter´s eyes - 9000 hours of specialist restoration in wood

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Abstract:

For eight years I have been observing, through my carpenter eyes, and reflecting over the details of the 17th century roof of Skokloster House. I have been the head carpenter leading 25 specialists, hand-picked for their special skills in carpentry and blacksmithing.

The House was built in 1654-71, by the field marshall Carl Gustaf Wrangel. Luckily, letters between the book keeper and count Wrangel, together with several documents listing quantities of material and labour over the years, have been preserved. These documents were presented in a book by PhD Erik Andrén in 1948. [1] The House was built in several stages with general cuts in the construction between each building season. Parts of the roof construction are built with reused beams and left over material from the lower levels in the House. There are also roof trusses relocated in the attic. Over the years, when the roof has needed restoration and strengthening support, the carpenters have continued to reuse material that was available, lying on the attic, cleaving larger beams into smaller pieces and pit-sawing beams into boards and laths. They also used wood from the 18th century, when the window frames were changed.

In our restoration 2009-2016, we continued reusing material that was available in the attic and from the local forest, using traditional methods and hand tools. After 8 years, we also left a lot of timber, that had not been used, on the attic for the next generation to use. Leaving new and reused building material for future needs, has become a restoration method/philosophy that is a part of Skokloster's values. We have saved the most interesting parts for the museum.

Keywords: *restoration philosophy - reusing wood - traditional tools and methods - local forestry.*

[1] *Erik Andrén. 1948. Skokloster ett slottsbygge under stormaktstiden*

Traces of the immaterial heritage

Skokloster House is the largest private house ever built in Sweden (fig. 1). It's also considered to be one of the most outstanding Baroque Museums in Europe.[2] Skokloster is complete with about 50 thousand artefacts including furniture, books, textile, paintings, tools, weapons, library etc. An important aspect of the research method is the interplay between building research and the practice of craftsmanship in previous restorations. Observing and reflecting over the details in the preserved attic has given us a broad perspective of how to solve carpentry problems. Opening up a historical building is like going to a library and opening a book that has not been read for centuries - given that you can read the language!

Fig. 1 - Skokloster House 1654-1671.

Fig. 2 - Inner corner without the valley rafter.

Different levels of the carpenters skills and ambition can be related to each building phase of the House. The first part, the seaside, has a roof construction made by craftsmen who had the opportunity to do a good job without stress and getting well paid. Count Wrangel wanted the House to be pompous and richly decorated, but he was pennywise so the building engineer struggled to get the local farmers and accommodated military to work for less money. The building project was suffering in quality, more for each year. The second last building phase, the roof trusses were produced poorly and were more or less thrown up together. The consequence was that the pieces did not fit well so brutal adjustments had to be done on site. Waiting for the next building phase temporary rafters were put up to support one side of the roof but were left in place and built in. This is one of many characteristic values of the attic.

Count Wrangel did not spend much time at the building site, mostly he was on the continent. He communicated with the bookkeeper through several letters over the years. These letters are a treasure of information making it possible to follow the building process down to when nails were bought and rafters delivered, even the names of the persons involved. Inspired by the latest techniques and architects, Wrangel was changing his mind about how the palace should be built. One detail, a novelty in this country, was an integrated water collector, lowered into the roof end. Secondary cut into the roof trusses and formed by boards, covered with copper plate, leading the water out to the corners towards the towers. Copper pipes led the rain water down to the ground. Obviously, this installation did not work so well in Swedish winter climate, so the last two stages of the roof has no integrated water collector. Originally the chimneys had profiled masonry but later that became out of fashion. In 1673, the copper plates from the water collectors were removed and reused to redesign the top crowns of six of the House's chimneys. After that, the roof end was poorly rebuilt with some boards, nailed to hold the roof end together. This was also one of many reasons why the House had to be restored.

Originally the House was planned to have curved, masonry gables on all sides. Wrangel realised it would cost too much, so he decided there would only be three, two of them built in wood. Only the masonry gable, on the east seaside, was completed, carrying Wrangel's coat-of-arms and crowned on top with a cresting in carved oak, one of the largest carvings ever made in Sweden. There are traces of the wooden gable sills, made of reused profiled floor beams from the lower levels. We saw that they were probably never completed, and taken down before the roof was finished with tiles. Several other building details tell about default of payment and carpenters trying to improvise solutions. For example there have been 12 dormers on the eastern half of the roof, made by another carpenter, not the same who built the roof trusses. This carpenter simply cut off all the rafters located where the dormers should be. Later, probably in the 18th century, these 12 dormers were taken down and the roof was poorly rebuilt without replacing the missing rafters. Only the tile laths were bridging over the gap. Now, 350 years later, the laths was collapsing, stretching the tiles apart, cracking the whipped plaster on the backside, causing drastic water leakage. The need for restoration was urgent. Another main reason for the restoration was the missing valley rafters in the eastern inner corners. The carpenters did not connect the two roofs to each other correctly. They simply cut off the rafters (valley jacks) without connecting them to anything, letting each truss hang on top of its collar tie, on top of the upper plate (fig. 2). A copy of Architectura Civilis from 1649, with charts of similar roof constructions, is still found today in the library of Skokloster House.

Obviously the carpenter did not get any information from that book. The roof started to suffer when all the tiles were laid on it, adding extra weight.

In 1960-70, a huge restoration action was made to save Skokloster's roof, led by Professor Ove Hidemark, one of the great restoration architects in Sweden during the second half of 20th century.[3] All tiebeams and common rafters were restored with impregnated planks, nailed together into beams, mounted with stainless steel, designed by Tyréns Constructing Company. Materials that will survive anything forever. To prevent a roof collapse many beams were temporarily bolted with iron clamps, in trying to support the two inner corners without valley rafters.

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[2] *Skokloster museum web page: www.skoklostersslott.se/en/collections-0*

Specialist restoration 2008 - 2016

This temporary installation did not save the collapsing inner corners and in 2008 a specialist group was formed to work out the best restoration method for this unique building without disturbing the original roof landscape in the attic. First, the roof had to be investigated to find all damages and what had caused them. Then the National Property Board of Sweden, the castle curator, the architect, a static engineer and craftsmen specialised in metalwork, masonry and carpentry, including myself, formed a plan for the restoration.

The roof construction of the two corners without valley rafters were collapsing inwards, breaking the upper, inner plates and even breaking off two 12 m high chimneys at the attic floor. All deformations were measured by Carl Thelin, specialist in old wooden constructions. He made a 3D model of the roof, calculating the static loads. The conclusion was that the roof desperately needed it's missing valley rafters to take away the loads correctly. New full length rafters were also needed where the 12 dormers had been. Our goal was to preserve as much as possible of the old timber, traces and toolmarks. The authentic soul of the attic wasn't to be harmed. I became subcontractor for all the wood work. Another building company was responsible for the work with tiles, copper plates, scaffolding etc. The work started in 2009 with the most damaged part of the roof, where one of the dormers had been. In 2010 the seaside roof was partly restored including the gable and a new fully reconstructed cresting, carved in oak. All the old parts are now stored on the attic. After a storm in 2012, 50% of one roof side was sliding down. I desperately rescued it by preventing the roof from falling down, with ten lever pulleys in the attic. This installation became permanent until the restoration in 2016.

We started producing timber for the restoration in the winter 2013. A suitable forest for the new rafters was found on the Sko peninsula, close to the House. It was less costly to produce all necessary timber the traditional way in the local forest, instead of buying it from a sawmill. The restoration was done in three periods between 2014 - 2016. Beside the mobile crane, we tried lifting the timber up manually, the traditional way. It worked really well and was cheaper and more fun than using the modern crane. Our and professor Hidemark's restoration philosophy[4] was to work as if the time had been standing still, try to be 17th century craftsmen, using the same tools, inch measure and working methods. Of course the battery chain saw and drilling machine helped us a lot, also better food and water instead of porridge, beer and spirits, mattered. But I wanted everyone to try traditional workways first before using modern power tools, to better understand toolmarks and details of importance. Out of 9000 hours of restoration, 50% was done with traditional tools, not only because we liked it, but because it was more efficient (fig. 3).

[3] *Statens Fastighetsverk. 2001. Vårdprogram för Skoklosters slott.*

Fig. 3 - Pit sawing outside Skokloster.

Fig. 4 - Tile laths work like a flexible net.

The roof has 12 km tiles lath that had to be changed because of leaking tiles (fig. 4). We found interesting tooltraces related to the production method on one third of the laths. Normally you see laths made with saw, but we were puzzled to see that they had used a 3 mm plane making grooves on both sides of the board and then cleaved it apart into a lath. The last piece of the board still had its natural shape on one side. We could also see that they had reused rafters that were cut off where the chimneys were built. From these rafters 32 mm boards were pitsawn and then made into laths.

Fixing the shape of the roof was difficult. Because of deformation over the years the roof did not match our new rafters, but by nailing all the laths on them the differences were evened out. This roof construction is a unique, flexible roof with trusses standing over the inner reinforced frame with a 1” gap between the rafter and the upper plate, on top of the inner framework. This allows the trusses, with their laths, work like a flexible net, using the inner frame as a support in storms and snow loads. During the work in 1960-70 all trusses were left lying with their collar ties on top of the upper plate, thereby losing their flexibility. All the load was directly transferred into the framework and down into the walls. Now, without the load of 82.000 tiles and mortar, the frame could be drawn / pushed back towards its original position. We added a diagonal half-frame, holding the two outer corners back (fig. 5). We also added the missing valley rafters and dragon beams for all the collar ties to connect to, leading the load of the roof into the valley rafters. When installing this, we wedged out the roof trusses, mounted all pieces and then took away the wedges to leave a 1” gap for the trusses to flex. It worked fine.

Fig. 5 - Diagonal half frame supporting the outer corner with a valley rafter and dragon beam.

Fig. 6 - New rafters where the former dormers used to be located. Hewn and pit sawn.

There had been lack of maintenance for centuries before The National Property Board of Sweden bought it from the previous owner in 1967. For the restoration in 2008 they wanted craftsmen specialists with skills in ”reading” the construction, the tool traces and the antiquarian values, instead of an ordinary building company. Our experience from other similar restorations suited this project. We also could deliver a full documentation with detailed descriptions of the work.[5]

A difficult task was to restore the wooden, decorated soffit, reaching 300 m all around the House. It had been badly repaired over the years. It is made of five pieces, hand planed, profiled and nailed together into a 1 m wide cornice. Later built palaces have cornices made of bricks and plaster, Skokloster cornices are some of the last preserved wooden ones. The individual pieces were not exactly same in shape and size, so we had to make new ones piece by piece.

The roof over the banquet hall, reaching over the whole west part of the House’s side, is made after a chart in the book Architectura Civilis. The hall was supposed to have a roof holding a stucco ceiling, spanning over the room without tiebeams, larger than any hall in Sweden ever built. That was count Wrangels intention. But the great hall was never finished because Wrangel died in Germany in 1676 and all workers realised that they would not get paid for their work anymore, so they went home and left it unfinished ever since. Here our work started, trying not to distort the construction. But some parts of it just didn't function any more, so we had to do something. We rearranged how the hall's roof connected into the south and north part of the House, reaching into the roof construction past the valley corners.

We managed to preserve all old rafters and studs that were temporarily put up 350 years ago, as important evidence from the working process. All new timber that we added was sawn in a modern saw mill, but with joinery of 17th century carpentry. All pieces that we changed in the restoration was pit sawn or hewn with old tools from that time (fig. 6). We also reused wood from the roof construction. Our choice to reuse disassembled original timber, is part of the restoration philosophy. We saved interesting parts for the museum or relocated the timber to another places in the roof construction. Every piece was marked with a pencil, where it came from and in what year it was relocated. There is reused material everywhere in the attic that craftsmen over time have used in their restoration work. We also brought up a lot of timber, nails, planks and boards that we did not use. They are now left on the attic for the next generation to use, we think that is the most true thing to do to this building, to continue in our former craftsmens' foot prints.

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A digital tool for BIM software to improve the data management in built heritage interventions: the case of Garai Urtuena farmhouse

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Abstract

The built heritage is an essential part of the cultural landscapes. Their quality preservation is relevant for the maintenance of the cultural values of a society. However, nowadays due to the lack of regulations and to the lack of scientific procedures of the architectural services, the conservation of the heritage values of the existing building is in serious risk. Therefore, there is an important necessity to create specific process to protect them and to achieve sensitive retrofits.

This research proposes a procedure that combines three scientific methodologies with the aim of identifying properly the historical transformations of the building and its heritage values as well as the constructive condition of all its constructive elements. The paper evaluates the efficacy of this procedure in a specific case study: Garai Urtuena, a XVth century baserri.

Key words: *Archaeology of architecture, Method, Built heritage, BIM, Typological studies*

1. INTRODUCTION

1.1. WORK ENVIRONMENT

The built heritage represents the essence of the society that has lived in that environment for years, decades and centuries. ICOMOS defines it as “a characteristic and attractive result of society”, so is above all the result of the expression of the world’s global cultural diversity (Azkarate, Ruiz de Ael, M. J. et al. 2003, p.14). In this sense, traditional buildings need to be understood as sources of the cultural identity of a society and as synthesis of the values feels as its own (Santana, A. 1998, p.1). Therefore, the sensitivity of any architectural intervention on them is relevant in order to preserve properly their values along the time.

However, as the current regulations do not protect all the built heritage is common to find in the Basque landscape many architectural interventions that devaluate the intrinsic heritage values of the existing buildings.

For this reason, the spirit of this work is to face this situation and to develop a scientific method in order to improve the praxis of architectural interventions in non-protected built heritage.

1.2. OBJECTIVES

Currently the technicians have many different difficulties when they define a project, and this new procedure should help to face them. These are the detected main obstacles:

- The projects' scale and economy

As many existing buildings property is private, the current professional fees do not allow to the technicians to develop completely the different phases of a scientific restoration. Therefore, the new method must reduce the hours of work even there is more information to manage.

- Lack of protection from the institutions

As it is not viable for institutions to protect all the built heritage, not all of them have regulated the strategy to preserve their values, and for this reason it is necessary to base the technical work on procedures which analyse all of the existing elements of the building.

- Unreachable or restrictive software:

Considering the real fees of architecture bureaus, the software to manage and design the architectural interventions on built heritage are not economically proportioned or they are restrictive. So, the new method must be an agile and independent digital tool which needs to be compatible with the main digital software of the office.

In consequence, understanding the work environment, the main objective of the new method is to optimize the workflow of the scientific restoration to offer a competitive service for non-protected buildings and limited economy investment projects.

1.3. CASE STUDY

With the aim of testing the new tool in a real case, a case study is selected: Garai Urtuena farmhouse. It corresponds XV century building which is situated in Gatika, a little town in the Basque Country, Spain. The building is not protected by the current regulations and it has rectangular floor plan and it is supported by a wooden internal structure and thick exterior stonewalls.

Illustration 1. Main façade of Garai Urtuena farmhouse

2. EXISTING METHODS AND TOOLS FOR SCIENTIFIC RESTORATIONS

Understanding the current work environment in built heritage, two main tools must be underlined. The new scientific procedure must integrate both tools.

On the one hand, archaeology of the architecture understands the buildings as historical document in permanent transformation. No one should be legitimated to intervene in a historic building if previously all the information is not read and analyzed (Azkarate, 2001). In this sense, this discipline considers many different tools with aim of achieving a correct interpretation of the built heritage. All of them must work through holistic and multidisciplinary methodologies.

On the other hand, nowadays there are several software to manage the architectural projects. Some of them are specialized in the management of heritage and constructive analysis of the existing buildings (for example, PETROBIM). However, these software show obstacles to respond to professional needs which are related to a real comprehensive management of architectural projects.

However, more than two decades ago BIM software were developed in order to facilitate a real control of all the information generated and collected during the whole process of any architectural process. The main aim is to insert that info into a virtual model of the building.

BIM modelling is considered the following evolution of CAD software and currently lots of small, medium and big companies work based on them.

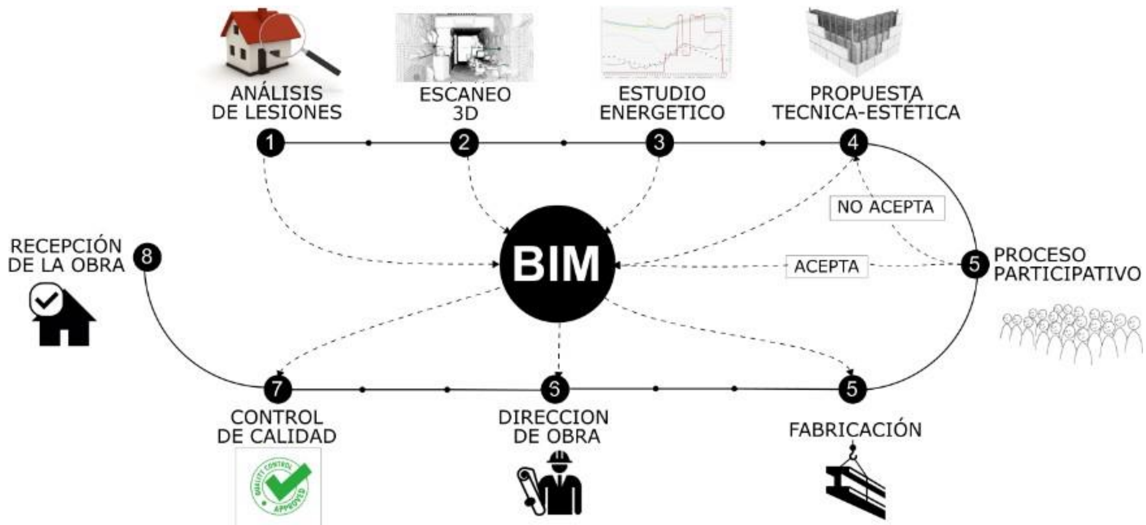

Illustration 2. BIM software interaction in an architectural project

3. PROPOSAL OF A SCIENTIFIC MULTIDISCIPLINAR PROCEDURE

Once the work environment is understood, a new digital friendly tool is developed: "BIM ONdare". This consists in a tool that integrates the scientific procedures with BIM software.

To get that purpose, basing on scientific procedures a new main structure is proposed:

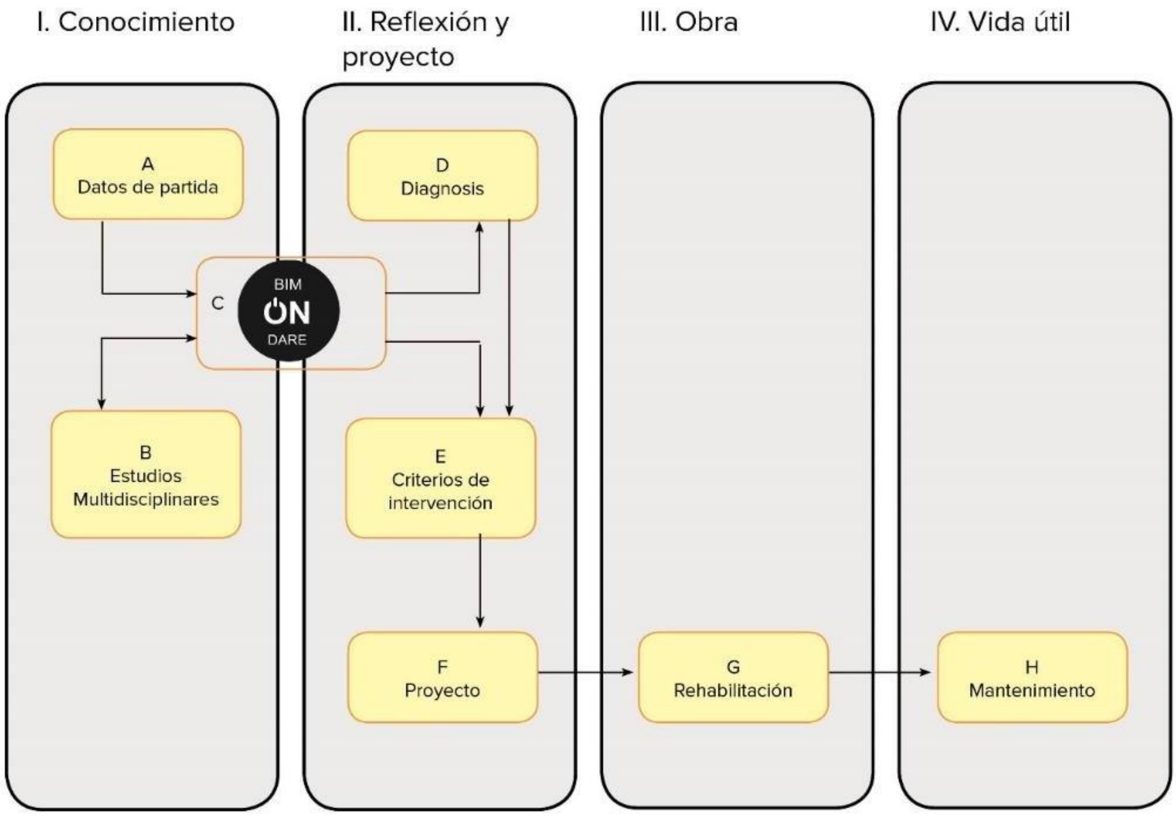

Illustration 3. New structure for scientific procedure

The architectural intervention in built heritage is mainly divided in four principal chapters.

- I. Knowledge.
- II. Reflection and project
- III. Construction period
- IV. Life cycle.

The new tool reacts with the first and second stages.

Firstly, it helps to manage the data gathering and to integrate the multidisciplinary studies and then, it is a procedure that provides to understand better the different readings of the diagnosis and to stablish the intervention criteria.

This tool is also integrated with the BIM models. Even it corresponds to a new software, it can understand the BIM modelling information, it is able to process that info and to give it back to the BIM software providing the common technical continuation of the architectural project.

In the following chapters are detailed the first two stages: starting point and multidisciplinary studies

3.1. STARTING POINT

In the beginning of the process, there is the "starting point". The aim of this stage is to collect as much as information is possible before analysing any aspect of the building. These are the task which must be carried out.

This "A" stage is divided in two different subphases:

- A1. Data gathering: This based on multidisciplinary readings of the building. There is no processing
- A2. Processed. In this phase the readings of the previous subphase are processed.

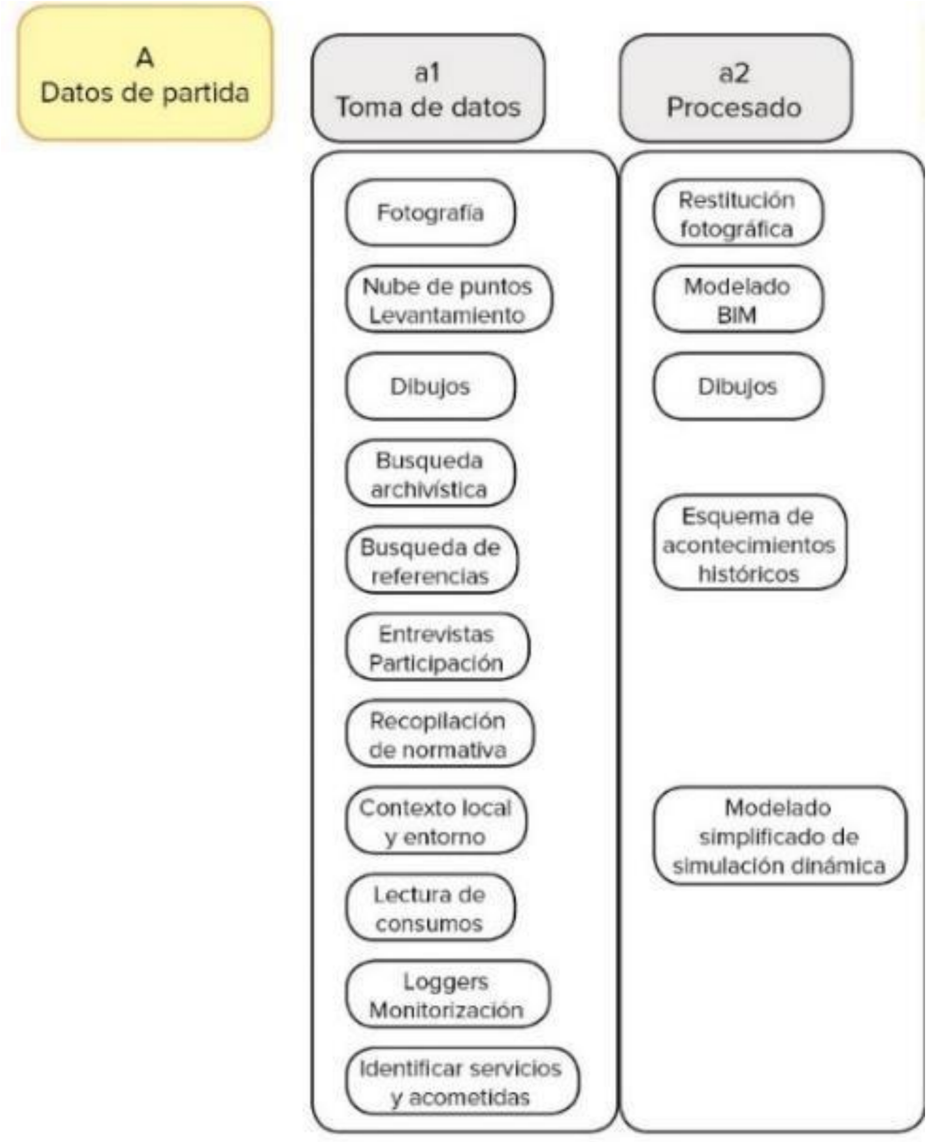

Illustration 4. 1st stage. Data gathering

3.2. MULTIDISCIPLINAR STUDIES

In the second phase many multidisciplinary studies must be carried out. These can be divided in three principal groups:

- Stratigraphic analysis will help to understand the historical phases of the buildings.
- Existing damages analysis will conclude in the constructive state of

each constructive element.

- Structural typology analysis: Many different buildings can be supported by the same type of structure. This analysis can help to understand the structural behaviour of the building or to detect the lack of any important piece which should constitute the structure.
- Constructive typology analysis
- Colour and aesthetic analysis
- Functional and special analysis
- Circulation and privacy analysis
- Historical and significance analysis
- Regulations analysis.

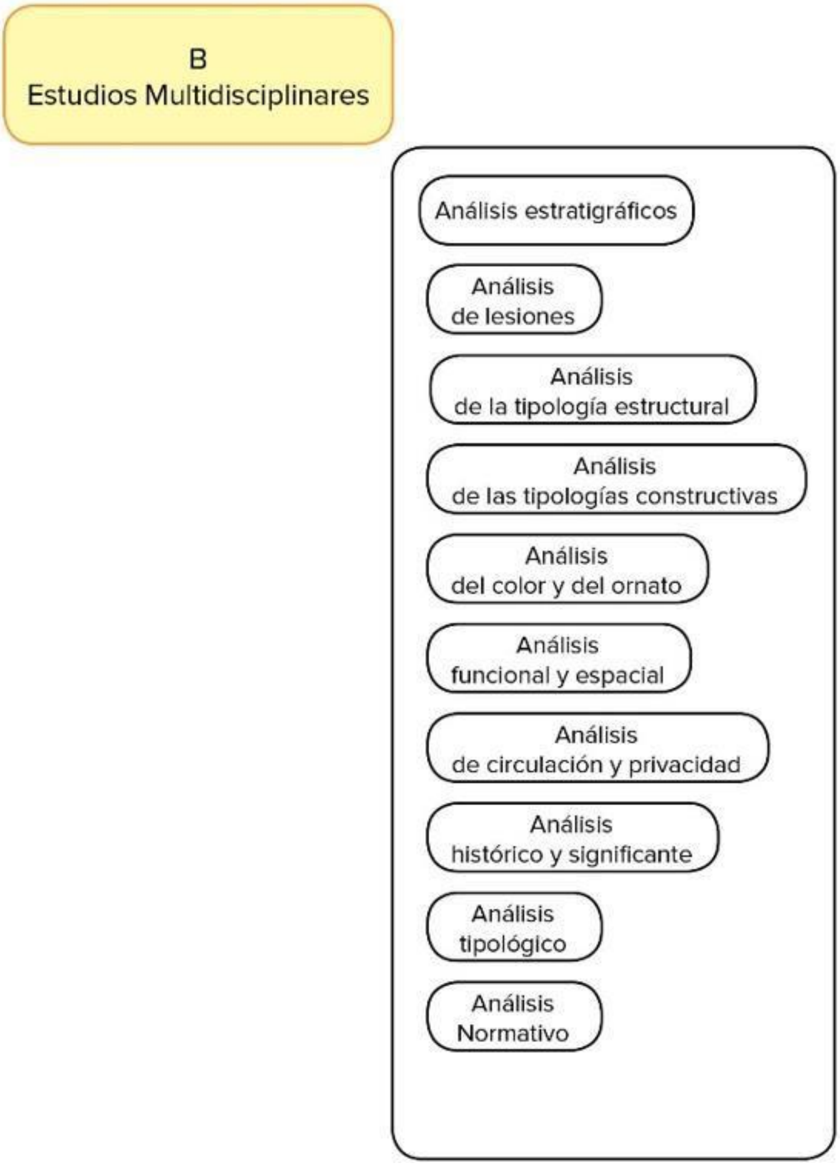

Illustration 5. 2nd stage. Multidisciplinary studies

Once the tasks of each stage are identified a new workflow is proposed.

3.3. WORKFLOW. INTEGRATING "BIM ONDARE" INTO RESTORATION PROCESS

The current scientific restorations are based on detailed procedure. The modification of the stablished stages must be clear, and the data management must be well defined. For this reason, a specific workflow is proposed:

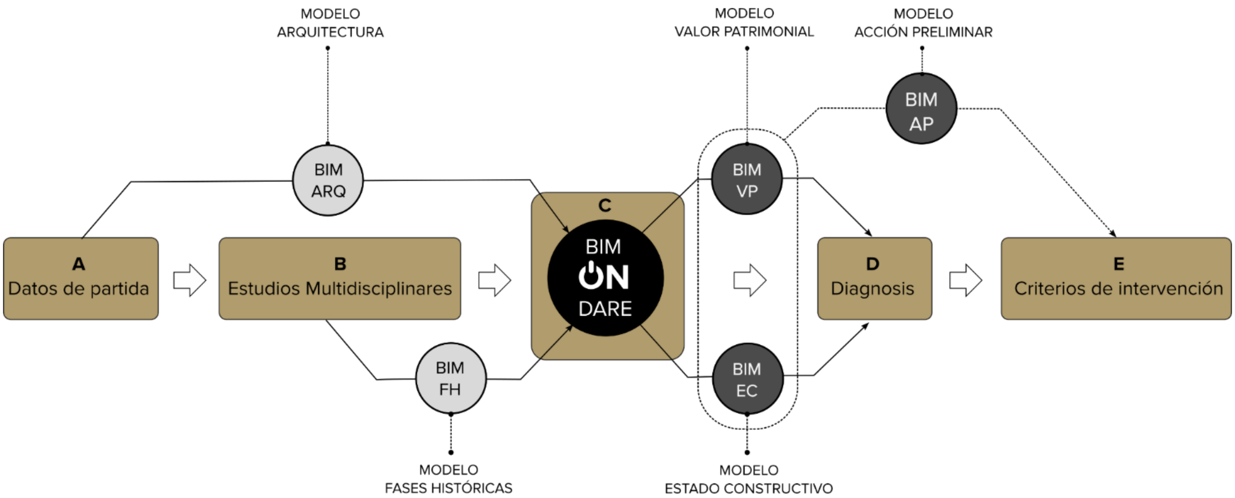

Illustration 6. New workflow for BIM ONdare integration into the scientific process

To get the main purpose of this research, the proposed workflow requires to create specific new BIM models before opening the new digital tool. These models provides a better understanding of the historical transformation of the buildings and its current architectural state.

- BIM ARQ. ARCHITECTURE BIM HYPERMODEL

The information is collected during the starting point stage in the main BIM software. After this an architectural BIM model needs to be exported. This must gather textures, positions, ID and geometry of the constructive elements.

- BIM FH. HISTORICAL PHASES HYPERMODEL

After processing the gathered information in the first stage a historical phases model of the building is developed in the BIM software. To get this purpose properly is recommended to finish to model it after inserting all the needed data to BIM ONdare software.

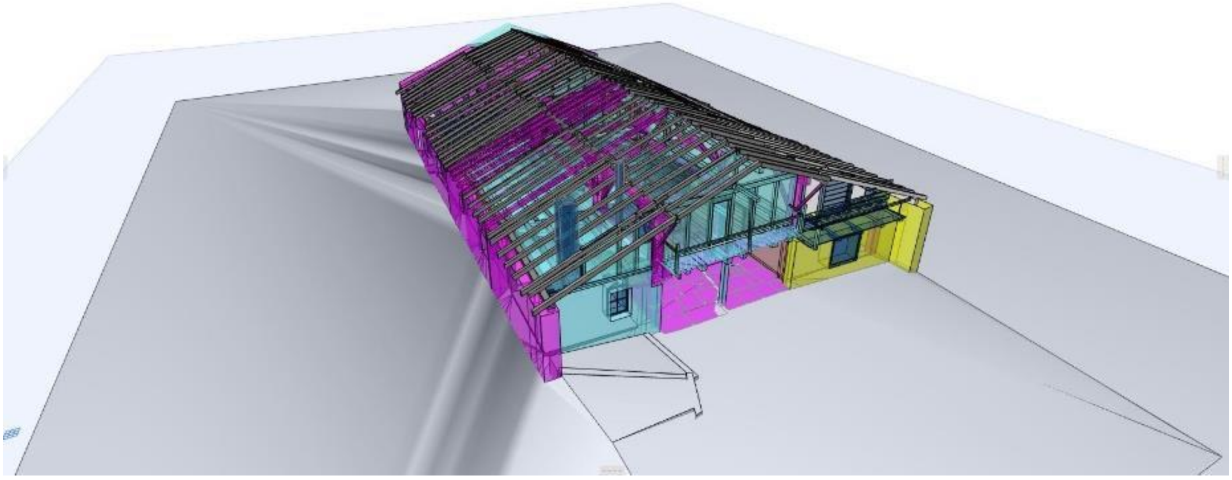

Illustration 7. Historical phases model of Garai Urtuena

3.4. BIM ONDARE. THE NEW DIGITAL TOOL COMPATIBLE WITH BIM SOFTWARE

Once the architecture model is exported, afterward it is imported into BIM ONdare software to carry out the next analysis.

Illustration 8. BIM model integrated in BIM ONdare

This software has two main objectives:

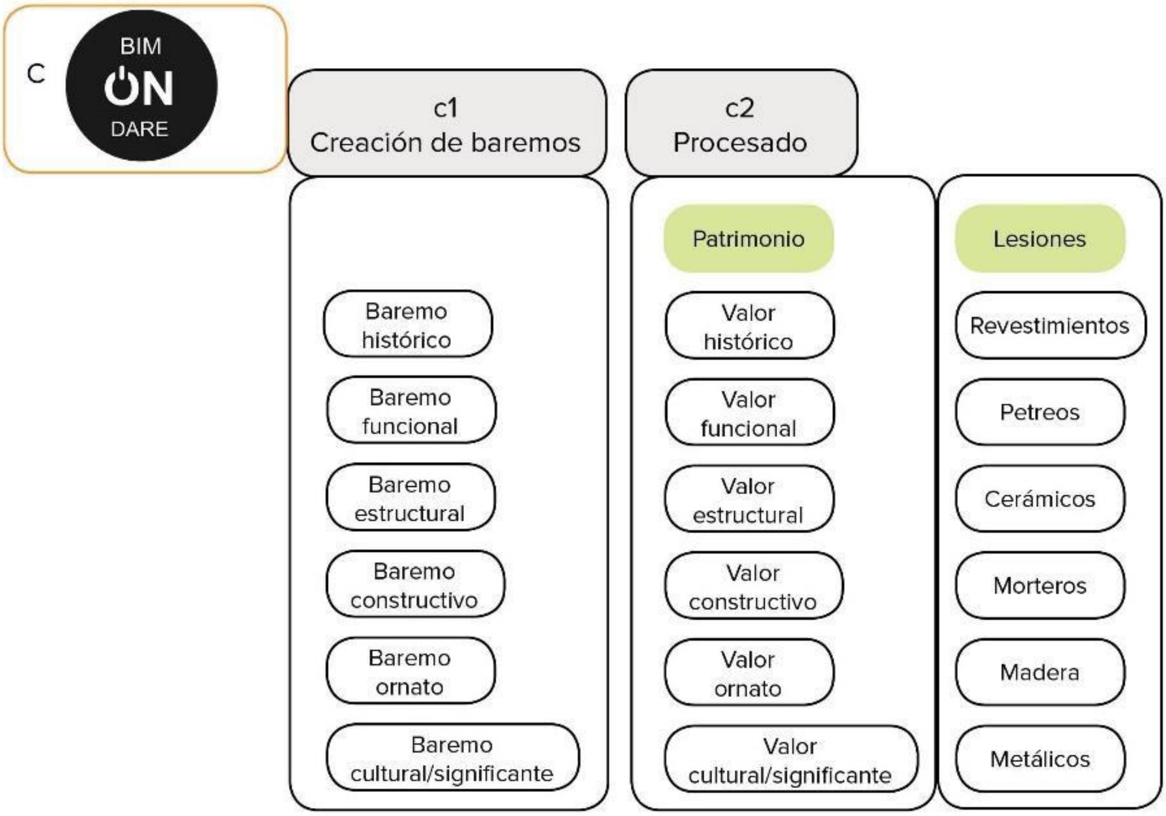

Illustration 9. The scheme of the tasks to carried out by BIM ONdare

- To generate the heritage value of each element. The heritage value is the result of a specific algorithm between the following different values.
  - Historic value
  - Functional value
  - Structural value
  - Constructive value
  - Aesthetic value
  - Cultural/significance value

- To analyse the current damages of the constructive elements. Depending the materiality of these elements, the needed analysis will be different. the following ones are proposed:
  - Covering
  - Stone elements
  - Ceramic elements
  - Mortars
  - Wooden elements
  - Metallic

Once this information is inserted, all the info must be exported again, and consequently inserted into the main BIM software.

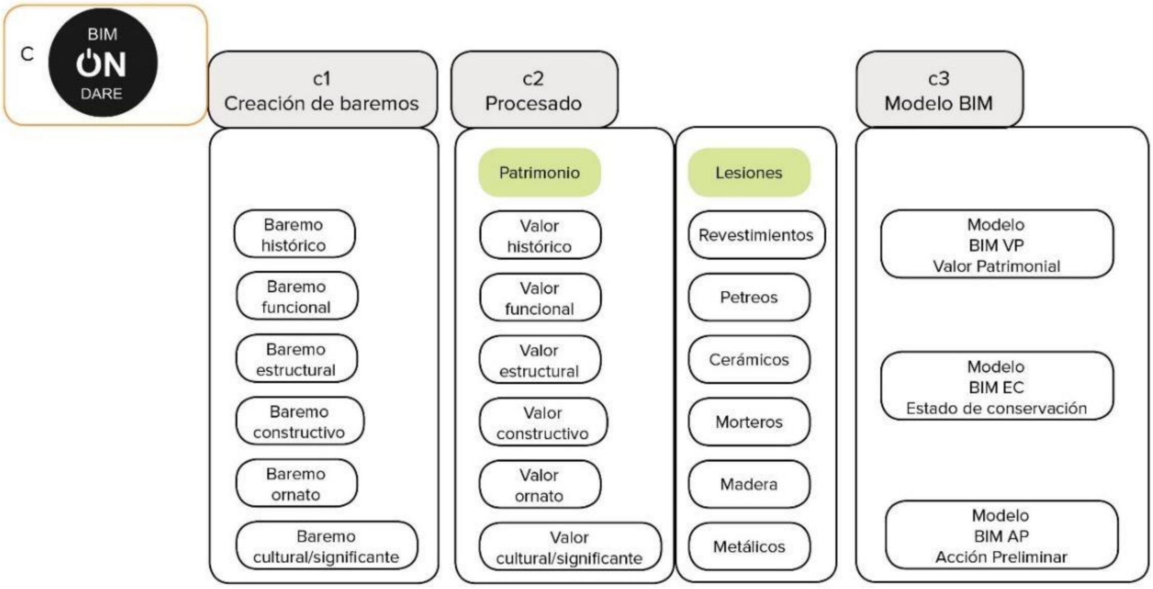

Illustration 10. The 3 different type of BIM model exported from BIMONdare

Once the new info is inside of the main BIM software, three new BIM hypermodels are created.

- BIM VP. HERITAGE VALUE HYPERMODEL

This hypermodel exposed the heritage values of each element, which is calculated by BIM ONdare software. With his info the technicians know perfectly the value of all the constructive elements, and it can be decided properly which of them must be conserved, restored or replaced without altering the cultural value of the existing building.

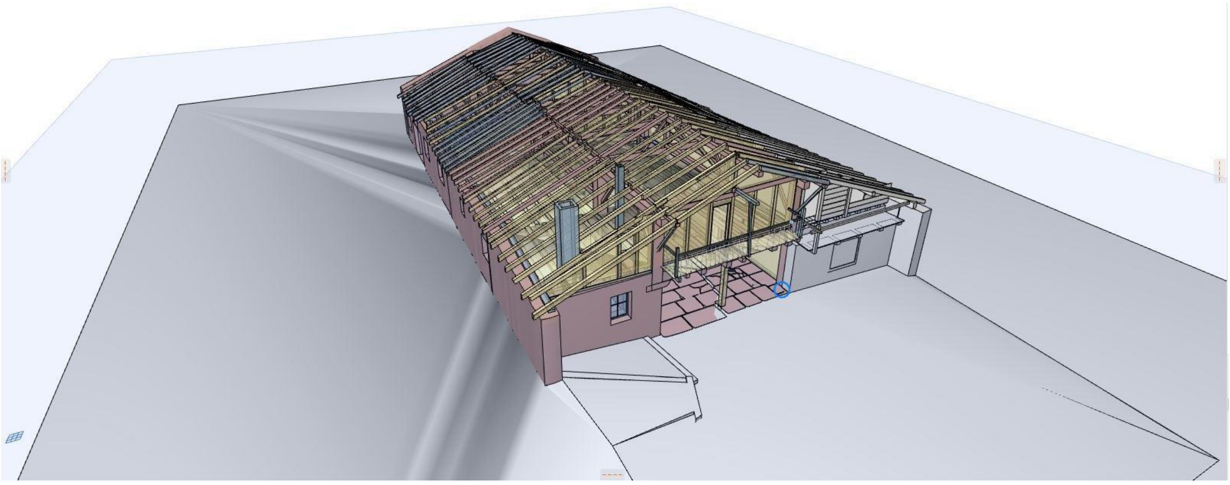

Illustration 11. The heritage values model

- BIM EC. CONSTRUCTIVE STATE HYPERMODEL.

This model gathered the conservation state of all the constructive elements. If they have any damage and if this can or must be restored.

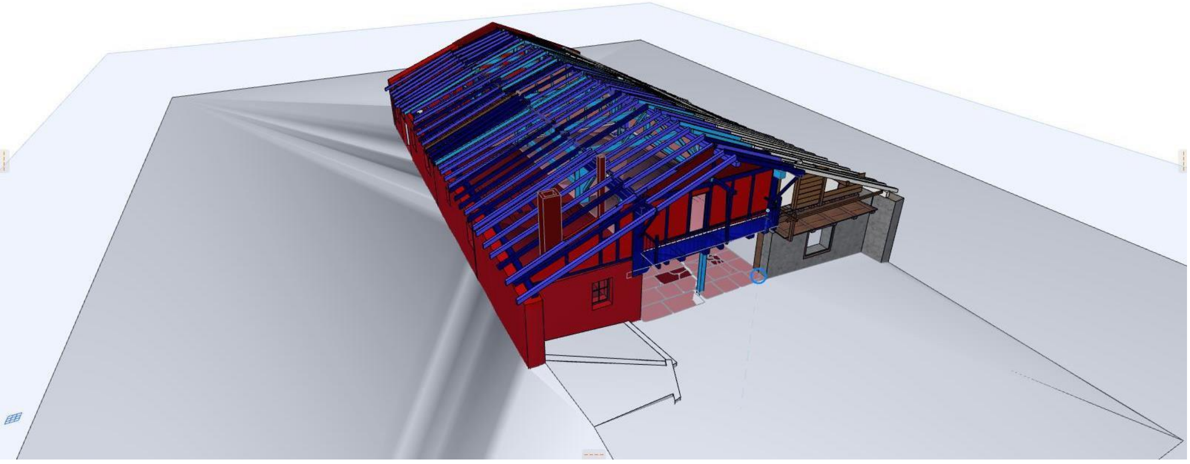

Illustration 12. The constructive state model

- BIM AP. PRELIMINARY ACTINS HYPERMODEL

This model is the result of the combination of BIM VP and BIM EC. The decision of conserving or not an element must be based on its constructive state value and heritage value of each element. For this reason, this model provides to the technicians an easier and more adequate decision making system.

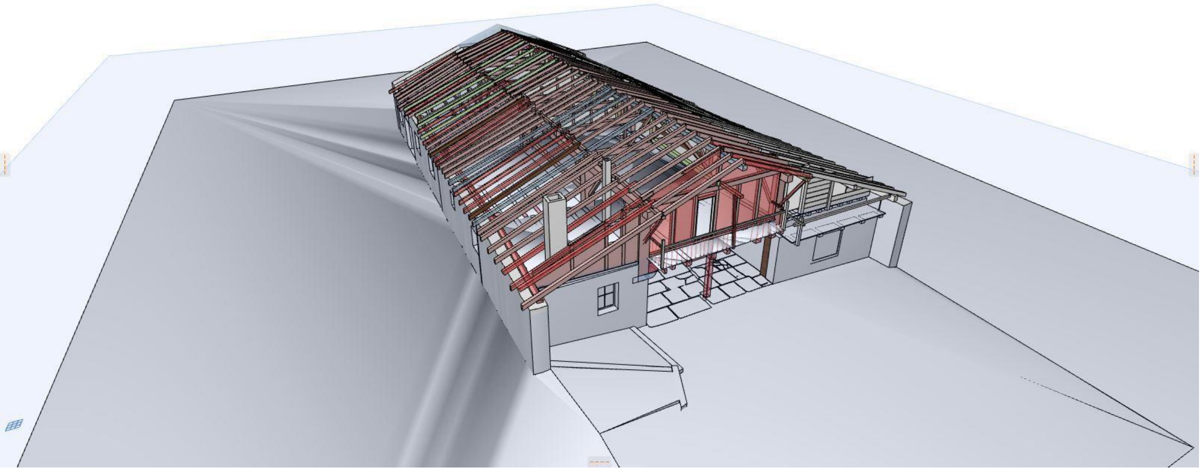

Illustration 13. The heritage values model

4. CONCLUSION

The main aim of the work is to create a method to optimize the workflow of the scientific restoration to offer a competitive service for non-protected buildings and limited economy investment projects. In this way, the method carried out for this research facilitates the management of all the needed info and it permits to conclude in a proper diagnosis of the existing buildings in an easier and faster way than the existing methodologies. It can generate automatically the heritage values of each element and a sheet per each element with the full added info.

The method also provides an absolute control of the input information and permits to introduce directly the information into the building information modelling. Additionally, with this tool the architects can achieve a better understanding of the constructive damages of the building and a calculated heritage value of each constructive element. All these benefits contribute to the architectural bureaus to face the common obstacles as the economy of the projects and the restrictions of software. Apart from that, the application of this new method could also help to the institutions to guarantee a correct restoration of all built heritage even they were not protected by the regulations.

To sum up, despite being a scientific experimentation and having its limitations, this research meets satisfactorily its main goals. For that reason, further research needs to develop the following stages for the method until completing the whole scientific procedure applicable in all of the architectural bureaus.

To finish, it is essential that all the parties involved in the quality preservation of the heritage work together in an interdisciplinary way, from the most academic students and professional technicians to public institutions. We all share the obligation to preserve the cultural heritage that we have inherited from our grandparents.

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PRESERVATION AND DEVELOPMENT OF VILLAGES IN THE DISTRICT OF DALARNA IN SWEDEN

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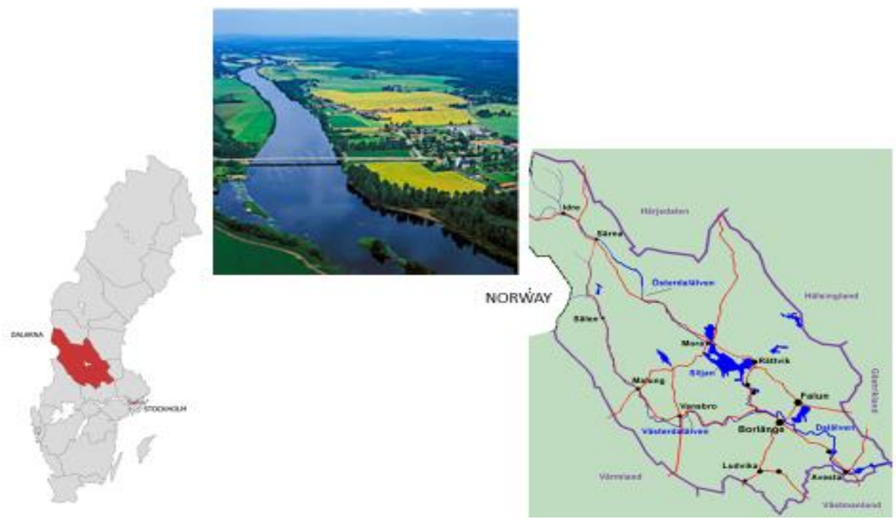
Introduction

Dalarna is a region in the middle of Sweden on the western border of Norway. The landscape is hilly with many lakes, rivers and huge forests and small fields for cultivation. This has formed the living conditions in this area. It was impossible to live on farming alone, and families had to combine it with work in other areas, often construction or factory work in the closest cities which were Gävle or Stockholm. A tradition of weekly or monthly commuting from Dalarna began as early as the beginning of the 19th century as industrialism expanded.

MAP OVER DALARNA; *OVANSILJAN, NEDANSILJAN AND VÄSTERDALARNA*



Due to the lack of land for cultivation, all available arable land had to be protected. Villages were built adjacent to this land and cattle were not allowed to graze on land suitable for cultivation. Instead they were left to graze in bushes and deciduous woods. Unmarried girls took cattle up the hillside into the forests on the mountain, where they stayed the whole summer. This created three different village types in Dalarna:

A) The village itself mostly organized as a row or cluster village
B) A mountain village only used in the summer
C) A mixed village where part of the village acted as a mountain village for another village

From the 18th century there were a series of land reforms in Sweden. Food production and forestry had to be made more efficient. In almost all of Sweden this transformed the landscape completely. Arable land was re-destributed and villages split up so that each owner built a new house on the new family land.

The villages in Dalarna, more than 100, dating from the medieval time, have preserved the old village structure, located around lake Siljan or along the rivers Öster- or Västerdalälven

THE VILLAGES HAVE GROWNIN AN ORGANIC WAY INTO A ROW VILLAGE OR A CLUSTER VILLAGE

TIBBLE VILLAGE, BOTH CLUSTER AND ROW VILLAGE

However, in Dalarna the villagers refused to adopt this reform. This means that, apart from Dalarna, there are almost no villages in Sweden or in Finland anymore. Here, villages have developed from the Middle Ages and often around small scale mining, which has not left many traces visible today. The main traces of former mining activities are in the village or lake names that can be linked to mining. These villages are today growing after many years of population decline. The concern used to be how to preserve these villages from decay, the concern is now how to preserve them from uncontrolled growth.

TIBBLE IN LEKSAND MUNICIALITY IS A PROTECTED VILLAGE

This is a forest region and all buildings were built of wood as well as all parts of the buildings. The wooden material was not restricted to residential houses but also included churches, town halls, and schools and so on. On very early houses, as well as storage houses, the sill logs were erected on natural stones. The walls made of logs with openings for light. These openings were closed using shutters. Glass was expensive and was not used widely before the 18th century. The roofs were insulated from humidity, rain and snow, with the birch bark in several layers kept in place by wooden logs or wooden shingles. Terra cotta tiles were not used before in the 19th century.

The oldest timber buildings in Sweden are in Dalarna. The oldest is a house that dates from 1237, and what in Sweden is called a Fire House, since it has no chimney and the smoke from the fire is let out through a hole in the roof. The floor is an earth floor. There are a lot of other medieval buildings in many villages, mostly different kinds of storage buildings from the 13th century onwards. These storage buildings are often in their original form since they have always been used for the same function.

We can understand how widespread the knowledge of log timber building was by studying the log joints of the medieval storage houses. Each one has the log joints cut in a different way, telling us that each family had their own way of cutting and assembling these buildings. Additionally to these, we have two very simple storage houses and a guesthouse, the Ornäs guest house, from late 15th century/very early 16th century that have been very well preserved since they were designated as National Monuments as early as 1666 due the role they played for King Gustav Vasa when he escaped the nobles in Stockholm and fled to Dalarna for support their in 1523.

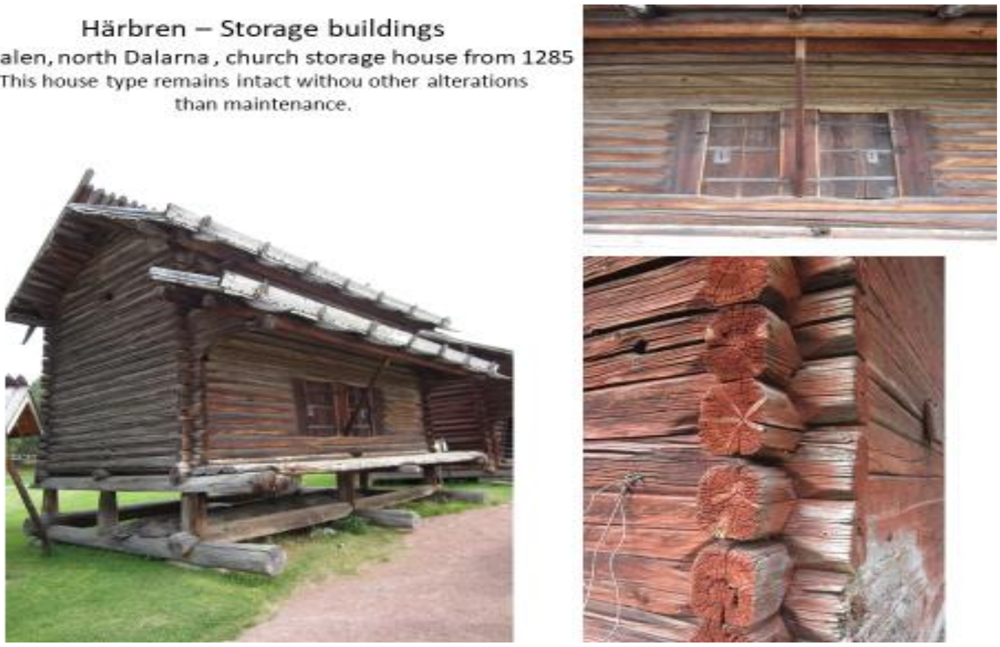
MIXED VILLAGE – STYRSJÖBO IN LEKSAND MUNICIPALITY

I will not tell this story here, but will mention that this early advertisement and enhancement of the Vasa family to ensure their claims to rule has given us today additional knowledge of medieval timber building techniques. The Ornäs guest house was turned to a museum in the 1760s and is the first museum in Sweden! Due to this it was beautified and clad with wooden shingles as well as painted red, a change that has caused constant problems ever since, due to the roof angle being not suitable for shingles.

The oldest secular wooden house in Sweden
'Fire House' in Mora from 1237

The house has no chimney and all parts are of wood, the foundation resting on natural ston blocks, the walls as well as the roof. The smoke was released through an opening in the roof.

The situation of residential buildings in the villages is the opposite of the storage houses. They have contantly changed. Up to the mid-19th century, they were almost always based on one of two house types: the *single room house* or the *double room house* type. These houses have been mostly added to, and sometimes changed to meet the new demands of the residents. A single room house type could have been changed to a double room house type or an extra floor added. The measurements of the buildings are based on the length of a log. The houses were about 5 – 6 meters wide, with the same length and each room connected to the next by a log joint. Another type was the *side room type,* which is a larger version of the sinle room type.



Farm complexes contained different houses for different functions: the main residential house, occasionally a smaller residential house as well, different types of storage houses, stable, barn, hayloft, etc, plus some houses and storage structures built in a more remote location to avoid losing everything, especially all food, in case of fire. The houses were always grouped around a courtyard, which was closed by a fence to forbid wild animals from entering.

The buildings continuously changed with new technological advances, such as in wood cutting tools and in the 18 - 19th centuries, the introduction of the industrially produced wooden products. When industrial wooden boards became common, villagers saw an opportunity to clad their timber houses to reduce drafts. Generally one can say that the workmanskip of these simple buildings was very high. They were built by skillful craftsmen, of high quality wood. The logs used were at least 200 years old, grown in the right environment for the purpose they were supposed to manage.

Rankhyttan
Barn from late 15th century
State monument in 1666 due to its links to King Gustav Vasa

From late 19th century new house types were introduced in the villages, house types influenced by what villagers saw in the cities where they were working. Now houses with higher rooms were introduced, houses with new plan types such as the cross form; the L-form as well as a 6-room plan, in Sweden called Hall House. Still, all of them were painted in the Swedish Red paint and did not attract attention from the other houses.

Guest House to richer farm house in Ornäs
Dating from 1503,according to dendrochronologial testing.
State monument in 1666 due to its links to King Gustav Vasa

Existing or new houses were decorated with decorative wooden boards cut with the new jigsaw scroll saws. These decorative parts were often painted in divergent colours in linseed oil paint.

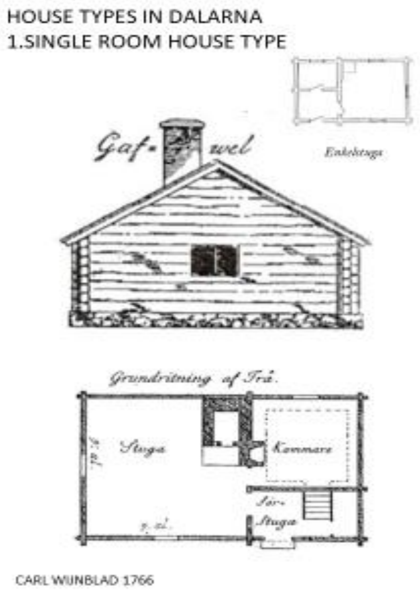
Today the villages of Dalarna look very cohesive due to the red colour with which ALL houses are painted even if details have other colours. This is a colour derived from the copper industry in Falun, the world's main copper supplier in the 16th century. The colour was claimed to resist insects and was first used to paint churches and town houses. People in villages could not afford this paint before the 19th century and only at the beginning of the the 20th century did almost all villages become red. Today this is the signum of the villages in Dalarna.

Timber building techniques in the 15-16th centuries

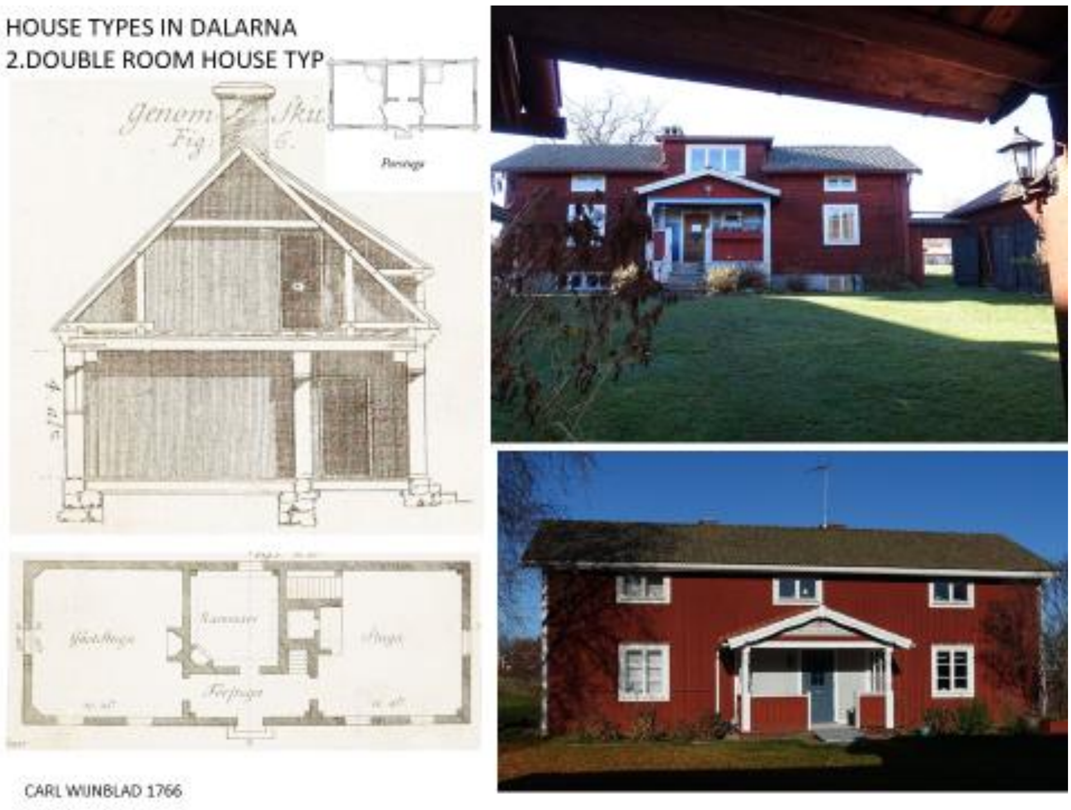
This typical red paint, together with visible log timber houses that the villagers had abandoned when new more comfortable possibilities were introduced, was what the national Romantic Movement in Sweden promoted as the true expression of the Swedish building tradition. Influenced by the Arts & Crafts Movement, they turned against industrial products and advocated the hand produced. Dalarna was described as the heart of Sweden, the only part where the true tradition was still alive. Artists, architects and cultural personalities moved here, but with very different demands. They were not willing to squeeze into the small traditional houses typical for the villages but built large houses in a new scale for these villages based on the English assymetrical house plan, alien to Dalarna. But these houses were built in log timber with details claimed to derive from the Viking era or the medieval period! Houses with industrial products, and especially if they were not painted with the Swedish red paint were derided in publications by among others, Ellen Kay, who was a very influental cultural person of this time.

This was the first time the gradual developement of the local building tradition in the villages was halted and divergent objects introduced. This also brought new inhabitants with completely different values, 'the tourists' as they were called by the locals. It was not only the form and scale of the houses that were new, but also the building process. These buildings were not designed and produced by the villagers from a tradition that had evolved through time, but were often designed by architects and build by hired builders or contractors.

This has played a significant role in the general perception of traditional buildings of Sweden. These 'tourists' were the most famous artists, poets, architects and musicians of this time in Sweden and became the ones depicting life and traditions in Dalarna through their work. Not the local inhabitants themselves. A story of Dalarna was created based on these fantasies and this image still exists today and influences the concept of which built additons should be accepted in the villages even if these buildings differ in scale from the village houses and were rarely painted with the Swedish red paint, but with tar which was considered to be an older material for the protection of wood.

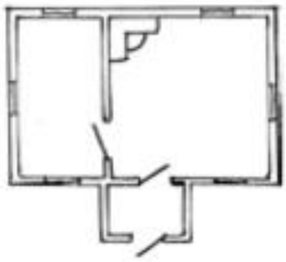


Village life did not change very much during the 20th century since the villagers had always worked somewhere else; commuting has a long tradition, now suitable for a modern life style. Almost all houses have been modernized with new kitchens, bathrooms and toilets. This was done without any exterior change. But still young people moved to bigger cities and the growth of the villages was modest until recently. A small number of houses were built in the 1930s to the 1970s and they were often built in the style of that period but clad with red painted wooden boards. This makes them blend in into the villages and you will not notice them when passing by. This shows the dominant effect of the red-painted wooden material that stands out as more important than the form as long as the scale is similar to the surrounding buildings. These houses were in their form neither influenced by the traditional houses nor by the national Romantic houses, but were as the latter, often built by contractors in the prevailing style.



However, life in the villages always continued to exist even in periods when many moved out and only returned on holidays. Some villages had up to ten times more inhabitants in the summer time than the rest of the year. So even if the familes moved out, the houses were not sold, but treasured by the descendants. This area became a popular area for summer residents which the local tourist industry took advantage of. And to attract tourists they used the story from the turn of the last century to attract visitors. Tourist villages with heavy logtimber houses, wrongly promoted during the last century, were built close to the biggest lake, Siljan. House producers started producing logtimber houses for those who bought a piece of land for a summer residence. A massive advertisement of these houses was produced, falsely calling them Dala-houses as if they would be typical of the local tradition. This was however difficult for the buyers to understand. And these producers could erect the house in a very short time since it was initially produced in a factory.

HOUSE TYPES IN DALARNA
3. SIDE ROOM HOUSE TYPE



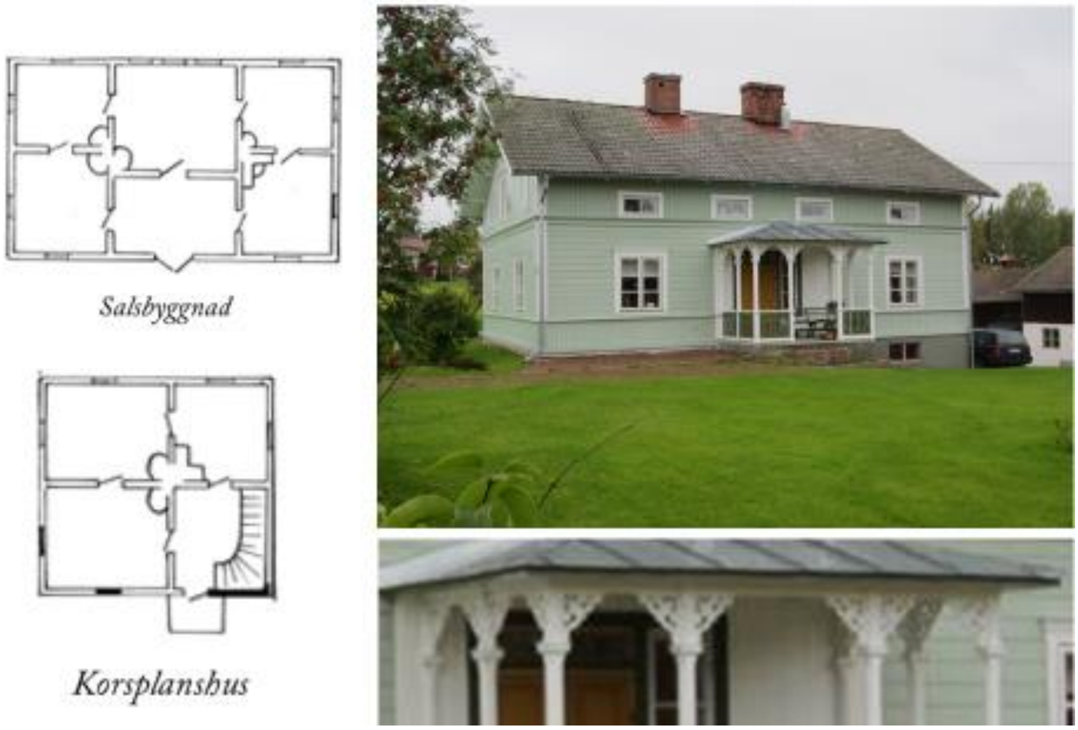
Sidokammarstuga

Recently there has been a drastic population change in the villages in Dalarna, speeded up by the awareness of sustainable living. Young families want to move permantly to the countryside, eat locally produced food and live a life they can control. Both descendants of Dala-people and others move in. As an example, in the municipality of Leksand which has 20 000 inhabitants, more than half of them live in the villages. About 400 requests for building permits has been handed in each year, for the past few years. These building permits mainly concern new buildings or changes to existing buildings in the villages.

THE RECTANGULAR COURTYARD WITH A 'MÅNGHUSSYSTEM', A SYSTEM WHERE DIFFERENT BUILDINGS WITH DIFFERENT FUNKTIONS WERE GROUPED AROUND THE COURTYARD

This raises the question of how to protect and still develop the villages, many of them being protected zones. Changes are easily very visible in small scale areas like these. There is confusion about what the local building tradition looks like.
The municipality of Leksand has contracted antiquarians at the local historic museum of Dalarna to investigate each village with what they call a *Cultural environmental analysis.* They investigate both each building and its value according to certain criteria and the village as a whole, the layout, the streets and the surrounding natural landscape. Based on this investigation they characterize the village and its buildings and give recommendations on which values to preserve, which changes could be allowed, which changes could be stressed etc.
This work is ongoing at the moment and the reports are not yet finished. The municipal planning office hopes to be guided by these reports when evaluating the building permits. This has yet not been tested but this is a method planned to be used for both preserving and developing the villages.

HOUSE TYPES IN DALARNA FROM THE MIDDLE OF THE 19TH CENTURY ONWARDS
4. L- SHAPED , CROSS SHAPED PLAND OR THE HALL HOUSE



There is however already general advice now being given by historians at Dalarna’s Museum. They stress that **modernization** within the existing building is the main goal. This will not change the context, and even if a first stage of modernization was done in the 20th century, the comfort requirements are even higher today.

Many of the existing buildings are small, based on the single room or double room house plan. If the request is enlargement, the first choice should be to **extend** the existing building with the ’grammar’ of the existing building. This means to extend with additional rooms with the same measurements as the existing and/or to build a second floor in half or full height. They call it to continue **with the traditional *module*.**
Additions such as new verandas and/or balconies have always been added to the existing buildings and this is encouraged by the authorities. A small addition can solve a logistical problem.

STYRSJÖBO – EXAMPEL OF A MIXED VILLAGE
THE UPPER PART WAS A MOUNTAIN VALLAGE FOR THE NEIGHBOUR VILLAGE, HEDEN, WHILE THE MOUNTAIN VILLAGE OF STYRSJÖBO S HIGHER UP ON GRANBERGET MOUNTAIN

ADDITIONS INTHE OUTSKIRTS OF THE VILLAGES ARE LESS SENSITIVE

If this is not possible, due to the site or surrounding buildings, a preferable addition would be to create an L-shaped building. This was typical at the end of the 19th century and would be suitable today as well.

EXAMPLES OF HOW THE ORGANIZATION OF THE HOUSES IN THE VILLAGES HAVE BEEN PRESERVED
NEW HOUSES WERE PAINTED WITH SWEDISH RED PAINT WITH WHITE DETAILS IN LINEN SEED OIL PAINT LIKE BEFORE

Another possibility is to **transform** one or some of the outhouses to a residence. This will however restrict the placement of new windows, especially towards the village street. Many of the storage buildings that were important for the life earlier are outdated today. Of course they still serve as storage, but storage space today can be smaller. Some are already changed to garages.

NATIONAL ROMANTICISM
KLING HOUSE IN STYSJÖBO

If none of the above mentioned actions are possible and a completely **new house** is required there are a number of issues to consider. First of all is the placement– how should the new house relate to the existing ones. This is an issue also when an empty plot within the village is being used. The existing structure/layout of the village must be considered. The buildings towards the village street were always the outhouses. The orientation of the main residential building is often similar in each village. This should be considered even when building a new building.The same concerns the storage building and the garage.

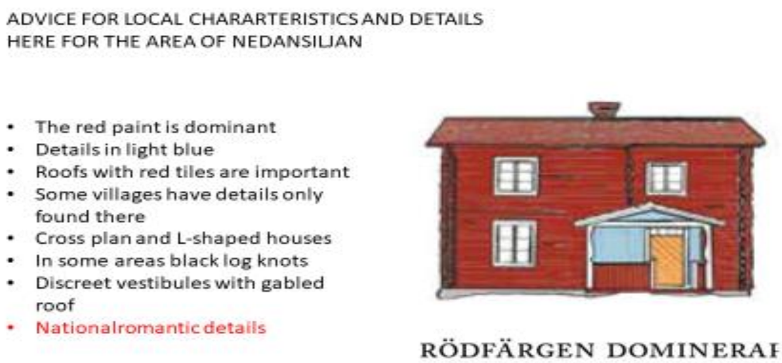
DARDEL HOUSE IN STYRSJÖBO, PARTS COLLECTED AND BROUGHT HERE, PARTS DESIGNED BY AN ARCHITECT FROM GOTHENBURG. THE FAMOUS ´SWEDISH PAINTER NILS DARDEL AND HIS FAMILY USED THIS HOUSE AS THEIR SUMMER RESIDENCE

Another important issue when building a completely new building is the choice of the new building’s character. Should its architecture be modern or should it look like the traditional houses?

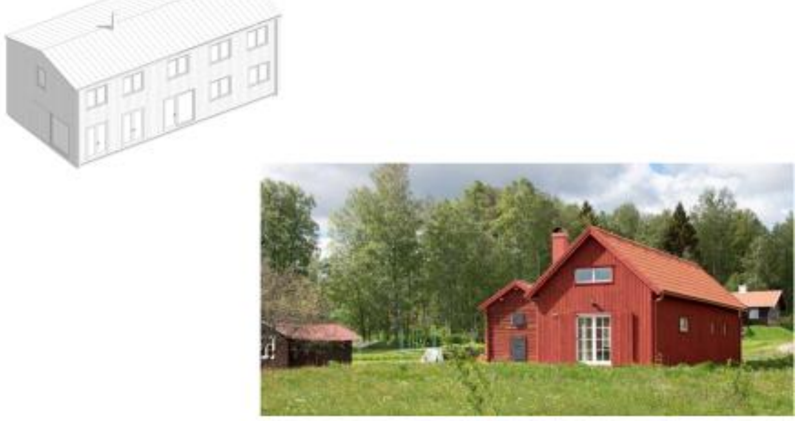
Dalarna Museum experts do not have specific requirements but discuss different options. They discuss what a pastische building is and if this is something to strive for. They have arguments for different choices and claim that to integrate a building with modern architecture in these environments often demand the skill of an architect. They humbly believe it is ‘safer’ to integrate a building similar of traditional style than to introduce something modern, without insisting that this is a priority. Instead they claim that this is a safer choice if building without help from an architect. Most residential one family houses in Sweden are designed by engineers or factory owners, not by architects. This is the reason for the advice. The museum experts also give examples of suitable ready-made houses for these villages, since these houses are within the rage of what most people can afford.

What is building within ‘the spirit of the existing context’? Even the authorities claim that a pastische is not what they would prefare people to build since this is impossible to achieve. Still, historic building experts are often more in favour of some kind of similarity to a traditional house, while the architect often prefers a modern one in harmony with the village context. Since there is a big confusion, created by the National Romantic movement even if they themselves brought a completey new house type into the villages, of what a traditional house looks like, clients are often prefering heavy log timber houses believing this is the local tradition.

In their list of advice the historic building experts list qualities the new building or addition should have. This advice contains demands for wooden facades, red painted facades, craftmanship of the same high quality that we find in the villages and awareness of important details such as roof eaves, windows, doors, architraves, verandas, etc. The ability to legally restrict and control such details is almost impossible. The authorities can only appeal to the public, raise their knowledge and awareness. This they do through different publications.



However, the knowledge that guided how existing buildings could be changed to suit new needs or how to add new buildings within the village context has lost. New building types have for one hundred years been integrated into these villages and new actors have taken charge of the building process, actors without the natural link to the building tradition. The choices of what to build are often done without an awareness of the historic context, and clients are fooled by the National Romantic story of local vernacular architecture. Even if their ambition is to build something suitable, something traditional, the buildings they erect too often become a sad misinterpretation of the traditional buildings.

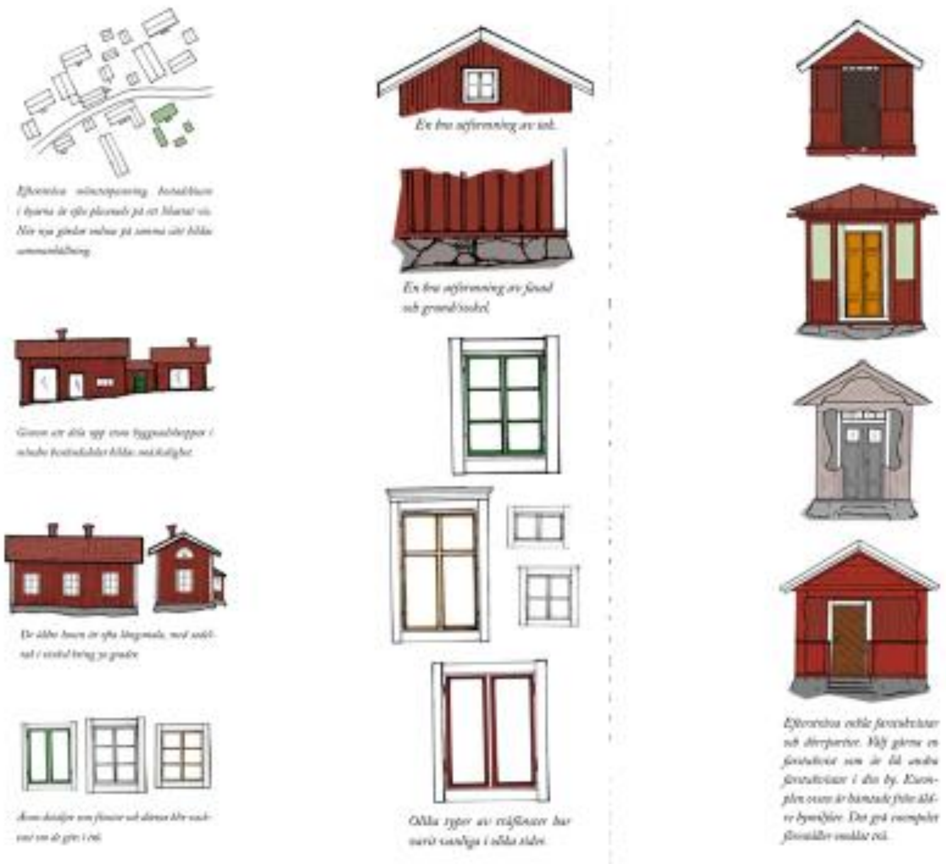


EXAMPLE OF A INDUSTRIALLY PRODUCED HOUSE SUITABLE FOR THIS REGION

Having lost the link with tradition in these sensitive historic villages that are growing and becoming more and more popular to live in, the local authorities try to take a guiding role that used to be handed down from generation to generation. The natural successive change was abruptly stopped by the National Romantic movement together with the change of the building process that was handed over from self-built houses to contractors with engineers designing houses instead of following a traditional concept.

There is a limit of how much change is possible before the villages lose their historic identity. That is why the recommendation is to restrict changes within the heart of the village and be less restrictive in the village outskirts. The discussion on what is suitable and what is not, will be a neverending dialogue.

I will end my presentation by showing examples of work from our architect's office in this region.



The first one is an extension to an old farm house where a legendary folk musician lived. His niece with her family inherited this house, of a single room house type in two stories. This was too small for a family of five people, so an extension was necessary. This was done by extending the existing house with one unit of the existing module and making it a double room house in two stories. To get more comfortable stairs to the upper floor a veranda with the staircase was added as well. In addition the extension was built with a basement that is completely non-traditional. Here a laundry was placed as well as new installations for the house. The boiler room was placed in the adjacent barn and the pipes drawn underground to the new basement. The whole house was modernized with a modern heating system that replaced the wood heating tiled stoves as the main heating device. Water and sewage systems were also installed. The extention was done in the same style as the existing building with a two-storey veranda as an addition. This also followed the architecture of the existing building, but with a slightly more free interpretation.

KNIS KARLSGÅRDEN IN TIBBLE
A SIDE ROOM TYPE PROLONGED 1983

Another example is this veranda that does not follow the vernacular style but is a more modern addition in tune with the context. With this addition the house was opened towards the garden and the lake view. The traditional houses often had entrances from the north, with double doors to prevent cold air entering the house, and by this the facade towards the south could let in maximum of sun light all year round. These houses were not built for recreation or the life style we have today, but were besides being residential, were also places for work. There was no time for recreation. No need for a pleasant contact with the garden.

KNIS KARLS FARM IN TIBBLE VILLAGE WAS MODERNIZED BY ADDING A MODULE IN TWO FLOORS WITH A BASEMENT AS WELL AS A VERANDA WITH THE STAIRS TO THE UPPER FLOOR.

MATTSSON & WIK ARKITEKTER 1983

The last example is a completely new house on a spectacular site with views in two directions of Lake Siljan. The client was a wealthy businessman and had clear opinions of what he wanted: a traditional house, based on symmetry and the double room house plan. Still, he wanted a huge living room for receptions where he wanted to be able to have a folk musician playing from a balcony overlooking the living room. The wife, an artist, also needed a studio somewhere as well. The house looks like a traditional double room house type in one and a half storey, which was also common, towards the street and all the exceptions, the huge living room, the studio, etc, were placed as a grandiose extension towards the garden and the lake view.

HOLMBERGS FARM IN STYRSJÖBO. ADDITION WITH A VERANDA IN A DIFFERENT STYLE AND COLOUR

All these examples were carried out before the recommendations from the authorities were set up. Some of them are used as examples for planned projects today. But they are all 20 – 30 years old. Should we continue in the same way or could we in a natural way continue the trend that was lost in the last turn of the century, to gradually adopt new technology and incoorporate it into the traditional buildings? Today the inhabitants do not build their houses themselves which distance them from many desicions that has to be made in the building process. But we face a major change towards new sustainable systems which are one driving cause for the growth of these villages so even the building method can change and perhaps be carried out in a cooperative way where everyone contributes with his/her expertise. As in the old days, this would give the inhabitants both better control of the building process and the results as well as involve them as in the process. There would be a development towards a new vernacular architecture, and hopefully a circular economy as well.

Övre plan 1:300

Entréplan 1:300

Souterrängplan 1:300

NEW BUILDING AS AN INFILL
IN TÄLLBERG
MATTSSON & WIK ARKITEKTKONTOR
1986

This has occurred in one village where idealists have moved in and decided to produce almost all food they eat themselves, build CO_2 neutral houses and live a life in a similarly sustainable manner. Not all will do the same, but there is a clear trend towards this in Dalarna. The authorities happily support this but have to hurry with awareness rising of the existing values in these villages, as they do. Hopefully this will avoid future buildings that are meant to fit in, but are instead a monstrous interpretation of the local traditional architecture.

AN OVERVIEW OF WOODEN BUILT HERITAGE CONSERVATION IN ISTANBUL THROUGH PERIODICALS

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Abstract

Istanbul was a remarkable and inspiring city with its wooden built heritage. Unfortunately, the tradition of wood structures came to an end in the 20th century due to the changes in building technology. The lack of protective legislation, technical and financial assistance and awareness in property managers and users led to the loss of many structures. Urban development caused by population growth also had a severe negative impact on the conservation of the authenticity of Istanbul's urban fabric. The oldest wooden house in Istanbul today dates back to the end of the 17th century, and the remaining wooden built heritage is from the 19th century. After the amendments in the Law on the Conservation of Cultural and Natural Property (2863) in 2005 (such as the establishment of Directorate for the Inspection of Conservation Implementations (KUDEB), conservation proposals involving the use of traditional materials and techniques reduced the prevalence of reinforced concrete interventions. This paper aims to give a limited overview of the conservation works on wooden heritage through 45 periodicals published by the Istanbul Metropolitan Municipality and the General Directorate of Foundations, Istanbul 1st Regional Directorate. The wooden buildings studied through the periodicals published since 2009 include palaces, religious buildings and residences that have different functions and architectural features. The studies can be classified under documentation, analysis and interventions such as conservation and reconstruction subtitles. The general overview provides the possibility to understand the conservation problems, the approaches, the need of periodical maintenance and the adaptive reuse issues in Istanbul over the last decade.

Keywords: *Istanbul, wooden heritage, interventions, periodicals.*

INTRODUCTION

Wooden buildings constitute an important part of Turkey's architectural heritage: the wooden construction tradition was highly appreciated and had always been preferred in residential architecture in Istanbul. At the beginning of the 20th century, 95% of the houses were built using this method (Günay, 2016: 35-36). Due to disruptive changes in construction techniques, traditional building crafts dwindled. The lack of technical and financial assistance from public authorities for their conservation and many other reasons lead to an increase in their losses (Ahunbay, 2012: 36). After the new amendments in the related law in 2005, the use of traditional materials and techniques became more widespread in the conservation of wooden buildings, and were shared in publications issued by the official bodies which are sometimes responsible for the interventions. This study aims to give a general overview to the wooden built heritage of Istanbul through selected periodicals published from 2009 to the present: "Proceedings of Symposium on Restoration and Conservation of Timber Structures" (6), "Restoration Conservations Studies" (21) and "Restoration Annual" (18) for a total of 45 volumes. The study is constrained to the conservation or reconstruction works of entirely wooden buildings, covering the conservation of 10, reconstruction of 5, and façade rehabilitation of two streets. As a capital city of the Ottoman Empire, Istanbul was always a center of creative arts. The examined wooden buildings are registered as cultural assets with different functions and characteristics such as palaces, religious buildings and residences. Some of them are along the Bosphorus coastline or in the historic peninsula of Istanbul, which is a UNESCO World heritage site. The studied buildings have a wide range of conservation issues. The common ones can be classified under inappropriate interventions/repairs (use of different species of wood, construction technique and details, concrete elements; surface finishes such as cement based plasters, paints, coatings; annexes, opennings etc…), abandonment, neglect, misuse, fire, accident (fig. 1), lack of maintenance and loss of original function. The main causes of decay seen on wood material are environmental and climatic conditions, temperature and humidity fluctations, fungal and insect attacks, and lack of ventilation. The consequences of these problems include distortion of the structure, missing or decayed parts of architectural elements, plaster separation and cracks.

Figure 1. Hekimbaşı Salih Efendi Mansion after a tanker accident, Bosphorus, 2018.

EVALUATION OF WOODEN BUILT HERITAGE WORKS IN ISTANBUL

The protection and conservation works of wooden heritage in Istanbul have been increasing in number over the last decade. The interventions observed in wooden buildings have different phases as seen in all other types of buildings. The aim, process and types of interventions observed in the studied buildings are classified below:

Aim, approach and principles: The aims of conservation works in wooden buildings vary: in Hıdiva Palace, this is "*the least intervention is the best restoration*". After the conservation of the wooden elements, the survival of the structure was ensured for approximately 40-50 years (fig. 2). For the conservation of Tuzcuoğlu House, the authentic characteristics of the building were preserved, while a new spatial organization was made for its re-use. "*The restoration surpassed the sole purpose of "conservation" and became an "information reading" tool*". The holistic/integrated conservation approach, authenticity and sustainability by national and global criteria were key choices in the conservation of wooden houses by

Figure 2. Hıdiva Palace, Bosphorus, 2018.

KUDEB in Süleymaniye, and their experiences were shared in 6 volumes for educational purposes. To protect the integrity of the building for future generations and to exhibit clearly the present-day materials and techniques used in reinforcement works were the main aims in the Harem of Yıldız Palace. The decayed wooden elements that were not entirely replaced were conserved to show their historical and technical value. Also mentioned among aims was to provide the highest quality of craftsmanship. Project associates examined the related articles of the national/international laws and charters to determine the methodology of the practice. To remove inappropriate works and to respect the original materials and techniques were the main principles for the conservation of Ertuğrul Tekke Mosque (fig. 4). The aim of façade rehabilitation on the wooden houses of Cemil Meriç and Şehsuvarbey Streets was mainly to overcome bureaucracy, provide technical and economical assistance to the owners for the maintenance and repair of these buildings, and to create a tourist attraction while generating awareness in the community about the conservation of wooden heritage through local administrations (fig. 6).

Figure 3. House reconstruction, a conserved house and an abondoned house at Süleymaniye, Fatih, 2019.

Persons Responsible: The civil architecture examples mostly belong to individuals while some were acquired by public bodies such as the reconstruction project of Doğanzade House, which was prepared by Istanbul Metropolitan Municipality, Directorate of Cultural Heritage Projects. Additionally, the façade rehabilitation of 6 private wooden houses was made by Üsküdar Municipality after establishing a wood workshop (with craftworkers and vocational school students) with full support of KUDEB. The wooden houses in Süleymaniye were also conserved by KUDEB and a timber training workshop was involved in the project (fig. 3, 5). Some monumental buildings are the property of foundations: the conservation of the Ertuğrul Tekke Mosque and the reconstruction of Yenikapı Lodge were performed under the supervision of the General Directorate of Foundations. The architectural projects are generally prepared by architects who have Master of Science degrees on Architectural Conservation. The technical team consists of specialists such as civil, electrical and mechanic engineers. For monumental and important conservation works a scientific council of different specialists and academicians participate in the preparation and implementation processes, or some unofficial meetings were organized to inform and solicit comments such as those for the reconstructions of Sipahiler Ağası Mansion, and Abdülhamid II's Winter Garden.

Figure 4. Conservation of Ertuğrul Tekke Mosque, Beşiktaş, 2009.

Preparation of the projects: The conservation projects were prepared after extensive documentation and visual analysis phases. Research was performed in the libraries and archives of relevant institutions and organizations. All written documents (books, academic thesis, articles, tax, land registers etc.) and visual documents (old photos, aerial photos, historic maps, cadastral maps etc.) were collected and analyzed. For the reconstruction of Sipahiler Ağası Mansion, an expert librarian was assigned to work beside the architecture team. Other academics were responsible for comparing old and new photos and determining the location of the building by different photogrammetric methods. The reconstruction of Zeytinburnu Mevlevi Lodge was based mainly on old exterior and interior photos. However, photograph is not always a definitive way of understanding building construction techniques. In the case of the reconstruction of Abdülhamid II's Winter Garden, it was not possible to determine precisely if the roof structure was pig casting or wood and to draw all the details of the system from one small photo. For Hıdiva Palace, the photographs likely taken by its architect Antonio Lasiac in 1901 were a valuable source for the wooden façade elements' restitution. Oral history studies were also an important data for the reconstruction of Bahariye and Yenikapı Mevlevi Lodges.

Figure 5. Façade rehabilitation of wooden houses at Süleymaniye by KUDEB, Fatih, 2008.

Excavations, non-destructive and laboratory testing: The reconstruction of wooden buildings require excavations first to confirm their previous existence on the site, and these were conducted under the control of the Archaeology Museum in accordance with the decisions of Istanbul Cultural and Natural Heritage Preservation Board in the case of Sipahiler Ağası Mansion. For Doğanzade House, GEORADAR ground scanning system was preferred. Laboratory tests are critical to identifying the original techniques and materials. Therefore wood, natural and artificial stone, mortar and plaster samples are analyzed in the laboratories of universities or participating institutions. The small pieces of wood on marble feet in Abdülhamid II's Winter Garden were identified to be pine and the pillars were reconstructed by using wood instead of pig casting. 1/1 scale or smaller models were prepared. Another important component is measuring distortion before or during the intervention process. In cases such as a house in Arnavutköy, determining the original wall paint and a color survey required the supervision of a certified restorer from the Ministry of Culture Conservation Center.

Approvals and intervention process: The responsible organ in municipalities for simple repair and maintenance works is KUDEB (Directorate for the Inspection of Conservation Implementations). The conservation projects of the registered cultural assets prepared by the architects are approved by Istanbul Cultural and Natural Heritage Preservation Board before they can be started. During the intervention process, depending on the results of diagnostics and laboratory tests, it is possible to get new approvals, revise the projects and propose changes in conservation works. The property type, dimensions of the building, and persons responsible for implementation also shape the intervention process.

Interventions: Conservation works have different degrees of intervention such as repairs, reinforcement etc. Reconstructions are not conservation methods but along qualified conservation projects, critical reconstructions have also been made in Istanbul in the last 15 years. Some temporary precautions are taken before or during the interventions. The buildings are protected by temporary wooden or steel roof structures such as those seen in Yıldız Palace

Mabeyn Kiosk and Tuzcuoğlu House conservations. Temporary shoring systems are also used. The rebuilding of load-bearing walls while shoring ceilings or the restoration of the ceiling beams are done by shoring the load-bearing wooden elements. For example, in the Yıldız Palace Harem, the wooden dome structure was suspended by jacks and telescopic props on the beams without changing the loading regime. In Hıdiva Palace, floors were levelled by lifting the system carefully.

Figure 6. Façade rehabilitation of wooden houses at Kumkapı by KUDEB, Fatih, 2019.

Wood conservation is a core element of interventions in wood structures. Depending on the deteroriation, decayed wooden elements (beams, columns, trusses) that lost their bearing function may be replaced totally or partially while respecting details from all periods (original wood species, joints, connections and dimensions). Conservation of structural frame, roof, eaves, window frames, façade and floor coverings are also common interventions. The wood used for structures is generally oak and pine, and the original choice of wood species is very important. For instance, dry and water-based impregnated local wood material was used in the reconstruction of the wooden dome of Yenikapı Lodge, and in conservation works of smaller wooden houses. Inappropriate window frames, shutters, doors, façade and roof coverings were removed and reproduced with original wood species and details in the studied buildings. However, due to the unavailability of necessary solid wood and dimensions and structural calculation results, industrial glued laminated wooden elements were preferred in some works such as the reconstruction of Tunuslu Hayreddin Pasha Mansion, the roof reconstruction of Abdülhamid II’s Winter Garden, and the conservation of wooden walls in the Ahmet Ratip Pasha Mansion.

Strengthening decayed and deformed roof, floor and wall systems is a part of many projects. The choice between original or present-day materials depends on deterioriation. The usage of metal-wood connections is seen in authentic wood elements reinforced by steel: in Ahmet Ratip Pasha Mansion, new details were created with I-profile steel girders on eaves. In the Tuzcuoğlu House conservation, steel nails were used beside galvanized nails. In a house in Arnavutköy, new wooden beams were added to the floor beams but flexible screws were used instead of traditional nails in order to support the new additions. The strengthening work of the wooden ridge beams in the roof of the Harem structures in Yıldız Palace were consolidated by steel cable and tensioning. On the other hand, a second supplementary steel system was developed for Abdülhamid II’s Winter Garden to carry the wooden roof structure loads, and the effects of vibration on the main structure were regularly measured by experts. The techniques used for the wooden roof and ceiling of Harem structures in Yıldız Palace were tensioning and hanging as well as the addition of a new truss system were used. Reinforcement of ground and foundations is also seen in some cases such as the reconstruction of Sipahiler Ağası Mansion, which is a waterfront structure: after creating a durable basement with mini piles, reinforced concrete shells which are strong enough for buoyancy of water were made. The ground of Hıdiva Palace was also reinforced by pillars using the jet-grout system.

Inappropriate annexes, elements or layers were removed to display the authenticity of the buildings. The masonry tomb in the Yahya Efendi Complex was destroyed to reconstruct a wooden dome. Addition of new spaces such as a basement is a radical intervention seen in some reconstruction works, such as in the Sipahiler Ağası Mansion, where in accordance with legal requirements and the needs of new function, a basement floor was built. Insulation of roofs and façades is important for the durability of the wooden structures: in the reconstruction of Sipahiler Ağası and Tunuslu Hayreddin Pasha Mansions, waterproofed and thermal insulation (stone wool) layers were placed under the façade wooden cladding boards as necessary. In a house in Arnavutköy, the façade was insulated against heat and sound with mineral wool and water, and a flame-resistant coating was applied under façade boards. The plumbing, electrical wiring and lighting system are also technicals details that need attention: Abdülhamid II's Winter Garden is illuminated with diffuser lighting fixtures and NYM cables carrying energy to the lighting elements through a carrier system; in the Arnavutköy house, heating and electrical installations were crossed floors in fireproof cover pipes, and insulation was made with mineral wool. For the reconstruction of Tunuslu Hayreddin Pasha Mansion, a special place was created in the inner walls.

The six studied reconstruction examples which are the main scientific discussion in this article have different aims: For Sipahiler Ağası Mansion, the primary purpose is to rebuild in a way that preserves the original construction technique in accordance with international conservation principles and techniques, and to have a function that ensures the longevity of the building. In Doğanzade House, besides preserving the traditional architecture by utilizing original materials, the aims were to preserve dimensions and construction techniques (with original details), to make new arrangements for daily use such as wet areas, and to prolong building life while protecting the space planning. The Culture and Tourism Ministry -despite their unfavorable approach to the reconstruction- has decided to rebuild Abdülhamid II's Winter Garden as a museum due to its unique memorial presence. The interior design of the Zeytinburnu Mevlevi Lodge considered the architectural features of its period and those of the "Mevlevi" (Sufi) orders.

Building Name	Location	Date of construction	Original/New Function	Interventions
"Harem" Structures of Yıldız Palace	Beşiktaş-Yıldız	End of the 19th century	Harem section of Yıldız Palace / Harem Museum	Conservation
Ertuğrul Tekke Mosque	Beşiktaş	1887-1888	Mosque/Mosque	Conservation (2008-2010)
Yahya Efendi Complex	Beşiktaş-Yıldız	1538	Tomb and religious building/ Tomb and religious building	Conservation (2009-2013)
Hıdiva Palace (Valide Pasha Mansion)	Bebek-Beşiktaş	End of 19th century (1901 the openning)	House / Consulate General of Egypt	Conservation (2008-2011)
Ahmet Ratip Pasha Mansion	Kadıköy-Acıbadem	1900-1905	House/Public purpose	Conservation (2013-2016, 2017-…)
House	Fatih-Süleymaniye	End of 19th century and	House/ İstanbul Site Management Directorate	Conservation (2009-2012)

	(Kirazlımescit Street)	beginning of 20th century		
House	Fatih-Süleymaniye (Kayserili Ahmet Pasha Street)	Late 19th century or early 20th century	House/İstanbul Metropolitan Municipality Directorate of Cultural Heritage Conservation	Conservation (2010-2011)
Mirgün Kiosk	Sarıyer-Emirgan	19th century	House/Research center	Conservation (2010-2011)
House	Beşiktaş-Arnavutköy	Late 19th century	House/House	Conservation (2011)
Tuzcuoğlu House	Üsküdar-Beylerbeyi	Beginning of 19th century	House/ Office	Conservation (2012-2013, 7 months)
Houses (4) at Şehsuvarbey Street	Fatih-Kadırga	19th and 20th centuries	Houses/ Houses	Façade rehabilitation (2009-2010)
Houses (4) at Cemil Meriç Street	Üsküdar	19th and 20th centuries	Houses/ Houses	Façade rehabilitation (2010)
Bahariye Mevlevi Lodge	Eyüp	1877-1910 1910-1925	Religious building/ Human and Civilization Movement	Reconstruction (Contract of the project 2005)
Yenikapı Mevlevi Lodge	Zeytinburnu-Merkez Efendi Street	1598	Religious building/Fatih Sultan Mehmet University	Reconstruction (2005-2007)
Mehmed Emin Ağa Mansion	Beykoz-Kanlıca	1811- 1833 ?	House/ Defined as a communal clubhouse in the master plan.	Reconstruction
Tunuslu Hayreddin Pasha Mansion	Fatih-Sultanahmet	Mid 19th century	House/İstanbul Municipality private social	Reconstruction
II. Abdülhamid's Winter Garden at Yıldız Palace Mabeyn Kiosk	Beşiktaş-Yıldız	End of 19th century (The Mabeyn Kiosk, 1901)	Winter garden/ Museum	Reconstruction (2002)
Doğanzade House	Fatih-Zeyrek	Early of 19th century	House/	Reconstruction project

Table 1. List of studied wooden buildings through periodicals.

CONCLUSION

Protection and conservation of wooden built heritage are closely related to matters of policy, education and awareness. The limited documentation concerning the remaining wood structures is generated by academic research, theses, projects or implementations, and the latest publications are valuable sources for education and sharing the traditional knowledge and skills used. But there are many cultural assets in Turkey and there is no database center, an institute or a research center that focuses on our vulnerable wood heritage by documenting the value they carry. We need more comprehensive studies for understanding the variety of methodologies and techniques used in our wooden built heritage. Non-destructive and laboratory tests are becoming more common recently, and architectural projects of the monumental wooden buildings are prepared with the scientific consultation of specialists and scholars. However, the decision to use industrial glued laminated wooden elements due to the lack of historic forest reserves and necessary original wood species with original dimensions is a serious problem for conservation and reconstruction works. The decisions of the technical team and the skills of craftworkers and builders on site are also crucial. Unique and different original wood joinery techniques, proposed metal-wood connections need to be analyzed more, and new designs and solutions must be practiced while preserving the authencity. It therefore appears to be a necessity that more wood workshops and courses which bring together academics, specialists, craftworkers and students are organized.

The coordination problems observed between public authorities, contractors and project owners during the intervention process need to be resolved. The long duration causes other conservation problems for wooden buildings, which are more vulnerable than masonry ones. All of the studied wooden buildings need regular monitoring and periodical maintenance after intervention with a protocol for their continuing protection and cultural significance. More wooden buildings are being reconstructed along the Bosphorus and in the historical peninsula due to the high average income of these locations. The Law on Conservation by Renovation and Use by Revitalization of the Deteriorated Historical and Cultural Immovable Property (5366), the 2018 principle resolution adopted by the Ministry of Culture and Tourism on the reconstruction of religious buildings, and the notes on master plans in the historic peninsula frame the legislation which is needed for the reconstructions even though the approaches of international charters and specialists have been prudent'. As a fundamental guide, "Principles for the Conservation of Wooden Heritage" adopted by ICOMOS in 2017 and other related charters can raise the quality of future interventions on our wooden built heritage.

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SCOTTISH RENAISSANCE PAINTED TIMBER DECORATION: THE QUEST FOR A HOLISTIC CONSERVATION APPROACH

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Abstract

The 'Scottish Renaissance' (c.1540-1650) was an era of thriving creativity in Scotland. During this period, a distinctive style of decorative interior became fashionable in properties throughout the country. While most wall panels have not survived, over one hundred painted timber ceilings were unintentionally preserved behind later plaster ceilings. Since their rediscovery, conservation of paintwork has been the primary focus. In contrast, timber substrates have been (at best) ignored, or (at worst) mistreated. A more holistic approach is being sought to redress the imbalance. This paper describes the challenges facing conservators in caring for and displaying these rare survivals in the 21st century.

Keywords: *Scottish Renaissance, painted timber, conservation, challenges*

General Introduction

Much of the 16thC through to the mid-17thC was a period of thriving creative activity in Scotland. This era, often referred to as the 'Scottish Renaissance', has left us with a collection of decorative timber interiors in properties throughout the country, particularly along the east coast. While most painted wall panels (both on plaster and wooden substrates) have been destroyed over the centuries, a number of painted timber ceilings have survived, unintentionally preserved by being concealed behind later plaster ceilings. These decorative interiors have a distinctive national style, although they also share a striking similarity to others of roughly the same era in France, Scandinavia and the Baltic States. Incredibly, new discoveries are still occasionally made during building works. The main objective of this paper is to describe some of the challenges facing conservators in caring for and displaying these rare survivals in the 21st century.

Over the years, restorers and conservators have been concerned primarily with the painted decoration, focussing on paint loss and colour alteration. In contrast, the history of wood conservation in these buildings, other than insect infestation treatment, has been poor - damaged timbers have been (at best) ignored, or (at worst) mistreated. Perhaps due to a loss of knowledge regarding wood-crafting skills and a lack of suitable timber, restoration over the past sixty years has involved crude, unsympathetic replacement methods and materials. Since their rediscovery, the importance of these timber substrates has been overshadowed by the attention paid to the decorative paintwork they support.

Scottish Renaissance Decoration

To provide context, this paper begins with a description of the buildings in which the painted timbers are located, the different types of construction, and the materials used for decoration.

Painted ceilings were a popular fashion featuring in dwellings owned by a wide range of society during the Scottish Renaissance. They can be found decorating significant rooms in properties ranging from royal palaces and castles to private chapels and the homes of wealthy merchants, particularly all along the eastern coast of the country. Many more decorative interiors would have been painted than survive today; of those still in existence many have been heavily restored, a few are in vulnerable condition, and others have been removed from their original setting and relocated. Despite this, there are over a hundred buildings in Scotland where Renaissance painted ceilings still survive *in situ*.

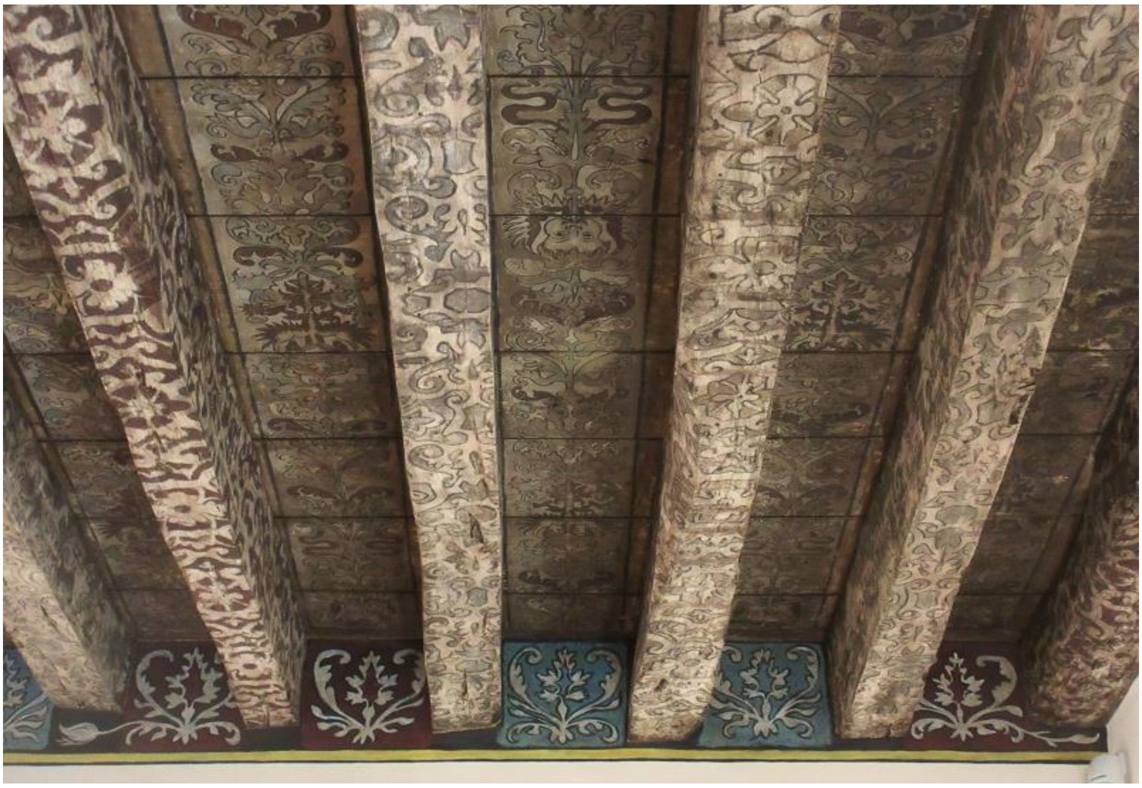

Fig. 1 – Riddle's Court board and beam painted ceiling and frieze.

The ceilings fall predominantly into two structural categories: 'board and beam' construction (Fig. 1); and 'barrel vault' or 'coved' construction (Fig. 2). Open board and beam ceilings, the most prevalent, have designs painted on three sides of their oak or pine support beams and on the pine boards spanning each narrow bay. The reverse sides of the painted boards generally serve as floorboards in rooms above. Board and beam schemes would usually have included a frieze, painted between the beam ends onto timber-lined or plaster walls; however very little frieze evidence has survived. Occasionally the painted decoration extends down entire walls (although, for insulation, sleeping spaces probably had textile hangings below the frieze). The second type of ceiling, the barrel vault, consists of a series of closely fitted boards (tongue and groove jointed) suspended from the roof, creating a continuous surface on which to paint (paintings on the much less common coved ceilings are treated similarly).

Decoration was executed *in situ*, using tempera paint consisting of powder pigments in a medium of animal glue. Also, a varnish layer of pine resin mixed with walnut oil was sometimes used as a coating on specific elements of the paintings.[22] Designs on surviving ceilings range from popular fruit and flower motifs representing ‘plenty’ (but with no definite symbolism), to paintings with highly symbolic, religious or moralistic references. Other motifs such as arabesques or Celtic knot-work designs appear to be simply decorative. For board and beam ceilings, the style of decoration is somewhat dictated by the long, narrow compartments created by the beams. Decoration tends to be repeating patterns within the board area, and designs or script on the beams. The continuous surface of barrel vaults is often divided into more manageable compartments by means of *trompe l’oeil* coffering, or elaborate strap-work with cartouches. Regardless of the designs commissioned, their classical origins evidently reflect the cultural and intellectual aspirations of the owners.

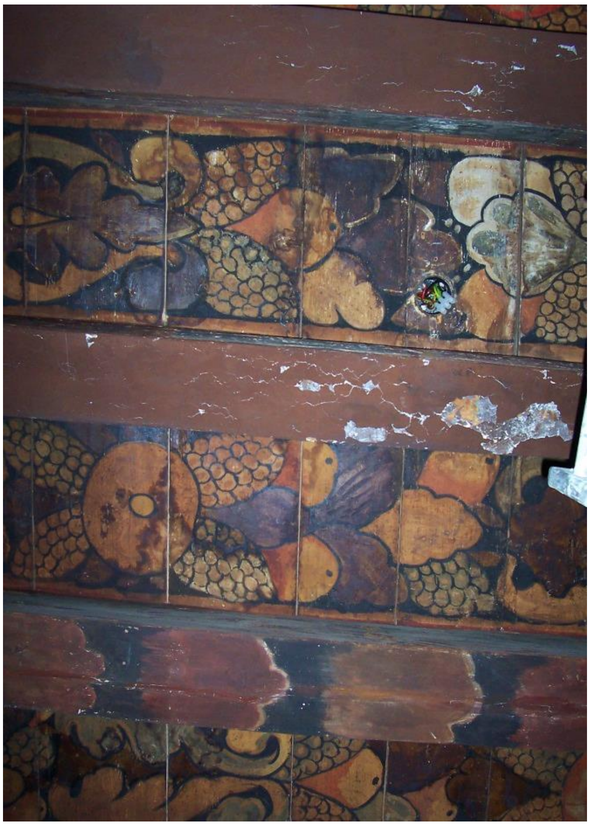

Fig. 2 – Culross Palace barrel vaulted ceiling. Fig. 3 – 302/4 Lawnmarket ‘plastic wood’ fill.

Academic study of the decoration in terms of subject matter, inspiration or technique has been limited. Indeed, it wasn’t until 2003 that Dr Michael Bath published his comprehensive study *Renaissance Decorative Painting in Scotland*, which identified sources and listed all known schemes at the date of publication (including those lost). This book remains the definitive study to date, and identifies sources of many of the iconographical features deriving from the engravings and emblem books circulating around Europe at the time. These decorative images generally entered the country via trading connections (Bath, 13), as trade along the east coast of Scotland expanded significantly during this period. Clear cultural links were established with the Low Countries (Bath, 2; Howard, 7-8) and dendrochronology has confirmed that the

[22] Michael Pearce (previously scientific researcher, HES), in personal communication (2010), noted that research had identified this as the varnish of choice to highlight elements of glue-size painted ceilings in Scotland from 1580 to 1630.

majority of pine used in Scottish construction during the 16th and 17th centuries was imported from southern Norway and the Baltic States (Crone, 28-33).

Nevertheless, by the mid-17th century Scottish Renaissance painted decoration was beginning to fall out of fashion. Many ceilings had already been damaged or destroyed by fire, which was a constant threat for overcrowded timber buildings. Uneven beams were shaved back to apply lath, and boldly-coloured boards were either ripped out to be recycled as lath, or concealed behind whitewashed ornamental plaster ceilings that became the predominant taste supplanting this tradition with the arrival of English plasterers towards the mid-17th century. Such was the fate of Scottish Renaissance painted timber ceilings at the three properties discussed in this paper: Culross Palace (Culross, Fife); 302-304 Lawnmarket (now part of Radisson Collection Hotel on the Royal Mile, Edinburgh); and Riddle's Court (Royal Mile, Edinburgh).

Treatment upon Rediscovery

Hidden for centuries behind false plaster ceilings, the majority of these colourful decorative schemes were uncovered over four hundred years later during a flurry of redevelopment and construction works in Scotland. Some survivals had suffered losses due to fire damage, but this paper will focus on two other common causes of wood loss: deliberate mechanical damage (such as the undersides of lower lying beams chopped back); and deterioration of the timber due to prolonged damp and wood beetle or fungal attack.

<u>Mechanical Damage</u>

The treatment approach for shaved back beams has varied depending upon the conservation era and intended future use of the room, and while many ceiling beams have remained untreated, others have been dramatically 'restored' with varying degrees of success.

An extreme example of a 1960s treatment approach is the restoration of two board and beam ceilings in a townhouse at 302-304 Lawnmarket in Edinburgh's Old Town[23]. Shortly after rediscovery of the decoration the property was revamped as city council offices. The 16th century beams were cut out to fit into new locations, where the ceilings required the support of reinforced steel joists. The undersides of many beams had been roughly chopped back during the 17th century for attachment of lath and plaster. 1960s restoration treatment involved filling the rough undersides of beams to an even surface using a resin-based filler known as 'plastic wood'. A few coats of brown paint were then applied to the resin fills, presumably in an attempt to mimic wood. Over time the extensive resin fills had become badly cracked and the brown paint was flaking (fig. 3).

In 2010, this Scottish Renaissance building was again renovated and incorporated into a 20th century luxury hotel. New use of the rooms as hotel bedrooms meant that the painted ceilings were expected to have a more 'finished appearance'. Attempts were made to remove the unsightly resin fills, however this proved to be extremely difficult as the filler was firmly embedded in the grain of the wood. Instead, conservators reduced the fills as much as possible and masked remnants beneath a thin layer of gypsum plaster. These areas were then stippled using reversible paint colours to match the surviving decoration. In other words, the design and colours are fully recreated but the method of application distinguishes it from original Renaissance paintwork (fig. 4). Unfortunately, there were limitations with regards to treatment

[23] This historic structure was incorporated into the GFB Hotel Missoni in 2010, and has since been sold on to become the Radisson Hotel Collection Royal Mile, Edinburgh.

of the ceilings (time and budget constraints, and an unenthusiastic client). Ideally all traces of 'plastic wood' filler would have been removed, allowing the prospect of treatment options which would respect the history of the ceilings by leaving the wood exposed.

Fillers used in the latter part of the 20th century have been less controversial, with a greater focus on reversible materials such as gypsum plaster. An example of this is found at Gladstone's Land, a Scottish Renaissance townhouse in Edinburgh owned by The National Trust for Scotland (NTS). Beams with losses were filled in the 1980s using gypsum plaster and stippled in a neutral earth tone to unify missing areas of paintwork (fig. 5). Nevertheless, there was still a clear desire to restore lost decoration rather than leave any rough timber exposed.

Fig. 4 – 302/4 Lawnmarket 2010 restoration; plaster over 'plastic-wood remains'.

Fig. 5 – Gladstone's Land 1980s restoration; plaster fills, neutral tone stippling.

In the 21st century, newly discovered ceilings or dramatic changes in the use of a historic structure occur less frequently. When they do, the approach tends to be much less intrusive than in the past. An example can be found at Riddle's Court in Edinburgh, where a very unusual Scottish Renaissance painted ceiling was exposed and restored in 1960, and a further three contemporary ceilings were discovered during renovations in 2015. The 1960s phase of treatment included cutting holes in decorated ceiling boards to install light fittings (fig. 6). Although shaved back beam soffits were left unfilled, inexplicably they were painted brown (fig. 7). During conservation treatment in 2017, the brown paint was removed and original pine left exposed. Likewise, lost or damaged ceiling timbers on the three ceilings discovered in 2015 have been left untreated (other than cleaning away centuries of surface grime, dead spiders etc).[24]

Deterioration

Culross Palace in Fife (another NTS property) is unique in that it was the first Scottish Renaissance building to be recognised as a monument of national importance and an outstanding example of its type[25]. The structure was built in the late 1500s by a successful

[24] From unpublished conservation treatment reports by Scottish Wall Paintings Conservators (SWPC), 2017 and 2018.
[25] http://portal.historicenvironment.scot/designation/SM5288

merchant trading coal and salt with Scandinavia and the Low Countries. Falling into a state of disrepair over the centuries, it was eventually saved by NTS and restored in the 1930s[26].

After falling out of fashion back in the mid-17th century, many of the painted wall panels and ceiling boards were ripped from the interior and stacked up either in damp storage rooms or exposed to the elements outside. NTS arranged for the panels to be fumigated and rotted sections cut away before being reinstalled in the property. However, the resulting appearance was distracting given the vast quantity of gaps of various shapes and sizes.

Restoration interventions back in the 1930s were somewhat desperate and experimental, using methods and materials that conservators (with the benefit of hindsight) would never choose today. Vulnerable decorative paint remains received most of the attention, which in this particular case made for dire consequences[27]. The timber substrates fared better, but losses were filled with a variety of materials: these include sawdust or wood shavings mixed with animal glue; builders' putty painted brown; gypsum filler bound with animal glue or resin; and other unrecognisable combinations. Many of these fills have since shrunk, come loose or are falling out; others have irreversibly hardened and are securely attached to the historic timbers. Not only are some of these fillers inappropriate and potentially damaging, but they draw attention away from the original fabric of the building.

Fig. 6 – Riddle's Court 1960s restoration; cable holes cut in 16thC boards.

Fig. 7 – Riddle's Court 1960s restoration; brown paint on shaved back beams.

Over the decades interventions have become more conservation 'conscious'. In the 1980s losses in timber wall linings at Culross Palace were filled using balsa wood (ochroma pyramidale), which is extremely lightweight, soft (despite being classified as a hardwood) and easily shaped. Importantly, it is not affected by environmental changes and so exerts no pressure on the original wood once inserted to fill gaps. In an attempt to 'blend' this material with the surrounding wood, the balsa fills were painted brown. Unsurprisingly they bear little resemblance to the original (fig. 8); also, over time the brown paint has become worn and the

[26] Restoration work was carried out by Stenhouse Conservation Centre, the precursor to Historic Environmet Scotland (HES).

[27] Early restorers used a beeswax/resin/oil mixture to consolidate severely flaking paint. The oil and resin have oxidised and darkened over time leaving the designs virtually impossible to see.

balsa inserts have shifted or fallen out. The current appearance is one of neglect; but rather than replacing with new balsa fills, a better approach is being sought.

Conclusions and Thoughts for the Future

Fifteenth century timber, whilst valued from a structural perspective as a support for painted decoration, appears to have been overlooked in its own right. Historic substrates are as irreplaceable as the painted decoration we consider so precious, and we have an obligation to protect them for future generations. A more holistic conservation approach is now needed to redress the imbalance in caring for our wooden built heritage.

Previous restoration methods and materials used in Scottish Renaissance buildings are often irreversible and unacceptable by modern conservation standards. Also, these early interventions do not respect the character of the timber and aesthetically undermine its appearance. Now that some restoration materials have failed, there is a window of opportunity to critically review the situation and reach out to wood specialists from the international community for inspiration and better options. Whether repairs or fillers are actually required must be carefully considered; where intervention is deemed necessary we must find more sympathetic and suitable materials. But exactly what specialist skills are required, and what materials are considered suitable in the 21st century?

Fig. 8 – Culross Palace 1980s restoration; balsa wood fills.

The loss of traditional tools knowledge and woodworking skills most certainly play a part in the mishandling of timber heritage conservation. Also, a history of poor forestry management in Scotland is a problem that sadly pre-dates the structures we aim to conserve (the stores of appropriate timber required for conservation purposes are simply not available). Future care of Scottish Renaissance timber will require a new approach with alternative methods and materials. It is hoped that collaboration with wood conservation specialists, woodcrafters, architects and structural engineers - not just on a local level, but internationally – will prove to be an invaluable source of inspiration.

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Conservation of Wooden Tserkvas in Ukraine: A New Initiative

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Abstract

In the summer of 2019, a two-week educational workshop was conducted in Lviv, Ukraine, under the auspices of the Lviv Polytechnic National University, as a fundamental component of an expanding architectural conservation program. The goal of the workshop was to introduce 15 participants to the contemporary theory, methods, and practice of conservation assessment as it relates to wooden architecture. Its focus was on Ukraine's vernacular wooden churches, or "tserkvas" in Ukrainian – with more than 3,000 of which have survived to this day. In 2013, 16 outstanding examples of these Ukrainian log churches located in the Carpathian Mountains were designated by UNESCO to the World Heritage List, such as St. George Tserkva in Drohobych, built in the second half of the 17th Century.

Figure 1. Tserkva of St. George circa 16c. – Drohobych a UNESCO World Heritage Site

Introduction

These integrated works of architectural art distinguish themselves by their highly skilled joinery, innovative structural solutions used in their construction, and a wall of icons which separates the altar from the congregation, called an iconostasis. Many of these churches have painted interiors on some or all of the walls and distinctive, regional stylistic forms and many are in dire need of conservation.

Their uniqueness generated international scholarly interest beginning with the late 19th century by members of the Lviv Polytechnic National University faculty. Although conservation recommendations also began to be written in the 19th century, in truth these tserkvas were cared for mostly by local craftsmen, who were well versed not only who were well versed not only in the craft and traditions of church building, but also in the continued maintenance and repair of these buildings. The 20th century, unfortunately, was a period of significant disruption, with two major wars, border changes, and wholesale population migrations within the territory of present-day Ukraine. During the Soviet period, most tserkvas were closed or repurposed for such uses as granaries and warehouses.

In the years after World War II, various Soviet Ukraine governmental departments addressed the preservation of architectural monuments; however, it was not until 1969 that a separate department was formed to address the specific needs of the conservation and restoration of wooden architecture. Since then, more than 250 wooden churches have undergone some degree of restoration and conservation.

Despite these scholarly interests and conservation efforts, Ukraine’s political and cultural instability and economic hardships since independence in 1991 limited the preservation of these tserkvas. Laboratories closed, preservation departments lost staff members, and worldwide advances in the field were not fully integrated into daily practice. Today, however, as a result of the 2004 Orange Revolution and the 2013-14 Revolution of Dignity the citizens of Ukraine are now deeply engaged in the process of re-defining their cultural identity, and re-assessing their history.

Recognizing this state of affairs, Professor Mykola Bevz, Head of the Department of Architecture and Conservation at the Lviv Polytechnic National University, and the guiding force in spearheading the tserkvas’ UNESCO designation, saw the need to add wooden architecture and artifacts conservation to the university curriculum and to create a fully-equipped conservation laboratory.

Since he felt that Ukraine lacked the expertise for this undertaking, he began several conversations with western colleagues, among them Myron Stachiw, architectural historian, former head of the Fulbright Program in Ukraine, and Yuri Yanchyshyn, furniture conservator. These conversations led to the Fulbright foundation awarding a grant to Yuri Yanchyshyn who visited Ukraine in 2018 and taught at the Lviv Polytechnic. Students were introduced to the theory and practice of the conservation of wooden architecture and artifacts through a comprehensive series of lectures.

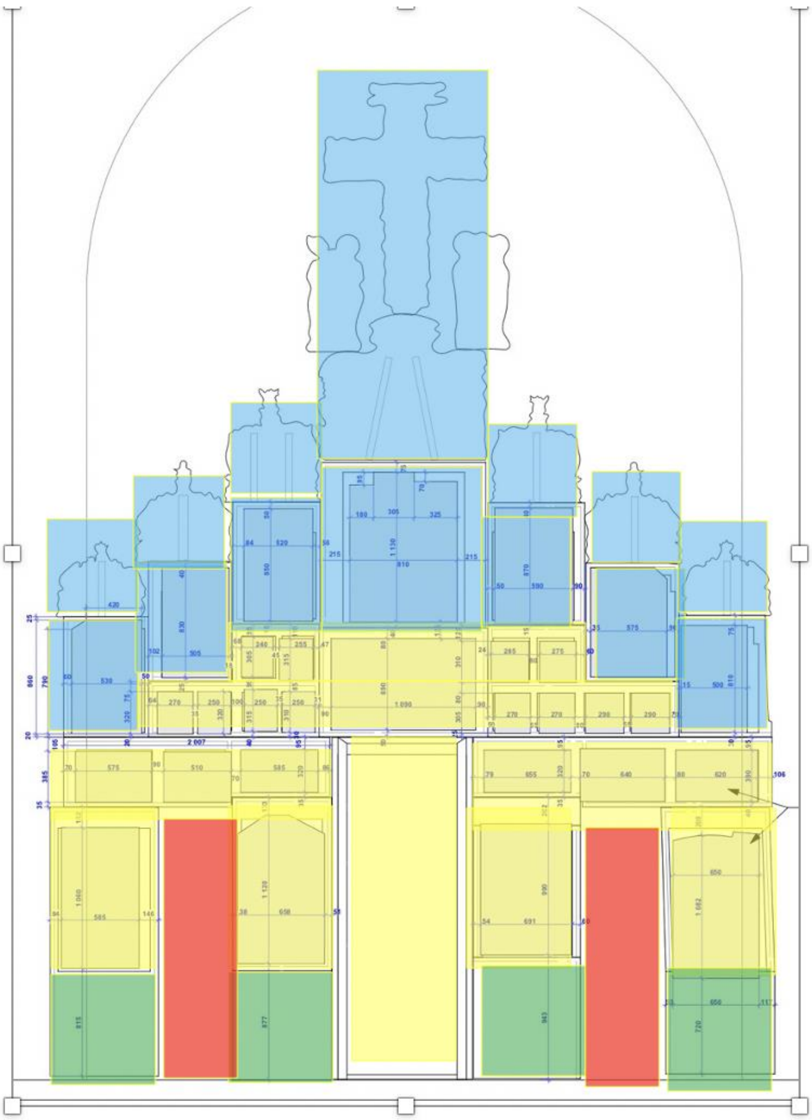
The 2019 summer workshop focused on introducing participants to contemporary conservation assessments on two structures: an 18th-century iconostasis and a late 17th-century log church.

The workshop also included a series of lectures by scholars and specialists detailing the history of wooden sacral architecture in Ukraine and its restoration; current international-accepted conservation practices and approaches; procedures of building archaeology; and field trips to several wooden churches in the region, including some undergoing structural conservation, such as replacing the bottom rows of degraded timbers by raising the entire church, or replacing of the shakes, called gonty, on a church belltower.

The investigation and assessment of the 18th century iconostasis of the Church of Nativity of the Blessed Virgin in the Village of Krups'ke, now located in the church/museum of St. Klymenta in Lviv, introduced participants to the inconostasis' unique history and methods of construction; iconography; and carved, painted, and gilded elements.

Figure 2, Church of St. Klymenta 1895 - iconostasis circa 18 c.

Careful investigation revealed that this iconostasis was composed of elements from several different iconostases, contrary to perceived historical interpretation. This practice was not unusual, whereby iconostases and their parts were re-sited to other churches for various reasons. Among these was the replacement of older churches with new buildings and new iconostases. The replacement iconostases were then often reconfigured and combined with elements from other iconostases to fit the new architectural space. The iconostasis in St. Klymenta is one such example. A comparison of photographs of the installation in the church in Krups'ke with that of the re-installation in the church of St. Klymenta in Lviv. A comparison illustrates that the latter reproduced the configuration of the Krups'ke installation reasonably accurately. However, it became clear that the original Krups'ke installation was a combination and reconfiguration of iconostasis elements from more than one source, as illustrated by measured drawings completed by workshop participants.



Drawing: Maksym Chorniy

Figure 3, Church of St. Klymenta - this iconstasis is a combination & reconfiguration of iconostasis elements from various sources.

The method of attaching the necessary framework built to stabilize the free-standing iconostasis in its new location, unfortunately, introduced undesirable elements to its further preservation. One example of this is the improper attachment of the icons and original framework to the new supporting structure. In doing so, the properties of expansion and contraction of wooden elements were not taken fully into account. The installers had used inflexible joining fasteners, potentially leading to future splits in the icons and original wood framework. Our recommendations were to replace these rigid joining plates with ones that would have slots to allow for wood movement.

This exercise of observation and careful documentation prepared workshop participants for the more significant challenge of the Church of Theophany, erected in the late 17th century in the village of Kuhayiv.

Figure 4, Tserkva of the Theophany circa 17c. – village of Kuhaiv

The tripartite, horizontal log structure with three, open log towers was constructed of hewn and rounded oak timbers with variously notched corner joints. The roof surfaces were originally covered with long, riven, feather-edged and grooved shakes called gonty, mentioned previously.

The church in Kuhayiv is no longer in active use by the congregation, as a new masonry church was constructed nearby nearly a decade ago. The old church has suffered extensive environmental damage over the past century, hastened by its disuse in the past decade.

Workshop participants encountered a building covered with tarps applied five years ago to prevent further water infiltration. This procedure proved to be unsuccessful.

The issue of pronounced water penetration has always been a prominent concern with these complex constructions of multiple roof towers. By the early 20th century, the two end towers had already begun to lean inward due to structural damage resulting from water penetration. The construction of connecting roof crickets between the towers appeared to offer a solution, as shown in this early 20th c. photograph. However, restoration of the church in the 1970s and 1980s to its original configuration included removal of these roof crickets. Unfortunately, this removal was not accompanied by adequate preventive measures against further water penetration in the valleys between adjacent towers, and resulted in additional deterioration and inward leaning of the towers.

This neglected preventive measure also contributed significantly to the deterioration of the walls below the valleys. An additional aspect of water damage was revealed by the bowing and distortion of the church's walls as a result of the settlement of the building's underpinnings and sills. Other damage included extensive insect infestation, which is still active and results in further damage to the timbers.

Measured drawings executed by workshop participants when compared to earlier renderings and images documented the continued settlement and sagging of the structure. Further observations revealed that the structure had been raised multiple times to replace sills and lower timbers using traditional methods over the past three centuries, as documented by large peg holes in the wall logs used to attach vertical timbers on the interior and exterior of the structure. The structure was then lifted using wedges and levers from below utilizing notches in the vertical timbers.

Comparison of the existing structure with historic photographs also indicated that the earlier 19th-century sacristy had been removed and replaced in the mid-20th century.

As part of the investigation of the exterior of the structure, participants were introduced to microscopic wood identification, and such identification was performed on two representative timbers of the log walls; both were determined to be white oak.

Interior investigation focused on the iconostasis and the painted interior walls. This investigation involved a systematic visual examination, multiple excavations, ultraviolet light analysis, and documentation employing photographs, sketches, and measured drawings.

During the late 20th century restoration, the interior walls were covered by canvas and painted, as indicated by an inscription on the canvas made at that time. Selective removal of this canvas wall covering and excavations revealed earlier polychrome painting and stenciling over a white-wash layer. A scanning electron microscope analysis of this whitewash layer revealed an initial oil-based zinc white, barium sulphate and kaolin layer, followed by an oil-based calcite layer.

The iconostasis of this church provided another example of the re-siting and marriage of elements of at least two iconostases, illustrated by the missing end columns and mitered joints, and the misaligned rows of icons and doorways through the iconostasis into the apse.

Excavation on elements of the iconostasis revealed original silvering and polychromy beneath multiple paint layers, or in the case of the deacon’s doors, of original polychromy hidden beneath later paint layers. Preliminary UV analysis revealed restoration overcoat layers on selective icons.

These preliminary findings call for more advanced future analyses. The 2019 workshop was a pilot program – a first attempt at organizing a workshop such as this in Ukraine. Planned future workshops will address these limitations and assist in planning a more comprehensive and analytical approach to the process of conservation assessment.

photos – M. Chornij

Figure 5, Church of the Theophany circa 17c. – village of Kuhaiv *iconostasis: a marriage of various elements.*