Towards a wooden heritage conservation theory in Spain

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Each construction material has its own physical properties that condition its use in architecture. Choice on which material to use is also based in availability and economy. Traditional architecture in Spain has been built for centuries mainly with the use of stone and wood, but the use of brick and adobe is also relevant.

Industrial revolution brought new materials and with them new techniques that gradually relegated the use of classical materials. Technology associated to steel first, and then concrete, involved the beginning of a new collection of materials and techniques that still keep being incorporated to the architect’s palette.

However, there is one material that has been used since the beginning of architecture and has been able to keep its validity in modern architecture, and this material is wood. Despite the evident crisis that affected its use in the mid-20th century, today its use is recovering.

The same properties that make wood attractive for being used in contemporary architecture are those that made it attractive for building in the past. Most of Spanish heritage has been built combining stone or brick with wood.

Before being cut down, wood has had to bear compression and tension efforts due to the tree’s weigh and to the action of wind. As a consequence, its capacity to support bending efforts combined with its low density have made it suitable for floors and roofs. In those cases, most elements support bending efforts and some of them tension efforts. Stone and masonry are used for compressed elements such as walls, arches or vaults.

Together with these properties, wood has specific characteristics that have conditioned the architecture while affect to its future preservation. Among those are anisotropy, hygroscopicity and durability.

In order to build with wood, two basic features are needed: wooden elements and a way to join them. The capacity to join wooden elements affects to the capacity to create architecture. Apart from more recent methods such as glued joints, wood elements may be connected by tying, joining and nailing. The most common, but not the only, used to create our historic architecture are the wooden joints.
As joining consists in removing material from two or more wooden elements to make them fit, loads are transmitted along the contact planes and this fact conditions the structural behaviour of the joints. Our traditional joints have almost no capacity or none at all, to resist moments. This fact results in isostatic structures, and stability has thus, to be achieved by using triangulation or by combining wooden structures with masonry. This fact is also relevant regarding to heritage preservation.

Wood has been widely used in Spanish architecture. The Palloza still can be found in Galicia and is one of the most primitive constructions still active in Europe\(^1\). Wood that is tied with ropes is placed on top of circular stone walls to create its roofs. More usual is the case of wood used for floor structures composed by beams and joists varying their complexity from the simplest beam and plank solution to the complex decorated coffered ceilings. A case of sophistication in coffered ceiling design is Gaudi’s Güell Palace in Barcelona.

For centuries a particular system of structural interlaced carpentry was developed in large regions of Spain, whose main characteristic is the strict integration of complex geometric decoration with structure. It gained complexity gradually and reached a first step of prefabrication with the incorporation of a double hip rafter (moamar)\(^2\). Sophistication reached its utmost level with the creation of wooden domes where ten-pointed\(^3\) star geometric pattern design was adapted to the spherical surface. The highest degree\(^4\) on carpentry mastering could only be reached by demonstrating the capacity to design and build one of those interlaced wooden domes. Good examples are the domes covering the Ambassadors chamber in the Royal Alcazar of Sevilla and the stairs of the House of Pilate.

Another case that deserves to be mentioned is the architecture of the wooden churches in the Basque Country. Located in a small area, there is a wide variety of designs and solutions for vaults\(^5\), domes and roofs, as a consequence of a long tradition in building with wood.

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\(^2\) “La primera sutileza que incorpora la capintería española, y que va a permitir su gran desarrollo, es el desdoblamiento de las limas (Limas moamares), lo que posibilita la prefabricación de la armadura por paños, simplificando su montaje.” Nuere, E. (1989). La carpintería de armar española. Madrid: Ministerio de Cultura. Dirección General de Bellas Artes y Archivos, p. 68.


However, the use of wood is not limited to monumental architecture, and in most of the centres in cities and villages, architecture is made with a combination of wood and stone. Nonetheless, and despite being a country with a long tradition in building with wood, with an extraordinary richness in heritage and a long tradition in its preservation, the relation of professionals on heritage preservation with wood is still not normalized.

The Venice Charter issued in 1964, sets the theoretical principles for the conservation and restoration of monuments and sites. From the very beginning, the charter was seen as focused in the preservation of stone buildings\(^6\) and responding to a Eurocentric mentality. Such a mentality fits with the Spanish tradition in heritage preservation, and might be the reason why most professionals in our country don’t feel the need to explore further, in a territory that apparently is not of any use in their professional practice.

In 1987 Knut Einar Larsen was invited to visit Japan and have a close view of the Japanese tradition on heritage preservation. As a result he wrote in 1994 the book Architectural Preservation in Japan\(^7\) that is key to understand the Nara Conference on Authenticity, and the resulting Nara Document on Authenticity issued that same year. The book starts with the following question: “do historic buildings made of wood behave differently from buildings made of more durable materials so that the internationally accepted preservation doctrine is less relevant?” The answer resides in the content and existence itself of the Nara Document on Authenticity.


Being Spain a country with a large number of professionals and institutions devoted to heritage preservation, wood is in fact considered as secondary and professionals devoted to its preservation a minority. This situation implies a gradual loss of wooden heritage as result of the prevailing “practice on restoration that might be very conservative when intervening in walls while very prone to substitution regarding to old wooden structures.”

Responding to the question posed by Larsen in his book, the preservation of wooden heritage has needed the Nara Document on Authenticity to feel comfortable in the ambit of International Charters. Conceived in the spirit of the Charter of Venice, it introduces the concepts of cultural heritage diversity and cultural context.

In the case of wood and due to its specific features, solutions for its preservation have to be specific both regarding to theory and techniques. In that context, the IIWC issued the “principles” document in 1999. The approaches set in the document are general and following the spirit of Nara have to be adapted to each cultural context. In fact there is no single way, but several approaches that have to be accepted in order to reach a global vision of the issues related with wooden heritage preservation. The 1999 document is now in revision and the complexity drawing up such a general document resides in attaining the establishment of a framework that comprises every culture and approach without resulting too ambiguous.

Preservation of wooden heritage comprises extremely opposite approaches. One of them might be represented by an Italian philosophy that understands “minimum intervention” as the preservation of the actual condition of wood without any alteration, even avoiding the recovery of its structural function. In this case, another structure, e.g. metallic, takes on the load bearing function.

The opposite interpretation of the same “minimum intervention” concept might be the Japanese approach of disassembling and reassembling a wooden heritage property. As an

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10 Ibid. art. 6.
11 Ibid. art.11.
13 “We have come to realise that there is in fact no single way, but rather several approaches which must be accepted…” Larsen, K. E., & Marstein, N. (2000). Conservation of Historic Timber Structures. An ecological approach. Bath: Butterworth-Heinemann, p. IX.
example, the Kokawa-dera\textsuperscript{14} door in Kokawa. Intervention comprises a comprehensive research, including historic-structural diagnosis and the repair and replacement of damaged members. The purpose of this process is also to preserve as much of the original material as possible.

![Image 5: Partial representation of the Horyu-Ji five storey pagoda. Nara prefecture. Japan. Built in the 7th century, it is believed to be the oldest building on earth.](image)

The 1999 \textit{“Principles for the preservation of historic timber structures”} are the unified theoretical basis of the IIWC and involve the version that represents the prevailing vision of the experts on wooden heritage preservation of the world. Both examples mentioned above, are the result of different interpretations of the \textit{“minimum intervention”} principle conceived each one in a specific cultural context. Such different approaches are but two of many possible, and show how every concept stated in the \textit{“principles”} can be a subject of discussion.

In such a context it seems reasonable to create a debate that will help lay down a preservation theory in Spain adapted to our cultural context and being compatible with the prevailing general theory on heritage preservation. It also seems reasonable to incorporate that specific approach to the IIWC discussions in order to enrich the necessary debate.

\textbf{Towards a theory of wood heritage preservation. Material authenticity}

Along time, approaches regarding to wooden heritage preservation have evolved. Intervention criteria today are different to those prevailing in the 19\textsuperscript{th} century, and techniques

have also evolved. Similarly, evolution\textsuperscript{15} of the society itself as well as economic and cultural factors affect to preservation.

The main goal in preservation and conservation is to maintain the historical authenticity and integrity of cultural heritage, as stated in the 1999 principles. Among the many definitions of integrity and authenticity, we have chosen the following: “integrity refers to the process of identification of all the elements that together define the significance of the property; Authenticity instead refers to the qualification of such elements in terms of their truthfulness and credibility”\textsuperscript{16}.

Material authenticity is related with truthfulness and credibility of the materials that form it, of all of those materials. We understand that in the stone fabric, all the material together with the historical alterations are important, and thus, have to be understood as pages of a book that transmits the history of the building, and as a consequence respected. Accordingly, we also have to understand that part of the material authenticity of the property resides in its wooden frames.

![Image 6: Medieval tower in Donamaria, Navarra. Spain. The preservation works included the disassembling and reassembling of the whole wooden structure, with repair of damaged members and replacement of those irrecoverable.]

Similarly to the stone fabric, when preserving wooden architecture a comprehensive diagnosis is needed aimed to understand not only its actual conditions but historical, constructive aspects and the relations with other materials. The more we want to keep to the minimum intervention idea, the more comprehensive will have to be the research and diagnosis of the wooden fabric. This includes every wooden element be it part of the structure, walls, partitions, decoration, and furniture, including joinery, carvings and paintings.

\textsuperscript{15} ICOMOS. (2014). Nara+20. On Heritage practices, cultural values and the concept of authenticity. Nara: ICOMOS.

This idea is present in the discussions of the updating of the principles and could be enunciated as follows: “...to do so one should preserve as far as possible in all its credibility, every element qualifying the significance of the property”.

Image 7: Debre Birham Selassie church in Gondar, Ethiopia. Built in the 17th century for the Emperor Eyasu the second. Both the walls and the wooden frames are painted.

The structural function

In the above definition of integrity, the word “elements” refers both to tangible and intangible. Therefore, both the materiality of the wooden frames and their function are included, and in the case of a structure, its function is resistant. It is thus relevant that the preservation of a structural wooden construction includes every effort necessary to maintain its resistant function.

As stated above, wooden joints in our cultural environment have limited or no capacity at all to support moments, and as a consequence wooden structures are isostatic. One of the features of isostatic wooden structures is that each element is independent from surrounding elements and their relation is through force transmitting planes. Thus, one element belonging to a frame can be repaired or replaced without altering the structural functionality of the ensemble.

Image 8: Drawing of a typical building in the centre of a Spanish city. The outer walls are made of masonry and the inner frame is completely made of wood.
This attribute enables to focus the issues related with built heritage preservation with very different scopes, as might be the single element, a part of the structure or the construction as a whole. Similarly, any intervention in a wooden structure should keep the relation among single elements without altering the structural function of each one of them. Provisos to this assertion might be considered when the preservation of the structural function implies corrections\textsuperscript{17} to the original frame due to pathologies or changes in the load path.

Like any construction, wooden structures suffer deformations that might appear in individual elements (e.g. bending of a beam) or larger parts as loss of verticality in facades. Deformations in the wooden structure might be the consequence and even the origin of deformation in other parts as the stone or brick fabric. Except when stability is compromised, \textbf{an artificial alteration of those deformations should be avoided}.

\textbf{To intervene}

Wood heritage preservation is not different to any other material regarding to the need of documentation, previous studies, diagnosis and multidisciplinary approach. In order to achieve the maximum material\textsuperscript{18} preservation, a comprehensive diagnosis\textsuperscript{19} of the wooden structure will be required.

The purpose of any wood heritage preservation works should include the material conservation if possible, of every timber element on the construction. However frequently, the conservator has to intervene in the wooden frame. Pathologies might reduce functionality, for instance, structural, of an element, set of elements or structure. The intervention in that case should be aimed to recover that said functionality. In Knut Einar Larsen’s words, “\textit{repair is a painstaking intervention in the historic fabric, aiming at replacing only decayed parts and otherwise leaving the structure and the materials intact}”.\textsuperscript{20} In the case of a fabric suffering loss of resistance, we will define \textbf{repair} as all the actions aimed to recover the lost structural efficiency of a wooden element or frame. If the pathology results in


\textsuperscript{20} Larsen, K. E. Op.cit, p. 5.
deformations that endanger the stability, repair could be defined as those actions aimed to recover a secure geometry for the structure with the minimal alteration of the actual shape. It might result that even if the structure has not suffered any loss of efficiency, it is still necessary to intervene. Spain is a country with a rich and diverse heritage. A change of use is frequently implemented with the purpose of preserving the building. One of the consequences\(^{21}\) of the change of use is an increase in loads affecting to the structure. Under these conditions it might be that the structure is not capable to resist the new conditions, forcing the conservator to intervene in order to increase the structural efficiency. We will define thus, to **reinforce** as the actions aimed to increase the structural efficiency of an element, ensemble of elements or a structure, adapting them to the new conditions.

Image 9: Condestable palace in Pamplona, Navarra. Spain. A change of use saved the building from an imminent ruin. A surgery intervention was carried out in the wooden structure, keeping most of the original materials including the deformations.

When none of the former interventions is viable, replacement might be the last solution. Four are thus, the intervention modes available in a wooden frame: maintenance, repair, reinforcement and replacement.

**Intervention techniques**

Wooden architecture is diverse, as diverse are the climates, cultures, traditions, tools, techniques and species that affect it. Having specific features that differentiate it from the rest, the knowledge required to intervene in wooden heritage has also to be specific. Accordingly intervention techniques are also specific. Being true that techniques have to be dependent on the project\(^{22}\), it is also true that they have to be mastered to be able to design freely. Lack of knowledge about the material, the architecture built with it and the intervention


techniques result in a dramatic loss of wooden heritage. Whoever masters the preservation theory but not the techniques will be unable to accomplish his ideals, risking using his theoretical knowledge to justify the loss of heritage. Otherwise, whoever masters the techniques but not the theory might solve specific issues without knowing the adequacy of the techniques or the approaches implemented.

The 20th century crisis that dramatically reduced the use of wood in our country led to a dramatic loss on knowledge. However, much of the knowledge needed to the preservation of heritage resides in tradition. The recovery of craftsmanship is thus crucial.

Although not usual in our country, basing the preservation techniques on carpentry and traditional techniques is the usual way in other countries with a wider wooden tradition. “The need to use modern materials in repair work may also result from the lack of competent craftsmen”\textsuperscript{23}. This lack of knowledge affects to the whole ensemble of actors involved in the process, including architects.

Nevertheless, the best way to face wood heritage preservation is by using techniques based in wood to repair or reinforce wood. For centuries, Japanese carpenters have repaired wooden structures cutting out the damaged parts, replacing them with wood and joining both parts with joints, respecting thus, the most of the original structure\textsuperscript{24}. Although not systematized nor organized, there is a large catalogue of solutions spread in many countries, valid to face an extensive collection of pathologies of wood. Of those, many are based on the use of traditional joinery while others have been designed anew but derived from traditional joinery adapted to specific requirements. There are some solutions with the same origin that

\textsuperscript{23} Larsen, K. E., & Marstein, N. Op.cit, p.5.

have been designed anew to perform maximal structural efficiency. The logical name for
them all is **grafts**.

We might define a graft as a repair or reinforcement carried out in a wooden structural
element with the only use of wood and joining both parts with joinery, fasteners, glue or a
combination of them.

The 1999 principles state that “any proposed intervention should for preference follow
traditional means”. Being limited the capacity of traditional joinery to solve structural issues in
different situations to those that fuelled the original design, variations of those originals
should be considered, namely those based on them and aimed to be executed with wood.
Solutions based in the efficiency of other materials and techniques alien to wood should be
considered once the former are discarded.
The different behaviour of alien materials and techniques might result in pathologies. Their use should be the result of a thoroughful research about the adequacy of those techniques and materials to the specific case. The name of these solutions: prosthesis.

All the above implies the availability of wood of the same species, quality, moisture and dimensions as the original. It also presupposes the existence of carpenters that should be used to traditional carpentry and heritage preservation techniques. Finally, it presupposes the existence of professionals of every discipline and especially architects with knowledge of the material, traditional architecture, preservation theory and techniques.

Photographs

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Drawings

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