Advanced Materials Research Vols. 250-253 (2011) pp 1143-1146
Online available since 2011/May/17 at www.scientific.net

doi:10.4028/www.scientific.net/AMR.250-253.1143

Juniper timber: potentiality of a vernacular raw material

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Key words: juniper features and proprieties, traditional architecture, compression resistance, resistance test

Abstract. This research presents some features about juniper timber, above all related with aspects of its structural use (for supports, pillars, beams, roofs...) in some vernacular architecture. Therefore, a special attention is driven to botanical, technical, mechanical features, typical for this type of rare wood. Its traditional use in the Iberian Peninsula and throughout the Mediterranean Basin is still visible in some cases of study, presented in the research. Good constructive qualities make juniper timber a great candidate for further test-researches and experiments, focalized on the family of traditional and"ever green "constructive materials.

Introduction

The purpose of this research, summarized in this article, is to classify and undertake a careful study of a type of wood, *juniperus thurifera,* called *sabina albar* in Spanish*,* as a timber that can be used perfectly, both in construction and in craftsmanship. In this case, the research has a special focus upon the great structural behavior of this timber, whether in pillars or in thatched roofs.

Fig.1 (from the left) Examples of juniper timber in vernacular architecture: pillars, thatched roof, mil (RUIZ CRISTINI)

Also Vitruvius, in the *Ten books of Architecture*, speaks about this timber; showing some definition and some descriptions of the qualities of this material and methods of employment. (Book 2. Chapter 9. Section 49):

The Latin name, *thurifera*, can also be useful so as to understand one of the most significant features of the timber –i.e. the resin that the wood contains; *juniperus* comes from Latin "*ieniperus*", which means juniper, while *thurifera* comes from "*thuris*"= incense and "*fer*"= to carry; in other words the name of the tree can sound like " juniper that carries incense".

Juniper timber; a botanical approach

The Juniper tree has an incredibly slow growth and the trunk can also reach a height of 20 m but, of course, it's not so common, as we usually find examples of "just" 4 or 8 m high. The slow process (the

trunk only increases 1-3 mm in diameter each year...) can guarantee an incredible density to the timber, above all in some older special trunks of 1 or 2 m in diameter. The oldest examples of juniper were found in Morocco with a 5m-diameter and a 16m-perimeter.

The trunk is featured by a grey bark, which is scarcely scored by waved grooves, along the whole tree, looking like the common juniper species. Analyzing the tree we can discover a conic, irregular trunk, brown ash-colored, fibrous and with deep cracks that break off into splinters; also the base of the trunk has an aged and scored root system, due to the slow growth process. The *juniperus thurifera* also has shoots broken into enlarged galls. The main branches are really thick and developed.

Fig.2 (from the left) Juniper tree: detail of the branches and of the trunk (RUIZ CRISTINI)

The top is more or less conic, above all during the first stage of the life of the tree. The adult examples have a more defined top, due to the natural growth or maybe to the cutting down of some branches (in Spanish, the process of cutting down these lower branches is called *ramoneo*). This technique is employed by shepherds, avoiding the lowest and sourest branches, to feed their livestock. The *juniperus thurifera* has female and male examples (*dioicus species*); during the first days of spring the male tree expands the pollen into the air, without the aid of insects, in a process that's like a mist, through which it can fertilize the female species.

Juniper timber: architectural features through Mediterranean Basin

The cases of study, focalized on the features of the species in the Iberian Peninsula, can show how the tree can grow on the high plateaus or on the moors such as those in the provinces of *Soria, Burgos, Palencia, Guadalajara, Segovia, Valencia (north), León (north), Albacete, Zaragoza* or *Cuenca*. On the other hand, trying to describe a statistic distribution of the woods, we have discovered how the percentage of these woods can represent around 1% of the forests, visible in the Spanish territory (around 125.000ha).

In conclusion, we can really consider this species like a "vestige" of the Tertiary period, a survival relic of prehistorical glaciations. It's hard for it to sprout and bloom and it has an extremely slow growth, that also makes its replanting or reforestation quite difficult. (It's truly interesting to see how *junprerus thurifera* woods are considered "priority habitat" according to 92/43 CEE directive).

The use of *juniperus thurifera* timber is related to the survival of the economy, to seasonal migration of the livestock and to the employment of immediate natural resources. For this reason juniper timbers and resins (all the species, from *thurifera* to *communes*) are witnessed to the methodical use in construction and craftsmanship. In *Ibiza* and *Formentera* Islands (East of Spain), there's a systematic tradition of using juniper in beams and flat-terrace structural floors. Especially in the *Essaouira* area (Morocco) we can find the tradition of using the authoctonus dark timber of *juniperus phoenicea,* both in cabinetmaking and in construction. Apart from Morocco woods, one of the great junipers woods in the Iberian Peninsula is close to *Soria*, on the inner plateaus, in a village called *Calatañazor*. Here, one can find a great extension of *juniperus thurifera,* with trunks like "pitchforks" (as vertical supports) and with a sort of natural arcade morphology; for this reason the area is the one that presents a most intensive use of this timber in construction techniques. There are also important traces of the use of *juniperus thurifera* timber in beams, joists, logs, boards in the

Rincón de Ademuz area *(Valencia)*, as in the northern area of the province of *Cuenca*. In this last case the timber is seen above all in the structure of arcades of *Beteta* village, or in yards covered with thatched roofs, up to structural floors or up to lintels of ovine shelters, with great examples of boards, 1 or 2 m long.

Juniper timber: endurance tests

During the study, due to a complete lack of mechanical references on this timber, there was basically to determine some properties about juniper timber features. The authors decided to work with 5 samples of this timber, submitting them both to destructive and non-destructive tests, confronting the results with information on very "hard" timber (*Pinus Pinaster*) and "soft" one. (*Populus Nigra*).

Junipers samples were dived into three lots, depending on different conditions of service. Hereby, the aim was to analyze 3 different behaviors of Juniper timber. Summing, the three lots were: samples from thatched roofs (more than 40 years old), samples from traditional tiles roof (more than 35 years old), and recent samples for woodcutting timber.

These samples were analyzed first by non-destructive technologies like resistograph and ultrasound system detection of timber quality.

The results provided by the resistograph on Juniper timber samples, were more valuable than both *Pinus Pinaster* and *Populus Nigra* samples (few values of decay, cavities and cracks…)

On the other hand, the ultrasound system results established that the ultrasound speed in five samples was changing from 2643 m/s up to 4107 m/s (the values of U.S. speed in *Pinus Pinaster* samples were of 6086 m/s and in *Populus Nigra* samples, of 4434 m/s) .This information was important to establish that, in spite of the bad conditions of timber exposition (i.e. in thatched roofs more than 40 years old) the timber quality was high. Regardless of the weather and bugs exposure, timber density and resistance were quite good.

Fig.3 (from the left) Juniper timber samples: resitograph test and ultrasound system test (RUIZ CRISTINI)

Once these experiments had been made, the research started with other samples tests, in this case to establish timber endurance resistance. On one hand the idea was to study Juniper timber compression resistance (parallel to the fibers) and on the other hand to establish flexion resistance. For this reason we used 5 Juniper timber samples with normal dimensions. Dampness and density values of the Juniper samples were controlled in the laboratory (dampness between 11.50 %- 15 %- and density between 560 -600 kg/m3). Considering the results of the mechanical tests we can resume that:

- values of endurance resistance (compression), according to the different samples, were quite excellent, between 27 and 42 kN/mm2
- the values of flexion resistance, were included between 22 and 40 kN/mm2
- the values of endurance resistance (with Pilodyn system) for tangential fiber tests gave good perforation results, between 11-12 mm, sensitively better than for *Pinus Pinaster* samples.

The research establishes the mechanical behavior of five Juniper timber samples; with good levels of mechanical behavior, in some cases like coniferous timber raw material (class C18 or C20).

Fig.4 (from the left) Juniper timber normalized samples: Pylodin test and endurance resistance test (RUIZ CRISTINI)

Conclusion: "state of art" of juniper timber

The features of this wood would not ´match´ with the current lack of interest in it.

We have to consider that actually it's a protected species (especially in Spain) and there's a relative scarcity of this timber-raw material on the territory. On the other hand, we have to consider that other materials, like oak, holm, ilex wood, more available on the territory, would not resist bugs, weather and dampness attacks like timber does. The use of this material in vernacular architecture reflects the capability of wise men to use the resources of the territory, in a perfect thousand-year-old balance of technique and respect for the environment. So we can consider this legacy and go on with the study. In this sense, the recent endurance and ultrasound tests would open new horizons for future use of this type of timber. The good results of the analysed samples (like class C18/20 conifeorus timber) can be developed in further studies and in successive experiences (i.e projects of controlled/protective planting of juniper trees).

Summary

II.31 Architecture and building material-traditional construction material

Acknowledgments

Isabel Rodriguez Abad, Dep. Construcción Arquitectonicas, ETSGE, UPV, Spain, for the support in the analytical tests; Ramón Luz Pastor, city mayor of Sesga, Valencia, Spain-for the trunks supplied for the tests; ArgimiroYuste, the carpenter who has kindly cut and prepared the juniper samples.

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Advanced Building Materials
doi:10.4028/www.scientific.net/AMR.250-253

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doi:10.4028/www.scientific.net/AMR.250-253.1143