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Short Communication

Different conditions for drying of beech lumbers in Kosovo

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The aim of the study is to present the coefficients of swelling and shrinkage for the beech wood. Mostly, the values of swelling and shrinkage, obtained from of heart of red wood, are higher than white beech wood. The swelling is smaller in naturally drying lumbers than in kiln drying. Because of calculated values of over dimensions needed for swelling, there was calculated also the coefficient of partial swelling, during the relative humidity from 30 to 10%. The coefficient of shrinkage increases in white wood of beech, but it remains nearly the same in heart red wood of beech.

Key words: Swelling, shrinkage, density, radial cutting, tangential cutting, longitudinal cutting.

INTRODUCTION

Wood fibers are dimensionally stable when the moisture content is above the fiber saturation point (usually about 30% moisture content). Below 30% moisture content, wood changes its dimension depending on the gain or loss of moisture. In the case of moisture loss, the result is shrinkage; however in the case of moisture gain the result is swelling (Rietz and Rufus, 1971; Skaar, 1988).

Shrinkage usually begins at 25 to 30% moisture content. This is called the fiber saturation point. If the shrinkage continues to drop to zero percent moisture content, an oven-dry state is present. Swelling occurs as wood gains moisture, when it moves from zero to 25 to 30% moisture content, the fiber saturation point. Different woods exhibit different moisture stability factors. The characteristics of these dimensional changes are anisotropic-different in axial, radial, and tangential directions. However, they always shrink and swell mostly in the direction of the annual growth rings (tangentially), about half as much as across the rings (radial) and only in minuscule amounts along the grain (longitudinally) (Kalo and Marjani, 1983; Aranda et al., 2000).

The moisture content of wood below the fiber saturation point is a function of both relative humidity and temperature in the surrounding air. When wood is neither gaining nor losing moisture, equilibrium moisture content (EMC) is reached (Kollmann and Cote, 1968; Dimoshi and Rjepaj, 1971).

The aim of this study is to find the coefficient of swelling and shrinkage of beech wood in Kosovo in tangential, radial and longitudinal direction for white beech wood and red heart of beech wood.

MATERIALS AND METHODS

The moulds for testing of physical characteristics were categorized according to the STAS 2682-83 for the lumbers used from the air drying of beech, respectively from two kind of wood beech, white beech wood and red heart of beech wood. Drying was carried under different conditions such as:

i.) Air drying.
ii.) Kiln drying, in temperatures up to 100ºC, respectively t = 80, 90 and 100ºC, each of them were combination with three value of relative humidity; φ = 30, 40 and 50%.
iii.) Kiln drying, with superheated steam method in temperatures over 100ºC, respectively in temperatures t = 110ºC and φ = 50%.

After the categorizing, moulds that stayed for a long period of time gain a moisture from 10 ± 2%. Following this, the test of their physical features was dispensed with. Physical characteristics of two kinds of beech wood and the coefficient of linear swelling and shrinkage, the coefficient of total volume of swelling and shrinkage were defined.
For diagnosis of volume mass and dimensions of moulds, weighing machine with 0.001 g and caliber with 0.02 mm were used.

Drying of wood moulds up to the anhydride was made with small laboratory kiln drying with electricity.

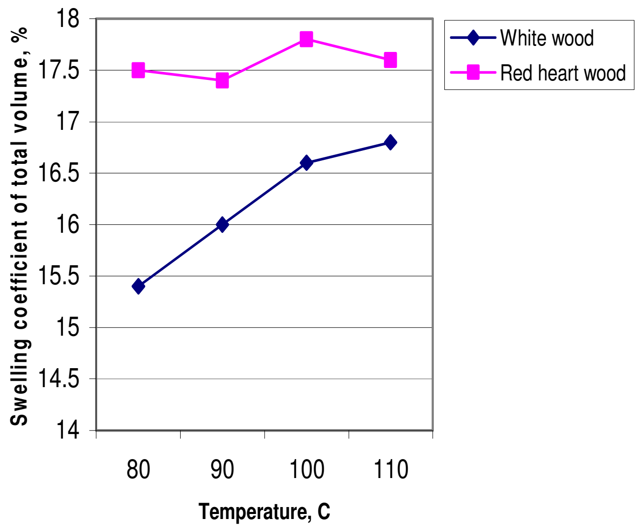

Figure 1. Influence of temperature in coefficient of total swelling volume in beech wood.

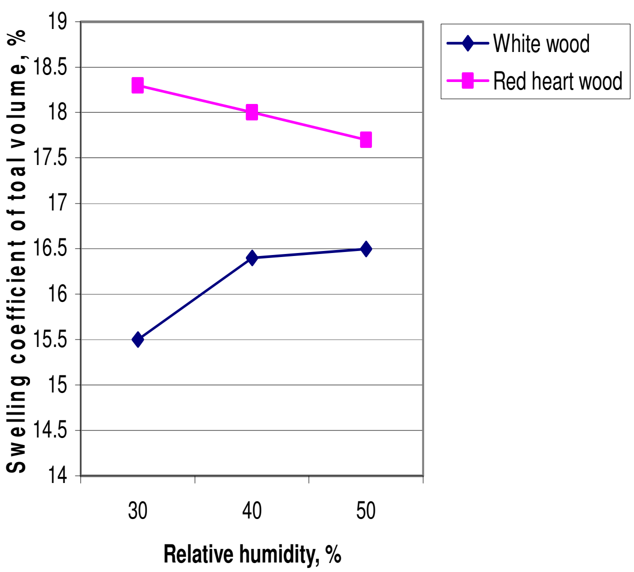

Figure 2. Influence of relative humidity in coefficient of total swelling volume in beech wood.

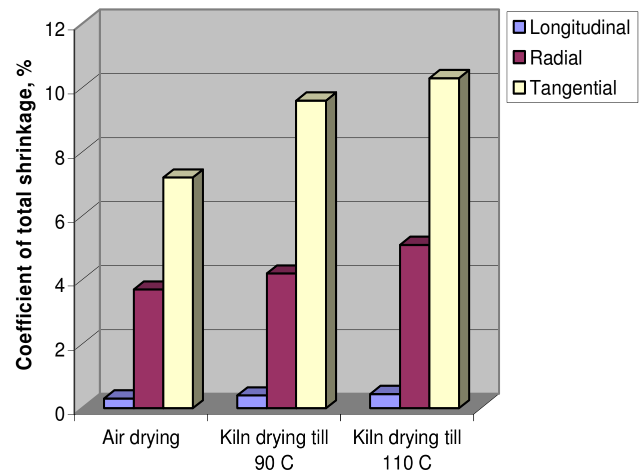

Figure 3. The coefficient of variation for total linear shrinkage of beech wood according to the structural orientation and drying method.

RESULTS AND DISCUSION

In the tangential direction, the swelling coefficient is 1.5-2.0 times greater than in radial direction, which isobtained according to the general theory of anisotropy of the wood. According to the method of drying (air drying or kiln drying) in radial coefficient case, the values are comparative (4.2-6.1% for white beech wood in air drying, compared to 4.6-6.6% for white beech wood in kiln drying). In case of the tangential and volume coefficient a greater difference is observed, a larger value with approximately 20% is recorded for the wood, which was dry in kiln.

According to the results we have obtained, the influence of the temperature in the swelling coefficient grows, and the swelling coefficient depends on drying temperature in the case of white beech wood, but is approximately the same in the red heart beech wood (Figure 1). If we see the influence of the relative humidity, there is a larger growth and the swelling is also bigger for the white wood (Figure 2), similar to the volume mass, this influence is more evident than the temperature. In general, the values for red heart wood are larger than the values of the white wood. In all cases, the shrinkage is smaller in beech wood dried in air than in beech wood in kiln drying (Figure 3).

The difference is smaller in longitudinal and radial shrinking; however it is approximately 25% (for 1.3 - 1.4) in case of the coefficient in tangentially direction. According the results of the experiment, minimal value of shrinkage is observed from the length of the fiber, which is 5 times bigger in the radial direction and up to 10 times bigger in the tangential direction. According to the results of the experiment, total shrinkage is the smallest in longitudinal direction (0.25-0.55%). Shrinkage in radial direction is between limits of 3.9-6.2% for the wood dried in air and 4.5-6.2 for the wood dried in kiln, considering the part, where the material was taken and the temperature as well.

Shrinkage in tangential direction has a value of interval from 7.2-9.9% for wood dried in air and 9.4-12.6% for the wood dried in kiln. So that, value tangential shrinkage is approximately 1.7 times higher than it is in radial direction in the wood dried in air; and respectively 2 times higher in the wood dried in kiln. In the end, in kiln drying the increasing difference between radial and tangential shrinkage increases the risk of deformation of the part of the lumber. The volume shrinkage has a value of interval

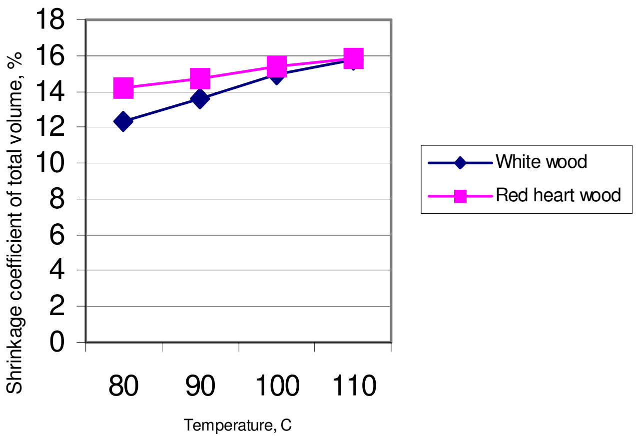

Figure 4. Influence of temperature in coefficient of total shrinkage volume in beech wood.

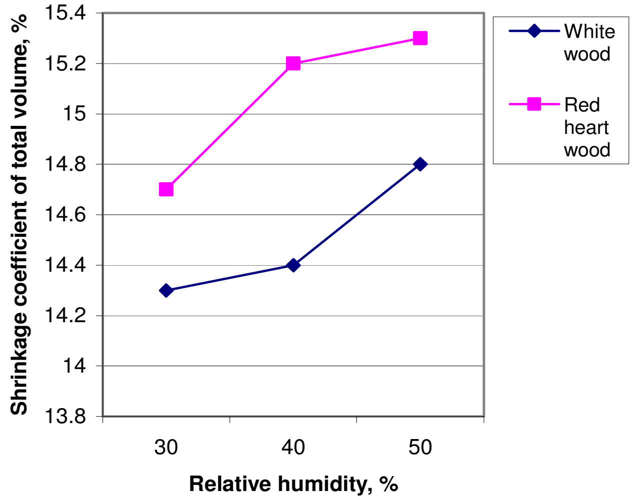

Figure 5. Influence of relative humidity in coefficient of total shrinkage volume in beech wood.

from 11.0-16.5%. Conforming the results, the coefficient of linear and volume shrinkage increases parallel to the increasing temperature (Figure 4).

In the interval from 80-100°C, the tendency of growing value of shrinkage is evident in the all wood specimens according to this study. When the temperature exceed 100°C, in both cases (in the white wood and the red heart wood), only minor changes in shrinkage can be observed. The shrinkage increases as the relative humidity increases, but the influence is diminutive and the values are in the narrow interval with maximum difference from 2% between extreme values (Figure 5).

The coefficient of partial shrinkage is determined with diminution of moisture from 30 to 10% (Table 1). As seen, shrinkage is smaller in the white wood than in the red heart wood, given the proportional relation to volume mass. For practice, applying the pieces that contain white wood and red heart wood can be considered the coefficient of the values of the shrinkage in the drying: 3.6% in radial direction and respectively 7.5% in tangential direction.

Table 1. Medium value of coefficient of partial shrinkage (30-10%) for beech wood.

No.	Kind of wood	Coefficient of partial shrinkage, %		
		In radial direction	In tangential direction	Volume
1	White wood	3.2	7.1	10.5
2	Red heart wood	4.1	7.9	12.2

Conclusions

The following conclusions from this study were reached relative to the coefficient of swelling and shrinkage for the beech wood in Kosovo. Total volume shrinkage is 11.0-16.5%, and total shrinkage in longitudinally direction is 0.3-0.7%. The coefficient of swelling for the lumber grows parallel to the increase in temperature. The increase of the temperature is larger in the white wood than in the red heart wood.

The shrinkage of the lumbers grows with the increase of the temperature, especially between 80-100°C. White wood and the red heart wood of the beech have the tendency for decrease of the shrinkage in the temperature over 100°C.

Drying of beech wood in low relative humidity loses its quality according to its physical characteristics, which react when decreasing values from 10-15%, with a decrease of relative humidity from 50 to 30%. The time period of drying wood of beech is reduced from 80 - 90°C, for 1.3 times from 80-100°C, but time period grows for 2 times with grows temperature from 80 - 110°C. Kiln drying of the beech wood made the reduction of volume mass and shrinkage coefficient for 20%.

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