CHIP AND CHIPLESS WOODWORKING PROCESSES, 10(1): 159–163, 2016
Zvolen, Technical University in Zvolen, ISSN 1339-8350 (online), ISSN 2453-904X (print)

FINGER JOINTED OF BEECH AND POPLAR WOOD – PROPERTIES

Alena Rohanová – Peter Kriššák – Ondrej Bajza

Abstract

Paper is focused on the verification of the beech and poplar finger joints samples. Modulus of rupture and modulus of elasticity have been determined according to STN EN 408. Bending properties have been compared to the reference samples. The influence of the finger joint direction was taken into the consideration – horizontal and vertical. New type of cutter producing 22 mm long finger joints was also tested. This type of finger joints are approved by standard STN EN 14080: 2013. Joints were glued together by polyurethane glue with 12% moisture contents of wood.

There were lower modulus of rupture in the case of finger joint samples (beech, poplar) comparing to the reference samples. Such decrease of the modulus of rupture is in accordance with literature (beech, oak). Beech and poplar modulus of elasticity values were higher comparing to the reference samples. Horizontal direction of finger joints had the highest significant influence on modulus of elasticity. Factors affecting joints produced by new technology were analysed. Experiment findings of finger-jointed beech elements can be utilized in light composite beams and glued timber production.

Key words: *beech, poplar, finger joint, modulus of rupture, modulus of elasticity*

INTRODUCTION

In European union countries there is general lack of quality coniferous raw material. Therefore new alternative woods are searching, of which the most interesting is beech wood, alternately too poplar wood (BUSTOS *et al.* 2001).

Finger joints in glued products represent sophisticated joints, which allows high quality construction elements with shape and dimension diversity. Joint is made by fingers and glue and is recommended for use after testing. Strength and elasticity characteristics of elements are influenced by shape and length of finger joints (small, medium, large), type of material (wood species) and glue. Requirements for glued products and minimal production requirements of finger joints (medium, large) are stated in EN 14080:2013. Examples of different applications are shown in Fig. 1 (ROHANOVÁ, 2013).

Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen
e-mail: rohanova@tuzvo.sk, pkrissak1@gmail.com, bajza.ondrej@gmail.com

Fig. 1 Various sizes of finger

MATERIAL AND METHODS

Beech timber (*Fagus sylvatica* L.) and Aspen poplar timber (*Populus tremula* L.) was used for the experimental testing. Dimensions of test samples are given in the Table 1. Test samples were conditioned for 12 ± 2% moisture content (relative humidity 65 ± 5 % and 20°C), which is reference moisture content according to EN 384.

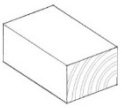
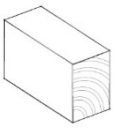
Table 1 Sizes and types of samples

Timber	b [mm]	h [mm]	l [mm]	Type of samples	Load direction	Number
beech	26	38	480	finger- jointed	vertical	24
beech	38	26	350	finger- jointed	horizontal	20
beech	26	38	480	reference	vertical	3
beech	38	26	350	reference	horizontal	6
poplar	26	38	480	finger- jointed	vertical	15
poplar	38	26	350	finger- jointed	horizontal	11
poplar	26	38	480	reference	vertical	3
poplar	38	26	350	reference	horizontal	4

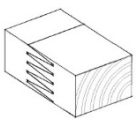
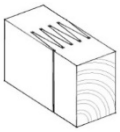
Finger joints were glued with polyurethane glue XILOBOND T FJ 10 with wood moisture content w = 12 ±2 %. Test samples were tested in four-point bending test according to EN 408.

Samples were divided in two groups after the conditioning:

- ***reference samples***: load direction:

horizontal „***b*** “ › ***h,***  vertical „***h***“ › ***b*** 

- ***finger- jointed samples***: finger direction:

horizontal  vertical 

Deformation at bending test was determined the neutral axis of the sample in the middle of the span, where he caught a steel pin (Fig.2).

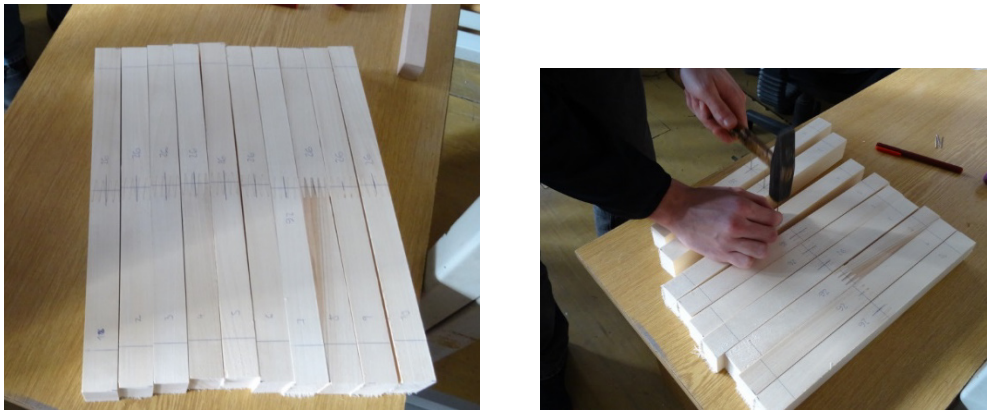


Fig.2 Sample preparation the bending test

Bending tests were performed at Rippers *FPZ 100* Laboratory Technical Univerisity in Zvolen (KND).
The device ALMEMO *2690/AHLBORN* writes strength and deformation in breach (Fig. 3).

Fig. 3 Bending test, measuring deformation

RESULTS

Results of experimental tests were evaluated with mathematic-statictical methods. Basic statistic characteristics, 3-factor ANOVA (**variables**: bendind strength f_m, modulus of elasticity E, **factors:** finger direction: horizontal (h_j), vertical (v_j)**, type of the sample**: finger-jointed (***klin.)***, reference sample (***ref.***)) were described.

Beech timber proves higher dependance in horizontal direction (r = 0,62) than in vertical (r = 0,47), Fig. 4. With lower modulus of elasticity (up to 15 000 MPa) is bending strength higher in horizontal direction, after 15 000 MPa it´s higher in vertical direction.

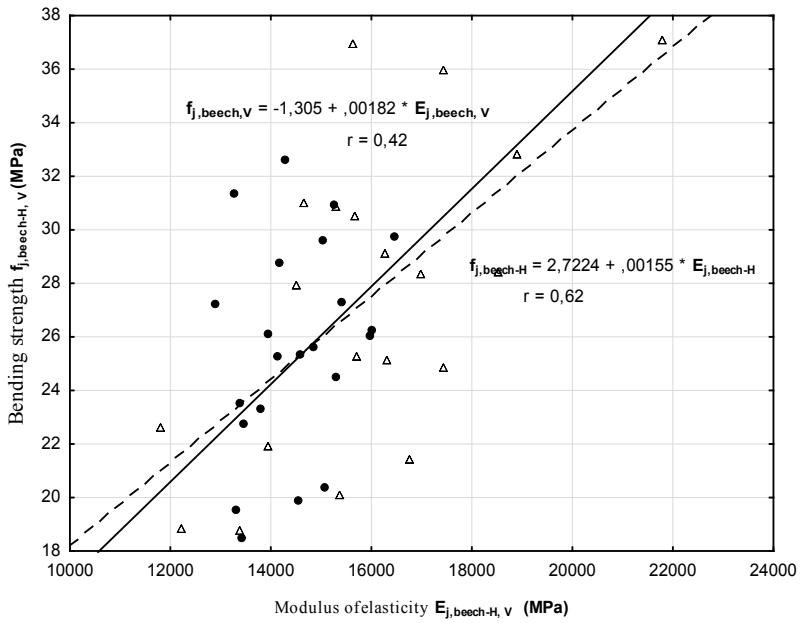


Fig. 4 Dependance of bending strength to modulus of elasticity for beech samples

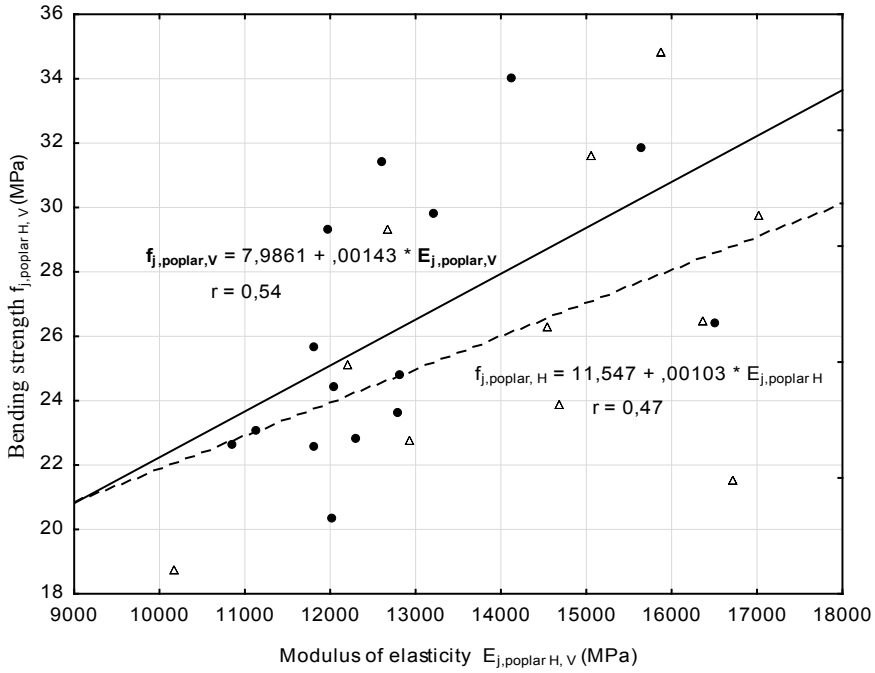


Fig. 5 Dependance of bending strength to modulus of elasticity for poplar samples

Higher dependance was determined in vertical direction (r = 0,54) than in horizontal direction (r = 0,47). Bending strength is higher in vertical direction and with growing modulus of elasticity the difference is getting higher (Fig.5).

CONCLUSIONS

Experimental testing of finger-jointed beech and poplar samples has shown remarkable lower values of bending strength in both directions comparing to the reference samples. It is assumed that a reason can be new experimental confirmed technology of finger joint production and gluing (milling factors, glue type, pressing process and other). The values of modulus of elasticity were higher in both directions in compare to reference samples (36 to 53%). Vertical orientation of finger joints is more suitable for timber elements with small crossection.

AKNOWLEDGMETS

This study was supported by project under the contract VEGA contract No. 1/0395/16.

REFERENCES

1. BUSTOS, C. – BEAUREGARD, R. – MAHAHHAD, M. 2001. Effect of joint geometry on the performance of structural finger-jointed black spruce wood.s.503. Joints in Timber Structures, 653s. ISBN: 2-912143-28-4.
2. ROHANOVÁ, A. 2013. Predikcia parametrov kvality smrekového konštrukčného dreva. Technická Univerzita vo Zvolene, 2013. 79s. ISBN: 978-80-228-2631-0.
3. EN 408: 2011 Timber structures. Structural tinber and glued laminated timber. Determination of some physical and mechanical properties.
4. EN 14 080: 2013 Timber structures. Glued laminated timber and glued solid timber. Requirements.
5. EN 384: 2010 Timber structures. Determination of characteristic values of mechanical properties and density.