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COMPARATIVE ANALYSIS BETWEEN THE DESTRUCTIVE BENDING MOMENTS OF END AND T-SHAPE CORNER JOINTS OF FRAME STRUCTURAL ELEMENTS MADE OF SOLID CHESTNUT WOOD WITH A CROSS SECTION OF 50 X 25 MM

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ABSTRACT

A comparative analysis between the destructive bending moments of end and T-shape corner joints of details from solid chestnut wood (Castanea sativa Mill.) with cross section of 50 x 25 mm has been done.

In this study has been found that the types of joints and the area of their contact surface have considerably influence on their strength characteristics. The T-shape corner joints have in average about 20 % higher destructive bending moment compare to the end corner joints. The non-dismountable mortise and tenon joints are destroyed by average of 80 % higher bending moment compare to the dismountable joints. Dowel joints have two times lower bending moment compare to the mortise and tenon joints and from 3 to 24 % higher bending moment compare to the dismountable joints.

Key words: End and T-shape corner joints of frame structural elements; Destructive bending moments of corner joints; Sweet chestnut solid wood

INTRODUCTION

This article is a continuation of the previous two publications on the strength and deformation characteristics of the end and T-shape corner joints of components [Gruevski, G. 2007, Kyuchukov, G., Gruevski, G. Kyuchukov, B. 2010, 2012], made of sweet chestnut solid wood with density of 600 kg/m^3 [Kyuchukov, G., B. Kyuchukov, 1999] with 50 x 25 mm cross section (Fig. 1 and 2). The joints are with tightness varying from 0,05 to 0,15 mm.

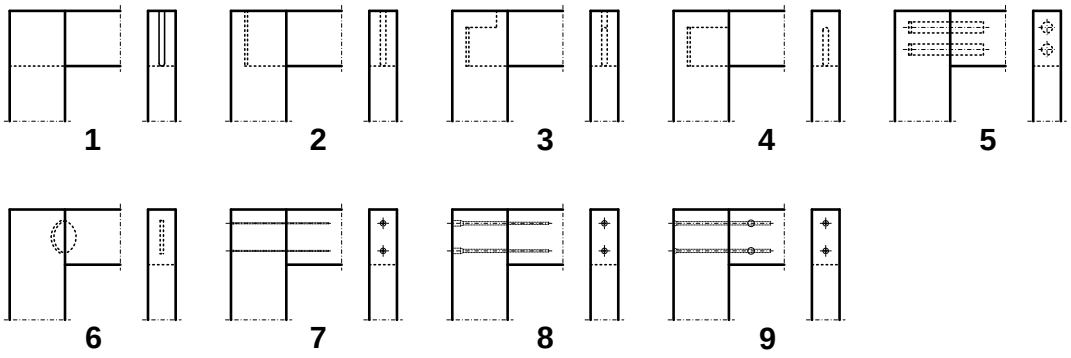

Figure 1: End corner joints of components made of solid chestnut wood: 1 – open mortise and tenon; 2 – half open mortise and tenon; 3 – haunched mortise and tenon; 4 – stub blind mortise and tenon; 5 – with two dowels ϕ 10 mm; 6 – biscuit butt joint; 7 – with two screws for wood; 8 – with two one-piece connectors "Confirmat"; 9 – with two connectors with screw and cross dowel.

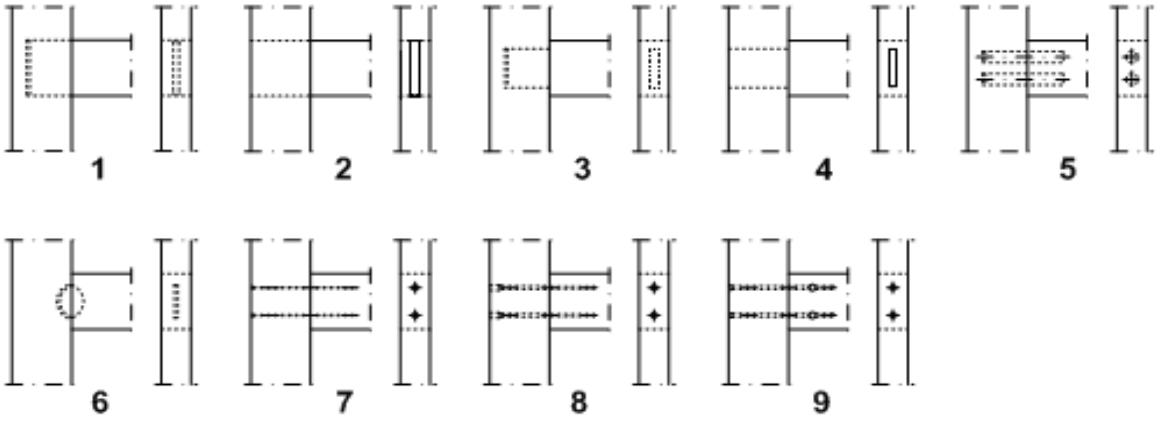

Figure 2: T-shape corner joints: 1 – stub blind oval mortise and tenon - type A; 2 – oval through mortise with tenon - type A; 3 – stub blind oval mortise and tenon with beveled edges - type B; 4 – with oval through mortise and tenon with beveled edges - type B; 5 – with two dowels ϕ 10 mm; 6 – biscuit butt joint; 7 – with two screws for wood with hidden head; 8 – with two one-piece connectors "Confirmat"; 9 – with two connectors with screw and cross dowel.

The sizes and testing schemes of the test samples under bending load are given in Fig. 3.

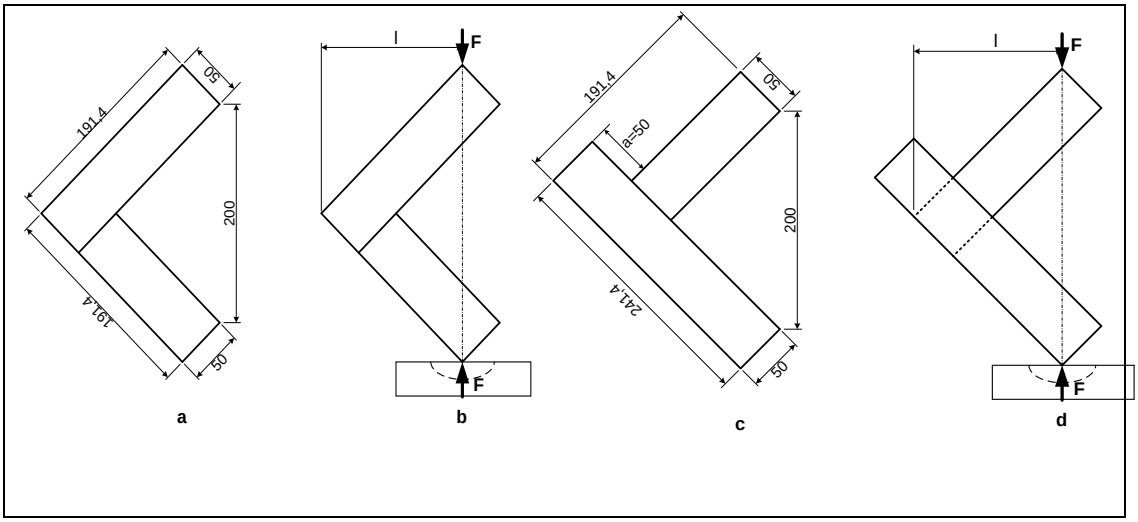

Figure 3: Sizes and testing schemes of the test samples: a and b – end corner joints; c and d – T-shape corner joints.

COMPARATIVE ANALYSIS BETWEEN THE DESTRUCTIVE BENDING MOMENTS OF END AND T-SHAPE CORNER JOINTS

The comparative data between the destructive bending moments of end and T-shape corner joints of structural elements made of solid chestnut wood with cross section 50 x 25 mm are graphically presented in Fig. 4. In compliance with the comparison opportunities according to their construction, the comparative data between the end and T-shape corner joints are combined as illustrated in the charts and Fig. 4.

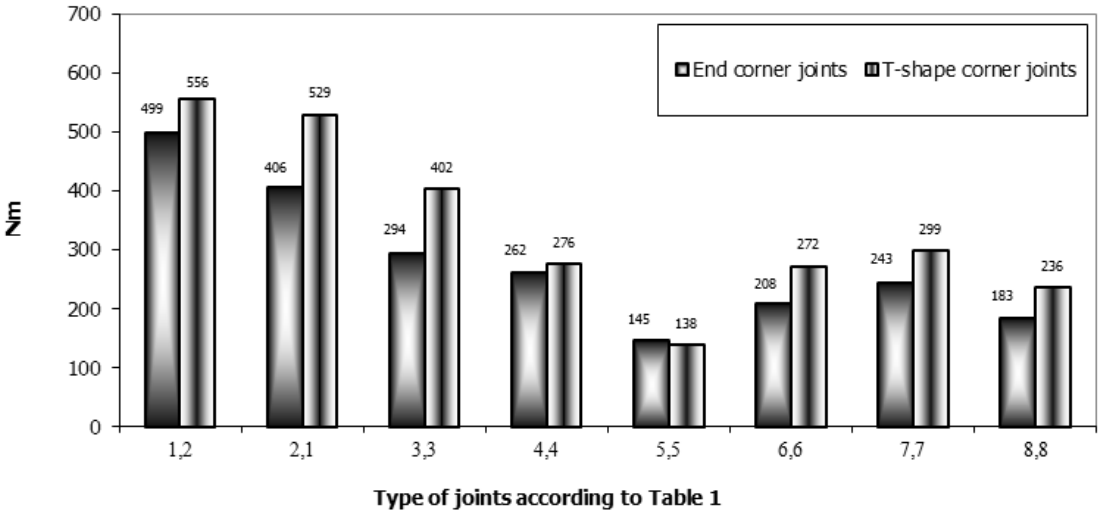

Figure 4: Comparative data on the destructive bending moments of end and T-shape corner joints of components made of solid chestnut wood with cross section 50 x 25 mm according to the combination of their serial number in Table 1.

The ratio between the destructive bending moments of comparable T-shape and end corner joints are presented in Table 1.

Table 1: Ratio between the destructive bending moments of T-shape and end corner joints of components of solid chestnut wood with cross section 50 x 25 mm

End corner joints		**Comparable T-shape to end corner joints**		**Ratio**
Name (see fig. 1)	**Destructive bending moment, $M_{b.E.}$**	**Name (see fig. 2)**	**Destructive bending moment , $M_{b.T.}$**	**$M_{b.T.}$/ $M_{b.E.}$**
1. Open mortise and tenon and tenon	499	2. Oval through mortise and tenon, type A	556	1,11
2. Half open mortise and tenon	406	1. Stub blind oval mortise and tenon - type A	529	1,30
3 Mortise and tenon	294	3. Stub blind oval mortise and tenon with beveled edges - type B	402	1,36
4. With two dowels	262	4. With two dowels;	276	1,05
5. Biscuit butt joint	145	5. Biscuit butt joint	138	0,95
6. With two screws for wood	208	6. With two screws for wood	272	1,30
7. With two one-piece connectors “Confirmat”	243	7. With two one-piece connectors “Confirmat”	299	1,23
8. With two connectors with screw and a cross dowel	183	8. With two connectors with screw and a cross dowel	236	1,28
Note: *The end corner joint with haunched mortise and tenon and the T-shape corner joint with biscuit butt joint are not included in the table since there are no appropriate double to be compared with.*				

The data in figure 4 and table 1 show that the destructive bending moments of the T-shape corner joints surpass the destructive bending moments of the end corner joints of

components made of solid chestnut wood with cross section 50 x 25 mm by 1,00 to 1,36 times or by around 20% on average. This can be explained with the fact that it is relatively more difficult to destroy the wood under pressure when it is a T-shape corner joint than an end corner joint because of the bigger distance between the front parts of the components.

CONCLUSION

The comparative analysis of the results from the study on the impact of the type of end and T-shape corner joints of components made of solid chestnut wood with 50 x 25 mm cross section on their strength characteristics under bending pressure give grounds for drawing the following more general conclusions and recommendations:

- The type of joint has a significant influence on their strength characteristics.
- Gluing wood with modern polyvinyl acetate adhesives provides greater strength for the glued joint than the strength of splitting wood as a result of which under bending load all types of corner joints of components made of solid chestnut wood with 50 x 25 mm cross section get destroyed outside of the gluing area. A necessary condition for that is to make the joints with tightness from 0 to 0,15 mm.
- The area of contact surface of the joints of components made of solid chestnut has a tremendous impact on their strength characteristic.
- The destructive bending moment of the T-shape corner joints is by around 20 % higher compared to the destructive bending moment of the end corner joints.
- The non-dismountable mortise and tenon corner joints of structural elements made of solid chestnut wood have 80 % higher bending moment compared to the dismountable corner joints.
- The dowels joints have two times lower bending moment compare to the joints with mortise and tenon and from 3 to 24 % higher bending moment compare to the dismountable corner joints.
- The type of the joint has great impact on the strength characteristics of the dismountable corner joints of structural elements made of solid chestnut wood. The difference between their destructive bending moments varies from 13 to 32 %.
- The specified values of the destructive bending moments should be taken into consideration for strength design of seating furniture made of solid chestnut wood.

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