

COMPARATIVE ANALYSIS BETWEEN THE DESTRUCTIVE BENDING MOMENTS OF END AND T-SHAPE CORNER JOINTS OF DETAILS FROM SOLID CHESTNUT WOOD WITH TWO TYPES OF CROSS SECTION

Georgi Gruevski¹, Borislav Kyuchukov²

¹Faculty of Design and Technologies of Furniture and Interior – Skopje,
e-mail: gruevski@fdtme.ukim.edu.mk

²University of Forestry, Faculty of Forest Industry –Sofia, e-mail: borislav65@abv.bg

ABSTRACT

A comparative analysis has been done on the experimentally found destructive bending moments in the loading of bending of the most commonly used end and T – shape corner joints of details from solid chestnut wood with two types of cross section of the details – 50 x 25mm and 50 x 30mm.

It has been found, that the type of joints and the thickness of the joining details have a definite impact on their destructive bending moments.

With the increase of the thickness of the details from 25 to 30 mm (with 20 %), the destructive bending moments in the loading of bending of the end glued and dismountable corner joints increase respectively with around 28 % and with 33 %, and of the T – shape corner joints – with around 23 % and around 17 %.

It is recommended that the found out destructive bending moments in the loading of bending and the most commonly used end and T – shape corner joints of details from solid chestnut timber with cross section 50 x 25mm and 50 x 30 mm be taken into consideration in the choice of the type of joints in the sitting furniture construction.

Key words: corner joints of details from solid chestnut wood; destructive bending moments in loading of bending; sitting furniture

INTRODUCTION

The hardness and deformation characteristics of the corner joints of the details from solid wood are one of the factors which define the load potential the form resistance and the durability of furniture construction for sitting, including their durability of exploitation. They depend on a number of factors – type of physic-mechanical properties of timber, cross section of the joint details, type and parameters of the joints, properties of the glue seam of the joints, degree of solidity of the joints, roughness of the contact surfaces in the joint details, etc. With a view to that in the laboratories for testing and measuring of the furniture are carried out systematically test for the defining of the de-

structive bending moments and the coefficients of hardness of the angle joints in the construction of the skeleton of sitting furniture simulation exploitation loads (Jivkov V., 2001, Gruevski G. 2007, Kyuchukov G. et. al. 2004–2013). In the present publication a comparative analysis between the destructive bending moments of the most common used end and T-shape corner joints of details from solid chestnut wood with two types of most commonly used in practice quadrangular cross section – 50 x 25 mm and 50 x 30 mm has been done.

METHOD OF WORK

The type of the tested corner joints is shown schematically on figures 1 and 2.

The type, form and measures of the of the sample bodies (fig. 3) as well as the preparation and conditions for their testing in

loading of bending with the collection of the frames are analogical to those given in the previous publication.

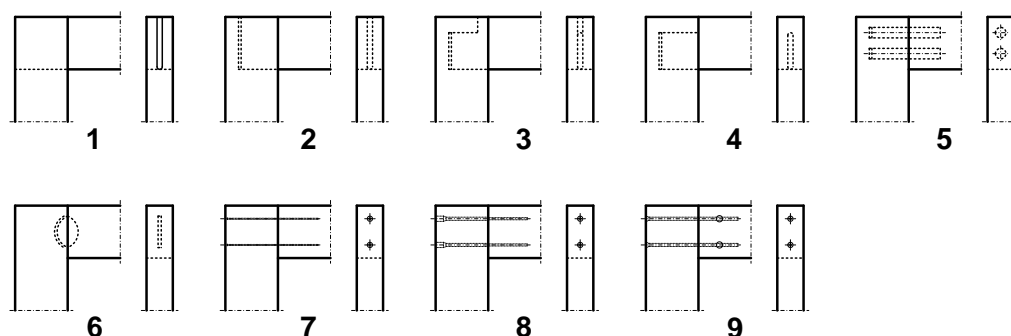


Figure 1: End corner joints:

Glued corner joints: 1 – open mortise and tenon joint; 2 – half-open mortise and tenon joint; 3 – hunched mortise and tenon joint; 4 – mortise and tenon joint; 5 – joint with two dowels; 6 – joint with wooden “Lamello plates”. Dismountable corner joints: 7 – joint with two countersunk screws for wood; 8 – joint with two one-piece connectors “Confirmat”; 9 – joint with two connectors with screw and cross dowel.

COMPARATIVE ANALYSIS OF THE RESULTS FROM THE TESTING

On table 1 are given the comparative data for the results of the experimental research for the destructive bending moments of the tested type's corner joints. From them

it could be seen that the type of the joint is defining for its hardness in loading of bending moments. Defining factor for this is the surface for gluing of the contact surfaces of the joining details.

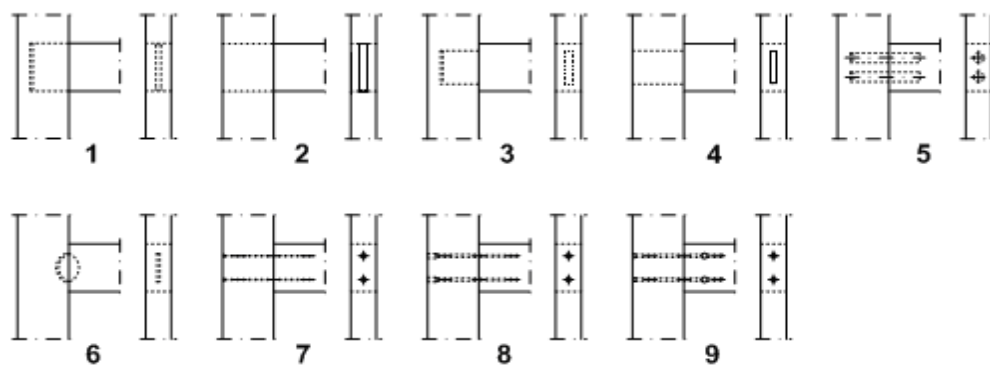


Figure 2: T-shape corner joints: Glued corner joints: 1 – Stub mortise and tenon, type A; 2 – Through mortise and tenon type A; 3 – Stub mortise and tenon, type B; 4 – Through mortise and tenon with shoulders, type B; 5 – joint with two dowels; 6 – joint with wooden “Lamello plates”. Dismountable corner joints: 7 – joint with two countersunk screws for wood; 8 – joint with two one-piece connectors “Confirmat”; 9 – joint with two connectors with screw and cross dowel

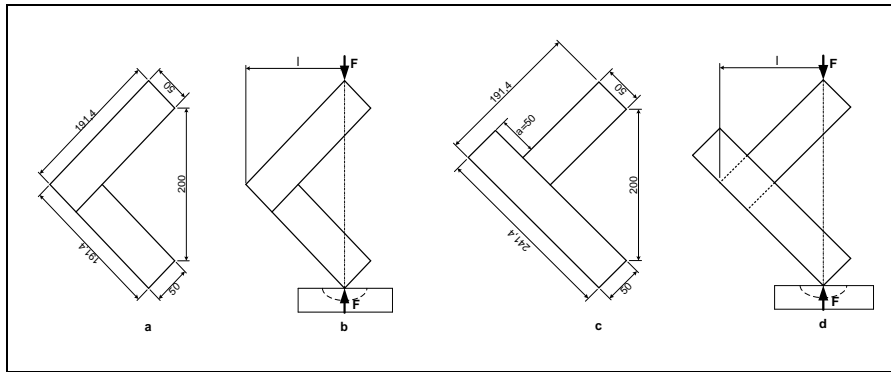


Figure 3: Sizes and testing schemes of the test samples: a and b – end corner joints; c and d – T-shape corner joints.

A good outlay idea for the correlation between the destructive bending moments of the tested types of end and T – shape corner joints could be received from the graphs on figures 4 and 5.

According to their destructive bending moments the glued end corner joints of the details with cross section 50 x 25 mm (see fig. 1) are arranged in the following hierarchical order: through open mortise and tenon,

through half - open mortise and tenon, through hunched mortise and tenon, through mortise and tenon, through two dowels and joint through wooden “Lamello plates”, and the dismantlable end corner joints – through two one-piece connectors “Confirmat”, through two countersunk screws for wood and joint with two connectors with screw and cross dowel (called “Swedish type”).

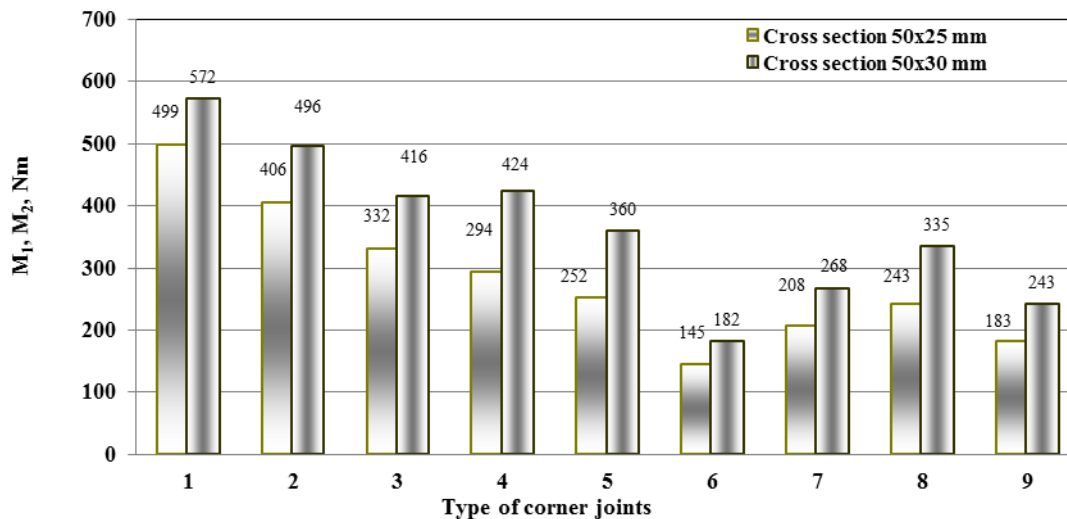


Figure 4: Comparative data on the destructive bending moments of end corner joints details from solid chestnut wood with of cross section 50 x 25 mm and 50 x 30 mm.

Table 1: Destructive bending moments of corner joints details from solid chestnut wood with of cross section 50 x 25 mm and 50 x 30 mm.

Type of corner joints	Destructive bending moments of cross section of details:		
	50 x 25 mm, M ₁ , [Nm]	50 x 30 mm, M ₂ , [Nm]	M ₂ / M ₁
A. End corner joints:			
I. Glued corner joints:			
1. Open mortise and tenon joint;	499	572	1.14
2. Half-open mortise and tenon joint;	406	496	1.22
3. Hunched mortise and tenon joint;	332	416	1.25
4. Mortise and tenon joint;	294	424	1.44
5. Joint with two dowels;	252	360	1.42
6. Joint with wooden "Lamello plates".	145	182	1.25
II. Dismountable corner joints:			
7. Joint with two countersunk screws for wood;	208	268	1.29
8. Joint with two one-piece connectors "Confirmat";	243	335	1.38
9. Joint with two connectors with screw and cross dowel.	183	243	1.32
B. T-shape corner joints:			
I. Glued corner joints			
1. Stub mortise and tenon, type A;	529	606	1,15
2. Through mortise and tenon type A;	556	677	1,21
3. Stub mortise and tenon, type B;	402	485	1,20
4. Through mortise and tenon with shoulders, type B;	481	556	1,16
5. Joint with two dowels;	276	406	1,47
6. Joint with wooden "Lamello plates".	138	161	1,17
II. Dismountable corner joints:			
7. Joint with two countersunk screws for wood;	272	285	1,05
8. Joint with two one-piece connectors "Confirmat";	299	331	1,11
9. Joint with two connectors with screw and cross dowel.	235	259	1,34

According to their destructive bending moments the glued T - shape corner joints of the details with cross section 50 x 25 mm (see fig. 2) are arranged in the following hierarchical order: through oval mortise and tenon, type A, through oval stub mortise and tenon, type A, through oval mortise and tenon with shoulders, type B, through oval stub mortise and tenon, type B, through two dowels and joint with wooden "Lamello plates", and the dismountable T – shape corner joints – through two one-piece connectors "Confirmat", through two countersunk screws for

wood and joint with two connectors with screw and cross dowel.

According to the destructive bending moments the end corner joints of the details with cross section 50 x 30 mm (see fig. 1) are arranged in the same hierarchical order, as well as the joints of the details with cross section 50 x 25 mm with the exception of the joints with hunched mortise and tenon and mortise and tenon which exchange their positions, but the difference between them is very small.

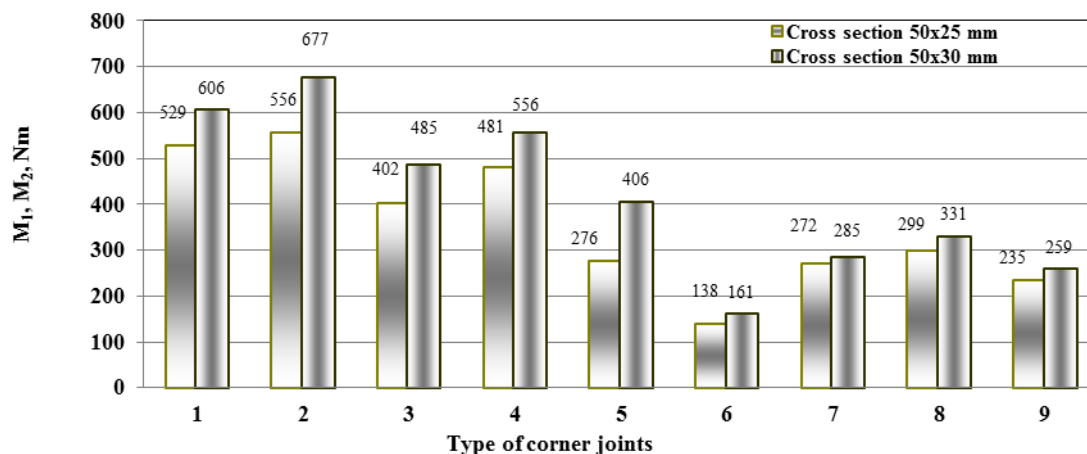


Figure 5: Comparative data on the destructive bending moments of T-shape corner joints details from solid chestnut wood with of cross section 50 x 25 mm and 50 x 30 mm, (from 1 to 9 according to table 1)

According to the destructive bending moments the T - shape corner joints of the details with cross section 50 x 30 mm (see fig. 2) are arranged with the same hierarchical order, as well as the joints of the details with cross section 50 x 25 mm.

From the data in the table and figures 4 and 5 it could be seen that the cross section of the details has considerable impact on the destructive bending moment of the joint.

The correlation between the destructive bending moments of the glued end corner joints of the details with cross section 50 x 30 mm and 50 x 25 mm is 1,28, e. g., with the increase of the thickness of the cross section from 25 to 30 mm (with 20 %), the destructive bending moments are increased with the average 28 %.

The correlation between the destructive bending moments of the dismantable end corner joints of the details with cross section 50 x 30 mm and 50 x 25 mm is 1,33, e. g., with the increase of the thickness of the cross section from 25 to 30 mm, the destructive bending moments increase with an average of 33 %. The middle increase of the destructive bending moments of the glued and dismantable end corner joints is about 30 %.

The correlation between the destructive bending moments of the T - shape corner joints of the details with cross section 50 x 30 mm and 50 x 25 mm is 1,23, e. g., with the increase of the thickness of the cross section from 25 to 30 mm, the destructive bending moments increase average with 23 %.

And the correlation between the destructive bending moments of the dismantable T - shape corner joints of the details with cross section 50 x 30 mm and 50 x 25 mm is 1,17, e. g., with the increase of the thickness of the cross section from 25 to 30 mm, the destructive bending moments increase on the average with around 17 %. The middle increase of the destructive bending moments of the glued and dismantable T - shape corner joints is around 20 %.

CONCLUSION

The results from the comparative analysis between the destructive bending moments in the loading of bending with the gathering of the shoulder frames of the most common end and T – shape corner joints of the details from solid chestnut wood with cross section 50 x 25 mm and 50 x 30 mm give reason to make the following more common conclusion and recommendations:

1. The type of joints have a definite impact on the destructive bending moments in loading in bending.

2. The cross section of the details has considerable impact on the destructive bending moments of the corner joints of the details in their loading when bending. With the increase of the thickness of the details from 25 to 30 mm (with 20 %), the destructive bending moments in the loading of bending of the end glued and dismountable corner joints increase respectively with around 28 % and with 33 % (or average with 30 %), and of the T – shape corner joints - with around 23% or 17% (or average 20%).

3. It is recommended that the found out destructive bending moments of loading in bending of the most commonly used end and T – shape corner joints of details from solid chestnut timber with cross section 50 x 25 mm and 50 x 30 mm be taken into consideration in the choice of the type of joints in the construction of furniture for sitting.

REFERENCES

- Der Große Häfele. (2012). Möbelbeschläge. Katalog, Nagold.
- Gruevski, G. (2007). Izstrajuvanja na sostavite vo konstruktsiite na stolovi, izraboteni od kostenovo drvo. Doktorska disertatsia, Faculty of Forestry, Skopje.
- Jivkov, V. (2001). Vlijanie na dopuskite I sglobkite varhu jakostnata karakteristika na osnovnite vidove nerazglobjaemi aglovi saedinenija pri mebelite. Doktorska disertatsia, University of Forestry, Sofia.
- Kyuchukov G. (1995). Konstruirane na mebeli. – Uchebnik za University of Forestry – Sofia, “Martilen”, Sofia.
- Kyuchukov, G., G. Gruevski, B. Kyuchkov. (2010). Comparative studies on destructive bending moments of end corner joints of components of solid chestnut wood with a cross section of 50 x 25 mm. – Proceedings “Innovation in wood-working industry and engineering design”, Sofia, November 2010, 206–210.
- Kyuchukov, G., G. Gruevski, A. Marinova, B. Kyuchukov. (2008). Stiffness coefficients under bending test of end corner joints of frame structural elements made of sweet chestnut wood. – 7th Symposium with International symposium “Furniture 2008”, Faculty of Wood Science and Technology, Zvolen, Slovakia, ISBN 978-80-228-1839-1.
- Kyuchukov, G., G. Gruevski, A. Marinova, B. Kyuchukov. (2008). Stiffness coefficients under bending test of T-shape corner joints of frame structural elements made of sweet chestnut wood. Proceedings “Innovation in woodworking industry and engineering design”, University of Forestry, Sofia, November 2008, 265–270.
- Kyuchukov, G., G. Gruevski, A. Marinova, B. Kyuchukov. (2009). Comparative analysis of stiffness coefficients of end and T-shape corner joints of frame structural elements made of sweet chestnut wood. – 20th International scientific conference, University of Zagreb, Proceedings, Zagreb, October 2009, 101–104.
- Kyuchukov, G., G. Gruevski, A. Marinova, B. Kyuchukov, V. Jivkov. (2011). Stiffness coefficients under bending test of end corner joints of structural elements made of sweet chestnut wood. – Zagreb university, 2011 г., International conference, 89–97.
- Kyuchukov, G., G. Gruevski, A. Marinova, B. Kyuchukov, V. Jivkov. (2012). Stiffness coefficients under bending test of T-Shape corner joints of frame structural elements with cross section of 50 x 30 mm made of sweet chestnut wood. – 23rd International scientific conference, Zagreb University, Proceedings, October 2012, 97–102.
- Kyuchukov B., G. Kyuchukov, V. Jivkov. Comparative study on the destructive bending moments of some T-shape corner joints from beesh wood with cross section of 50 x 25 mm. Zagreb university, 2012, 23rd International scientific conference, Proceedings, 103–110.
- Kyuchukov G., G. Gruevski, B. Kyuchukov: Comparative studies on destructive bending moments of T-shape corner joints of frame structural elements made of solid chestnut wood with a cross section of 50 x 25 mm. “Innovations in wood industry and engineering design”, 1/2012, University of Forestry – Sofia“, 79–85.
- Kyuchukov B., G. Kyuchukov, V. Jivkov: Comparative study an the destructive elements of solid beech wood with cross section of 50 x 25 mm. International scientific and technical conference “Innovations in wood industry and engineering

- design”, Yundola 2012, University of Forestry – Sofia“, No 1/2013.
14. Kyuchukov G., G. Gruevski, B. Kyuchukov. Comparative studies on destructive bending moments of end and T-shape corner joints of frame structural elements made of sweet chestnut wood with a cross section of 50 x 25 mm. International scientific and technical conference “Innovations in wood industry and engineering design”, Yundola 2012, University of Forestry – Sofia“, No 1/2013.