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EXAMINATION OF SOME STRENGTHS OF DISMOUNTABLE CORNER JOINTS IN CONSTRUCTION OF FURNITURE MADE OF PARTICLE BOARDS

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ABSTRACT

The results of the research on destructive bending moments of corner joints of structural elements made of particle boards, where these joints are used mainly in construction of storage furniture.

It was found that the type of joints has significant influence on the destructive bending moment. This is defined by the type and size of joint elements and the area of contact surfaces of the joints. We also investigated the influence of using the product on the destructive moment of different types of joints.

It is recommended that the research results are taken into consideration in strength design of furniture.

Key words*:* dismountable corner joints, destructive bending moments, norms for destructive bending moment

1. INTRODUCTION

Norms for the destructive bending moments of end corner open were worked out on the basis of the experimental research on the same types of joints of structural elements with a cross section 50 x 30 mm (Kyuchukov et al, 2014). The samples for the test were manufactured from particle board.

2. MATERIALS AND METHODS

The following types of end joints were tested: metal angle connector with screws (Figure 1), plastic angle connector with screws (Figure 2) and minifix connector (Figure 3). The parameters of the joints correspond to the Bulgarian State Standard 5527-73 and are given at figures 1 to 3.

There were 3 groups of specimens, the 1st group were specimens which were taken directly from the product which was previously tested according to MKS EN 14073-1, MKS EN 14073-2, MKS EN 14073-3, MKS EN 14074) directly cut off from the product, the second group were specimens which were also taken from a tested product but were first dismounted and then cut off from the product, and the third group were specimens made for testing and comparison (no previous tests done).

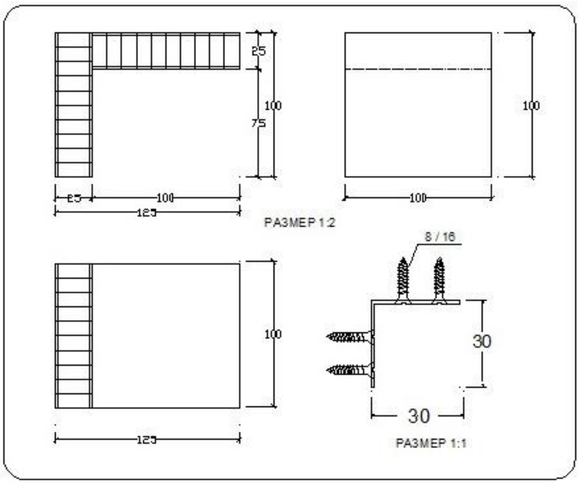


Figure 1.

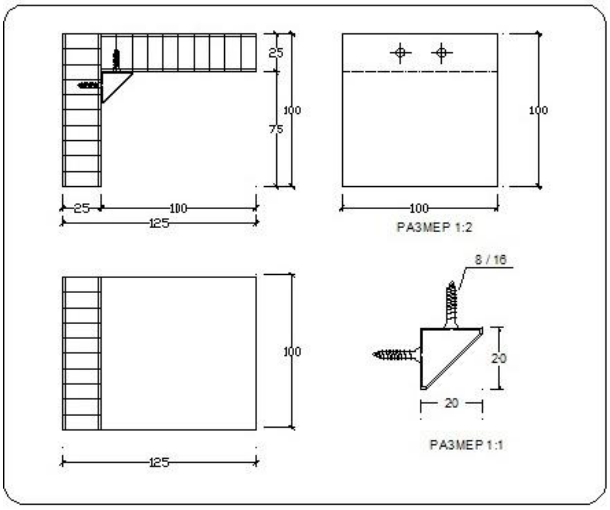
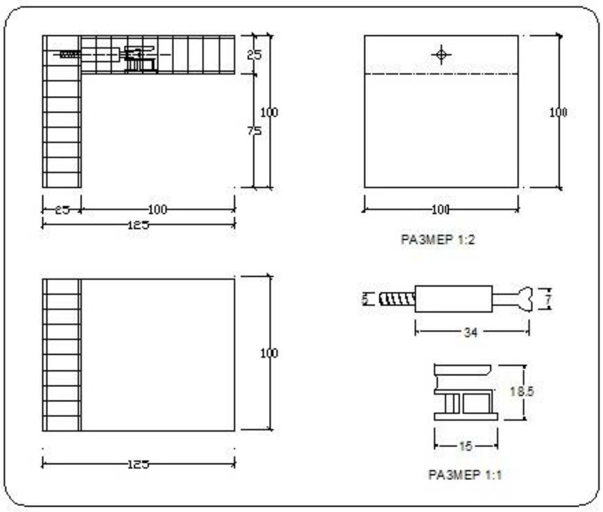


Figure 2.



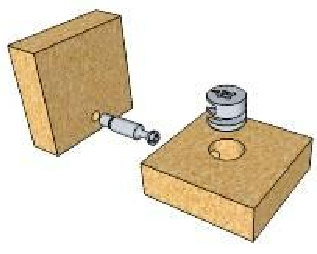


Figure 3.

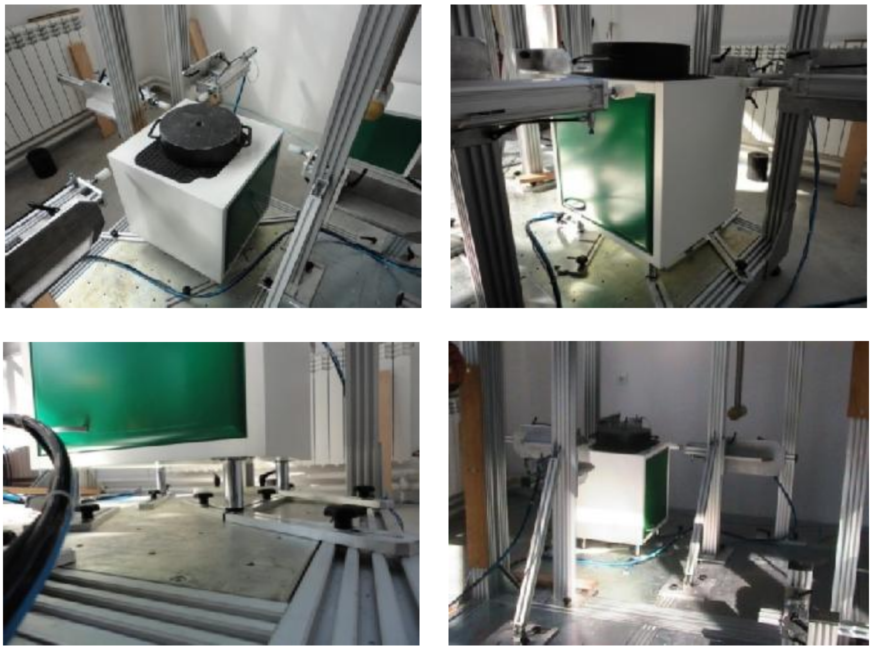


Figure 4.

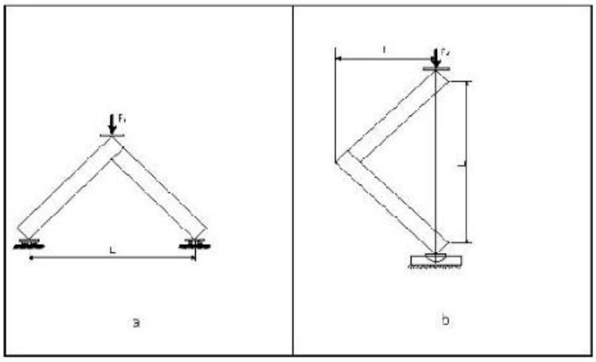


Figure 5. *Scheme for testing of test samples of end corner joints:*
a – in arm opening bending load; b – in arm compression bending load

The destructive bending moments M_1 under arm opening bending test and M_2 under compression bending test have been calculated correspondingly by the formulas (1) and (2).

$$M_1 = \frac{F_1 . L}{4} \quad (1)$$

$$M_2 = F_2 . l \quad (2)$$

where
F_1 – failure force in arm opening bending test in N
F_2 – failure force in compression bending test in N;
L – span distance of arm opening bending test in m
l – arm of bending in compression bending test in m

The results from the experiments were processed by the variation statistics methods.

The norms for the destructive bending moments of the corner joints of the frame structural elements were worked out on the basis of the results of the previously published experimental research (Kyuchukov et al, 2014), taking into account the dispersion of the data from the experimental research according to the Gauss law of normal distribution.

The normative values for the destructive bending moments of the tested corner joints of the frame structural elements made of solid spruce wood were determined by the formulas (3) and (4).

$$M_{1\,\mathrm{norm}} = \overline{x_1} - \alpha . s_1 \quad (3)$$

$$M_{2\,\mathrm{norm}} = \overline{x_2} - \alpha . s_2 \quad (4)$$

where
$\overline{x_1}$ is the mean value of the destructive bending moment of the joint at arm opening bending load, Nm; $\overline{x_2}$ – the mean value of the destructive bending moment of the joint at compression bending load, Nm;
α – the coefficient of uniformity;
s_1 – the mean square deviation at arm opening bending load, Nm;
s_2 – the mean square deviation at arm compression bending load, Nm.

The coefficient of uniformity α specifies the range of the experimental data spread. In the theory of probability there is a proof that all the variants of experimental data practically lie into the limits $\bar{x}$ ± 3s, and over 99 % of the data lie into the limits $\bar{x}$ ± 2,5s. Based on that fact, it can be assumed that the lower bound $\bar{x}$ – 2,5s can be accepted as a normative bound of the relevant strength characteristic of the tested types of corner joints in the frame structural elements made of solid spruce wood. The mean square deviation is function both of the data spread about the mean value and the number of the tested samples. It is determined that average variation coefficient v_{av} eliminates the influence of the accidental factors of particular samples of the given type of joint. In the arm opening bending test v_{av} = 12,6 %, and in the arm compression bending test v_{av} = 12,5 %. On this basis the value of the mean square deviation for each type of joint is specified by the formulas (5) and (6).

$$s_1 = \frac{v_{av}}{100} \cdot \overline{x_1} \quad (5)$$

$$s_2 = \frac{v_{av}}{100} \cdot \overline{x_2} \quad (6)$$

The normative values for the destructive bending moments of the tested end corner open joints in arm opening and arm compression bending load were determined by the formulas (7) and (8).

$$M_{1\,\mathrm{norm}} = \overline{x_1} - 2{,}5. \quad (7)$$

$$M_{2\,\mathrm{norm}} = \overline{x_2} - 2{,}5 . s_2 \quad (8)$$

3. RESULTS

The results from the research are presented graphically in Figures 5 and 6. From the data shown in the figures it is obvious that the destructive bending moment depends on the type of the joint as well as the scheme at which the joint was loaded.

The type of the joints has a considerable influence on the destructive bending moment. This is defined by the type and dimensions of the joint elements.

Number	GROUP 1 (N.м)	GROUP 2 (N.м)	GROUP 3 (N.м)
1	42,75	33,833	40,708
2	36,5	29,375	38,937
3	11,104	9,208	11,667

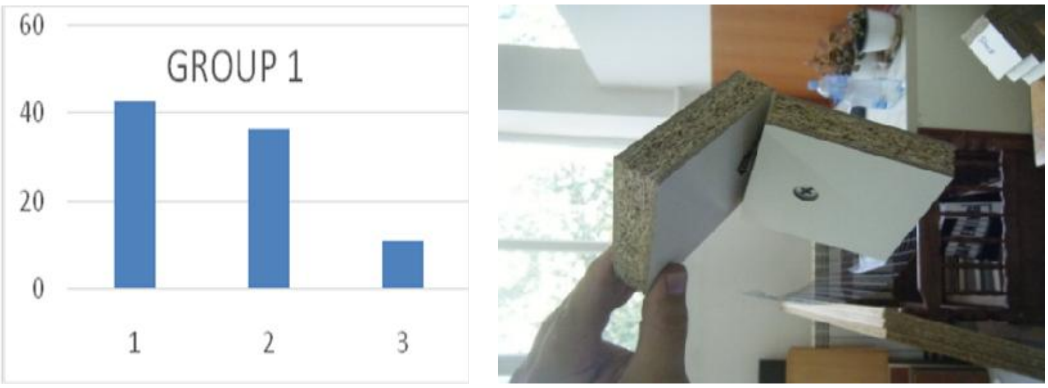


Figure 6. *Group 1, specimens taken directly from the previously tested product (directly cut off)*

Figure 7. *Group 2, specimens taken from the previously tested product (dismounted and then cut off from the product)*

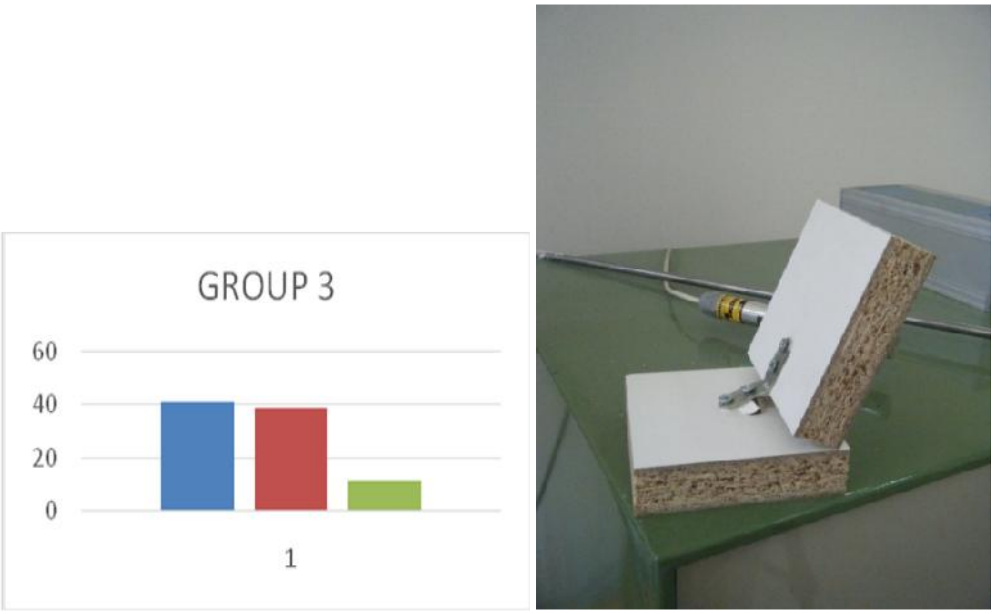


Figure 8. *Group 3, specimens made only for testing (no previous test done)*

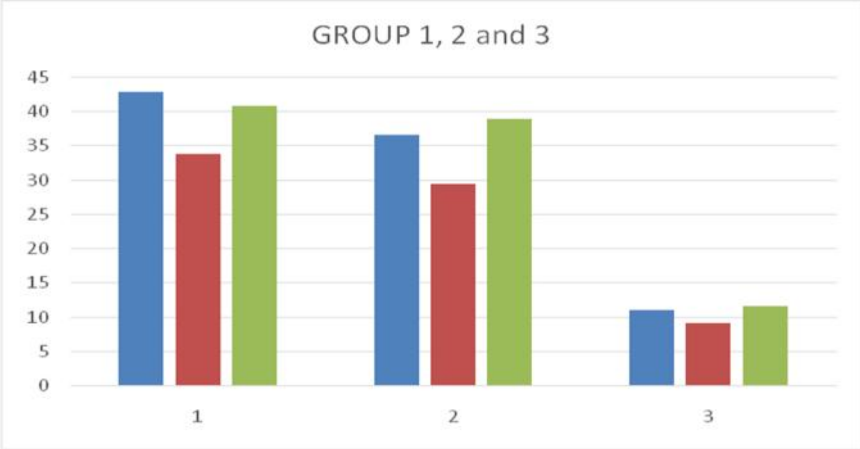


Figure 9. *Comparison of the results from the three groups and three different joints*

4. CONCLUSION

The results from the research carried out give reason to make the following more common conclusions:

1. According to the value of the destructive bending moment, the tested types of corner joints are set in the following hierarchical order:

- ,etal corner joint;
- plastic corner joint;
- minfix corner joint;

2. The differences in strength of the joints which were directly cut off from the product and the joints made only for testing are small.

3. The difference in strength of the joints which were dismounted and then cut off from the product and the joints made only for testing is 20% .

4. It is recommended that the strength characteristic of the tested joints should be taken into account in the strength design of sitting furniture, tables and beds.

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