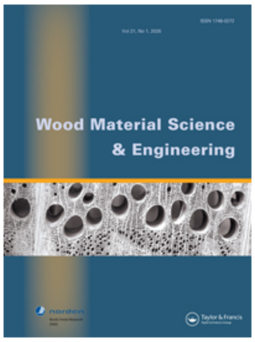


Taylor & Francis
Taylor & Francis Group

Wood Material Science & Engineering

ISSN: 1748-0272 (Print) 1748-0280 (Online) Journal homepage: www.tandfonline.com/journals/swoo20

Comparing furniture joint variants using a multi-criteria analysis

Nikola Janíková, Milan Šimek, Adam Kořený, Milan Gaff & Josef Hlavatý

To cite this article: Nikola Janíková, Milan Šimek, Adam Kořený, Milan Gaff & Josef Hlavatý (2026) Comparing furniture joint variants using a multi-criteria analysis, Wood Material Science & Engineering, 21:1, 653-662, DOI: 10.1080/17480272.2024.2445548

To link to this article: https://doi.org/10.1080/17480272.2024.2445548

Published online: 06 Jan 2025.

WOOD MATERIAL SCIENCE & ENGINEERING
2026, VOL. 21, NO. 1, 653–662
https://doi.org/10.1080/17480272.2024.2445548

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

OPEN ACCESS Check for updates

Comparing furniture joint variants using a multi-criteria analysis

Nikola Janíková, Milan Šimek, Adam Kořený, Milan Gaff and Josef Hlavatý

Faculty of Forestry and Wood Technology, Mendel University in Brno, Brno, Czech Republic

ABSTRACT

This research article compares selected furniture joints. The first part focuses on conventional joining techniques, including cam and dowel joints, and the second part discusses innovative joints, primarily plastic ones. The article also describes new connectors that allow simple assembly of furniture. The research deals with several parameters in a multi-criteria analysis: bending moment capacity under compression, bending moment capacity under tension, price of fasteners, machining time, assembly time, visibility and dismountability. Spearman's rank correlation coefficient is also used in the research, proving that there is a correlation between different parameters of the joints. This study aims to compare the performance of furniture joints based on various parameters, including strength, cost, and ease of assembly. The study looks at the individual connections from a different perspective, which can also be evaluated by users. The aim of the study was to evaluate the individual connections from several perspectives. Another aim was to find out whether the individual parameters interact or not. The utilization of a multi-criteria analysis enables furniture manufacturers to make informed decisions regarding joint selection and production processes.

ARTICLE HISTORY
Received 10 November 2024
Revised 16 December 2024
Accepted 18 December 2024

KEYWORDS
Furniture; CAM joints; ready to assembly; plastic joint; multi-criteria analysis

1. Introduction

Research aimed at the mechanical properties of furniture joints deals with classic joints, as well as dismountable or innovative joints in terms of appearance or production technology. Ready-To-Assemble (RTA) joints make transporting the furniture easier, improve storability and allow quick and easy assembly. These certain features, comes as very helpful to consumers as they can easily dismantle it and transfer it from one place to another in times of need (Mehtab *et al.* 2022). The dismountable structure should not affect the stiffness of the joint, which is a criterion for evaluating the joint's quality, (Krzyzaniak and Smardzewski 2019; Silvana *et al.* 2019) tested traditional cam joints with modern hidden joints, and then evaluated the samples with regard to several parameters: Technical criterion / strength design is defined by the achieved maximum momentum of force obtained by static testing. The technological criterion / design for manufacturing refers to the technological complexityand availability of machines, devices and tools for constructing structural composition. The aesthetic design / aesthetic criterion is observed through the visibility of the fasteners onthe back without the shelf and the visibility of the fastener openings when the shelf in functionis connected to the back. The functional criterion shall include the assessment of access to the parts of the showcasefor the assembly / dismantling of shelves. The economic criterion evaluated the monetary value of the fasteners used. Each parameter was assigned a score on a 5-1 scale (5 – best, 1 – worst). They then added up all the points and evaluated the individual connections. (Silvana *et al.* 2019) evaluated the following connections:Confirmat, Invis, Minifix 34, Minifix 24 and Clamex P14. Branowski *et al.* (2020) also evaluated individual connections using multi-criteria analysis in their work. They compared connections within several requirements and their importance. According to the number of important requirements, a given connection received a percentage representation in the entire matrix and a subsequent ranking. Their requirement importance according to mechanics experts: user-friendly assembly, assembly in production, possibility to disconnect, matching dimensions, low visibitily, without adhesives, considerable clamping force, considerable assembly clamping force, semi-rigid transfer, low costo of mass production, design quality, impact on the environmental, innovative character and possibility of repeated disassembly.

(Podskarbi *et al.* 2017) researched connector fittings and evaluated individual joint parameters. In addition to the parameters (visibility, dismountability, assembly force, method of connection, tools, aesthetics, rycycling and coefficient of assembly), they also studied the linear dependence between them. In their research (Kivanc and Burdurlu 2023) evaluated the tested samples of a solid wood table corner joint using multi-criteria analysis and several parameters (strength, price, aesthetics and capacity). They assigned a weight to these parameters, whereas the strength of the joint had the highest weight with a value of 0.442.

A sample consisting of pins with a surface coating of glue was also included in the current research. Pin joints are considered traditional furniture joints. (Tankut 2005) studied the dependence on the size of the part and the number of pins, comparing different sizes of samples with a different number of pins, as

CONTACT Nikola Janíková xjanikov@mendelu.cz Faculty of Forestry and Wood Technology, Mendel University in Brno, Zemedelska 3, Brno 613 00, Czech Republic

well as the dependence of the material used on the sample. Researched the differences between pin joints by testing different types of pins (Podlena *et al.* 2018). The tested samples included pins with a surface coating of glue, as well as one with a spiral grooving. Norvydas *et al.* (2005) searched for the optimal distance of wooden pins from the front edge of the part. The dependence between the distance of the joints in L samples joined with wooden pins was researched by (Hajdarevic and Martinovic 2016). The differences between pin diameter and bending stress in the angular plane were investigated by (Chen and Lyu 2018). Karaman (2021) tested the same type of RTA fittings with the addition of a pin. The addition of a wooden pin to the joint caused an increase in the values of the tested L samples. Malkoçoğlu *et al.* (2013) studied RTA joints with nylon dowel pins and cams, and they also tested specimens with different distances between the joint and the leading edge. Smardzewski and Prekrad (2002) compared cam joints with RTA joints, searching for the perfect joint for cabinet furniture. Jivkov and Marinova (2005) studied RTA joints, evaluating both their stiffness in L samples, as well as the laboriousness of assembly by the end user. Šimek *et al.* (2010) also studied the distance between RTA joints and the front edge. Wengang *et al.* (2024) tested L and T samples from different materials (particle board, plywood and block board). In each samples was same joint zinc eccenter and metric bolt with plastic part and plastic nut. Each eccenter was combine with dowel. The best results for bending moment capacity were achieved by eccentric joints in plywood.

Biscuits are another way of connecting furniture parts. The market now offers a wide range of solutions that are becoming increasingly popular among furniture manufacturers. The biscuits themselves have evolved over the years, and we can also find RTA biscuit joints now. Barboutis and Vassiliouo (2008) studied plastic biscuits and compared them with beech biscuits in their research. The destruction of a cam joint in comparison with a dismountable biscuit joint and the relationship between load and angular deformation were researched by (Sydor 2019). The same type of cam joints from different manufacturers were researched by (Barboutis and Vassiliou 2009), who used rod bolts in a longitudinal part with a different assembly type. Branowski *et al.* (2018) experimentally studied innovative eccentric joints with increased friction between mating parts. This joint relies on friction to hold the components together, using an eccentric fastener design.

Derikvant and Eckelman (2015) tested L frame joints using dovetail, pin and H joints. The tested samples were also made from different materials. A similar dovetail and H joint system was studied by (Dalvant *et al.* 2013). Other research by (Langová *et al.* 2013; Grič *et al.* 2017) and (Sebera and Šimek 2010) also investigated a possible self-locking joint. Corner joints without fittings were researched by (Kamboj *et al.* 2009) and (Demirci *et al.* 2020), who evaluated the wooden teeth, the adhesive used, the stiffness of the joint with a different number of teeth and the wood species used. In corner joints, the pin and the gap can be replaced with inserted joints made of wood, or zinc cams combined with plastic. Bas *et al.* (2023) dealt with this topic, testing beech T and L samples. In his research, Jivkov (2002) tested L samples with conventional joining methods and the effect of an additional plastic edge on the tested joints. The research of Jivkov and Grbac (2011), which focused on the differences between static and cyclic testing of corner joints, also dealt with similar samples. Ho Ch (1994) also studied cyclic testing of corner samples.

The aim of the study was to evaluate the individual connections from several perspectives. Another aim was to find out whether the individual parameters interact or not.

2. Material and methods

2.1. Material

Eight variants of furniture joints were tested on L-shaped specimens, each consisting of two 8 mm thick laminated particleboard pieces joined at a 90° angle. The overall dimensions of each specimen were 150 mm × 150 mm × 366 mm. They were made of three-layer particle board with a surface lamination thickness of 18 mm. The edge of the longitudinal part in the tested joint had a 0.5 mm plastic edge glued with EVA glue. 22 samples of each type of joint were produced for mechanical testing. With eight tested varinats, the total amount of samples was 176. Photographs of each component of the joint are included (Tables 1 and 3).

In the preparatory stage, 3D models of each sample (Figure 1) (Table 1) were created, in which the dimensions for the production itself were checked. Then the test specimens were made. After the test specimens were assembled and checked, the remaining samples were manufactured.

2.2. Methods

The multi-criteria analysis was divided into individual segments according to the selected parameters.

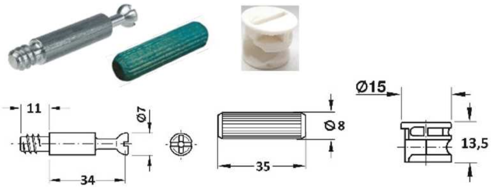
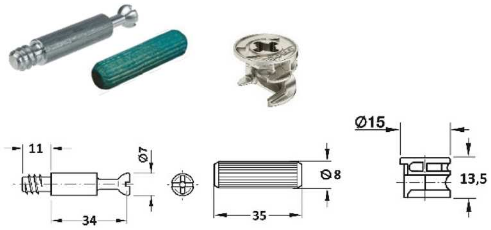
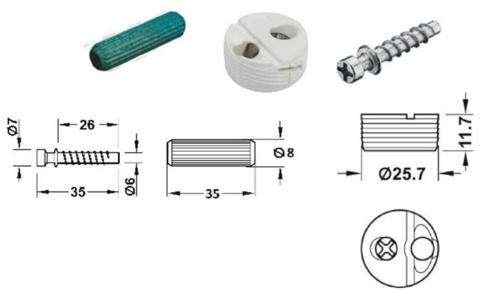
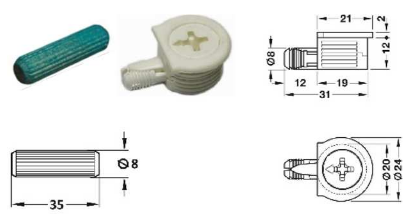
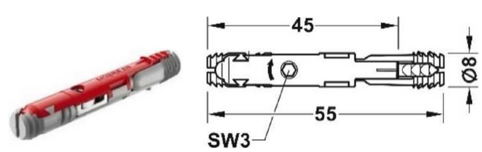
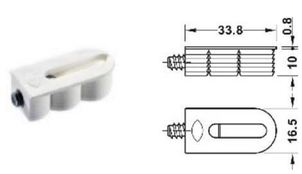
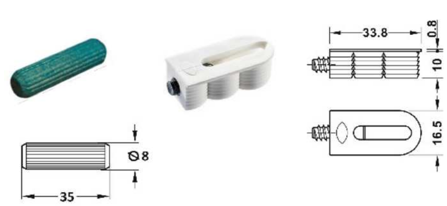
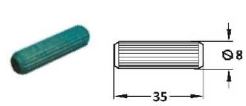
The following parameters were chosen for comparison:

- bending moment capacity under compression,
- bending moment capacity under tension,
- price of fasteners,
- machining time,
- assembly time,
- visibility,
- dismountability.

Mechanical testing of L samples was performed to determine the bending moment capacity under compression and bending moment capacity under tension. Method of testing L samples, bending moemnt capacity under compression and tension was same as reseachr Janikova *et al.* (2024). This mechanical testing was performed on an Instron 3365 universal testing machine with the addition of corner joint testing accessories. The results were then analysed and converted to Nm. The results for each value are shown in Table 3.

The price of fastenerswas determined based on the usual selling price on the market. The research on the price of individual fittings elements (price of fasteners) was determined based on the prices of several distributors from March 2024 (www.hafele.cz, www.schachermayer.cz, www.demos-trade.cz, www.jafholz.cz, www.drevotrust.cz and www.nobia.sk). The results for each value are shown in Table 3.

Table 1. Selected types of joints.

Sample marking	Used parts in sample	Number of fittings in sample
1 (PC, D)		2 pcs steel bolts 2 pcs plastic cam 3 pcs birch dowel preglued
2 (ZC, D)		2 pcs steel bolts 2 pcs zinc cam 3 pcs birch dowel preglued
3 (FP, D)		2 pcs screw cam 3 pcs birch dowel preglued
4 (FP, D)		2 pcs one-part plastic connector 3 pcs birch dowel preglued
5 (FP)		2 pcs one-part plastic connector
6 (FP)		2 pcs plastic connector with euroscrew
7 (FP, D)		2 pcs plastic connector with euroscrew 3 pcs birch dowel preglued
8 (D)		3 pcs birch dowel preglued

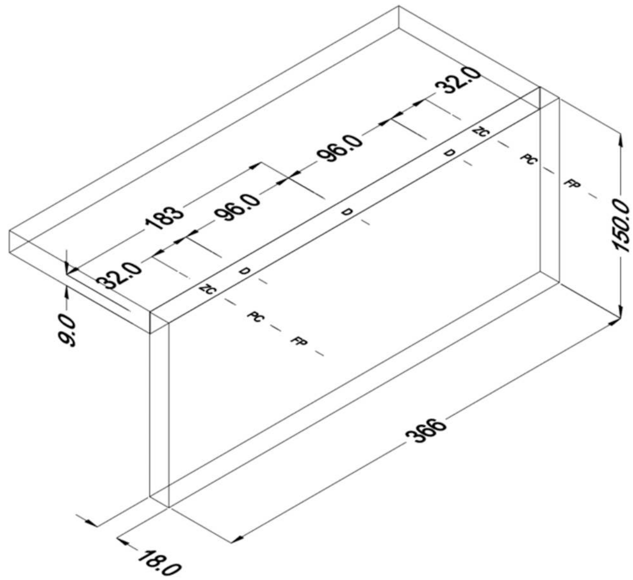


Figure 1. Schematic of the L-type component.

The time required to drill holes in the sample was tracked with a stopwatch (machining time). The time it took to drill the holes was measured for each type of sample, and the resulting times were averaged. The results for each value are shown in Table 3.

The time needed to assemble the samples (assembly time) was tracked with a stopwatch. The time it took to assemble both parts of the L sample was measured for each type of sample, and the resulting times were averaged. The results for each value are shown in Table 3.

The fact whether the final joint in the samples is visible or not (visibility) was also evaluated; this parameter was determined based on the visibility of the connector on the desc and was calculated in cm^2. The last evaluated parameter was the possibility to dismount the joint (dismountability). The results for each value are shown in Table 3.

3. Results and discussion

Our expectations for structural joints in terms of joint strength, design, material, processing time, etc., may vary. We may also expect the lowest possible joint price with regard to the nature of the furniture. A multi-criteria analysis was used to compare the individual parameters of the joints in the research. This is a method that is used to decide between several options. The point rating of each parameter is shown in (Table 2).

Each parameter was given a weight according to its importance in the multi-criteria analysis (Table 3). The parameters were rated with points according to the determined evaluation criteria (Table 2). and then multiplied by the weight of the given parameter (Table 3). The formula for calculating the point rating (1) with the given weight of the parameter is given for Sample 1 for the bending moment capacity under compression. This parameter reached a value of 33.61 Nm, which corresponds to 5 points according to (Table 2). These points were then multiplied by the value of the parameter according to (Table 3), which corresponds to a weight of 0.25.

Sample No. 1 therefore received 1.25 points for this parameter. All parameters for all the samples were calculated using the same method, and then all the points were added up to get the final sum of points for each sample.

$$\text{Point incl.value} = \text{Point} \times \text{Value} \rightarrow 1.25 = 5 \times 0.25 \quad (1)$$

Each company could then create its own multi-criteria analysis with its own values for each parameter, according to what would be the highest priority for it and what would be lower. Eccentric and Plastic connectors (sample 1, 2 and 7) connections are advantageous for those who want to achieve the highest possible Bending moment capacity under tension. Those looking for a hidden connection would prefer the Plastic and Pin Connector (samples 5 and 8). Users wanting the lowest cost coupling should choose the pin coupling. If production time is the limit, they need to focus on the values of machining time and assembly time. Spearman's rank correlation coefficient was created based on the data from the multi-criteria analysis, the aim of which was to determine the strength of the linear dependence between the parameters of the samples. The results of the correlation analysis (Table 4) can be divided into several levels of correlation dependence.

A multi-criteria analysis was created and Spearman's rank correlation coefficient was derived from it (Table 4). This analysis determined the following.

A very high degree of correlation was found for 8 parameters (dependence >±0.7).

There was a positive correlation between the following parameter combinations:

- bending moment capacity under compression × bending moment capacity under tension (Figure 2);
- bending moment capacity under compression × machining time (Figure 3);
- bending moment capacity under compression × assembly time (Figure 4);
- assembly time × visibility (Figure 5);
- machining time × assembly time (Figure 6)

Table 2. Point rating of each parameter in a multi-criteria analysis.

Parameter/number of points	0 points	1 point	2 points	3 points	4 points	5 points
bending moment capacity under compression, (Nm)	0–9.99	10–14.99	15–19.99	20–24.99	25–29.99	> 30
bending moment capacity under tension (Nm)	0–9.99	10–14.99	15–19.99	20–24.99	25–29.99	> 30
price of fasteners (€)	> 0.75	0.60–0.74	0,45–0.59	0,30–0.44	0.15–0.29	0–0.14
machining time (sec.)	> 150	120–149	90–119	60–89	30–59	0–29
assembly time (sec.)	> 75	60–74	45–59	30–44	15–29	0–14
visibility (cm^2)	> 4	3–3.99	2–2.99	1–1.99	0.01–0.99	0
dismountability (Yes / No)	No	Yes	–	–	–	–

Table 3. Evaluation of multicriteria analysis.

	Sample 1 		Sample 2 		Sample 3 		Sample 4 		Sample 5 		Sample 6 		Sample 7 		Sample 8 	
	Parameter	Point /Point incl. value	Parameter	Point /Point incl. value	Parameter	Point /Point incl. value	Parameter	Point /Point incl. value	Parameter	Point /Point incl. value	Parameter	Point /Point incl. value	Parameter	Point /Point incl. value	Parameter	Point /Point incl. value
Bending moment capacity under compression, (Nm) (value 0.25)	33.61	5/**1.25**	32.67	5/**1.25**	23.71	3/**0.75**	19.4	2/**0.5**	6.35	**0**	10.99	1/**0.25**	24.88	3/**0.75**	14.36	1/**0.25**
Bending moment capacity under tension, (Nm), (value 0.25)	35.48	5/**1.25**	34.4	5/**1.25**	29.0	4/**1**	23.51	3/**0.75**	7.45	**0**	24.46	3/**0.75**	41.3	5/**1.25**	17.26	2/**0.5**
Price of fastenersfasteners (value 0.15)	0.22 €	4/**0.6**	0.25 €	4/**0.6**	0.52 €	2/**0.3**	0.45 €	3/**0.45**	0.65 €	1/**0.15**	0.75 €	**0**	0.76 €	**0**	0.1 €	5/**0.75**
Machining time (sec.) (value 0.1)	162	**0**	162	**0**	146	1/**0.1**	134	1/**0.1**	85	3/**0.3**	73	3/**0.3**	162	**0**	54	4/**0.4**
Assembly time (sec.) (value 0.1)	73	1/**0.1**	73	1/**0.1**	90	**0**	70	1/**0.1**	30	3/**0.3**	60	1/**0.1**	90	**0**	40	3/**0.3**
Visibility (cm^2) (value 0.1)	1.76	3/**0.3**	1.76	3/**0.3**	4.82	**0**	4.11	**0**	0.28	4/**0.4**	5.28	**0**	5.28	**0**	0	**0.5**
Dismountability (value 0.05)	No	**0**	No	**0**	No	**0**	No	**0**	Yes	1/**0.05**	Yes	1/**0.05**	No	**0**	No	**0**
Sum of all points	**3.50 point**		**3.50 point**		**2.40 point**		**1.90 point**		**1.20 point**		**1.95 point**		**2.50 point**		**2.70 point**	

Table 4. Values of Spearman's correlation coefficients.

	Bending moment capacity under compression,	Bending moment capacity under tension	Price of fasteners	Machining time	Assembly time	Visibility	Dismountability
Bending moment capacity under compression	1						
Bending moment capacity under tension	0.847	1					
Price of fasteners	−0.348	0.078	1				
Machining time	0.865	0.802	0.046	1			
Assembly time	0.726	0.886	0.201	0.821	1		
Visibility	0.122	0.527	0.647	0.350	0.738	1	
Dismountability	−0.757	−0.604	0.565	−0.599	−0.592	−0.037	1

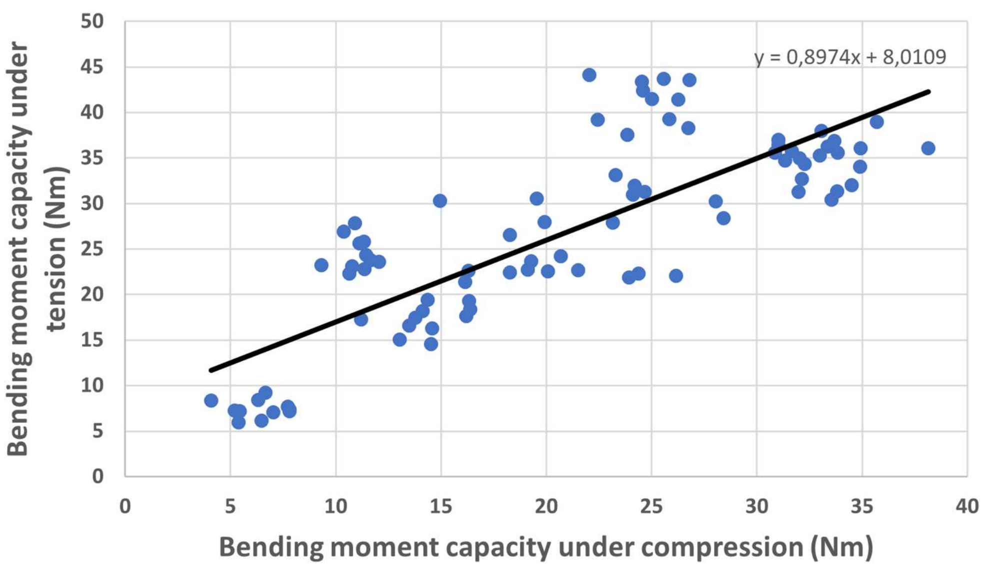


Figure 2. Graphs showing a high degree of positive dependence between parameters: bending moment capacity under compression × bending moment capacity under tension.

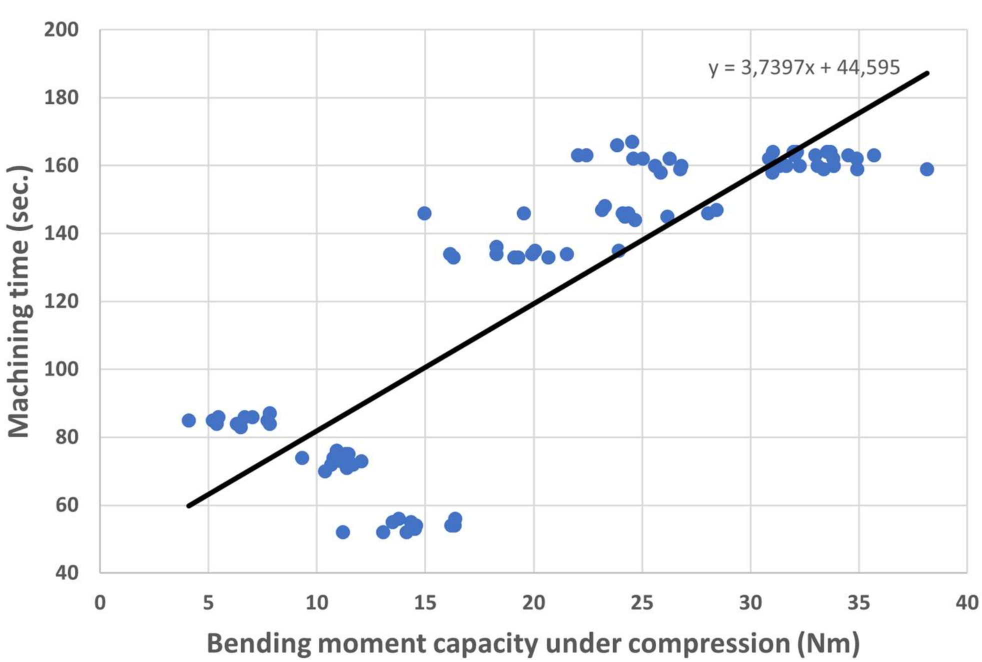


Figure 3. Graphs showing a high degree of positive dependence between parameters: bending moment capacity under compression × machining time.

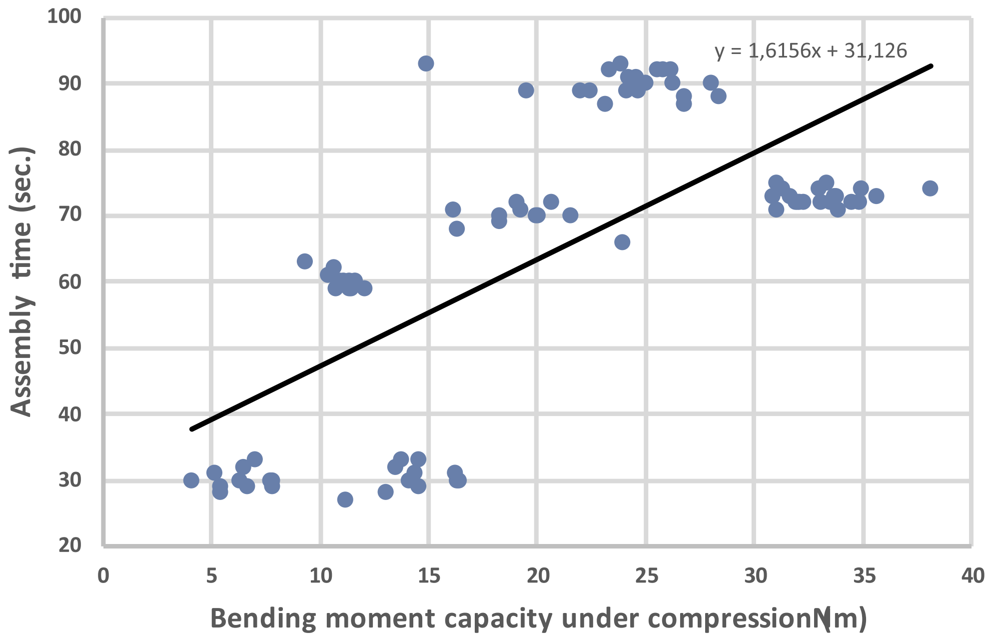


Figure 4. Graphs showing a high degree of positive dependence between parameters: bending moment capacity under compression × assembly time.

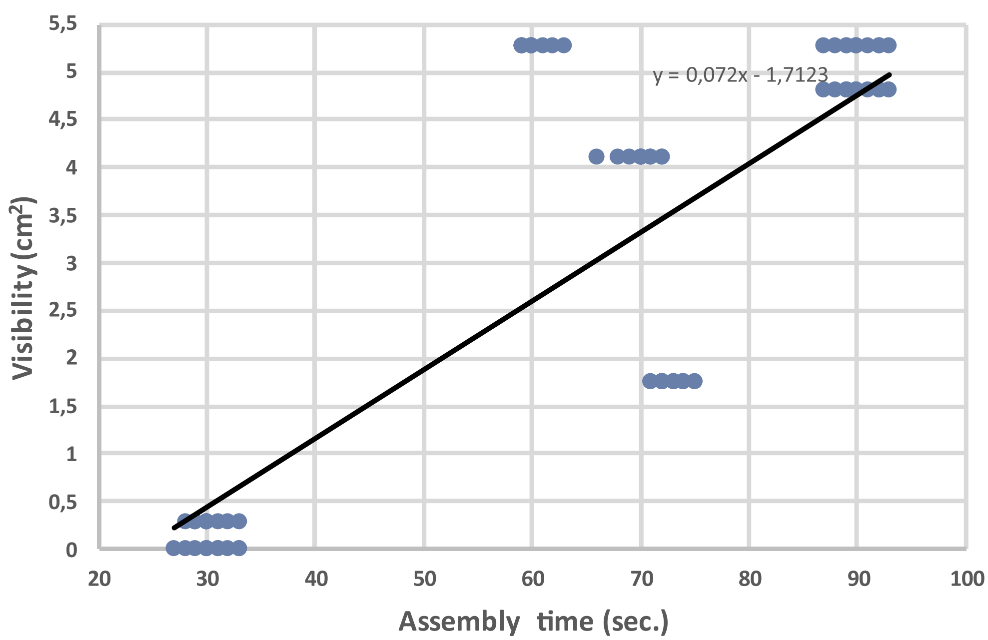


Figure 5. Graphs showing a high degree of positive dependence between parameters: assembly time × visibility.

- bending moment capacity under tension × machining time (Figure 7);
- bending moment capacity under tension × assembly time (Figure 8).

These positive high degrees of dependence are shown in Figures 2–8.

A negative correlation was found for the combination: bending moment values (compression) × dismountability. These all show high degrees of positive correlation.

A medium degree of correlation was found for dependence ±0.7– ±0.5. There was a positive correlation in the combination: bending moment capacity under tension × visibility; price of fasteners × visibility. A negative correlation was found between parameters: bending moment capacity under tension × dismountability; machining time × dismountability; assembly time × dismountability.

A mild degree of correlation was found for dependence ±0.5– ±0.3. There was a positive correlation in the combination: machining time × visibility. A negative correlation was found in the combination: bending moment capacity under compression × price of fasteners.

A low degree of correlation can be noted for dependence < ±0.3. A positive correlation was found between the combination: bending moment capacity under compression ×

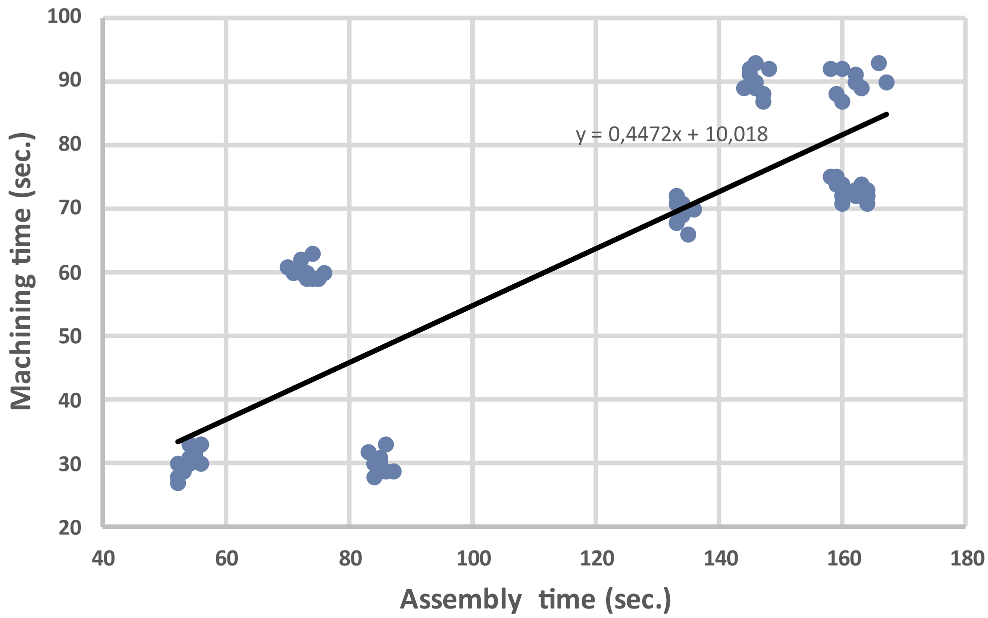


Figure 6. Graphs showing a high degree of positive dependence between parameters: machining time × assembly time.

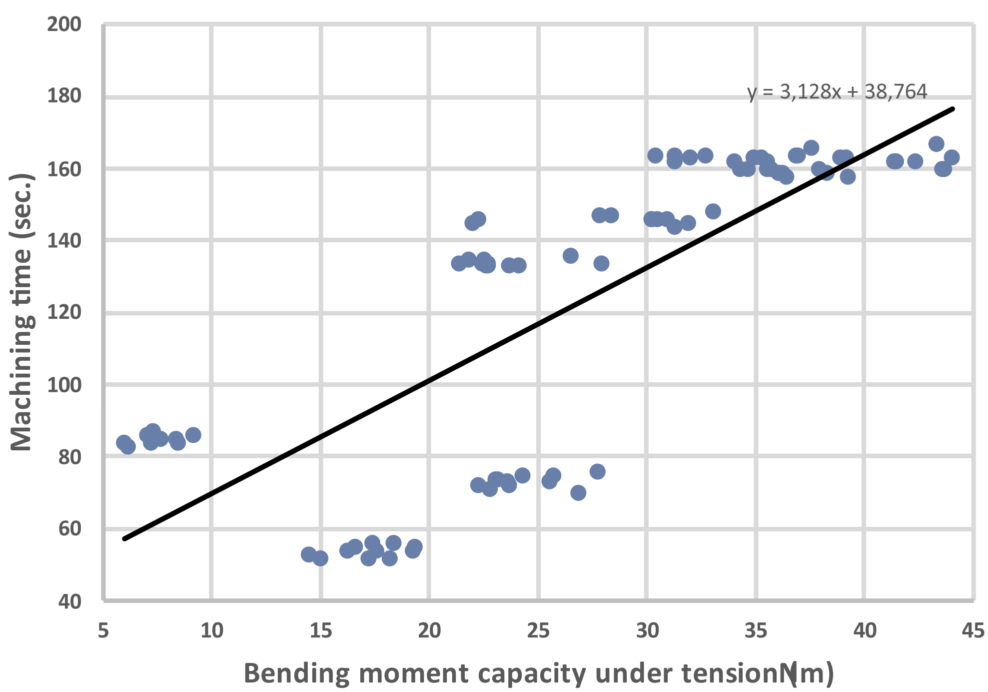


Figure 7. Graphs showing a high degree of positive dependence between parameters: bending moment capacity under tension × machining time.

visibility; bending moment capacity under tension × price of fasteners; machining time × price of fasteners; assembly time × price of fasteners. There was a negative correlation between the combination: visibility × dismountability.

Based on the linear dependencies (Table 4), it can be said that: the more time it takes to assemble the joint, the more visible the final joint is. The more time required to assemble the joint, the higher the resistance of the joint in bending tests in the angular plane. It is also true that the more time it takes to produce a joint, the higher its bearing capacity. The higher the price of fasteners, the more visible it is. We can therefore conclude that joints in which a large amount of material is used are also more expensive. Users may expect that the more time they invest in making a joint, the less time it will take to assemble it. This expectation was not confirmed, and we found that the longer it takes to manufacture the joint, the longer it will take to assemble it. Joints that score high in the angular plane bending – compressive stress test also score high in the angular plane bending – tensile stress test. Dismountable joints achieve lower values in bending tests in the angular plane. The expectation that the final visibility of the joint would be related to the ability to disassemble the joint was not confirmed. The assumption that less time is needed to

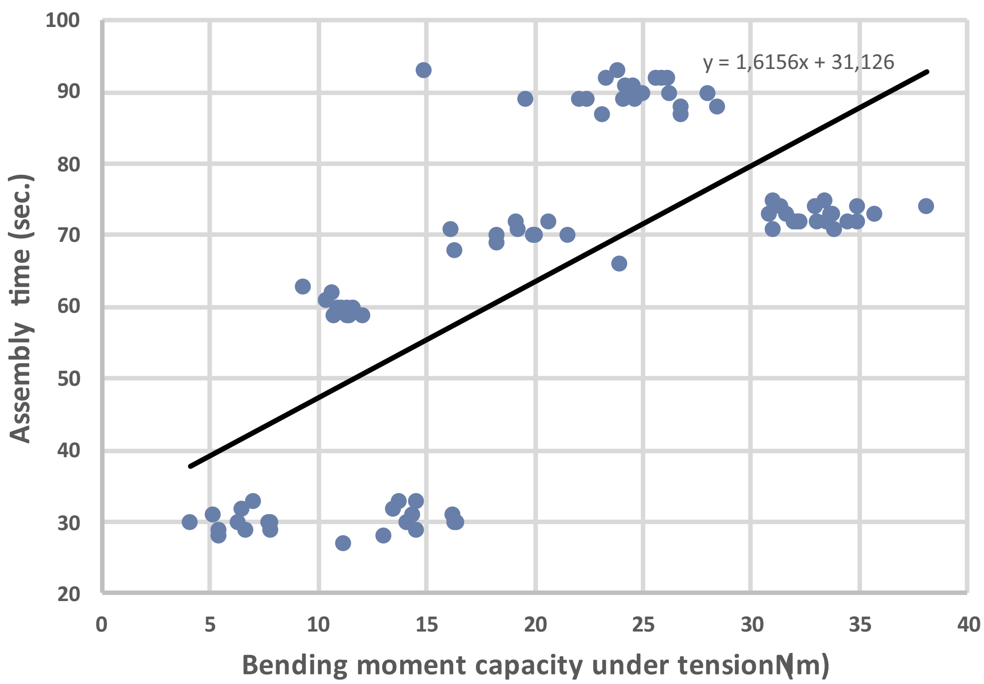


Figure 8. Graphs showing a high degree of positive dependence between parameters: bending moment capacity under tension × assembly time.

produce or assemble a joint for a higher price was not confirmed.

4. Conclusions

A correlation was found between the production/assembly time of a joint and its stiffness under stress in the angular plane. Tested joints that require a longer time to manufacture and assemble the joint achieved higher values in bending tests in the angular plane. A positive correlation was also found between visibility and assembly time. The visibility of the joint is thus directly related to the time spent assembling the joint. A correlation was also found between visibility and the price of fasteners. The more expensive the joint is, the lower its final visibility. No correlation was found between visibility and dismountability. This indicates that dismountability is not affected by the final visibility of the joint. It is important to note that glue-coated pins should be assembled promptly after wetting, as delayed assembly can lead to swelling and prevent proper jointing.

By employing a multi-criteria analysis, the study provides comprehensive evaluations of various joint variants, enabling furniture manufacturers to make informed decisions about fasteners selection and production processes tailored to their specific needs.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Barboutis, I. and Vassiliou, V., 2009. Improvements in the holding strength of CAM fittings used in eccentric joints, Annals of Warsaw University of Life Sciences – SGGW, *Forestry and wood technology* No. 67, Warsaw.

Barboutis, I. and Vassiliouo, V., 2008. Strength of furniture joints constructed with biscuits. *In*: *Proceeding of papers from international konference of nábytok*. Zvolen.

Bas, S., *et al.*, 2023. Performance comparison of wood furniture joints fastened with Domino tenons and connectors. *Research Squeare*. doi:10.21203/rs.3.rs-2661369/v1

Branowski, B., *et al.*, 2018. Experimental analysis of new furniture joints. *BioResources*, 13 (1), 370–382. doi:10.15376/biores.13.1.370-382

Branowski, B., *et al.*, 2020. Design issues of innovative furniture fasteners for wood-based boards. *BioResources*, 15 (4), 8472–8495. doi:10.15376/biores.15.4.8472-8495

Chen, M. and Lyu, J., 2018. Properties of double dowel joints constructed of medium density fiberboard. *Maderas. Ciencia y Tecnología*, 20. doi:10.4067/S0718-221X2018005003801

Dalvant, M., *et al.*, 2013. Analysis of factors affecting diagonal tension and compression capacityof corner joints in furniture frames fabricated with dovetail key. *Journal of Forestry Research*, 24 (1), 155–168. doi:10.1007/s11676-013-0336-y

Demirci, S., *et al.*, 2020. Effects of wood species, number of teeth, and adhesive type on moment capacities of box-joints. *Bioresources*, 15 (2), 3136–3146.

Derikvant, M. and Eckelman, C.A., 2015. Bending moment capacity of L-shaped mitered frame joints constructed of MDF and particleboard. *Bioresources*, 10 (03), 5677–5690.

Grič, M., *et al.*, 2017. Mechanical properties of furniture self-locking frame joints. *Bioresources*, 12 (3), 5525–5538.

Hajdarevic, S. and Martinovic, S., 2016. The effect of dowel spacing on the stress and strain of case-type furniture corner joint. *In*: *Proceedings of the 26th international DAAAM symposium*.

Ho Ch, E.C.A., 1994. The use of performance tests in evaluating joint and fastener strength in case furniture. *Forest Products Journal*, 44 (9), 47–53.

Janikova, N., *et al.*, 2024. Comparative study on the bending moment capacity and stiffness of innovative and traditional furniture corner joints. *Wood Material Science & Engineering*, doi:10.1080/17480272.2024.2391068.

Jivkov, V., 2002. Bending strength and stiffness of some end corner joints from 25 mm laminated particleboard. *In*: *Conference Nabytok at: Technical University Zvolen*.

Jivkov, V. and Grbac I., 2011. Influence of the cyclic loading on bending strength of different end corner joints made of MDF. *In*: *International*

Conference, Wood is good–EU challenges of the sector, October 21. Croatia: *Innovawood*. University of Zagreb, Faculty of Forestry, 59–66.

Jivkov, V. and Marinova, A., 2005. Investigation on ultimate bending strength and stiffness under compression of corner joints from particleboard with connectors for DIY furniture. *In*: *Conference: international scientific conference interior and furniture design at: Univerzity of Foresty*.

Kamboj, G., *et al.*, 2009. Influence of geometry on the stiffness of corner finger joints. *Bioresources*, 14 (2), 2946–2960.

Karaman, A., 2021. An investigation on the effect of wood species of dowels and the end distance of catch connectors (Clamex P-14) on the bending moment of L-type corner joints for RTA (ready-to-assemble) furnitures. *Wood and Fiber Science*. doi:10.22382/wfs-2021-05.

Kivanc, Y. and Burdurlu, E., 2023. Selection of wooden furniture joints with multi-criteria decision-making techniques. *Wood Material Science & Engineering*, 311–326. doi:10.1080/17480272.2023.2242329

Krzyzaniak, Ł. and Smardzewski, J., 2019. Strength and stiffness of new designed externally invisible and demountable joints for furniture cases. *Engineering Structures*, 199, 109674.

Langová, N., *et al.*, 2013. Strength properties of self-locking furniture joints with shape adapted for the production by CNC technology, Annals of Warsaw. *University of Life Sciences*, 83, 1898–5912.

Malkoçoğlu, A., *et al.*, 2013. Effects of number and distance between dowels of ready-to-assemble furniture on bending moment resistance of corner joints. *Wood Research*, 58 (4), 671–680.

Mehtab, T., *et al.*, 2022. Analysis of ready-to-assemble (RTA) furniture with reference to metropolitan cities in India. *Architecture Engineering and Science*, 3 (3), 160–170.

Norvydas, V., *et al.*, 2005. The influence of glued dowel joints construction on the bending moment resistance. *Material Science, Madziagotyra*, 11 (1), 36–39.

Podlena, M., *et al.*, 2018. Axial loading of different single-pin dowels and effect on withdrawal strength. *BioResources*, 13 (3), 5179–5192. doi:10.15376/biores.13.3.5179-5192.

Podskarbi, M., *et al.*, 2017. Design methodology of new furniture joints. *Drvna Industrija*, 67 (4), 371–380.

Sebera, V. and Šimek, M., 2010. Finite element analysis of dovetail joint made with the use of CNC technology. *Acta Universitatic Argicultirae et Silviculturae Mendelianae Brunensis*, 58 (5), 321–329. doi:10.11118/actaun201058050321

Silvana, P., *et al.*, 2019. Design analysis of showcase with console shelves. *In*: *Conference research for furniture industry*, Ankara, Turkey.

Šimek, M., *et al.*, 2010. The effectt of end distance and number of ready-to-assembly fasteners on bending moment. *Wood and Fiber Science*, 42 (1), 92–98.

Smardzewski, J. and Prekrad, S., 2002. Stress distribution in disconnected furniture joints. *Electronic Journal of Polish Agricultural Universities: EJPAU*, 5, 1–7.

Sydor, M., 2019. Load-bearing capacity and characteristic forms of destruction of furniture joints made with rastex 15 and P-10 clamex fasteners. *Annals of WULS, Forestry and Wood Technology*, 106, 38–48.

Tankut, A.N., 2005. Optimum dowel spacing for corner joints in 32-mm cabinet construction. *Forest Products Journal*, 55 (12), 100–104.

Wengang, H., *et al.*, 2024. The influences of selected factors on bending moment capacity of case furniture joints. *Applied Sciences*, 14 (21), 10044. doi:10.3390/app142110044.