Jaroslav Hrázský, Pavel Král[1]

Determination of relationships between density, amount of glue and mechanical properties of OSB

Analiza međusobnih odnosa gustoće, količine ljepila i mehaničkih svojstava OSB ploča

Original scientific paper · Izvorni znanstveni rad
Received – prispjelo: 16. 9. 2008.
Accepted – prihvaćeno: 25. 2. 2009.
*UDK: 630*863.21*

ABSTRACT • *This paper deals with problems of the effect of changes in density and amount of glue on mechanical properties of OSB (oriented strand boards). Tests of mechanical properties were carried out on OSB/3, 18 and 15 mm thick, produced on an OSB production line of the prominent manufacturer of board composite materials in the Czech Republic. In the first stage of the experiment, density was decreased in manufactured OSB with a nearly the same amount of glue. In the second stage, density was constant and the amount of glue changed. Bending strength, modulus of elasticity and tensile strength perpendicular to the board surface were determined in OSB samples of particular variants. Results of laboratory tests were compared with values given by the ČSN EN 300 standard for category OSB/3.*

Key words: *oriented strand board (OSB), density, bending strength, modulus of elasticity, tensile strength perpendicular to the board surface, amount of glue, PMDI glues*

SAŽETAK • *U radu se analizira utjecaj gustoće ploča i količine ljepila na mehanička svojstva ploča s usmjerenim iverjem – OSB ploča (*Oriented Strand Boards*). Mehanička svojstva mjerena su na pločama OSB/3, debljine 18 i 15 mm, koje je proizveo priznati proizvođač kompozitnih drvnih materijala u Republici Češkoj. U prvoj fazi eksperimenta proizvedene su ploče različite gustoće, uz približno jednaku količinu ljepila. U drugoj fazi proizvedene su ploče konstantne gustoće i s različitom količinom ljepila. Izmjerena je savojna čvrstoća, modul elastičnosti i vlačna čvrstoća okomito na površinu ploče svih ploča. Dobiveni rezultati uspoređeni su s vrijednostima koje su dane normom ČSN EN 300 za kategoriju ploča OSB/3.*

Ključne riječi: *ploče s usmjerenim iverjem (OSB), gustoća, savojna čvrstoća, modul elastičnosti, vlačna čvrstoća okomito na površinu ploče, količina ljepila, PMDI ljepila*

1 INTRODUCTION
1. UVOD

Density of particleboards is generally dependent upon the density of processed wood species. Further, it depends on the shape of chips, degree of their compression, and on the amount and type of additional substances. Particleboard density is also related to strength properties. The increasing density of particleboards, however, markedly affects the economy of production, han-

[1] The authors are assistant professors at the Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry, Brno, Czech Republic.
[1] Autori su docenti Fakulteta šumarstva i drvne tehnologije Mendelova sveučilišta agronomije i šumarstva u Brnu, Republika Češka.

dling costs, etc. From the point of view of practical use of particleboards as low as possible density is, therefore, optimal provided of course that the required values of particular physical and mechanical properties are preserved (Deppe and Ernst, 1991).

Tensile strength perpendicular to the board surface is an important property in terms of use of particleboards for construction purposes. Generally, the value of this property can be affected by the amount of glue. Higher spread of glue results in the increase of this property. With the increasing density of a particleboard, tensile strength perpendicular to the board surface also increases (Štefka, 1999).

Bending strength ranks among the most important and most characteristic properties of particleboards determining in principle their use. Bending strength fundamentally affects dimensions of chips expressed by "slenderness ratio". The density of processed timber species also affects the slenderness ratio. To achieve the highest strength properties of particleboards, the whole area of overlaying surfaces of particular boards and glued area between particular chips have to be appropriately large whereby the strength of particular chips given by their cross-section is transferred to the final particleboard (Hrázský and Král, 2007).

The bending strength of particleboards also depends on the density of boards and wood species, which were used in their production. In general, the strength of particular species is proportional to their density. Hence, the "degree of technical transformation of wood" on the area of isotropic particleboards is of great importance. With the increasing density of particleboards the bending strength of these boards increases (Štefka, 2007).

The objective of this paper was to determine relationships between the density of boards, amount of glue and mechanical properties of industrially manufactured OSB. Results of laboratory tests were compared with values given by the ČSN EN 300 standard for the OSB/3 board category.

2 MATERIAL AND METHODS
2. MATERIJAL I METODE

Tests of mechanical properties were carried out on OSB/3, 18 and 15 mm thick produced on an OSB production line of a prominent Czech manufacturer of board composite materials in the Czech Republic. The spread of glue and OSB density affect particularly the bending strength (MOR) and modulus of elasticity (MOE) on the main and secondary axis as well as tensile strength perpendicular to the board surface.

OSB/3 boards were manufactured using a PMDI isocyanate adhesive. This adhesive was used both in the surface and central layer of tested boards. Requirements for boards of the OSB/3 technical class are determined by the ČSN EN 300 standard. An experimental procedure for the determination of density is given by the ČSN EN 323 standard, for the determination of bending strength and modulus of elasticity in both axes by the ČSN EN 310 standard and for the determination of tensile strength perpendicular to the board surface by the ČSN EN 319 standard. OSB/3 boards in the thickness range >10 to <18 mm have to fulfil requirements given in Tab. 1 of the ČSN EN 300 standard.

Three pieces of OSB boards were sampled from each production variant 1.1 - 1.3 or 2.1 - 2.3. Necessary test specimens were cut out from the boards. A cutting plan given in Fig. 1 was used to obtain test specimens.

In the first stage of the experiment, density was lowered in manufactured OSB boards (Variants 1.1 - 1.3) and the amount of glue was slightly increased. In the second stage, density was constant and the amount of glue changed (Variants 2.1 - 2.3). Changes in parameters of produced OSB boards are given in Tabs. 2 - 5.

In particular samples, tensile strength tests were carried out perpendicular to the board surface and bending strength tests in both axes including modulus of elasticity. The tests of mechanical properties were selected because changes in density and amount of glue fundamentally affect these properties of OSB.

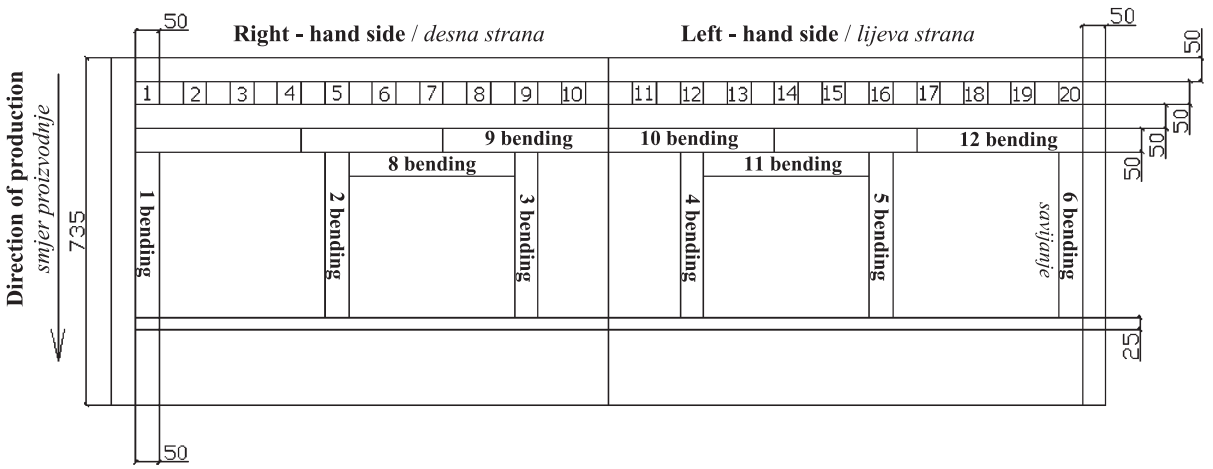

Figure 1 Cutting plan for sampling test specimens (1-20: tensile strength perpendicular to the board surface; 1-12 bending: MOR and MOE)

Slika 1. Plan rezanja za izradu uzoraka (1-20 uzorci za mjerenje vlačne čvrstoće okomito na površinu ploče; 1-12 uzorci za savijanje i mjerenje veličina MOR i MOE)

Table 1 Requirements for OSB/3 of selected thickness classes according to the ČSN EN 300 standard
Tablica 1. Zahtjevi za OSB/3 ploče određenih debljinskih razreda prema normi ČSN EN 300

Board type – OSB/3 *Tip ploče – OSB/3*	**Test procedure** *Procedura testiranja*	**Unit** *Jedinica*	**Requirements** / *Zahtjevi*		
			Thickness range / *Debljinski razred* (mm, nominal value)		
Property / *Svojstvo*			6 to 10	>10 to <18	18 - 25
Bending strength – main axis *Savojna čvrstoća – glavna os*	EN 310	N/mm^2	22	20	18
Bending strength – secondary axis *Savojna čvrstoća – druga os*	EN 310	N/mm^2	11	10	9
Modulus of elasticity in bending - main axis *Modul elastičnosti pri savijanju – glavna os*	EN 310	N/mm^2	3 500	3 500	3 500
Modulus of elasticity in bending - secondary axis *Modul elastičnosti pri savijanju – druga os*	EN 310	N/mm^2	1 400	1 400	1 400
Tensile strength perpendicular to the board surface *Vlačna čvrstoća okomito na površinu ploče*	EN 319	N/mm^2	0.34	0.32	0.30
Swelling after 24-hour storage in water *Bubrenje 24 sata nakon potapanja u vodi*	EN 317	%	15	15	15
Note: If a purchaser mentions that boards are to be used for special purposes such as floors, inner walls and roof structures, the EN 12871standard has to be taken into account. In other words, the fulfilment of other requirements can be requested. *Napomena: Ako kupac napomene da će ploče imati posebne namjene – za podove, unutarnje zidove i krovne konstrukcije, treba uzeti u obzir i normu EN 12871. Prema tome, može se tražiti ispunjavanje i drugih zahtjeva.*					
Option 1- alternative B / *Opcija 1 – alternativa B* Bending strength after the cycling test - main axis *Savojna čvrstoća nakon ciklusa testiranja – glavna os*	EN 321 + EN 310	N/mm^2	9	8	7
Option 1 - alternative A / *Opcija 1 – alternativa A* Tensile strength perpendicular after the cycling test *Vlačna čvrstoća nakon ciklusa testiranja*	EN 321 + EN 319	N/mm^2	0.18	0.15	0.13
Option 2 Tensile strength perpendicular after the boiling test *Vlačna čvrstoća nakon testa kuhanja*	EN-1087-1	N/mm^2	0.15	0.13	0.12

3 RESULTS AND DISCUSSION
3. REZULTATI I DISKUSIJA

Laboratory tests were carried out on OSB/3 boards, 15 and 18 mm thick. In the first stage of the experiment, in industrially manufactured OSB (Variants 1.1 - 1.3), density was decreased and glue spread was increased (Tab. 2). In the second stage, density was constant and amount of glue decreased - Variants 2.1 - 2.3 (Tab. 6).

3.1. Comparison of Variants 1.1 - 1.3
3.1. Usporedba vrijednosti za uzorke 1.1. do 1.3.

In Variants 1.1 - 1.3 of both thickness classes, OSB density was decreased for the purpose of determining the effect of density on mechanical properties of these boards. Tables 3 and 5 present the determined values of mechanical properties (bending strength, modulus of elasticity in both axes and tensile strength perpendicular to the board surface) for OSB, 15 and 18 mm thick. It is evident that owing to decreasing density, bending strength (MOR) and modulus of elasticity (MOE) decrease in both directions. The ČSN EN 300 standard sets minimum bending strength in the main axis of 20 N/mm^2 for OSB boards, 15 mm thick.

Boards 18 mm thick should exhibit minimum bending strength of 18 N/mm^2 in the main axis. These conditions fulfil all three variants of both thickness classes, but it is evident that due to decreased density, these values also decrease. A minimum requirement for bending strength in the secondary axis is 10 N/mm^2 in boards 15 mm thick and 9 N/mm^2 in boards 18 mm thick. Tables 3 and 5 show that this require-

Table 2 Variants of density in OSB, 15 mm thick
Tablica 2. Varijante gustoće OSB ploča debljine 15 mm

OSB 3 ECO – 15 mm	**Density** / *Gustoća* kg/m^3	**PMDI - surface layer** *PMDI – površinski sloj* kg/100 kg	**PMDI - central layer** *PMDI – središnji sloj* kg/100 kg
Variant 1.1 – *uzorak 1.1.*	575	3.30	3.60
Variant 1.2 – *uzorak 1.2.*	565	3.36	3.66
Variant 1.3 – *uzorak 1.3.*	555	3.42	3.73

Table 3 Values of density, bending strength, modulus of elasticity and tensile strength perpendicular for variants 1.1 - 1.3, OSB 15 mm thick
Tablica 3. Vrijednosti gustoće, savojne čvrstoće, modula elastičnosti i vlačne čvrstoće okomito na površinu ploče za uzorke 1.1 do 1.3, OSB ploče debljine 15 mm

OSB ECO 3 15 mm	**Density** *Gustoća* kg/m^3	**Bending strength** ∥ *Savojna čvrstoća* ∥ N/mm^2	**Modulus of elasticity** ∥ *Modul elastičnosti* ∥ N/mm^2	**Bending strength** ⊥ *Savojna čvrstoća* ⊥ N/mm^2	**Modulus of elasticity** ⊥ *Modul elastičnosti* ⊥ N/mm^2	**Tensile strength perpendicular** *Vlačna čvrstoća okomito* N/mm^2
Variant 1.1 - $\overline{X}$	576	25.44	5102	16.467	2399	0.32
$S_{\overline{X}^2}$	2.40	6.048	10978.27	2.643	7094.92	0.00001
$S_{\overline{W}^2}$	647.54	8.845	674859.64	6.628	28400.72	0.00288
Variant 1.2 - $\overline{X}$	564	23.76	4854	14.917	2230	0.33
$S_{\overline{X}^2}$	4.38	2.630	20072.60	0.092	72694.13	0.00001
$S_{\overline{W}^2}$	382.12	34.832	1177798.32	4.834	246950.97	0.00424
Variant 1.3 - $\overline{X}$	553	21.33	4278	13.298	2095	0.35
$S_{\overline{X}^2}$	9.38	0.998	103304.10	0.923	23905.02	0.00003
$S_{\overline{W}^2}$	647.54	14.207	304553.47	3.015	46970.22	0.00310

Table 4 Variants of density in OSB, 18 mm thick
Tablica 4. Varijante gustoće OSB ploča debljine 18 mm

OSB 3 ECO – 18 mm	**Density** *Gustoća* kg/m^3	**PMDI - surface layer** *PMDI – površinski sloj* kg/100 kg	**PMDI - central layer** *PMDI – središnji sloj* kg/100 kg
Variant 1.1 – *uzorak 1.1.*	570	3.30	3.60
Variant 1.2 – *uzorak 1.2.*	560	3.36	3.66
Variant 1.3 – *uzorak 1.3.*	550	3.42	3.73

Table 5 Values of density, bending strength, modulus of elasticity and tensile strength perpendicular for variants 1.1 - 1.3, OSB 18 mm thick
Tablica 5. Vrijednosti gustoće, savojne čvrstoće, modula elastičnosti i vlačne čvrstoće okomito na površinu ploče za uzorke 1.1 do 1.3, OSB ploče debljine 18 mm

OSB ECO 3 18 mm	**Density** *Gustoća* kg/m^3	**Bending strength** ∥ *Savojna čvrstoća* ∥ N/mm^2	**Modulus of elasticity** ∥ *Modul elastičnosti* ∥ N/mm^2	**Bending strength** ⊥ *Savojna čvrstoća* ⊥ N/mm^2	**Modulus of elasticity** ⊥ *Modul elastičnosti* ⊥ N/mm^2	**Tensile strength perpendicular** *Vlačna čvrstoća okomito* N/mm^2
Variant 1.1 - $\overline{X}$	571	24.78	5011	14.69	2297	0.32
$S_{\overline{X}^2}$	7.37	0.209	3245.60	0.08	43791.74	0.00002
$S_{\overline{W}^2}$	358.13	14.673	213169.60	2.48	34679.81	0.00076
Variant 1.2 - $\overline{X}$	563	23.84	4826	13.99	2187	0.35
$S_{\overline{X}^2}$	3.21	2.028	36063.79	0.20	9637.80	0.00001
$S_{\overline{W}^2}$	545.41	17.679	484623.47	3.02	45290.00	0.00099
Variant 1.3 - $\overline{X}$	552	24.26	4781	14.27	2240	0.37
$S_{\overline{X}^2}$	4.75	0.964	1562.13	1.27	8190.13	0.00005
$S_{\overline{W}^2}$	390.08	27.262	423536.37	2.26	51648.42	0.00279

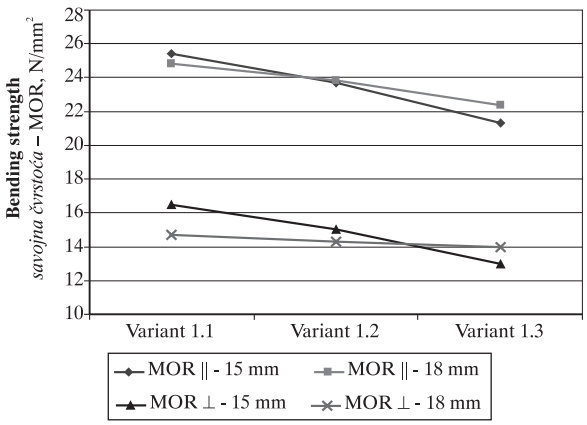

Figure 2 Values of bending strength (MOR) in OSB, Variants 1.1-1.3 in both axes
Slika 2. Savojna čvrstoća (MOR) OSB ploča debljine 15 i 18 mm, uzorci 1.1. do 1.3. u oba smjera

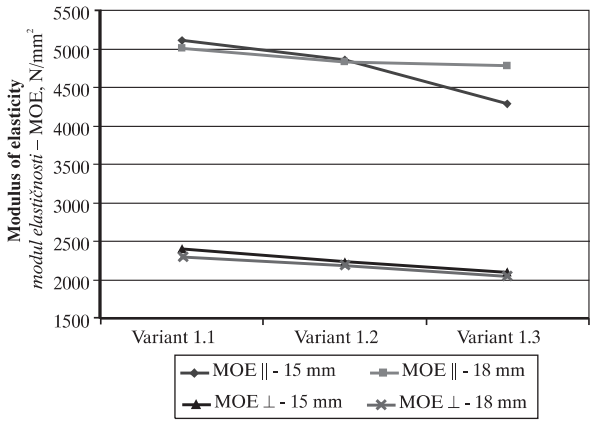

Figure 3 Values of modulus of elasticity (MOE) in OSB, Variants 1.1-1.3 in both axes
Slika 3. Modul elastičnosti (MOE) OSB ploča debljine 15 i 18 mm, uzorci 1.1. do 1.3. u oba smjera

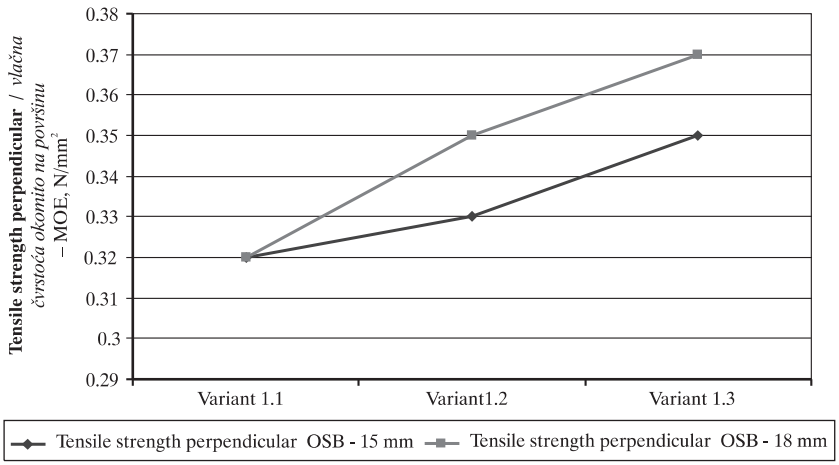

Figure 4 Values of tensile strength perpendicular to the board surface in OSB, Variants 1.1-1.3
Slika 4. Vlačna čvrstoća okomito na površinu OSB ploča debljine 15 i 18 mm, uzorci 1.1. do 1.3.

ment is fulfilled again by all variants but the decrease in bending strength occurs in connection with decreasing density of OSB. Tables 3, 5, 7 and 9 show the values of the variance between average values of OSB boards $S_{\bar{X}^2}$ and of the mean variability $S_{\bar{W}^2}$ in OSB boards presented.

Modulus of elasticity in the main axis in both thickness classes of OSB should be at least 3500 N/mm^2. The minimum value of modulus of elasticity in the main axis, which is determined by the ČSN EN 300 standard, is fulfilled in all variants of OSB of both thickness classes. Nevertheless, it is evident that with decreasing density, values of MOE also decrease. MOE in bending shows the same trend in the secondary axis.

In tensile strength perpendicular to the board surface, the trend is opposite. According to the ČSN EN 300 standard, the minimum value of tensile strength perpendicular to the board surface is 0.32 N/mm^2 for OSB 15 mm thick and 0.30 N/mm^2 for OSB 18 mm thick.

Based on Tables 3 and 5, it is evident that values of tensile strength perpendicular to the board surface increase with decreasing density, viz. up to 0.37 N/mm^2 in samples obtained from OSB of thickness of 18 mm. In samples obtained from OSB 15 mm thick, the maximum value of tensile strength of 0.35 N/mm^2 perpendicular to the board surface was determined in OSB 15 mm thick. This value was measured again in a sample of the lowest density.

Table 6 Variants of amount of glue in OSB, 15 mm thick
Tablica 6. Varijante količine ljepila u OSB pločama debljine 15 mm

OSB 3 ECO - 15 mm	**Density** *Gustoća* kg/m^3	**PMDI - surface layer** *PMDI – površinski sloj* kg/100 kg	**PMDI - central layer** *PMDI – središnji sloj* kg/100 kg
Variant 2.1 – *uzorak 2.1.*	575	3.3	3.6
Variant 2.2 – *uzorak 2.2.*	575	3.0	3.3
Variant 2.3 – *uzorak 2.3.*	575	2.7	3.0

Table 7 Values of density, bending strength, modulus of elasticity and tensile strength perpendicular for variants 2.1 - 2.3, OSB 15 mm thick
Tablica 7. Vrijednosti gustoće, savojne čvrstoće, modula elastičnosti i vlačne čvrstoće okomito na površinu ploče za uzorke 2.1 do 2.3, OSB ploče debljine 15 mm

OSB ECO 3 15 mm	**Density** *Gustoća* kg/m^3	**Bending strength** ∥ *Savojna čvrstoća* ∥ N/mm^2	**Modulus of elasticity** ∥ *Modul elastičnosti* ∥ N/mm^2	**Bending strength** ⊥ *Savojna čvrstoća* ⊥ N/mm^2	**Modulus of elasticity** ⊥ *Modul elastičnosti* ⊥ N/mm^2	**Tensile strength perpendicular** *Vlačna čvrstoća okomito* N/mm^2
Variant 2.1 - $\overline{X}$	576	25.44	5102	16.46	2409	0.33
$S_{\overline{X}^2}$	2.39	6.041	10978.35	2.651	8277.62	0.00004
$S_{\overline{W}^2}$	416.84	8.845	674859.64	6.628	30816.26	0.00320
Variant 2.2 - $\overline{X}$	575	24.73	5090	15.35	2313	0.31
$S_{\overline{X}^2}$	9.04	5.991	93321.26	0.611	7070.56	0.00008
$S_{\overline{W}^2}$	551.05	31.815	384660.78	5.586	51260.70	0.00163
Variant 2.3 - $\overline{X}$	577	22.413	4788	14.22	2252	0.28
$S_{\overline{X}^2}$	1.81	0.667	182272.57	1.702	46072.46	0.00005
$S_{\overline{W}^2}$	658.55	25.055	591214.10	3.869	56940.85	0.00105

Table 8 Variants of amount of glue in OSB, 18 mm thick
Tablica 8. Varijante količine ljepila u OSB pločama debljine 18 mm

OSB 3 ECO - 18 mm	**Density** *Gustoća* kg/m^3	**PMDI - surface layer** *PMDI – površinski sloj* kg/100 kg	**PMDI - central layer** *PMDI – središnji sloj* kg/100 kg
Variant 2.1 – *uzorak 2.1.*	570	3.3	3.6
Variant 2.2 – *uzorak 2.2.*	570	3.0	3.3
Variant 2.3 – *uzorak 2.3.*	570	2.7	3.0

Table 9 Values of density, bending strength, modulus of elasticity and tensile strength perpendicular for variants 2.1 - 2.3, OSB 18 mm thick
Tablica 9. Vrijednosti gustoće, savojne čvrstoće, modula elastičnosti i vlačne čvrstoće okomito na površinu ploče za uzorke 2.1 do 2.3, OSB ploče debljine 18 mm

OSB ECO 3 18 mm	**Density** *Gustoća* kg/m^3	**Bending strength** ∥ *Savojna čvrstoća* ∥ N/mm^2	**Modulus of elasticity** ∥ *Modul elastičnosti* ∥ N/mm^2	**Bending strength** ⊥ *Savojna čvrstoća* ⊥ N/mm^2	**Modulus of elasticity** ⊥ *Modul elastičnosti* ⊥ N/mm^2	**Tensile strength perpendicular** *Vlačna čvrstoća okomito* N/mm^2
Variant 2.1 - $\overline{X}$	571	24.78	5011	14.69	2298	0.32
$S_{\overline{X}^2}$	7.366	0.209	3245.60	0.078	43791.74	0.00002
$S_{\overline{W}^2}$	358.128	14.673	213169.60	2.484	34679.81	0.00076
Variant 2.2 - $\overline{X}$	571	20.87	4768	12.81	2102	0.28
$S_{\overline{X}^2}$	9.064	5.065	6537.36	0.560	1117.46	0.00004
$S_{\overline{W}^2}$	520.366	7.432	384171.67	2.025	26585.77	0.00202
Variant 2.3 - $\overline{X}$	569	20.15	4564	13.44	2150	0.26
$S_{\overline{X}^2}$	13.981	1.772	8315.27	1.264	710.97	0.00024
$S_{\overline{W}^2}$	875.671	19.717	707075.71	2.592	28025.12	0.00168

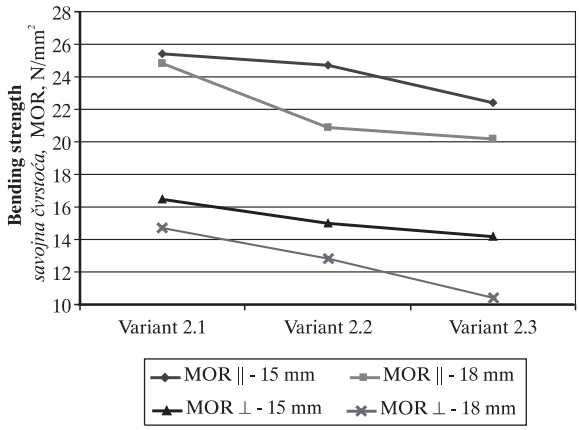

Figure 5 Values of bending strength (MOR) in OSB Variants 2.1-2.3 in both axes
Slika 5. Savojna čvrstoća (MOR) OSB ploča debljine 15 i 18 mm, uzorci 2.1. do 2.3. u oba smjera

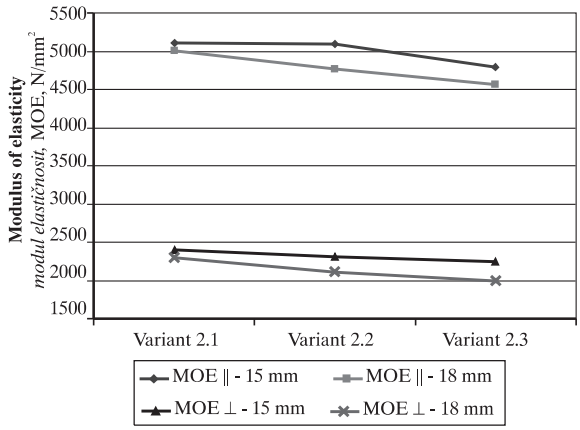

Figure 6 Values of modulus of elasticity (MOE) in OSB Variants 2.1-2.3 in both axes
Slika 6. Modul elastičnosti (MOE) OSB ploča debljine 15 i 18 mm, uzorci 2.1. do 2.3. u oba smjera

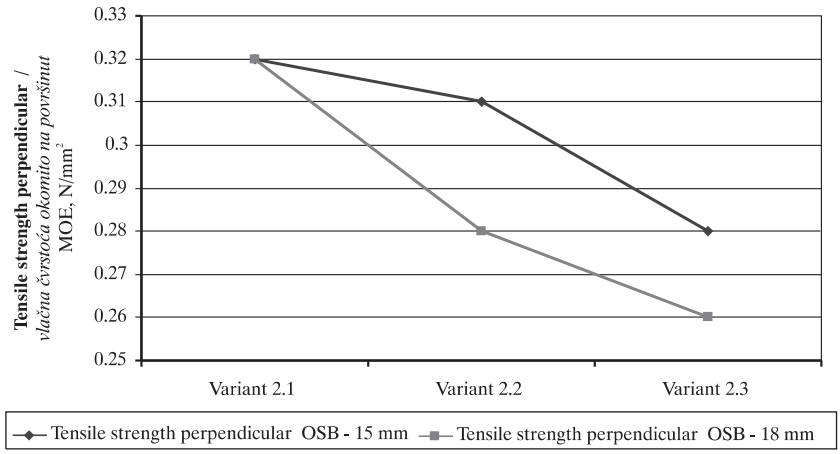

Figure 7 Values of tensile strength perpendicular to the board surface in OSB Variants 2.1-2.3
Slika 7. Vlačna čvrstoća okomito na površinu OSB ploča debljine 15 i 18 mm, uzorci 2.1. do 2.3.

Values of mechanical properties of OSB, Variants 1.1 - 1.3 are shown in Figs. 2 - 4.

3.2 Comparison of Variants 2.1 - 2.3
3.2. Usporedba vrijednosti za uzorke 2.1 do 2.3

In Variants 2.1 - 2.3 of both thickness classes, the amount of glue was decreased both in the central and surface layer in order to determine the effects of amount of glue on mechanical properties of OSB. Density of OSB panels was constant. Tables 7 and 9 show the determined values of mechanical properties (bending strength, MOE in both axes and tensile strength perpendicular to the board surface) for OSB, 15 and 18 mm thick.

It is evident that reduced amount of glue causes the decrease of values of bending strength and MOE in both directions. According to the ČSN EN 300 standard, 15 mm OSB are to reach the minimum bending strength of 20 N/mm^2 in the main axis and 18 mm boards 18 N/mm^2. All three variants of OSB of both thickness classes fulfil the condition. Nevertheless, it is evident that due to decreasing of amount of glue in OSB, the values of bending strength decrease.

A minimum requirement for bending strength in the secondary axis is 10 N/mm^2 in 15 mm OSB and 9 N/mm^2 in 18 mm boards. Tables 7 and 9 show that all variants fulfil again the requirement, but here there is also a visible decrease in values of bending strength. MOE in bending in the main axis at both thickness classes of OSB should reach at least 3500 N/mm^2. The minimum value of MOE in the main axis, which is set by the ČSN EN 300 standard, is fulfilled by all OSB variants of both thickness classes. Nevertheless, Tables 7 and 9 clearly show that with the decrease of the amount of glue, the values of MOE also decrease.

The minimum value of tensile strength perpendicular to the board surface, which is set by the ČSN EN 300 standard, is 0.32 N/mm^2 for 15 mm OSB and 0.30 N/mm^2 for 18 mm boards. Based on Tables 7 and 9, it is evident that the value of tensile strength perpendicular to the board surface decreases with the decrease of the amount of glue, viz. up to a value of 0.26 N/mm^2 in samples obtained from 18 mm OSB. The minimum value of tensile strength perpendicular to the board surface of 0.28 N/mm^2 was determined in samples obtained from 15 mm OSB. Thus, according to this test results, Variant 2.3 - OSB 15 mm thick and Variants 2.2 and 2.3 – OSB 18 mm thick do not fulfil the requirements set by

the ČSN EN 300 standard. Determined values of mechanical properties of OSB Variants 2.1 - 2.3 are presented in Figs. 5 - 7.

4 CONCLUSION
4. ZAKLJUČAK

The aim of this paper is to determine to what degree changes in density and amount of glue affect mechanical properties of OSB. In samples of OSB boards of particular variants, the following parameters were determined: bending strength, modulus of elasticity (MOE) and tensile strength perpendicular to the board surface.

The results of tests of mechanical properties showed that the decrease of density and the increase in amount of glue in Variants 1.1 and 1.3, cause lower bending strength due to the decrease of material (strands) in the OSB area, viz. in both axes as well as decrease of the values of both modulus of elasticity (Tabs. 3 and 5).

On the other hand there is an improvement of tensile strength perpendicular to the board surface. From the economic aspects, Variant 1.3 appears to be the most optimum variant, viz. both for 15 and 18 mm thickness. However, with further decrease of density, it is not possible to expect that OSB boards would conform to the requirements of a consumer because OSB with lower densities began to show impaired properties particularly at edges.

In Variants 2.1 and 2.3 of both thickness classes, the decrease of amount of glue in the surface and central layer at the constant density caused a measurable fall of values of all mechanical properties, however, particularly of tensile strength perpendicular to the board surface (Tabs. 7 and 9).

On the basis of the results of mechanical tests it is possible to conclude as follows:

- At the constant density and decreased amount of glue in the surface and central layer, decrease of all tested mechanical properties occurs (Tabs. 7 and 9).
- At decreased density and slightly increased amount of glue the impairment of bending strength and decrease of MOE in both axes occurs, while the tensile strength perpendicular to the board surface increases (Tabs. 3 and 5).

5 REFERENCES
5. LITERATURA

1. Deppe, H., J., Ernst, K. 1991: Taschenbuch der Spanplattentechnik. 3. überarbeitetete und erweiterte Auflage. DRW Verlag Leinfelden. 468 p. ISBN 3-87181-320-6
2. Hrázský, J.; Král., P. 2007: Wood-based composites. Part I.: Chips- and fibrematerials. MZLU Brno. 253 p. ISBN 978-80-7375-034-3
3. Štefka, V. 1999: Particleboard pressing process and transfer phenoma. TU Zvolen 61 p ISBN 80-228-0813-X
4. Štefka, V. 2007: Wood-based composites.. Part II.: Agglomerated materials technology. TU Zvolen. 204 p. ISBN 978-80-228-1705-9
5. *** CSN EN 310. Wood-based panels. Bending strength and modulus of elasticity determination. Czech standards institution, 1995: 8.
6. *** CSN EN 323. Wood-based panels. Density determination. Czech standards institution, 1994: 8.
7. *** CSN EN 319. Chips- and fibre boards. Tensile strength perpendicular to the board surface determination. Czech standards institution, 1994:12.
8. ***CSN EN 300. OSB - panels of oriented flat chips. Definition, classification and requirements. Czech standards institution, 1998: 20.

ACKNOWLEDGEMENT
ZAHVALA

The study was supported by the Ministry of Education, Youth and Sports of the Czech Republic, Project No. MSM 6515648902.

Corresponding address:

Assistant Professor JAROSLAV HRÁZSKÝ, PhD

Faculty of Forestry and Wood Technology
Mendel University of Agriculture and Forestry Brno
Lesnická 37
613 00 Brno, Czech Republic
e-mail: hrazsky@mendelu.cz