

Material testing of Metsa plywood and Sterling OSB

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Abstract

In this paper, the mechanical properties of Metsa plywood (**Metsa plywood**) and Sterling OSB (**Sterling OSB**) are investigated by experimental testing according to [2]. The aim is to provide the average mechanical properties of the material in terms of compression, tension and shear.

1 Motivation

Manufacturers of structural wood products such as plywood and OSB are required to provide a Declaration of Performance (DoP) to comply with regulatory bodies (for example, the European Union). Such a document specifies the characteristic values of the mechanical properties of the material, to be used for design purposes. The DoP of Metsa plywood and Sterling OSB are reported in an appendix to this document.

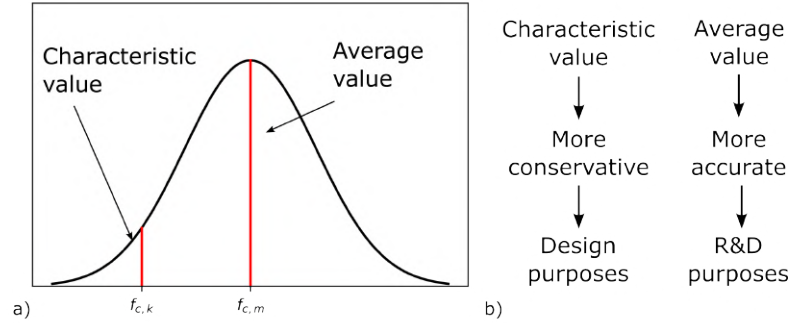


Figure 1: a) Characteristic and mean values on the normal curve and 2) when they are typically used.

It has to be noted that what the DoP specifies are *characteristic values* and not average values (except with a few exceptions). While the average is the mean of the distribution, the characteristic value represents the 5th percentile, i.e. the value with

95% probability of being overcome (Figure 1a). Such a value by definition is lower than the average, increasingly smaller depending on the standard deviation of the normal curve. In other words, the more variable is the capacity of the material, the furthest the characteristic value will be from the mean.

Characteristic values are used for design purposes according to building codes (e.g. Eurocodes [1]). This is because the aim of buildings codes is to minimize the probability of failure (also known as *semi-probabilistic approach*) by underestimating on purpose the material capacity.

When developing a new system, for example Skylark, it is important to know the average capacity of the material properties (Figure 1b). For example, when comparing the accuracy of an analytical model to predict a certain failure load observed during the experimental, the average values of the material properties should be considered instead of the characteristic ones. This is because the focus is on being accurate, and not conservative.

In a second phase, when a suitable model or equation is verified, then it can be used for design purposes in combination with the material characteristic values (as well as safety factors) according to the relevant building code (e.g. Eurocodes [1]).

2 Experimental testing

2.1 Plies orientation

Metsa plywood is made of spruce, and uses 4 x 3 mm plies with the grain parallel to the panel longer direction, and 2 x 3 mm plies with the grain parallel to the panel shorter direction (Figure 2). At the time of testing, specimens had moisture content between 9.5% and 10.5%, which was measured by means of a moisture meter.

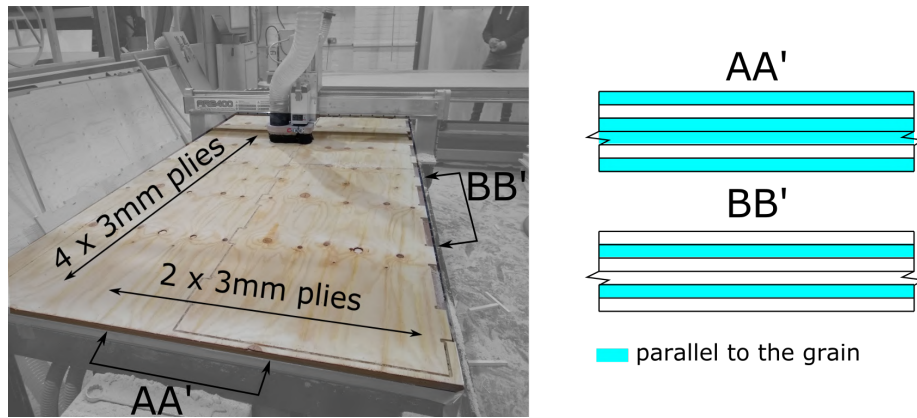


Figure 2: Orientation of the plies in the panel.

2.2 Compression

To evaluate the compression properties of Metsa plywood and Sterling OSB, 15 specimens were tested on a universal testing machine (Figure 3) according to the [2]. Specimens are made of three 18 x 67 x 300 mm blocks tested together, and specifically:

1. 5 plywood specimens were tested in the direction where 4 lamellae had the grain parallel to the load direction, and 2 lamellae had the grain perpendicular to the load direction (labelled *PLY* \updownarrow).
2. 5 plywood specimens were tested in the direction where 2 lamellae had the grain parallel to the load direction, and 4 lamellae had the grain perpendicular to the load direction (labelled *PLY* \leftrightarrow),.
3. 5 OSB specimens were tested (labelled *OSB*).

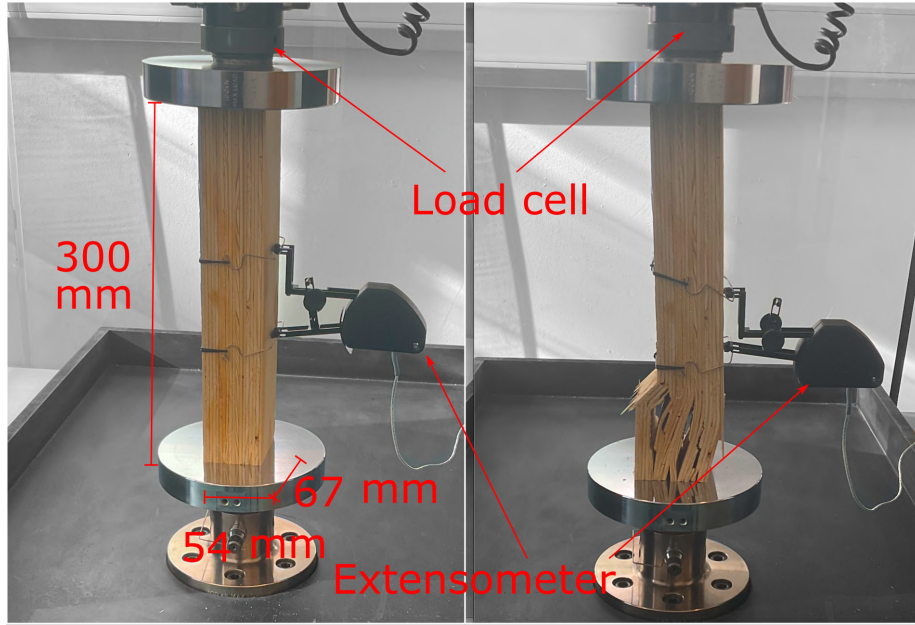


Figure 3: Standard compression test.

Load and displacement were monitored by using a load cell of the universal testing machine and an extensometer installed on the specimen, respectively. Compression stress σ_c and compression strain ε_c were calculated by using equation 1:

$$\sigma_c = \frac{F}{A_c} \quad \varepsilon_c = \frac{d}{l_{e,i}} \quad (1)$$

where F is the vertical force exerted by the actuator, $A_c = 3618 \text{ mm}^2$ is the cross section area of the specimen, d is the vertical displacement measured by the extensometer, and $l_{e,i}$ is the initial length of the extensometer.

Stress-strain curves are shown in Figure 4, while the most relevant quantities, including average compression strength $\sigma_{c,m}$ and average elastic compression modulus E_m are reported in Table 1. E_m was calculated according to equation 2:

$$E_m = \frac{\sigma_{40\%} - \sigma_{10\%}}{\varepsilon_{40\%} - \varepsilon_{10\%}} \quad (2)$$

where $\sigma_{40\%}, \sigma_{10\%}$ represent 40% and 10% of the compression maximum stress, respectively (Fig. 4). $\varepsilon_{40\%}, \varepsilon_{10\%}$ are the values of strain where such compression stress occurs.

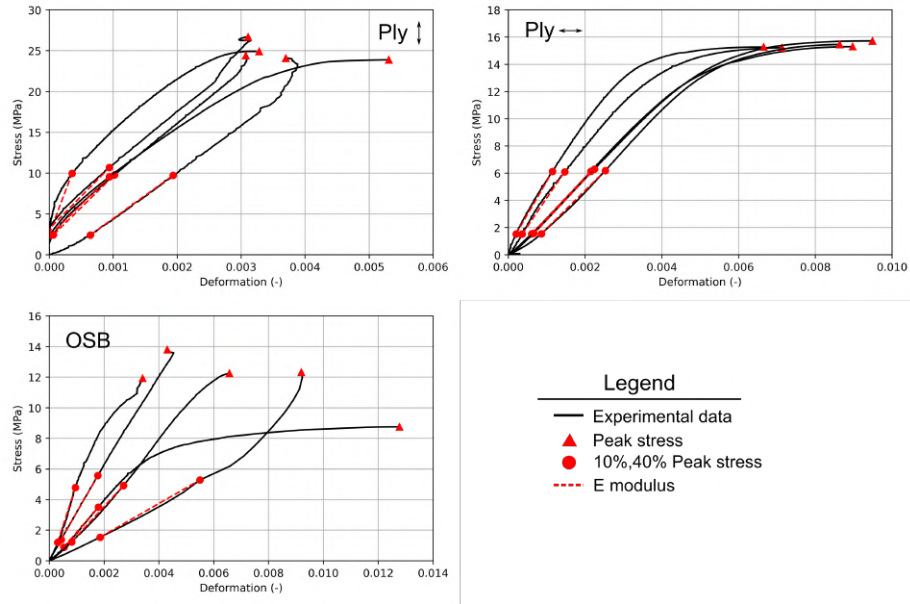


Figure 4: Compression test results.

From Fig. 4 and Table 1, it can be seen that:

1. *PLY* ↓ shows an average compression strength equal to 24.6 MPa, and an elastic compression modulus equal to 9969 MPa.
2. *PLY* ↔ shows an average compression strength equal to 15.4 MPa, and an elastic compression modulus equal to 3549 MPa.
3. OSB shows an average compression strength equal to 11.8 MPa, and an elastic compression modulus equal to 2755 MPa.

Table 1: Compression test results: σ_{max} peaks compression stress; $\varepsilon_{10\%}$, $\varepsilon_{40\%}$ deformation at 10% and 40% of the peak stress, respectively; E_c elastic compression modulus.

Material	Specimen	$\varepsilon_{10\%}$ (-)	$\varepsilon_{40\%}$ (-)	$\sigma_{c,max}$ (Mpa)	E_c (Mpa)
<i>PLY</i> \updownarrow	1	-1.39e-06	0.000357	24.9	20806
	2	6.58e-05	0.00102	24.4	7692
	3	1.22e-05	0.000939	23.9	7719
	4	-5.58e-05	0.000941	26.7	7984
	5	0.000643	0.00194	24.1	5645
				24.6	9969
<i>PLY</i> \leftrightarrow	1	0.000609	0.00215	15.3	2979
	2	0.000363	0.00147	15.2	4144
	3	0.000665	0.00225	15.7	2983
	4	0.000203	0.00115	15.3	4854
	5	0.000862	0.00253	15.5	2786
				15.4	3549
OSB	1	0.00185	0.00549	12.3	1027
	2	0.000532	0.00179	8.76	2083
	3	0.000817	0.00271	12.2	1951
	4	0.000432	0.00177	13.8	3129
	5	0.000310	0.000952	11.9	5585
				11.8	2755

2.3 Tension

To evaluate the tensile properties of both plywood and OSB, 15 specimens were tested on a universal testing machine (Figure 5) according to [2]. Specimens are 1 m long, 18 mm thick, 250 mm wide at the end section, and 150 mm wide at the middle section as per [2]. A bolted connection was designed to allow the force transfer from the universal testing machine into the specimen (Figure 5). In order to ensure that the failure occurred on the specimen reduced section and not in the bolted connection, two 9 x 300 X 180 mm plywood panels were glued on both ends of the specimens. Specifically, the following specimens were tested:

1. 5 plywood specimens were tested in the direction where 4 lamellae had the grain parallel to load direction, and 2 lamellae had the grain perpendicular to the load direction (labelled *PLY* \Downarrow).
2. 5 plywood specimens were tested in the direction where 2 lamellae had the grain parallel to the load direction, and 4 lamellae had the grain perpendicular to the load direction (labelled *PLY* \leftrightarrow).
3. 5 OSB specimens were tested (labelled *OSB*).

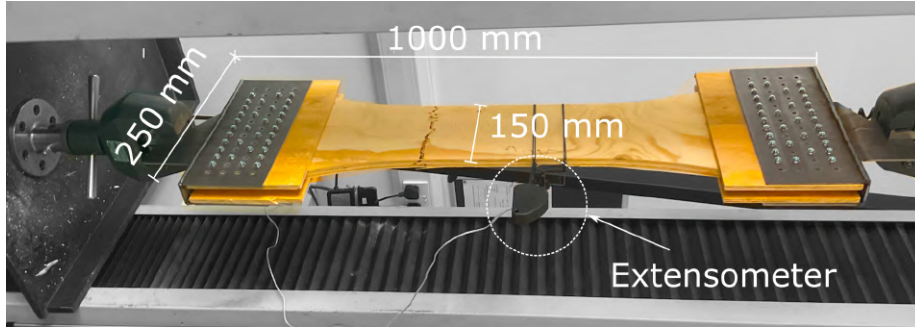


Figure 5: Standard tensile test.

Load and displacement were monitored by using a load cell of the universal testing machine and an extensometer installed on the specimen, respectively. Tensile stress σ_c and tensile strain ε_c were calculated by using equation 3:

$$\sigma_t = \frac{F}{A_t} \quad \varepsilon_c = \frac{d}{l_{e,i}} \quad (3)$$

where F is the vertical force exerted by the actuator, $A_t = 2700\text{mm}^2$ is the mid-span cross section of the specimen, d is the vertical displacement measured by the extensometer, and $l_{e,i}\text{mm}$ is the initial length of the extensometer.

Stress-strain curves are shown in Figure 6, while the most relevant quantities, including average tensile strength $\sigma_{t,m}$ and average tensile modulus E_m , are reported in

Table 2. E_m was calculated according to equation 4:

$$E_m = \frac{\sigma_{40\%} - \sigma_{10\%}}{\varepsilon_{40\%} - \varepsilon_{10\%}} \quad (4)$$

where $\sigma_{40\%}, \sigma_{10\%}$ represent 40% and 10% of the tensile maximum stress, respectively (Fig. 6). $\varepsilon_{40\%}, \varepsilon_{10\%}$ are the values of strain where such tensile stress occurs.

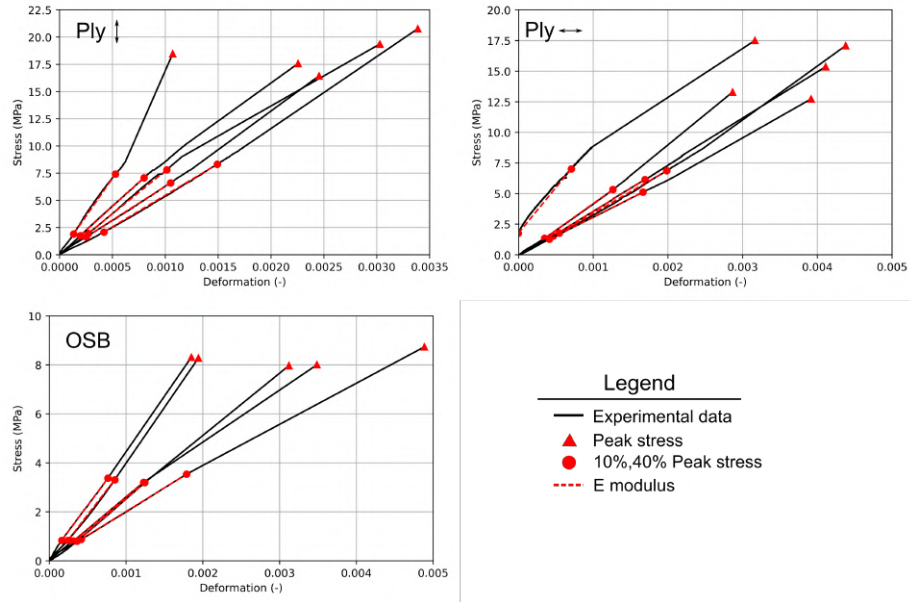


Figure 6: Tensile test results.

From Fig. 6 and Table 2, it can be seen that:

1. $Ply \updownarrow$ shows an average tensile strength equal to 18.5 MPa, and an elastic tension modulus equal to 8532 MPa.
2. $Ply \leftrightarrow$ shows an average tension strength equal to 15.2 MPa, and an elastic tension modulus equal to 4423 MPa.
3. OSB shows an average tension strength equal to 8.3 MPa, and an elastic tension modulus equal to 3111 MPa.

Table 2: Tensile test results: σ_{max} peaks tensile stress; $\varepsilon_{10\%}$, $\varepsilon_{40\%}$ deformation at 10% and 40% of the peak stress, respectively; E_t elastic tension modulus.

Material	Specimen	$\varepsilon_{10\%}$ (-)	$\varepsilon_{40\%}$ (-)	σ_{max} (Mpa)	E_t (Mpa)
PLY \updownarrow	1	0.000419	0.00149	20.8	5804
	2	0.000270	0.00101	19.4	7860
	3	0.000252	0.00105	16.4	6211
	4	0.000133	0.000527	18.5	13936
	5	0.000197	0.000798	17.6	8849
				18.5	8532
PLY \leftrightarrow	1	0.000348	0.00126	13.3	4353
	2	0.000464	0.00169	15.4	3743
	3	0.000545	0.00198	17.1	3544
	4	0.000413	0.00167	12.7	3064
	5	-3.52e-06	0.000706	17.5	7412
				15.2	4423
OSB	1	0.000314	0.00123	8.0	2616
	2	0.000415	0.00179	8.7	1939
	3	0.000361	0.00124498	8.0	2705
	4	0.000163	0.000762	8.3	4231
	5	0.000243	0.000853	8.3	4066
				8.3	3111

2.4 Shear

To evaluate the shear properties of both plywood and OSB, 24 specimens were tested on a shear apparatus (Figure 7). Specimens are made of two 38 x 38 x 18 mm blocks tested together, and specifically:

1. 8 plywood specimens were tested in the direction where 4 lamellae had the grain parallel to the shear plane, and 2 lamellae had the grain perpendicular to the shear plane (labelled *PLY* \updownarrow).
2. 8 plywood specimens were tested in the direction where 2 lamellae had the grain parallel to the shear plane, and 4 lamellae had the grain perpendicular to the shear plane (labelled *PLY* \leftrightarrow).
3. 8 OSB specimens were tested (labelled *OSB*).

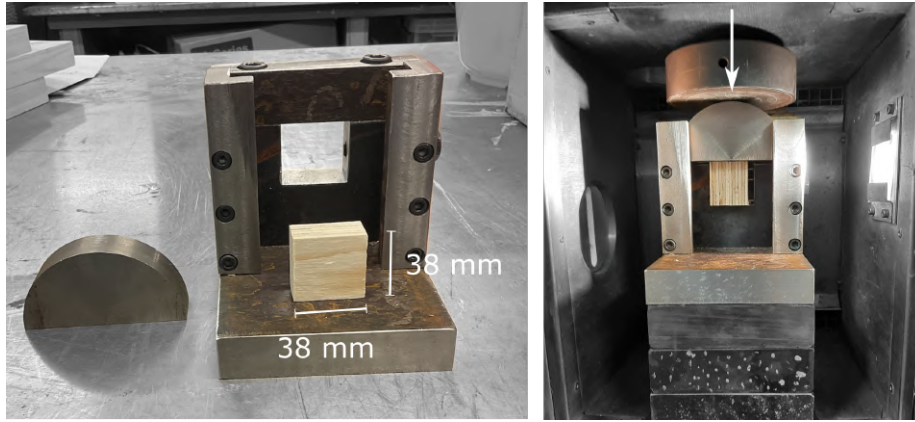


Figure 7: Shear apparatus.

Load and displacement were monitored by using a load cell and the loading head displacement of the universal testing machine. Shear stress σ_s and shear strain ε_s were calculated by using equation 5:

$$\sigma_s = \frac{F}{A_s} \quad \varepsilon_s = \frac{d}{l_s} \quad (5)$$

where F is the vertical force exerted by the actuator, $A_s = 1444\text{mm}^2$ is the shear area of the specimen, d is the vertical displacement and $l_s = 38\text{mm}$ is the length of the specimen.

In Figure 8, the typical failure modes of the specimens are reported. *PLY* \updownarrow shows a true shear failure: the shear plane is in fact clearly visible, and the wood fibres displace relative to each other. *PLY* \leftrightarrow and *OSB* show more a local crushing rather than a failure along a shear plane.

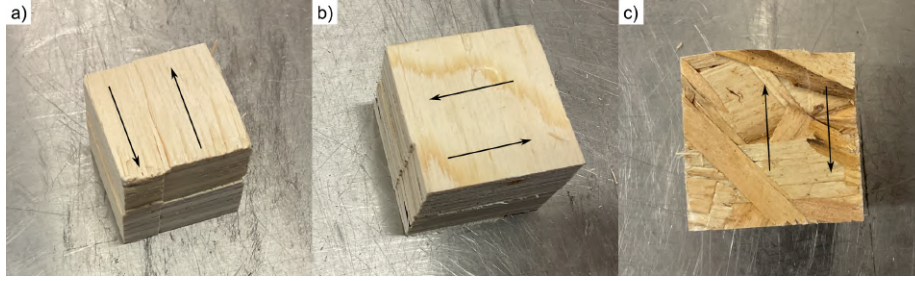


Figure 8: Typical failures observed in the specimens: a) $PLY \updownarrow$, b) $PLY \leftrightarrow$ and c) OSB.

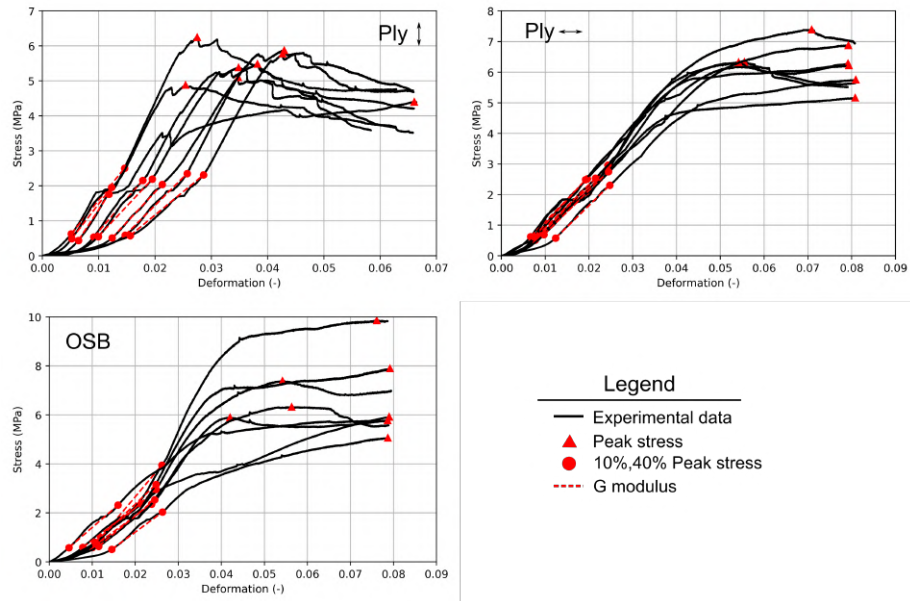


Figure 9: Stress-strain curves for the each of the tested specimens.

Stress-strain curves are shown in Figure 9, while the most relevant quantities, including average shear strength $f_{s,m}$ and average shear modulus G_m are reported in Table 3. G_m was calculated according to equation 6:

$$G_m = \frac{\sigma_{40\%} - \sigma_{10\%}}{\varepsilon_{40\%} - \varepsilon_{10\%}} \quad (6)$$

where $\sigma_{40\%}$, $\sigma_{10\%}$ represent 40% and 10% of the shear maximum stress, respectively (Fig. 9). $\varepsilon_{40\%}$, $\varepsilon_{10\%}$ are the values of strain where such shear stress occurs.

From Fig. 9 and Table 3, it can be seen that:

1. $PLY \updownarrow$ shows an average shear strength equal to 5.4 MPa, and an average shear

Table 3: Shear test results: σ_{max} peaks shear stress; $\varepsilon_{10\%}$, $\varepsilon_{40\%}$ deformation at 10% and 40% of the peak stress, respectively; G_s shear modulus.

Material	Specimen	$\varepsilon_{10\%}$ (-)	$\varepsilon_{40\%}$ (-)	σ_{max} (MPa)	G_s (MPa)
PLY \updownarrow	1	0.0051	0.0146	6.24	197.0
	2	0.0091	0.0178	5.39	186.3
	3	0.0064	0.0118	4.40	243.9
	4	0.0124	0.0213	5.10	171.4
	5	0.0147	0.0257	5.87	160.3
	6	0.0156	0.0286	5.78	133.0
	7	0.0099	0.0195	5.48	171.3
	8	0.0052	0.0123	4.88	207.8
				5.4	183.9
PLY \leftrightarrow	1	0.0077	0.0198	5.16	127.5
	2	0.0078	0.0223	6.33	130.7
	3	0.0094	0.0243	7.39	149.0
	4	0.0124	0.0247	5.75	139.7
	5	0.0080	0.0214	6.32	141.3
	6	0.0067	0.0196	6.29	146.1
	7	0.0074	0.0192	6.22	158.6
	8	0.0097	0.0244	6.88	140.2
				6.3	141.7
OSB	1	0.0100	0.0238	5.89	128.4
	2	0.0120	0.0262	9.86	208.9
	3	0.0115	0.0245	6.32	145.7
	4	0.0078	0.0213	5.92	131.2
	5	0.0145	0.0263	5.07	129.0
	6	0.0106	0.0248	7.39	156.0
	7	0.0107	0.0248	7.89	167.6
	8	0.0046	0.0160	5.78	152.3
				6.8	152.4

modulus equal to 183.9 MPa.

2. PLY \leftrightarrow shows an average shear strength equal to 6.3 MPa, and a shear modulus equal to 141.7 MPa.
3. OSB shows an average shear strength equal to 6.8 MPa, and a shear modulus equal to 3111 MPa.

Acknowledgements

The series of experiments was carried out at the University of Edinburgh. The contribution of Tom Reynolds and the technical staff in the structural engineering lab is greatly appreciated.

References

- [1] Normalisation Comite Europeen de. *Eurocode 1 - Actions on structures Part 1: General actions - Densities, self weight, imposed loads for buildings*. Brussels, Belgium, 2002.
- [2] Comite Europeen de Normalisation. *Timber structures - Test methods - Determination of mechanical properties of wood based panels*. Brussels, Belgium, 2004.

Appendix

DECLARATION OF PERFORMANCE

NO. MW/PW/421-001/CPR/DOP



1. PRODUCT-TYPE:

- Metsä Wood structural spruce plywood
- Uncoated or overlaid
 - Phenol-formaldehyde adhesive (exterior gluing quality)

2. TYPE, BATCH OR SERIAL NUMBER OR OTHER IDENTIFICATION:

- Metsä Wood structural spruce plywood
- Uncoated or overlaid
 - Phenol-formaldehyde adhesive (exterior gluing quality)

3. INTENDED USE OR USES:

Structural elements in internal or external applications in construction

EN 636-2 S

- for internal structural use in dry conditions
- for internal or protected external structural use in humid conditions

EN 636-3 S

(overlaid and edges protected)

- for internal structural use in dry conditions
- for internal or protected external structural use in humid conditions
- for external structural use

4. NAME AND ADDRESS OF THE MANUFACTURER:

Metsäliitto Cooperative
Metsä Wood
Askonkatu 9 E
FI-15100 Lahti, Finland
Tel. +358 10 4650 499
www.metsawood.com

6. SYSTEM OF ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE:

AVCP System 2+

7. CONSTRUCTION PRODUCT COVERED BY A HARMONISED STANDARD:

VTT Expert Services Ltd, Notified production control certification body No. 0809, performed initial inspection of the manufacturing plants and of factory production control and performs continuous surveillance, assessment and evaluation of factory production control under system 2+ and issued the certificate of conformity of the factory production control:

0809 – CPR – 1003

9. DECLARED PERFORMANCE

Harmonized technical specification EN 13986:2004

ESSENTIAL CHARACTERISTICS		PERFORMANCE								
		Sanded Metsä Wood spruce plywood								
		Nominal thickness (mm)								
Strength and stiffness for structural use:		9	12	12	15	18	21	24	27	30
		Number of plies								
		3	4	5	5	6	7	8	9	10
Characteristic bending strength (N/mm²)	II	22,9	20,6	25,6	23,1	21,5	20,7	20,5	19,4	18,9
	⊥	3,0	6,5	8,1	11,1	12,3	12,7	12,4	13,4	13,7
Mean modulus of elasticity in bending (N/mm²)	II	9178	8237	10235	9237	8615	8277	8205	7752	7558
	⊥	422	1363	1765	2763	3385	3723	3795	4248	4442
Characteristic compression strength (N/mm²)	II	15,5	11,5	21,1	17,6	19,7	16,8	22,3	16,4	17,8
	⊥	8,5	12,5	8,9	12,4	10,3	13,2	7,7	13,6	12,2
Characteristic tension strength (N/mm²)	II	9,3	6,9	12,6	10,6	11,8	10,1	13,4	9,8	10,7
	⊥	5,1	7,5	5,4	7,4	6,2	7,9	4,6	8,2	7,3
Mean modulus of elasticity in comp./tension (N/mm²)	II	6212	4591	8430	7034	7886	6732	8936	6566	7119
	⊥	3388	5009	3570	4966	4114	5268	3064	5434	4881
Characteristic panel shear strength (N/mm²)	II	3,5								
	⊥	3,5								
Mean modulus of rigidity in panel shear (N/mm²)	II	350								
	⊥	350								
Characteristic planar shear strength (N/mm²)	II	1,42	0,94	1,58	1,63	1,76	1,41	2,15	1,46	1,50
	⊥	-	-	0,81	0,87	0,64	1,18	-	1,12	0,72
Mean modulus of rigidity in planar shear (N/mm²)	II	45,1	35,5	66,1	50,5	71,4	51,8	142,9	52,1	63,2
	⊥	-	-	20,9	29,1	24,9	37,4	24,6	41,3	35,2

II = along the face veneer direction

⊥ = across the face veneer grain direction

Harmonized technical specification EN 13986:2004

ESSENTIAL CHARACTERISTICS		PERFORMANCE								
Strength and stiffness for structural use:		Unsanded Metsä Wood spruce plywood								
		Nominal thickness (mm)								
		9	12	12	15	18	21	24	27	30
		Number of plies								
		3	4	5	5	6	7	8	9	10
Characteristic bending strength (N/mm ²)	II	23,1	21,0	26,1	23,8	22,2	21,3	21,1	20,0	19,4
	⊥	2,7	6,0	7,5	10,4	11,7	12,1	11,9	12,9	13,2
Mean modulus of elasticity in bending (N/mm ²)	II	9244	8400	10437	9504	8889	8536	8438	7984	7776
	⊥	356	1200	1563	2496	3111	3464	3563	4016	4224
Characteristic compression strength (N/mm ²)	II	16,0	12,0	21,4	18,0	20,0	17,1	22,5	16,7	18,0
	⊥	8,0	12,0	8,6	12,0	10,0	12,9	7,5	13,3	12,0
Characteristic tension strength (N/mm ²)	II	9,6	7,2	12,9	10,8	12,0	10,3	13,5	10,0	10,8
	⊥	4,8	7,2	5,1	7,2	6,0	7,7	4,5	8,0	7,2
Mean modulus of elasticity in comp./tension (N/mm ²)	II	6400	4800	8571	7200	8000	6857	9000	6667	7200
	⊥	3200	4800	3429	4800	4000	5143	3000	5333	4800
Characteristic panel shear strength (N/mm ²)	II	3,5								
	⊥	3,5								
Mean modulus of rigidity in panel shear (N/mm ²)	II	350								
	⊥	350								
Characteristic planar shear strength (N/mm ²)	II	1,41	0,93	1,56	1,61	1,73	1,42	2,09	1,46	1,50
	⊥	-	-	0,78	0,85	0,62	1,15	-	1,10	0,70
Mean modulus of rigidity in planar shear (N/mm ²)	II	46,9	36,3	67,1	51,0	71,1	52,1	137,8	52,4	63,2
	⊥	-	-	20,0	28,2	24,2	36,5	24,1	40,5	34,6

II = along the face veneer direction

⊥ = across the face veneer grain direction

Harmonized technical specification EN 13986:2004

ESSENTIAL CHARACTERISTICS	PERFORMANCE						
Bonding quality	Class 3 (exterior)						
Release of formaldehyde	E1						
Reaction to fire	End use condition	Minimum thickness (mm)		Class (excluding floorings)		Class (floorings)	
	Without an air gap behind the panel	9		D-s2, d0		D _{fl} -s1	
	With a closed or an open air gap not more than 22 mm behind the panel	9		D-s2, d2		-	
	With a closed air gap behind the panel	15		D-s2, d1		D _{fl} -s1	
	With an open air gap behind the panel	18		D-s2, d0		D _{fl} -s1	
	Any	3		E		E _{fl}	
Water vapour permeability	Mean density		Wet cup		Dry cup		
	460 kg/m ³		66 μ		190 μ		
Airborne sound insulation	NPD						
Sound absorption	0,10 (250 Hz – 500 Hz) 0,30 (1000 Hz – 2000 Hz)						
Thermal conductivity	0,12 W/(m K)						
Impact resistance	NPD						
Strength and stiffness under point load	See annex 1						
Mechanical durability (EN 1995-1-1)	k _{mod}	Service class	Permanent action	Long term action	Medium term action	Short term action	Instantaneous action
		1	0,60	0,70	0,80	0,90	1,10
		2	0,60	0,70	0,80	0,90	1,10
		3	0,50	0,55	0,65	0,70	0,90
	k _{def}	Service class 1			0,80		
		Service class 2			1,00		
		Service class 3			2,50		
Biological durability (EN 335)	Uncoated or overlaid			Use class 2			
	Overlaid and edges protected			Use class 3			

10. The performance of the product identified in points 1 and 2 is in conformity with the declared performance in point 9.

This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

Signed for and on behalf of the manufacturer by:

Arto Salo
Vice President, Product Category Spruce plywood
Building and Industry business line

Lahti 1.7.2013



Harmonized technical specification EN 13986:2004

ESSENTIAL CHARACTERISTICS		PERFORMANCE						
Strength and stiffness under point load (50 x 50 mm ²) for floor and roof panels (EN 12871):		Metsä Wood spruce plywood long edges of the panel tongue and grooved, and short edges supported						
		Nominal thickness (mm)						
		12	15	18	21	24	27	30
		Number of plies						
		4	5	6	7	8	9	10
Span 300 mm	Ultimate limit state capacity (N)	2230	3170	4370	4700	6150	7810	9070
	Serviceability limit state capacity (N)	1300	2580	2980	4700	4900	6730	6880
	Stiffness R _{mean} (N/mm)	456	646	994	1270	1580	2370	3170
Span 400 mm	Ultimate limit state capacity (N)	2230	3170	4370	4700	6150	7810	9070
	Serviceability limit state capacity (N)	1300	2580	2980	4700	4900	6730	6880
	Stiffness R _{mean} (N/mm)	296	420	646	830	1026	1540	2060
Span 600 mm	Ultimate limit state capacity (N)	2230	3170	4370	4700	6150	7810	9070
	Serviceability limit state capacity (N)	1300	2480	2980	4700	4900	6730	6880
	Stiffness R _{mean} (N/mm)	161	228	352	452	559	839	1120
Span 800 mm	Ultimate limit state capacity (N)	1530	3170	3760	4590	6150	6900	9070
	Serviceability limit state capacity (N)	1190	2370	2340	4160	4900	5890	6880
	Stiffness R _{mean} (N/mm)	105	148	228	293	363	545	729
Span 1200 mm	Ultimate limit state capacity (N)	1180	1700	3450	4540	4980	6820	9070
	Serviceability limit state capacity (N)	1130	1510	2010	3900	3160	3650	6880
	Stiffness R _{mean} (N/mm)	57	81	124	169	198	297	397

Harmonized technical specification EN 13986:2004

ESSENTIAL CHARACTERISTICS		PERFORMANCE						
Strength and stiffness under point load (50 x 50 mm ²) for floor and roof panels (EN 12871):		Metsä Wood spruce plywood all four edges of the panel supported						
		Nominal thickness (mm)						
		12	15	18	21	24	27	30
		Number of plies						
		4	5	6	7	8	9	10
Span 300 mm	Ultimate limit state capacity (N)	4590	5380	7030	8390	7720	12500	13200
	Serviceability limit state capacity (N)	3910	4550	4540	7620	4660	6970	8960
	Stiffness R _{mean} (N/mm)	968	1190	1320	1810	2720	3850	4790
Span 400 mm	Ultimate limit state capacity (N)	4460	5380	7030	8300	7720	12500	13200
	Serviceability limit state capacity (N)	3910	4550	4540	7620	4660	6970	8960
	Stiffness R _{mean} (N/mm)	629	772	858	1180	1760	2500	3110
Span 600 mm	Ultimate limit state capacity (N)	4190	5200	7030	8120	7720	12500	13200
	Serviceability limit state capacity (N)	3910	3820	4540	7620	4660	6970	8960
	Stiffness R _{mean} (N/mm)	342	420	467	642	962	1360	1690
Span 800 mm	Ultimate limit state capacity (N)	3660	4840	6350	7940	7720	12500	13200
	Serviceability limit state capacity (N)	2400	3090	4540	5240	4660	6970	8960
	Stiffness R _{mean} (N/mm)	222	273	303	417	625	885	1100
Span 1200 mm	Ultimate limit state capacity (N)	3390	4110	6010	7580	7720	12500	13200
	Serviceability limit state capacity (N)	1640	2260	4540	4050	4660	6970	8960
	Stiffness R _{mean} (N/mm)	121	149	165	313	340	482	599

DECLARATION OF PERFORMANCE

Reference number **NOSB3DoPv7**

Norbord Europe Ltd

Morayhill, Dalcross

Inverness

IV2 7JQ

Unique Identification code of the product type*	Intended Use	Systems of AVCP	Notified Body	Harmonised standard
OSB/3 >6mm to 32mm*	Internal use as structural components in humid conditions	2+	0502	EN13986:2004+A1:2015
*The unique identification code of the product type is a combination of the technical class and the individual product's nominal thickness				

Declared performance (covering a range of product-types OSB/3 >6mm to 32mm*)

Essential characteristics	Performance													
Thickness range	6 to 10		>10 to <18		18 to 25		>25 to 32		15 T&G 600mm centres		18 T&G 600mm centres		22 T&G 600mm centres	
	0	90	0	90	0	90	0	90	0 - 90		0- 90		0-90	
¹ Characteristic Strength (N/mm ²)	18.0	9.0	16.4	8.2	14.8	7.4	NPD	NPD	16.4	8.2	14.8	7.4	14.8	7.4
- Bending														
- Compression f_c	15.9	12.9	15.4	12.7	14.8	12.4	NPD	NPD	15.4	12.7	14.8	12.4	14.8	12.4
- Tension f_t	9.9	7.2	9.4	7.0	9.0	6.8	NPD	NPD	9.4	7.0	9.0	6.8	9.0	6.8
- Panel Shear f_v	6.8		6.8		6.8		NPD		6.8		6.8		6.8	
- Planar shear f_r	1.0		1.0		1.0		NPD		1.0		1.0		1.0	
¹ Mean Stiffness values,(MOE) (N/mm ²)	3800	3000	3800	3000	3800	3000	NPD	NPD	3800	3000	3800	3000	3800	3000
- Tension E_t														
- Compression E_c	3800	3000	3800	3000	3800	3000	NPD	NPD	3800	3000	3800	3000	3800	3000
- Bending E_m	4930	1980	4930	1980	4930	1980	NPD	NPD	4930	1980	4930	1980	4930	1980
- Panel Shear G_v	1080		1080		1080		NPD		1080		1080		1080	
- Compression E_c	50		50		50		NPD		50		50		50	
Punching Shear Characteristic strength under point load $F_{max,k}$ (kN) (for floors and roofs)	NPD		NPD		NPD		NPD		2.64		4.12		4.96	
Punching Shear Mean stiffness under point load, R (N/mm) (for floors and roofs)	NPD		NPD		NPD		NPD		305		489		770	
Racking resistance(for walls) Characteristic Strength $F_{Rd,max,k}$ (N)	NPD		NPD		NPD		NPD		NPD		NPD		NPD	
Racking resistance (for walls) Mean Stiffness R_{mean} (N/mm)	NPD		NPD		NPD		NPD		NPD		NPD		NPD	
Soft Body Impact resistance Floors/Roofs Walls	NPD		NPD		NPD		NPD		Impact Class 1 Pass Roof		Impact Class 1 Pass Floor		Impact Class 1 Pass Floor	

NOSB3DoPv7

Embedment strength f _h (N/mm2)	NPD	NPD	NPD	NPD	NPD	NPD	NPD
²Reaction to fire (see notes to table for field of application details and associated documentation references) -			Minimum thickness	Class (excluding floorings)^g		Class (Flooring)^h	
	Without an air gap behind the panel^{abef}		9	D-s2,d0		D _{fi} ,s1	
	With a closed or open air gap ≤ 22mm behind the panel^{cef}		9	D-s2,d2		-	
	Closed air gap behind the panel^{def}		15	D-s2,d0		D _{fi} ,s1	
	With an open air gap behind the panel^{def}		18	D-s2,d0		D _{fi} ,s1	
	Any end use^{ef}		3	E		E _{fi}	
	a -Mounted without an air gap directly against class A1 or A2-s1, d0 products with minimum density 10kg/m3 or at least class D-s2, d2 products with minimum density 400 kg/m3. b -A substrate of cellulose insulation material of at least class E may be included if mounted directly against the wood-based panel, but not for floorings. c -Mounted with an air gap behind. The reverse face of the cavity shall be at least class A2-s1, d0 products with minimum density 10 kg/m3. d -Mounted with an air gap behind. The reverse face of the cavity shall be at least class D-s2, d2 products with minimum density 400 kg/m3. e -Veneered, phenol- and melamine-faced panels are included for class excl. floorings. f -A vapour barrier with a thickness up to 0,4 mm and a mass up to 200 g/m² can be mounted in between the wood-based panel and a substrate if there are no air gaps in between. g -Class Provided for in Table 1 of the Annex to decision 2000/147/EC h -Class Provided for in Table 2 of the Annex to decision 2000/147/EC						
	Water vapour permeability μ	NPD	NPD	NPD	NPD	NPD	NPD
Release of formaldehyde	E1	E1	E1	E1	E1	E1	E1
Release (content) of pentachlorophenol (PCP)	≤5ppm	≤5ppm	≤5ppm	≤5ppm	≤5ppm	≤5ppm	≤5ppm
Airborne sound insulation (surface mass) R (dB)	NPD	NPD	NPD	NPD	NPD	NPD	NPD
³Sound absorption Frequency range 250Hz to 500Hz (α)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
³Sound absorption Frequency range 1000Hz to 2000Hz (α)	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Thermal conductivity λ (W/m.K)	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Air Permeability V₀ (m3/h)	NPD	NPD	NPD	NPD	NPD	NPD	NPD
Durability							
Internal bond (N/mm²)	0.34	0.32	0.30	0.29	0.32	0.32	0.30
Swelling in thickness (%)	15	15	15	15	15	15	15
Bending strength after cyclic test – major axis (N/mm²)	9	8	7	6	8	8	7
⁴Mechanical (creep k _{def}) Service class 1	1.5	1.5	1.5	1.5	1.5	1.5	1.5
⁴Mechanical (creep k _{def}) Service class 2	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Mechanical (duration of load k _{mod})	Action Mode						
	Permanent	Long Term	Medium Term		Short Term		Instantaneous
⁴Service class 1	0.4	0.5	0.7		0.9		1.1
⁴Service class 2	0.3	0.4	0.55		0.7		0.9
Biological	Use classes 1 & 2						

NOTES TO TABLE

1 Taken from EN 12369-1:2001

2 reaction to fire classes from Table 1 of Commission Decision 2003/43/EC of January 2003 (OJEU L13 of 18.1.2003) corrected by Corrigendum (OJEU L33 of 8.2.2003) and amended by Commission decision 2007/348/EC of May 2007 (OJEU L131 of 23-05-2007); also reproduced in Table three of EN 13986:2004+A1:2015 for wood-based panels installed according to CEN/TR 12872

3 Taken from Table 10 of EN 13986:2004+A1:2015

4 Taken from Eurocode 5 EN 1995-1-1 2004+A2:2014

The performance of the product identified is in conformity with the declared performance.

This declaration of performance is issued in accordance with regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

Signed for and on behalf of the manufacturer by:

Lisa Munro

At: Inverness, Scotland

On: 07/07/2020

A handwritten signature in black ink that reads "Lisa Munro". The signature is written in a cursive style, with the first name "Lisa" and the last name "Munro" clearly legible.