

Spruce Ply

EASY ON SITE

METSÄ WOOD SPRUCE PLYWOOD MANUAL

1. INTRODUCTION

Metsä Wood delivers competitive and eco-efficient wood-based solutions for the needs of the construction industry, other industrial customers and home improvers. Metsä Wood plywood products are manufactured in Finland using highquality Nordic wood raw material.

Metsä Wood has a versatile product range based on high-quality raw materials, an efficient supply chain and outstanding customer service. The aim of the company is to develop understanding of customers' business to be able to develop solutions to match their increasingly demanding requirements. Metsä Wood spruce plywood products are certified, CE marked and environmentally friendly. They fulfil the strictest requirements set on wood based materials.

Metsä Wood spruce plywood products are excellent construction panels. They are ideal for both interior and exterior construction work and any other application which requires strength, dimensional stability and light-weight versatility.

SCOPE OF THE MANUAL

The purpose of this manual is to present the full Metsä Wood spruce plywood product range and suitable end use applications.

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METSÄ WOOD SPRUCE PLYWOOD

KEY ADVANTAGES:

Technical performance

- Light and dimensionally stable
- Strong and rigid
- Can act simultaneously as a load-bearing structure and bracing element
- Withstands impacts and other forms of bruising

Easy to use

- Easy to machine using conventional woodworking tools
- Easy to install with conventional wood fasteners
- Available with square edges and tongue and groove edge profiles
- Half-size panel availability

Durability

- Weather and boil-proof bonding (exterior phenolic gluing)
- Better natural mould resistance compared to pine plywood
- Low emissions
- Environmentally friendly (favourable carbon footprint)



1. Metsä Wood Spruce
2. Metsä Wood Spruce MouldGuard
3. Metsä Wood Spruce WeatherGuard
4. Metsä Wood Spruce Flex - white
5. Metsä Wood Spruce FireResist
6. Metsä Wood Spruce Flex - grey

	SPRUCE	MOULDGUARD	WEATHERGUARD	FLEX	FIRERESIST
RECOMMENDED APPLICATION					
FLOORS	★	★	★		★
ROOFS	★	★	★		★
CEILINGS	★	★	★	★	★
WALLS	★	★	★	★	★
ATTICS	★	★	★		
ON SITE BUILDING	★	★	★	★	★
GARAGES AND SHEDS (INTERIOR LINING)	★	★	★	★	★
AGRICULTURAL BUILDINGS (INTERIOR LINING)	★	★	★	★	★
WINDBREAK PANEL FOR BASE FLOOR		★			
FIRE CLASSIFIED INTERIOR LINING					★
TECHNICAL ROOMS	★	★	★	★	★

★ = product recommended for the application
 ★ = product also suitable for the application

2. FLOORING

Metsä Wood Spruce plywood is a strong, rigid and durable flooring panel, well suited for use as an assembly substrate for different surface materials, both for new constructions and renovation work.



The strong and rigid spruce plywood flooring panels have a good load-bearing capacity. The smooth and uniform surface of the panels is an ideal foundation for parquet floors, carpets and floor tiles. Spruce plywood panels can also be used on their own as ready-made floors in warehouses and other similar applications. In particular, the small deflections of the panels make the use of longer spans possible, which in turn helps save the amount of construction material required.

Floorings can be divided into two different categories: load-bearing floors and non-load-bearing floating floors. With tongue and grooved panels both structures can easily be built. Working with Metsä Wood Spruce is fast and efficient due to the light weight and stable dimensions of the panels. Large floor areas can be mounted quickly and final

finishing can be installed directly on top of the deck. A small opening in a floor structure can be built without a supporting frame; larger openings must have a supporting frame system around them.

The base panel is sanded spruce plywood with long edges tongue and grooved (TG2) to make the floor panel installation easy and fast. Four sides tongue and grooved (TG4) spruce plywood panels are an excellent material for building floating floor structures. Typical thicknesses for floor panels are 18, 21 and 24 mm depending on the span of the floor joists. The panel gross sizes measured with the tongue are 2410 × 1210 mm and 2410 × 610 mm. The corresponding panel net sizes are 2400 × 1200 mm and 2400 × 600 mm. Primary surface quality combinations for the flooring panels are II/III or III/III.



KEY ADVANTAGES OF METSÄ WOOD SPRUCE PLYWOOD IN FLOORING APPLICATIONS:

- Excellent strength to weight ratio
- Rigid panel with small deflections
- Easy to handle, joint and fasten
- Available with tongue and grooved profiles
- Available in half-size panels
- Dimensionally stable
- Low emissions
- Provides a safe working surface

PRODUCTS:

- Spruce
- Spruce WeatherGuard
- Spruce MouldGuard

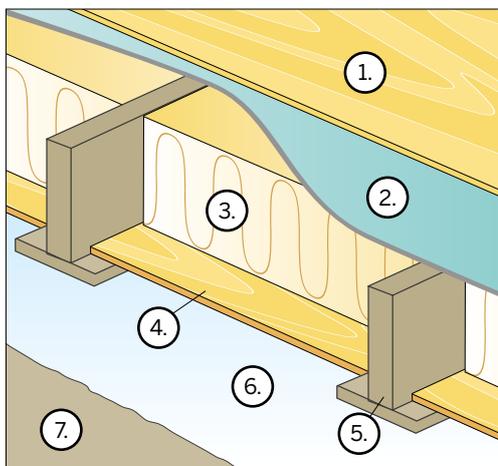
2.1 FLOOR STRUCTURES

A common structural application for plywood is to use it as a floor decking material with floor joists in a timber framing system. The following chapters present the common plywood floor structures, loading tables and installation instructions.

Floor structures can be divided into base floors and intermediate floors. Base floors can be either ground supported or ventilated structures.

BASE FLOORS

Base floor can be either ventilated beam/slab supported structure or non-ventilated ground supported structure. The ground below the base floor is often damp, and the structure should be physically separated from the moisture sources. Thermal insulation reduces the heat flow through the structure. Crawl space under the base floor must be ventilated to remove the excess moisture under the structure and it also reduces the risk of mould and decay. Spruce MouldGuard is recommended to be used as a windbreak panel in ventilated base floor structures due to its enhanced mould resistance properties.



1. Spruce plywood
2. Water vapour barrier
3. Insulation
4. Spruce MouldGuard plywood
5. Wooden joist
6. Crawl space
7. Gravel

Figure 1. Typical ventilated wood floor structure

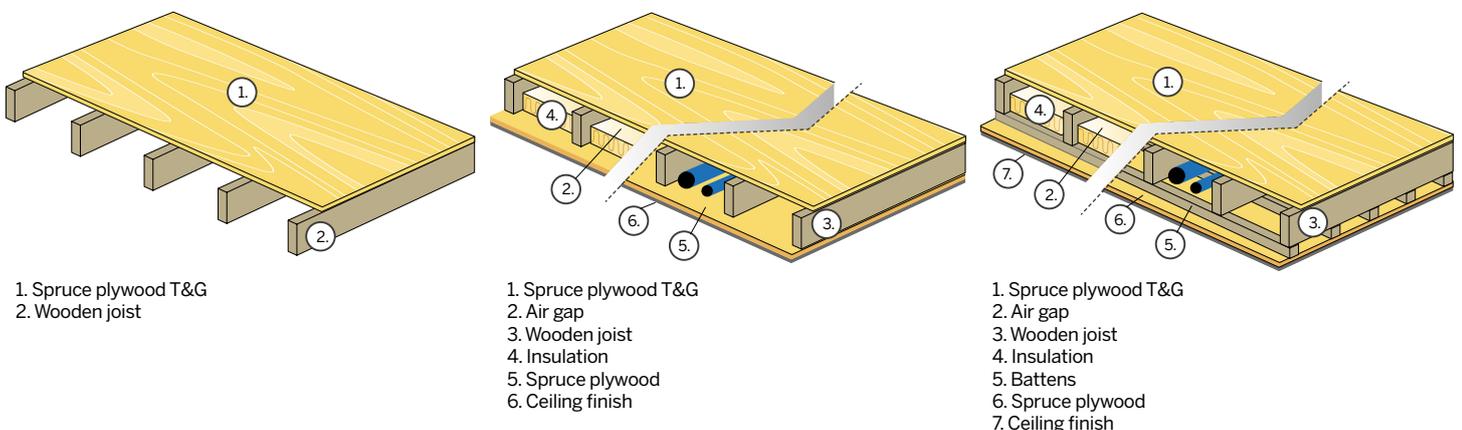


DID YOU KNOW

KERTO® LVL S-BEAM IS AN EXCELLENT MATERIAL CHOICE FOR FLOOR JOISTS. DIMENSIONALLY ACCURATE AND STIFF KERTO® LVL S-BEAMS ENABLE LONG SPANS WITH MINIMAL DEFLECTION. FIND OUT MORE ON WWW.METSAWOOD.COM/KERTO

INTERMEDIATE FLOORS

Intermediate floors are a load-bearing structure carrying the above loads. Spruce plywood panels assembled on top of timber joists creates a typical intermediate floor structure used especially in small housing. Insulation may be added in the structure to reduce the transmission of noise. The cavity between the joists can be utilized as an assembly space for wiring, pipework etc. Plywood panels can be also used as horizontal bracing for stabilizing the building.



1. Spruce plywood T&G
2. Wooden joist

1. Spruce plywood T&G
2. Air gap
3. Wooden joist
4. Insulation
5. Spruce plywood
6. Ceiling finish

1. Spruce plywood T&G
2. Air gap
3. Wooden joist
4. Insulation
5. Battens
6. Spruce plywood
7. Ceiling finish

Figure 2. Intermediate floor structures

FLOATING FLOORS

Floating floors can be positioned on top of concrete or timber floor structures. The primary purpose of the structure is to reduce the impact sound. In the floating floor structure rigid insulation material designed for the end use is placed in between the spruce plywood panel and the floor structure. The panels are recommended to be tongue and grooved on four sides (TG4) and glue should be used in the panel joints. Spruce plywood should not be fastened into the supporting floor structure.

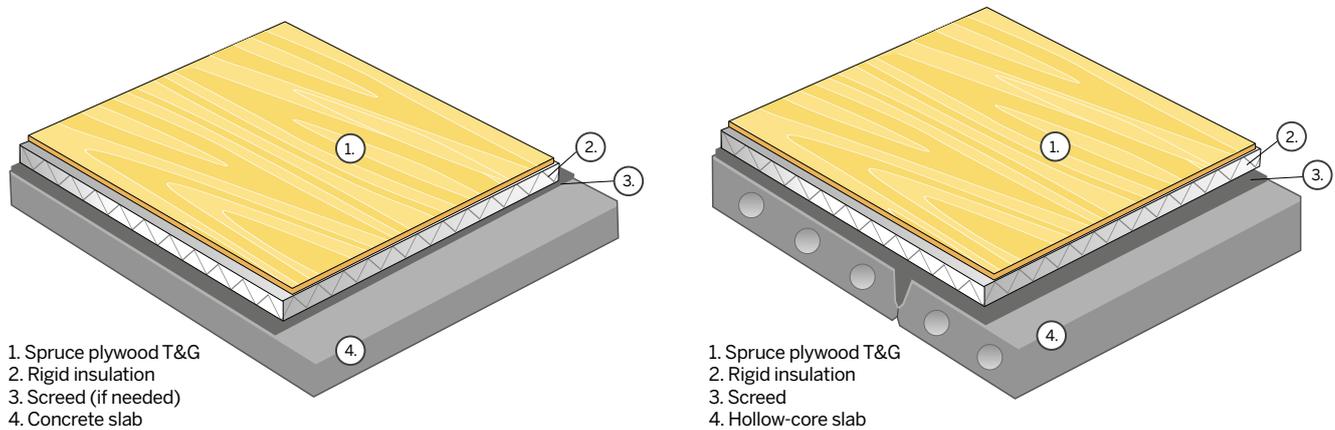


Figure 3. Floating floor structures

SURFACE OPTIONS

Several different kinds of finishing option can be used on top of the plywood floor paneling. These finishing options need to be taken into account as permanent load in the floor design.

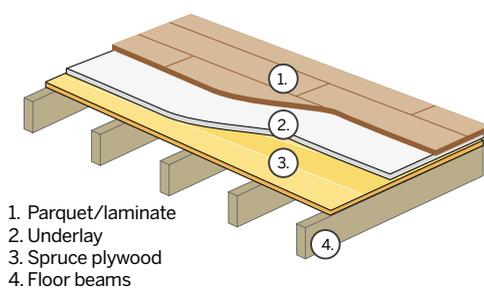


Figure 4. Parquet floor surface

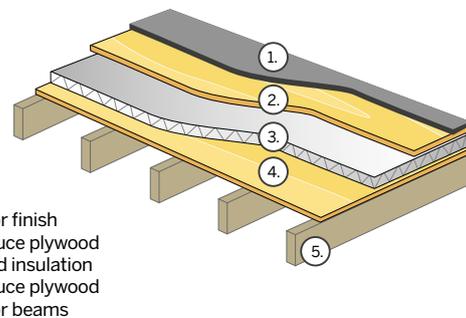


Figure 5. Floating floor (wood based)

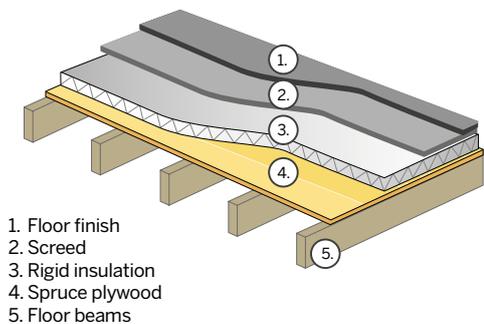


Figure 6. Floating floor (concrete/gypsum based)

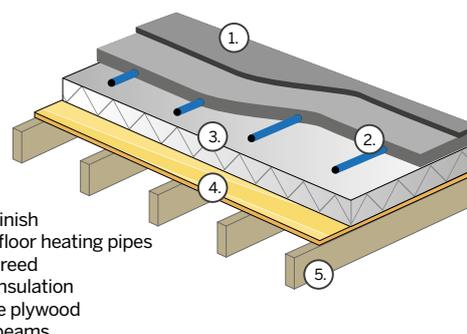


Figure 7. Floor structure with underfloor heating

2.2 FLOOR DESIGN

Structural design of floor panels takes into consideration support spacing, permanent and imposed loads, and panel thickness with related strength and elasticity properties. Generally deflection of the panel is the determining factor in the design. Permanent loads remain unchanged during the whole intended service life of the building. For example, self-weight of floor panels and the above surface structures are such loads. All the other loads are imposed loads.

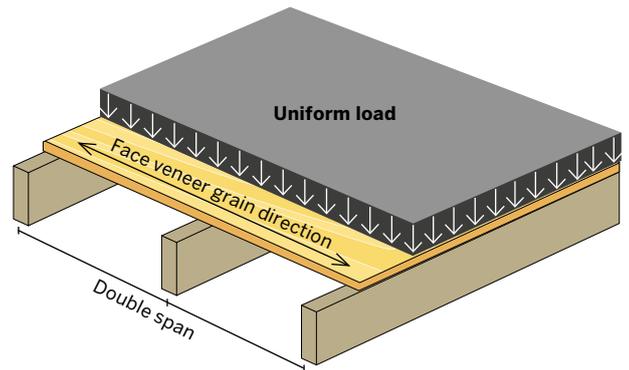


Figure 8. Uniformly distributed load

Table 2.1 Imposed loads on floors, balconies and stairs in buildings

CATEGORIES OF LOADED AREAS	UNIFORM LOAD	CONCENTRATED LOAD
	q_k [kN/m ²]	Q_k [kN]
CATEGORY A: Residential areas		
• Floors	2,0	2,0
• Stairs	2,0	2,0
• Balconies	2,5	2,0
CATEGORY B: Office areas	3,0	4,5
CATEGORY C: Congregated areas		
• C1: Areas with tables	3,0	4,0
• C2: Areas with fixed seats	4,0	4,0
• C3: Areas without obstacles	5,0	4,0
• C4: Sports and stage areas	5,0	7,0
• C5: Crowded areas	5,0	4,5
CATEGORY D: Shopping areas		
• D1: General retail shops	4,0	4,0
• D2: Department stores	5,0	7,0

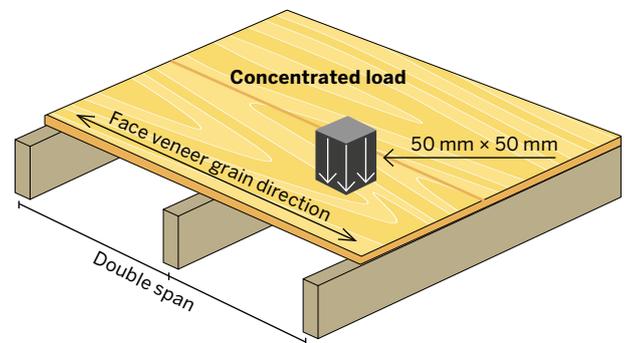


Figure 9. Concentrated load

The following preliminary design tables for Metsä Wood Spruce floor panels are given separately for uniform and concentrated imposed loads. These loads should not be combined according to Eurocode 1 as the uniform load determines the general effect and concentrated load determines the local effect. Separate tables are also given for four sides supported panels and long sides tongue and grooved panels (short edges supported). Service class 1 corresponds to dry indoor conditions. The design tables take into account ultimate limit state and service limit state including deflection limits. Permanent load includes the own weight of the panel and the floor structures above the panel.

NOTE. Imposed loads (table 2.1), deflection limitations and coefficients used in the calculations are based on the general version of Eurocodes and there may be variation between different countries (see National Annexes).

Table 2.2 Preliminary design table for Metsä Wood Spruce plywood with uniform load (all panel edges supported)

		MINIMUM PANEL THICKNESS [mm]											
Permanent uniform load g_k [kN/m ²]	Imposed uniform load q_k [kN/m ²]	0,3				0,5				1,5			
		2,0	3,0	4,0	5,0	2,0	3,0	4,0	5,0	2,0	3,0	4,0	5,0
Span [mm]	300	12	12	12	12	12	12	12	12	12	12	12	12
	400	12	12	12	12	12	12	12	12	12	12	12	12
	600	12	15	15	18	15	15	15	18	15	15	18	18
	800	15	18	21	21	18	18	21	21	21	21	24	24
	1200	21	24	27	30	24	24	27	30	27	30	30	-

Design calculations according to Eurocode (EN 1990, EN 1991-1-1, EN 1995-1-1), loaded area category A: residential areas, permanent uniform load includes the weight of the panel, service class 1, medium-term load-duration class, $k_{mod} = 0,8$, $k_{def} = 0,8$, consequences/reliability class 2 $K_{FI} = 1,0$, $\gamma_M = 1,2$, $\gamma_G = 1,35$, $\gamma_Q = 1,5$, $\psi_2 = 0,3$, combination of actions (6.10), characteristic combination, multispans panels, net final deflection $w_{net,fin} \leq L/200$, does not replace project specific structural design.

Table 2.3 Preliminary design table for Metsä Wood Spruce plywood with concentrated load (all panel edges supported)

		MINIMUM PANEL THICKNESS [mm]			
Imposed concentrated load Q_k [kN]		1,0	2,0	3,0	4,0
Span [mm]	300	12	12	18	21
	400	12	12	21	27
	600	12	15	21	27
	800	12	21	24	27
	1200	21	27	-	-

Design calculations according to Eurocode (EN 1990, EN 1991-1-1, EN 1995-1-1), loaded area category A: residential areas, service class 1, medium-term load-duration class, $k_{mod} = 0,8$, $k_{def} = 0,8$, concentrated load area 50×50 mm², consequences/reliability class 1 $K_{FI} = 0,9$, $\gamma_M = 1,2$, $\gamma_Q = 1,5$, $\psi_2 = 0,3$, combination of actions (6.10), characteristic combination, multispans panels, net final deflection $w_{net,fin} \leq \min(L/100; 6$ mm) (EN 12871), does not replace project specific structural design.

Table 2.4 Preliminary design table for Metsä Wood Spruce plywood with uniform load (long panel edges tongue and grooved and short edges supported)

		MINIMUM PANEL THICKNESS [mm]															
Permanent uniform load g_k [kN/m ²]	Imposed uniform load q_k [kN/m ²]	0,3				0,5				1,5							
		2,0	3,0	4,0	5,0	2,0	3,0	4,0	5,0	2,0	3,0	4,0	5,0				
Span [mm]	300	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
	400	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
	600	12	15	15	18	15	15	15	18	15	15	18	18	15	15	18	18
	800	15	18	21	21	18	18	21	21	21	21	21	24	21	21	24	24
	1200	21	24	27	30	24	24	27	30	27	30	30	30	27	30	30	-

Design calculations according to Eurocode (EN 1990, EN 1991-1-1, EN 1995-1-1), loaded area category A: residential areas, permanent uniform load includes the weight of the panel, service class 1, medium-term load-duration class, $k_{mod} = 0,8$, $k_{def} = 0,8$, consequences/reliability class 2 $K_{FI} = 1,0$, $\gamma_M = 1,2$, $\gamma_G = 1,35$, $\gamma_Q = 1,5$, $\psi_2 = 0,3$, combination of actions (6.10), characteristic combination, multispans panels, net final deflection $w_{net,fin} \leq L/200$, does not replace project specific structural design.

Table 2.5 Preliminary design table for Metsä Wood Spruce plywood with concentrated load (long panel edges tongue and grooved and short edges supported)

		MINIMUM PANEL THICKNESS [mm]			
Imposed concentrated load Q_k [kN]		1,0	2,0	3,0	4,0
Span [mm]	300	12	18	24	30
	400	12	18	24	30
	600	12	18	24	30
	800	15	21	24	30
	1200	21	27	-	-

Design calculations according to Eurocode (EN 1990, EN 1991-1-1, EN 1995-1-1), loaded area category A: residential areas, service class 1, medium-term load-duration class, $k_{mod} = 0,8$, $k_{def} = 0,8$, concentrated load area 50×50 mm², consequences/reliability class 1 $K_{FI} = 0,9$, $\gamma_M = 1,2$, $\gamma_Q = 1,5$, $\psi_2 = 0,3$, combination of actions (6.10), characteristic combination, multispans panels, deflection limitation according to table 2.3, does not replace project specific structural design.



2.3 INSTALLATION

Panels should always be installed with the face veneer grain direction parallel to the span between the joists. All short panel edges should be supported on joists.

Plywood should be conditioned to a moisture content corresponding to the moisture conditions inside the building. Packages should be opened to allow free air movement around the panels.

ASSEMBLY

- Before installation panels should be conditioned at least for one week in the end-use moisture conditions
- Optimal support spacing for Metsä Wood Spruce is *c/c* 300, 400, 600 and 800 mm
- Panels should be laid across the joists and short edges placed on supports
- Short edges should be staggered to avoid cross-joints
- Each panel should be continuous over at least three supports

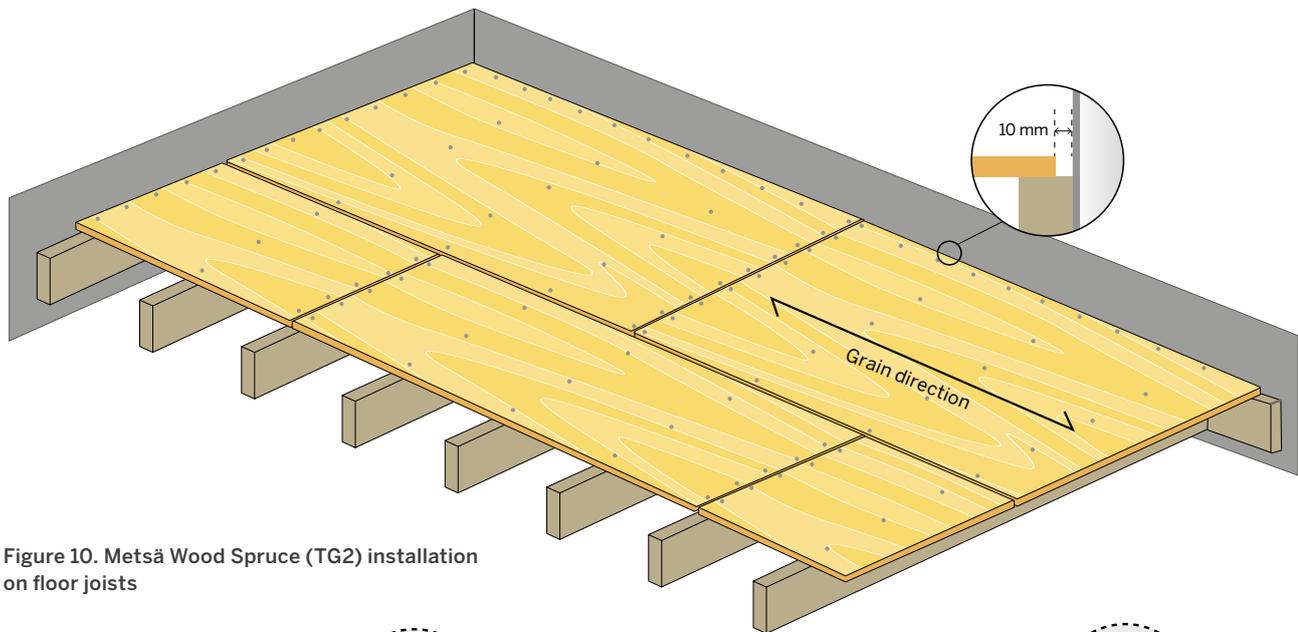


Figure 10. Metsä Wood Spruce (TG2) installation on floor joists

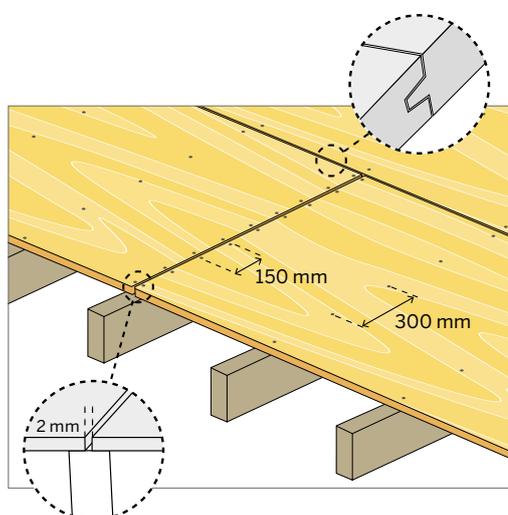


Figure 11. Metsä Wood Spruce (TG2) panel installation on floor joists

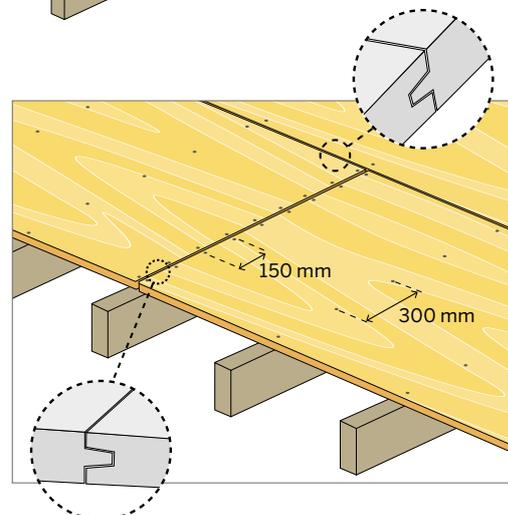


Figure 12. Metsä Wood Spruce (TG4) panel installation on floor joists

EXPANSION GAPS

- Minimum of 10 mm expansion gap should be left between the floor paneling and adjoining structure
- Fastened panels should have a minimum of 1mm/m expansion gap between the panels to allow moisture movements
 - between short edges 2-3 mm
 - between long edges 1-2 mm
- Floating floor panels should be installed without expansion gap between tongue and groove joints

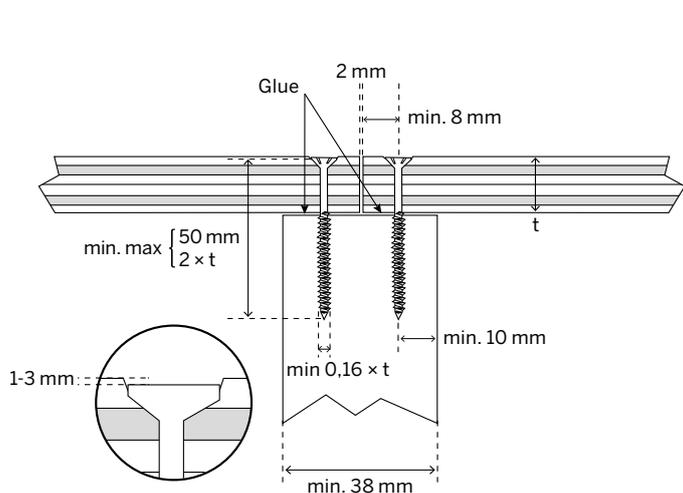


Figure 13. Fixing of square edge panels to wooden support

FASTENING

- Panel short edge should be placed in the middle of the support
- Spruce plywood does not require predrilling since its characteristic density is less than 500 kg/m³. Any need for predrilling comes from the requirements of the fasteners
- Bearing length of the panel is at least 18 mm on the support
- Fastener edge distance is a minimum of 8 mm
- Maximum fastener distance is 150 mm at the panel edges and 300 mm within the panel
- Use of PVAc or similar wood glue is recommended in TG joints and in panel-support connections to prevent creaking
- When fasteners are an essential part of the structural system, e.g. plywood is used as a bracing panel, the boundary conditions according to EN 1995-1-1 should be taken into account which may affect the dimensions presented in the below drawings (see Chapter 11)

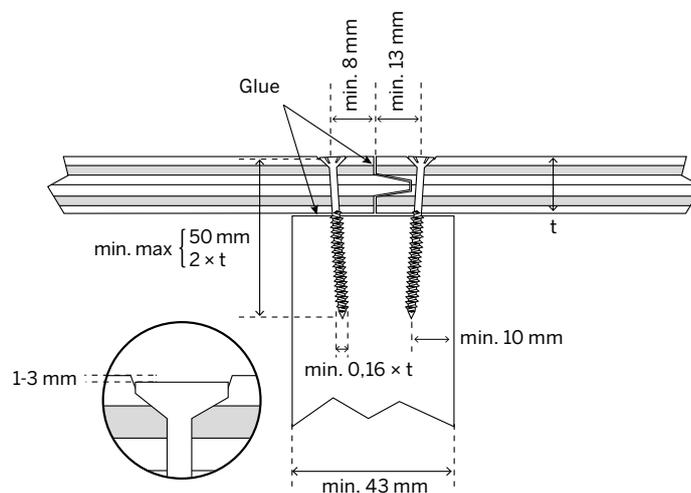


Figure 14. Fixing of TG panels to wooden support

FASTENERS

- Standard wood nails and screws can be used in dry and warm conditions (service class 1)
- Hot-dip galvanized or stainless steel fasteners should be used in unheated conditions (service class 2)
 - durability of the fasteners should be adjusted for the planned service life and actual corrosivity category
- Recommended fasteners
 - flat headed countersunk screws and flat headed annular ring nails
 - smooth shank screws allow tight joints
 - self tapping screws should be used when fixing panels to metal supports
- Minimum fastener length is at least 2 times the panel thickness or 50 mm (which is greater)
- Minimum fastener diameter is 0,16 times the panel thickness
- Heads of the fasteners should be countersunk by 1-3 mm

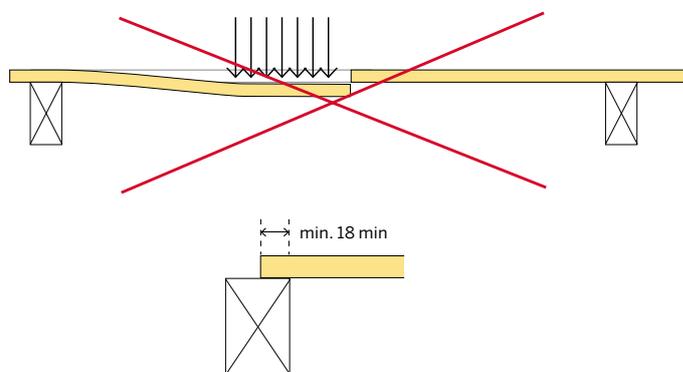


Figure 15. Unsupported square panel edges are not allowed, also short edges of tongue and grooved panels should be placed on supports

3. ROOFING

Metsä Wood Spruce MouldGuard is an ideal roof decking panel. Plywood panels located in an unheated space with relative humidity temporarily exceeding 75 % are recommended to be treated with wood preservative to reduce the risk of mould growth.



Roof structures can be designed in many different ways according to national building regulations and requirements. Strong and rigid spruce plywood is an excellent substrate for different roofing materials. Plywood panels can be also used as horizontal bracing for stabilizing the building. The light and dimensionally stable panels are easy to fit together and they can also be used as a safe working surface during the installation of the roofing.

Metsä Wood Spruce MouldGuard is surface impregnated with a wood preservative at the mill. The spreading of the anti-mould agent is carefully controlled to guarantee an even spread and sufficient amount of the anti-mould agent. MouldGuard production is part of the mill quality control system overseen by a third party certifier.

MouldGuard base panel is unsanded spruce with long edges tongue and grooved (TG2) to make the roof paneling installation easy and fast. Typical thicknesses for roof panels are 15, 18 and 21 mm depending on the span of the rafters and trusses. The panel gross sizes measured with the tongue are 2410×1210 mm and 2410×610 mm. The corresponding panel net sizes are 2400×1200 mm and 2400×600 mm. Primary surface quality combination for the roofing panel is III/III.



Tongue and groove joint



DID YOU KNOW

KERTO® LVL S-BEAM IS AN EXCELLENT MATERIAL CHOICE FOR RAFTERS. DIMENSIONALLY ACCURATE AND STIFF KERTO® LVL S-BEAMS ENABLE LONG SPANS WITH MINIMAL DEFLECTION. FIND OUT MORE ON WWW.METSAWOOD.COM/KERTO

KEY ADVANTAGES OF METSÄ WOOD SPRUCE PLYWOOD IN ROOFING APPLICATIONS:

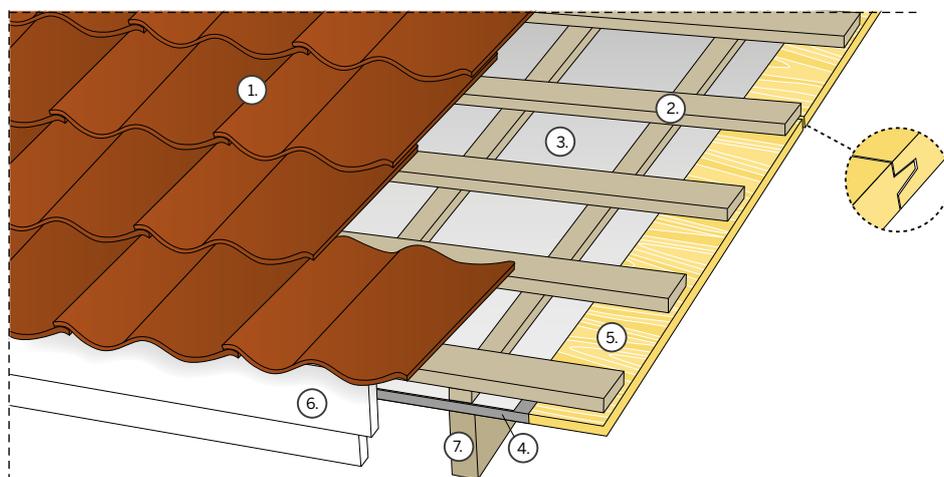
- Mould protection
 - MouldGuard has up to 5 times improved resistance against mould compared to untreated spruce plywood (ref. VTT tests)
- Time saving
 - easy to cover a large area fast with the light-weight tongue and grooved panels
- Material saving
 - Metsä Wood spruce plywood sizes are optimized for support spacings 400/600/800/1200 mm to minimize the material waste
 - fewer fasteners than with grid siding
- On-site safety
 - provides a good slip resistant working platform
- Stable constructions
 - spruce plywood can act simultaneously as a load-bearing structure and stiffening element

PRODUCTS:

- Spruce MouldGuard
- Spruce WeatherGuard
- Spruce

3.1 ROOFING MATERIAL OPTIONS

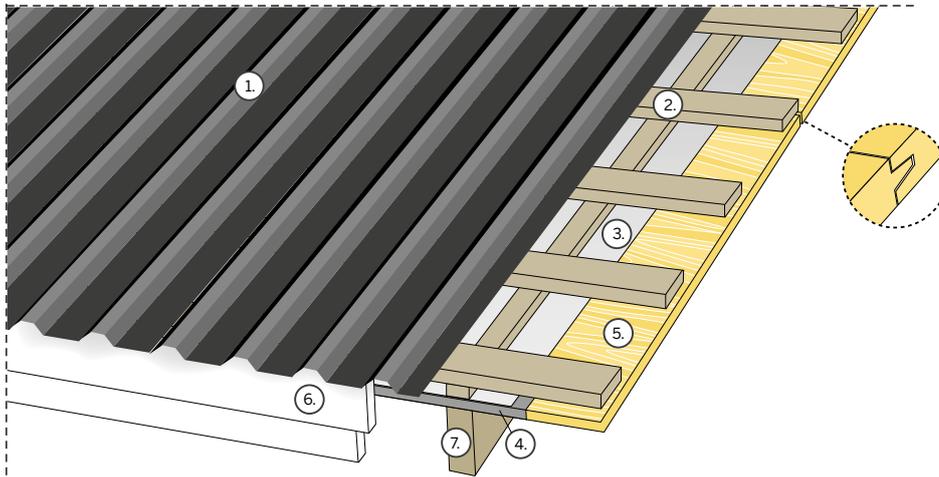
Light-weight and rigid Metsä Wood Spruce plywood is a commonly used roof decking material. It is suitable to be combined with different roofing materials, like roofing felt, steel sheets and roof tiles. This chapter presents some of the commonly used plywood roof structures and following chapters present loading tables and installation instructions.



ROOF STRUCTURE FROM THE TOP:

1. Roof tiles
2. Battens
3. Roofing underlay membrane
4. Drip edge placed under the membrane
5. Spruce MouldGuard plywood
6. Face boarding
7. Rafter

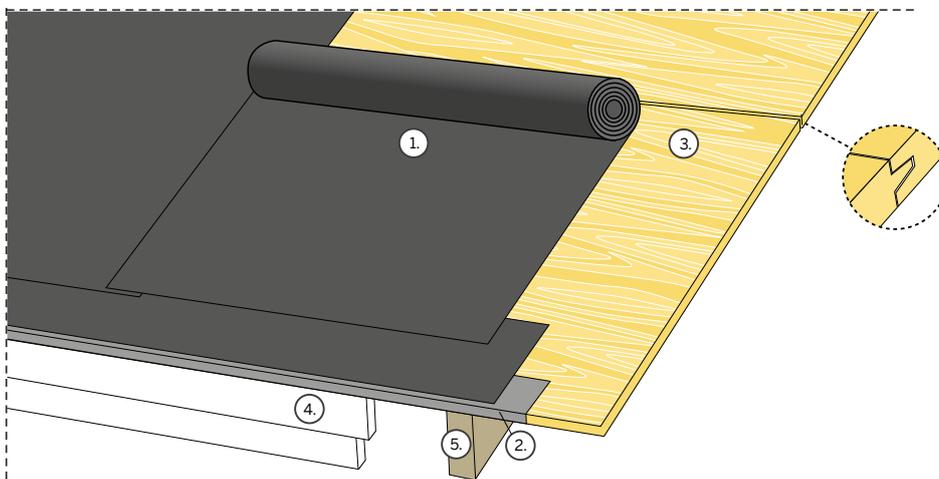
Figure 16. Roof tiles



ROOF STRUCTURE FROM THE TOP:

1. Steel sheets
2. Batten
3. Roofing underlay membrane
4. Drip edge placed under the membrane
5. Spruce MouldGuard plywood
6. Face boarding
7. Rafter

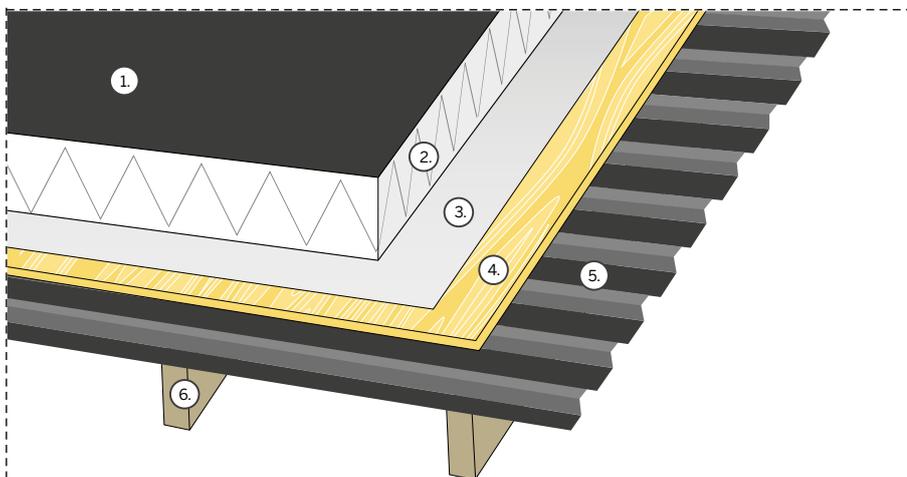
Figure 17. Steel sheets



ROOF STRUCTURE FROM THE TOP:

1. Roofing felt
2. Drip edge placed under the felt
3. Spruce MouldGuard plywood
4. Face boarding
5. Rafter

Figure 18. Roofing felt



ROOF STRUCTURE FROM THE TOP:

1. Roofing material
2. Rigid insulation
3. Water vapour barrier
4. Spruce MouldGuard plywood
5. Corrugated steel sheet
6. Rafter

Figure 19. Corrugated steel sheet structure

3.2 ROOF DECKING DESIGN

The following preliminary design tables for Metsä Wood Spruce roof decking panels are given as a combination of permanent and snow loads. Imposed loads are taken into account as separate loading cases. Wind loads are not taken into account. Tables are given for long sides tongue and grooved panels (short edges supported). Service class 2 corresponds to covered exterior conditions. The design tables take into account ultimate limit state and service limit state.

NOTE. Snow loads, imposed loads, deflection limitations and coefficients used in the calculations are based on the general version of Eurocodes and there may be variation between different countries (see National Annexes).

THE FOLLOWING LOADS HAVE BEEN TAKEN INTO ACCOUNT IN THE PRELIMINARY ROOF DECKING DESIGN TABLES:

- Permanent loads (incl. plywood and above structures)
 - roofing felt or steel sheet 0,3 kN/m²
 - roof tiles 0,6 kN/m²
- Imposed loads (category H)
 - uniform load 0,4 kN/m²
 - concentrated load 1,0 kN
- Snow load
 - according to country specific information
- Wind loads
 - not taken into account

Table 3.1 Preliminary design table for Metsä Wood Spruce plywood under roofing felt or steel sheets (long panel edges tongue and grooved and short edges supported)

SPAN	ROOF SLOPE	SNOW LOAD ON THE GROUND S_k (kN/m ²)								
		0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0	5,0
600 mm	0°	12	12	12	12	12	12	12	15	15
	15°	12	12	12	12	12	12	12	15	15
	30°	12	12	12	12	12	12	12	12	15
	45°	12	12	12	12	12	12	12	12	12
800 mm	0°	15	15	15	15	15	15	15	18	18
	15°	15	15	15	15	15	15	15	18	18
	30°	15	15	15	15	15	15	15	15	18
	45°	15	15	15	15	15	15	15	15	15
1200 mm	0°	18	18	18	18	21	21	21	24	24
	15°	18	18	18	18	21	21	21	24	24
	30°	18	18	18	18	18	21	21	21	24
	45°	18	18	18	18	18	18	18	18	18

Design calculations according to Eurocode (EN 1990, EN 1991-1-3, EN 1995-1-1), $C_e = 1,0$, $C_t = 1,0$, $\mu_1 = 0,8$ except 0,4 for 45° roof slope, permanent load 0,3 kN/m² includes the weight of the panel, service class 2, short-term load-duration class, $k_{mod} = 0,9$, $k_{def} = 1,0$, consequences/reliability class 2 $K_{FI} = 1,0$, $\gamma_M = 1,2$, $\gamma_G = 1,35$, $\gamma_Q = 1,5$, $\psi_2 = 0,2$, combination of actions (6.10), characteristic combination, multispans panels, net final deflection $w_{net,fin} \leq L/150$, for small snow loads the 1 kN imposed concentrated load (category H) is the most critical design case, does not replace project specific structural design.

Table 3.2 Preliminary design table for Metsä Wood Spruce plywood under roof tiles (long panel edges tongue and grooved and short edges supported)

SPAN	ROOF SLOPE	SNOW LOAD ON THE GROUND S_k (kN/m ²)								
		0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0	5,0
600 mm	0°	12	12	12	12	12	12	15	15	15
	15°	12	12	12	12	12	12	15	15	15
	30°	12	12	12	12	12	12	12	15	15
	45°	12	12	12	12	12	12	12	12	12
800 mm	0°	15	15	15	15	15	18	18	18	18
	15°	15	15	15	15	15	15	18	18	18
	30°	15	15	15	15	15	15	18	18	18
	45°	15	15	15	15	15	15	15	15	15
1200 mm	0°	18	18	18	21	21	24	24	24	24
	15°	18	18	18	21	21	21	24	24	24
	30°	18	18	18	21	21	21	24	24	24
	45°	18	18	18	18	18	18	18	18	21

Design calculations according to Eurocode (EN 1990, EN 1991-1-3, EN 1995-1-1), $C_e = 1,0$, $C_t = 1,0$, $\mu_1 = 0,8$ except 0,4 for 45° roof slope, permanent load 0,6 kN/m² includes the weight of the panel, service class 2, short-term load-duration class, $k_{mod} = 0,9$, $k_{def} = 1,0$, consequences/reliability class 2 $K_{FI} = 1,0$, $\gamma_M = 1,2$, $\gamma_G = 1,35$, $\gamma_Q = 1,5$, $\psi_2 = 0,2$, combination of actions (6.10), characteristic combination, multispans panels, net final deflection $w_{net,fin} \leq L/150$, for small snow loads the 1 kN imposed concentrated load (category H) is the most critical design case, does not replace project specific structural design.

3.3 OPENINGS

Openings are usually needed in panel structures for example for ventilation ducts and chimneys. Openings are divided into small openings ($\leq 200 \text{ mm} \times 200 \text{ mm}$ or $\leq \text{Ø } 200 \text{ mm}$) and large openings which exceed the small opening size limitations.

Adjacent drawing describes the placing of small openings. If multiple small openings are located in a single span the conservative approach is to support the openings like large openings.

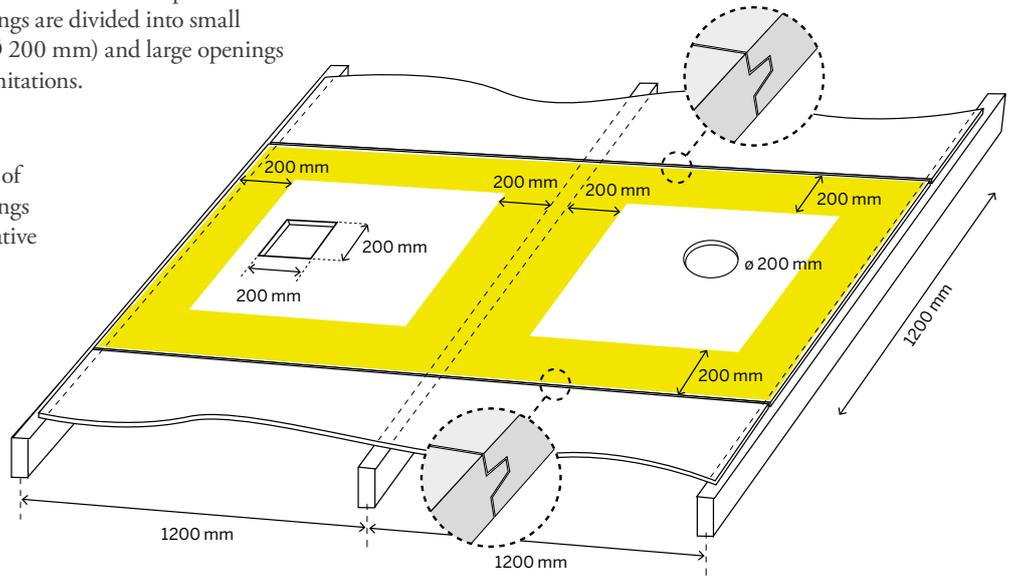


Figure 20. Placing of small openings

Large openings or small openings which are located near the supports and panel edges should be supported with additional beams (see drawings).

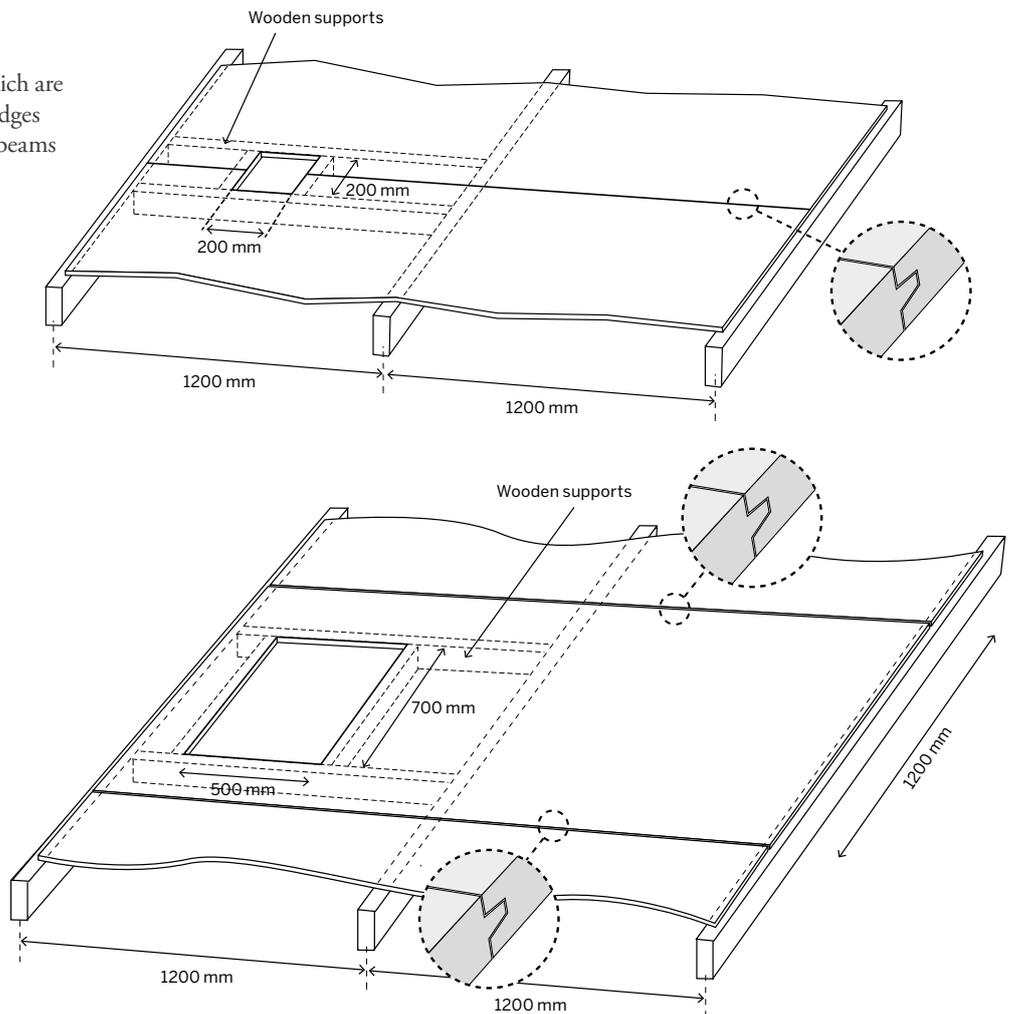


Figure 21. Supported openings



3.4 ROOF OVERHANGS

A roof overhang is a projection from a roof structure which extends beyond the face of the support. Eaves overhang protects the wall from rain and provides sun shade for the building.

Overhangs are constructed using cantilevers fastened to rafters under the roof decking. Required panel thickness can be taken from the previous design tables.

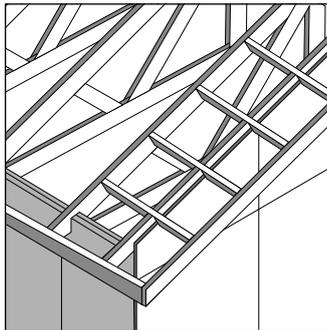


Figure 22. Cantilevers



DID YOU KNOW

KERTO® LVL Q-PANES STABILIZE STRUCTURES AND CAN BE USED AS A SELF-SUPPORTING ROOF PANEL TO CREATE A LIGHT-WEIGHT MODERN LOOK FOR ROOF OVERHANGS.

FIND OUT MORE ON WWW.METSAWOOD.COM/KERTO

3.5 INSTALLATION

Panels should always be installed with the face veneer grain direction parallel to the span between the rafters. All short panel edges should be supported on rafters.

In the pitched roofs the panel installation should be started from the eave, moving upwards towards the roof ridge. The panels should be laid with the tongue pointing upwards to hinder moisture accumulation in the grooves.

ASSEMBLY

- Optimal support spacing for Metsä Wood Spruce is c/c 400, 600, 800 and 1200 mm
- Panels should be laid across the rafters and short edges placed on supports
- Short edges should be staggered to avoid cross-joints
- Each panel should be continuous over at least three supports
- In the pitched roofs the panels should be laid with the tongue pointing upwards to hinder moisture accumulation in the grooves.

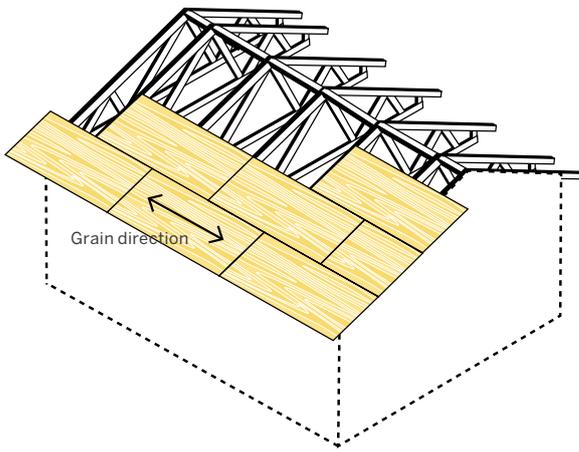


Figure 23. Panels are laid and fastened on wood trusses or rafters. The short edges of the panels are staggered.

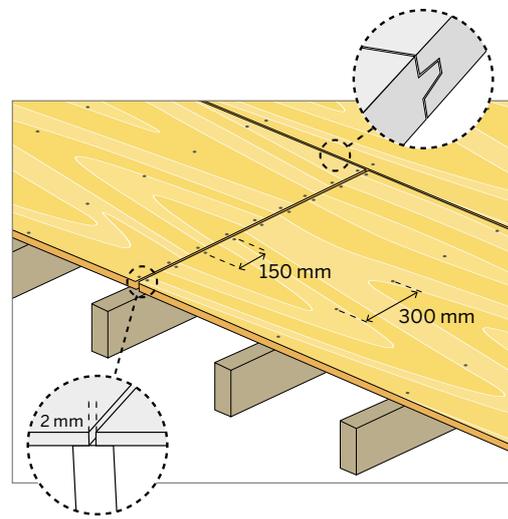


Figure 24. Metsä Wood Spruce (TG2) panel installation on rafters

FASTENING

- Panel short edge should be placed in the middle of the support
- Spruce plywood does not require predrilling since its characteristic density is less than 500 kg/m^3 . Any need for predrilling comes from the requirements of the fasteners
- Bearing length of the panel is at least 18 mm on the support
- Fastener edge distance is a minimum of 8 mm
- Maximum fastener distance is 150 mm at the panel edges and 300 mm within the panel
- When fasteners are an essential part of the structural system, e.g. plywood is used as a bracing panel, the boundary conditions according to EN 1995-1-1 should be taken into account which may affect the dimensions presented in the below drawings (see Chapter 11)

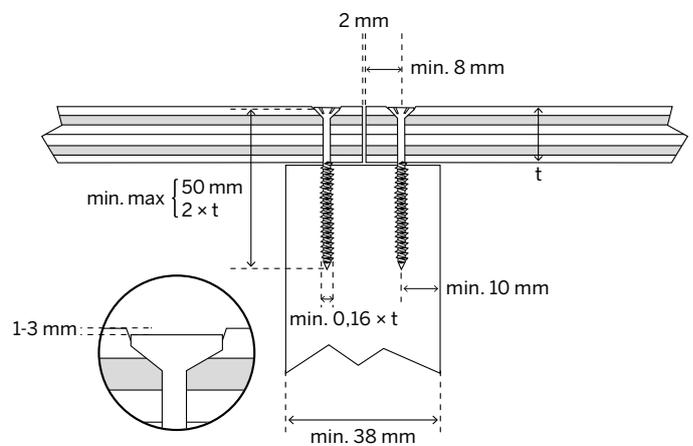


Figure 25. Fixing of square edge panels to wooden support

FASTENERS

- Hot-dip galvanized or stainless steel fasteners should be used (service class 2)
 - durability of the fasteners should be adjusted for the planned service life and actual corrosivity category
- Recommended fasteners
 - flat headed countersunk screws and flat headed annular ring nails
 - smooth shank screws allow tight joints
 - self tapping screws should be used when fixing panels to metal supports
- Minimum fastener length is at least 2 times the panel thickness or 50 mm (which is greater)
- Minimum fastener diameter is 0,16 times the panel thickness
- Heads of the fasteners should be countersunk by 1-3 mm below the panel surface

EXPANSION GAPS

- Fastened panels should have a minimum of 1 mm/m expansion gap between the panels to allow moisture movements
 - between short edges 2-3 mm
 - between long edges 1-2 mm

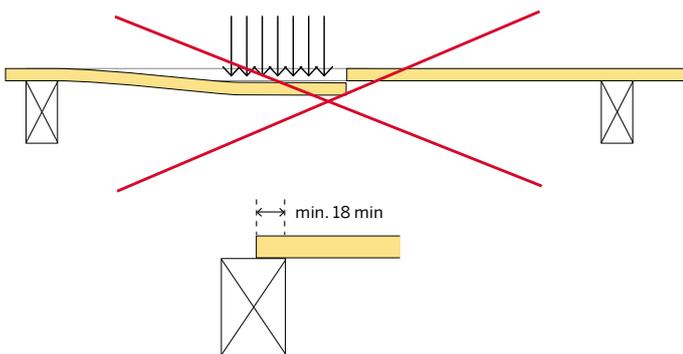
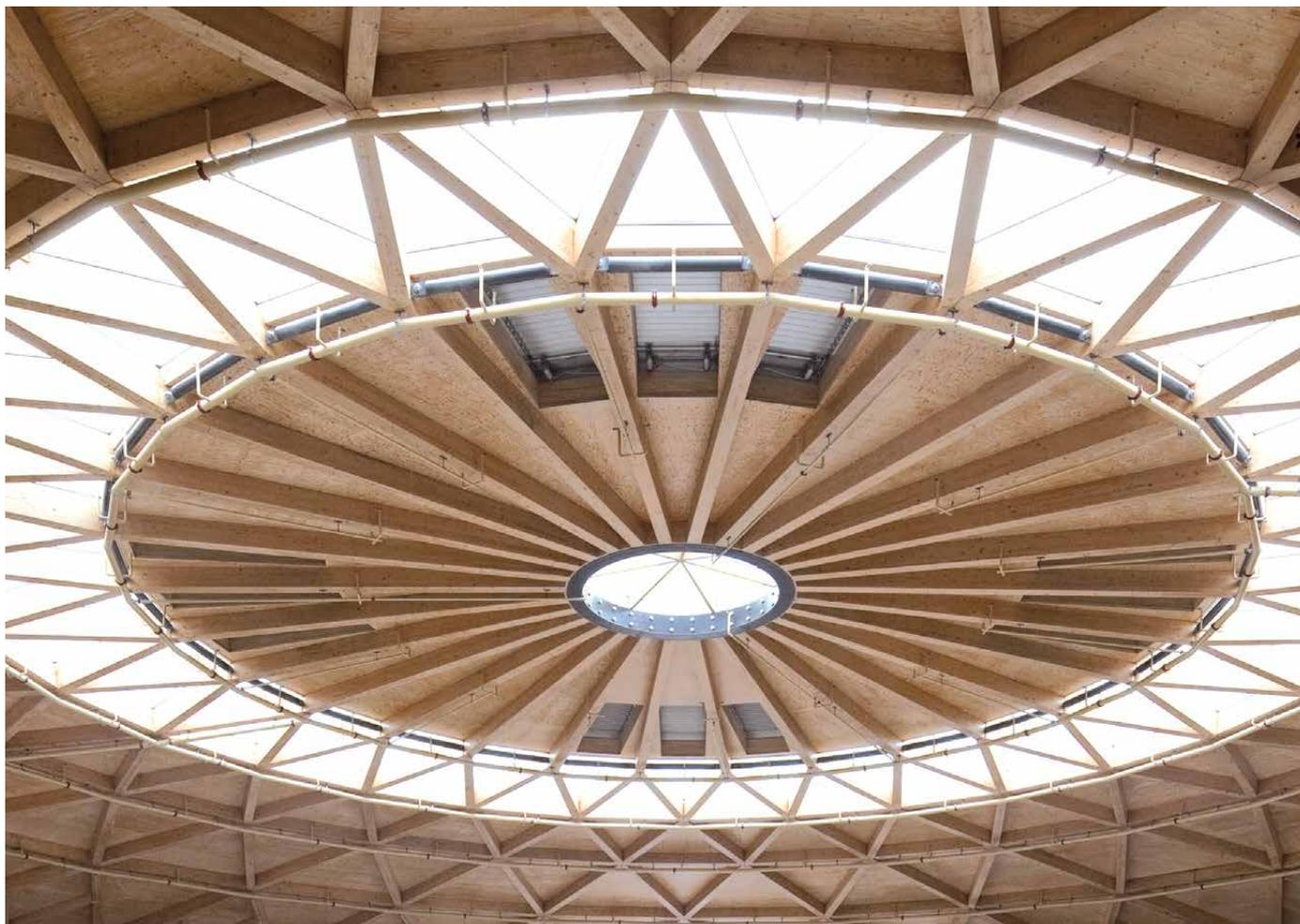


Figure 26. Unsupported square panel edges are not allowed, also short edges of tongue and grooved panels should be placed on supports

4. CEILINGS

Wood has always inspired architects and designers by creating a natural and unique atmosphere in interior applications.



Metsä Wood Spruce is suitable for ceiling paneling as an assembly substrate for other interior lining materials or as a ready finished surface, giving a light, vivid and warm appearance for the room. Spruce panels can be coated with all standard stains, lacquers and paints suitable for wood products.

Metsä Wood Spruce Flex has a smooth thermoplastic overlay, which is a ready finished surface for interior use. It is suitable for ceiling panels giving a light visual appearance and moisture resistance, especially in warehouses, industrial and agricultural buildings.

Plywood can also act as a part of bracing for buildings and there are spruce plywood products available with enhanced fire classification (see Chapter 9).

Typical panel sizes are 2400 × 1200 mm and 2400 × 600 mm. Most common thicknesses for the ceiling panels are 9, 12 and 15 mm. Primary surface quality combinations for the ceiling panels are II/III or III/III.



**KEY ADVANTAGES OF METSÄ WOOD
SPRUCE PLYWOOD IN CEILING APPLICATIONS:**

- Good capacity for hanging loads
- Ready finished surface with Spruce Flex
- Aesthetics
- Easy handling, jointing and fastening
- Low formaldehyde emissions

PRODUCTS:

- Spruce
- Spruce Flex
- Spruce WeatherGuard

4.1 INSTALLATION



Ceiling panels can be installed in two ways: panels can be fastened under the rafters/joists or panels can be fastened on top of rafters when both rafters and ceiling panels are visible. Panels installed under the rafters/joists should be fastened using threaded nails or screws according to EN 14592. Smooth nails are not allowed.

- Before installation panels should be conditioned at least for one week in the end-use moisture conditions
- Fastened panels should have a minimum of 1mm/m expansion gap between the panels to allow moisture movements
 - between short edges 2-3 mm
 - between long edges 1-2 mm
- Panel short edges should be placed in the middle of the support
- Panel joints can be filled with elastic putty, this is especially recommended for Spruce Flex in agricultural buildings
- Maximum fastener distance is 150 mm at the panel edges and 300 mm within the panel
- Spruce plywood fastened on top of the rafters
 - minimum fastener length is at least 2 times the panel thickness or 50 mm (which is greater)
 - minimum fastener diameter is 0,16 times the panel thickness
- Spruce plywood fastened under the rafters or joists
 - minimum fastener spacing and dimensions are calculated according to EN 1995-1-1 (see Chapter 11)
- Heads of the fasteners should be countersunk by 1-3 mm below the panel surface
- When fasteners are an essential part of the structural system, e.g. plywood is used as a bracing panel, the boundary conditions according to EN 1995-1-1 should be taken into account which may affect the dimensions presented in the below drawings (see Chapter 11)

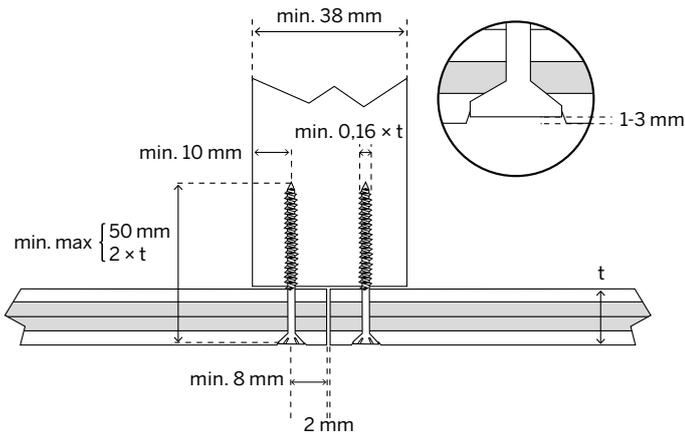


Figure 27. Fastening ceiling panels under the rafters/joists

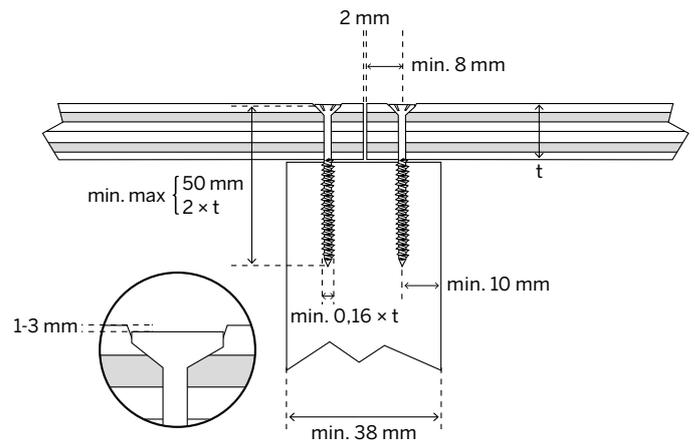


Figure 28. Fastening ceiling panels on top of the rafters

4.2 HANGING LOADS FROM A CEILING

Plywood provides an excellent base for hanging heavy objects from a ceiling without having a supporting beam behind the panel. Fastener withdrawal capacity depends on the density of plywood, type and diameter of the fastener, and penetration depth of the threaded part. Nail withdrawal capacity is much less than of a screw, therefore, only screws are recommended as fasteners for hanging loads.

Please note that when hanging heavy objects from a ceiling the load distribution on the beams must be taken into account in the structural design.

Self-tapping or self-drilling screws (root diameter 0,60-0,75 times nominal diameter) are used for hanging loads. The conical part of the screw's point side should entirely penetrate the plywood. The threaded part of the screw must penetrate the complete plywood panel.

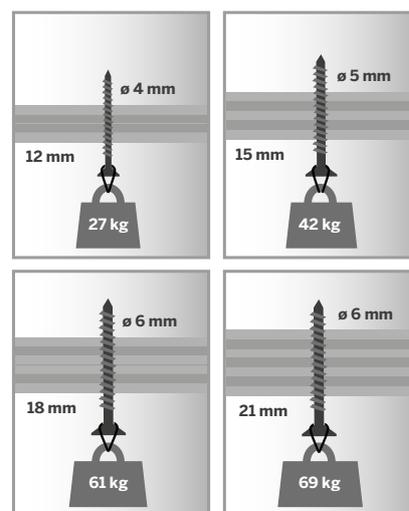


Figure 29. Maximum allowed hanging load per screw, permanent load duration class, service class 1 and 2

5. INTERIOR WALLS

Metsä Wood Spruce plywood is a versatile wall construction panel, suitable also for bracing structures. In the wall structures spruce plywood acts as a good base for fixings.



Due to excellent strength and stiffness properties spruce plywood is the most commonly used sheet material for bracing wood frame buildings. It is easy to install and fasten to various frame structures. Spruce plywood products with enhanced European reaction to fire classification are available for applications with fire performance requirements (see Chapter 9).

Typical panel sizes are 2400 × 1200 mm and 2400 × 600 mm. Most common thicknesses for the wall panels are 9, 12, 15 and 18 mm. Primary surface quality combinations for the wall panels are II/III or III/III.

Spruce plywood panels can be coated with all standard stains, lacquers and paints suitable for wood products.



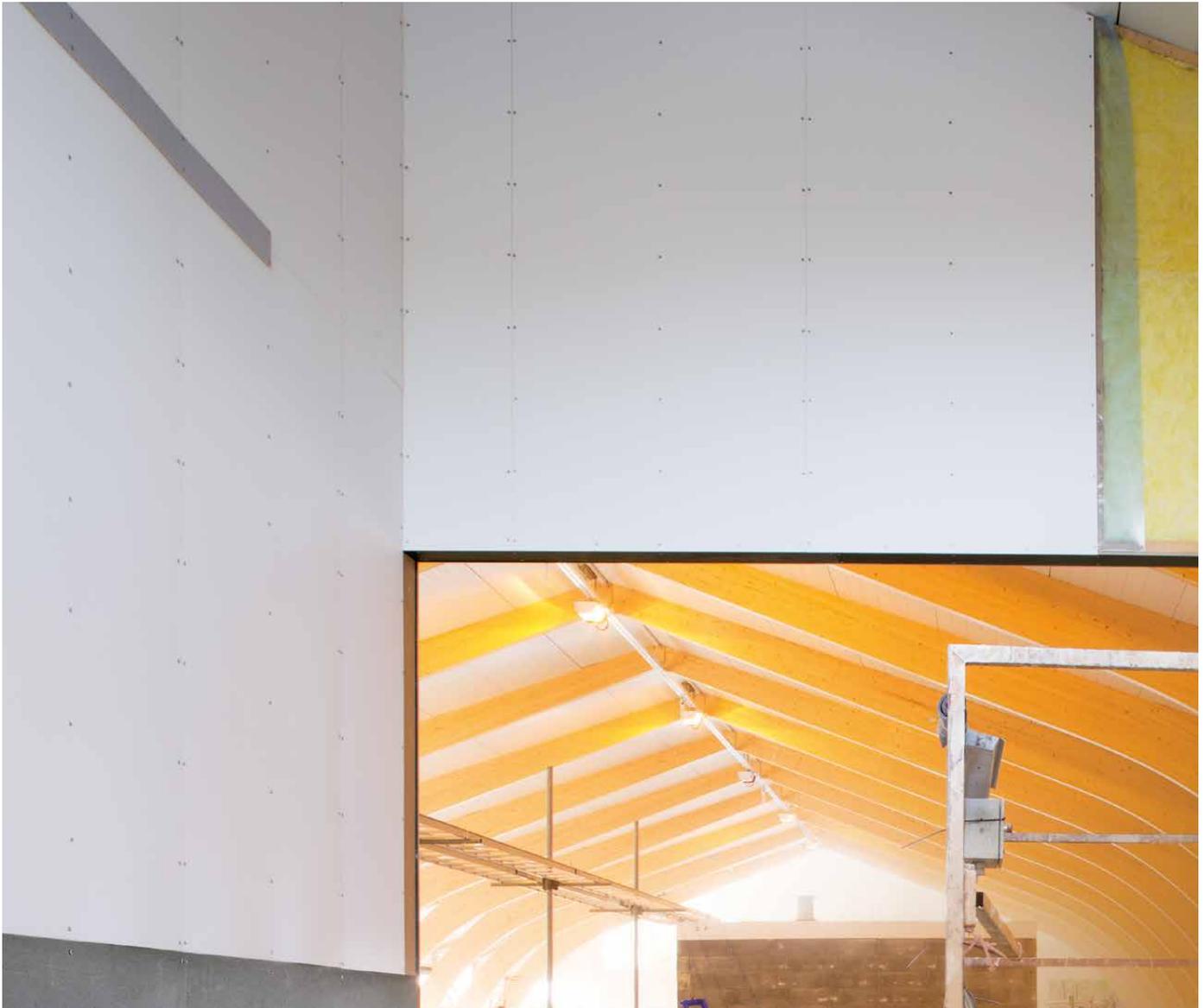
**KEY ADVANTAGES OF METSÄ WOOD
SPRUCE PLYWOOD IN WALL APPLICATIONS:**

- Provides a solid fixing base for hangings
- Can act as a bracing panel
- Excellent impact resistance
- Low emissions

PRODUCTS:

- Spruce
- Spruce Flex
- Spruce WeatherGuard

5.1 SPRUCE FLEX FOR WALLS



Metsä Wood Spruce Flex is a spruce plywood panel with a thermoplastic overlay. The technical advantages of spruce plywood combined with the thermoplastic overlay make Spruce Flex an excellent panel for various demanding interior applications. Spruce Flex panels have a smooth and light colour visual appearance, and an excellent impact and crack resistance. Surface is easy to clean with water and normal detergents.

Spruce Flex is suitable for interior applications, such as a wall and ceiling paneling in agricultural buildings, garages and warehouses. Spruce Flex as spruce plywood in general has a good capacity for hanging loads. Spruce Flex can also be used to protect the gypsum board wall and make the wall more impact resistant.

Panel edges are sealed against moisture absorption with a transparent edge sealing paint. Even though the edge sealing hinders the absorption of moisture into the panel, it does not eliminate it completely. If panels are cut to smaller pieces, edges need to be sealed with water-repellent paint.



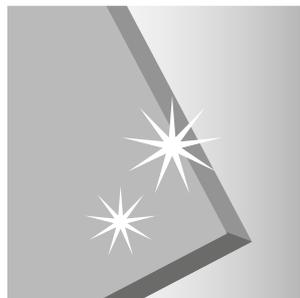
Plywood panel as a fixing base



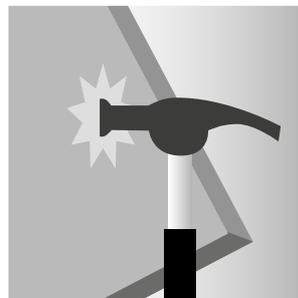
Spruce Flex is used to protect gypsum board wall



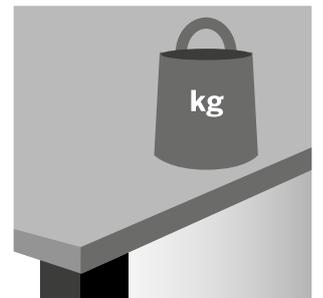
Light colour



Easy to clean



Impact resistant



Strong

5.2 PANEL BRACING

Bracing structures are typically wood frame walls covered with a structural paneling material like plywood. Plywood is used simultaneously as an interior paneling and as a bracing panel due to the good racking resistance of the panels. These wall structures transfer lateral loads into the building foundation. Bracing structures should be designed case by case. Maximum fastener distance is 150 mm at the panel edges and 300 mm within the panel.

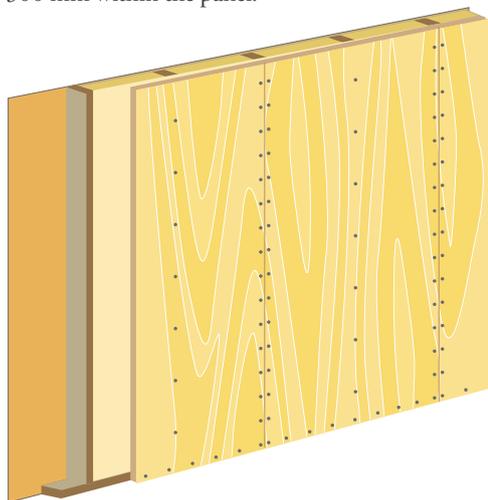


Figure 30. Panel bracing

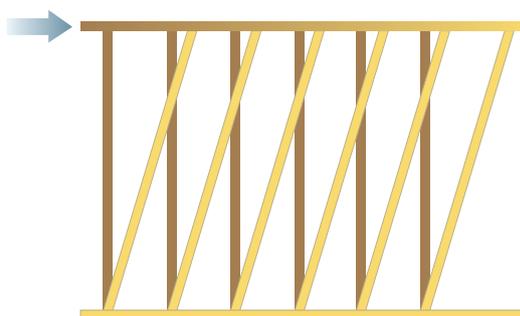
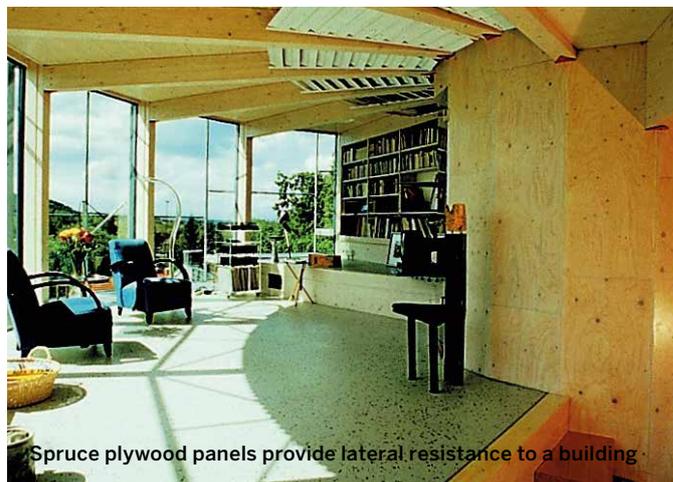


Figure 31. Laterally loaded wall structure without panel bracing

5.3 HANGING LOADS ON A WALL

Plywood provides an excellent base for hanging heavy objects on a wall without having a supporting stud behind the panel. Fastener lateral loading capacity depends on the density of plywood, and type, diameter and penetration depth of the fastener. Screws are recommended as fasteners for hanging loads.

Self-tapping or self-drilling screws (EN 14592) are used for hanging loads. Conical part of the screw's point side should penetrate entirely the plywood. We also recommend that the threaded part of the screw must penetrate the whole plywood thickness.

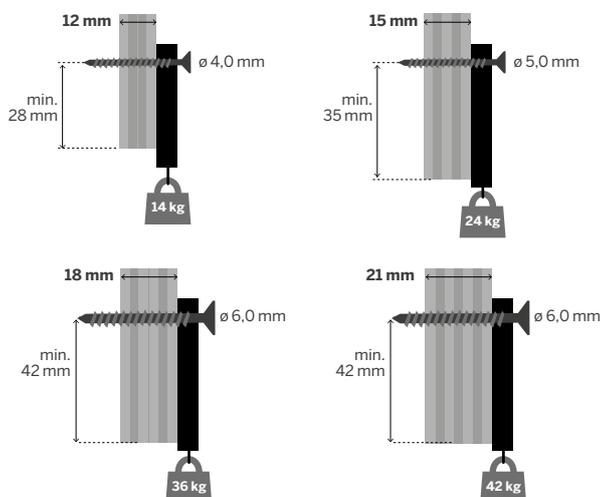


Figure 32. Maximum allowed hanging load per screw, permanent load duration class, service class 1 and 2, screw's characteristic tensile strength $f_{u,k} \geq 500 \text{ N/mm}^2$



5.4 INSTALLATION

Plywood should be conditioned to a moisture content corresponding to the moisture conditions inside the building. Packages should be opened to allow free air movement around the panels.

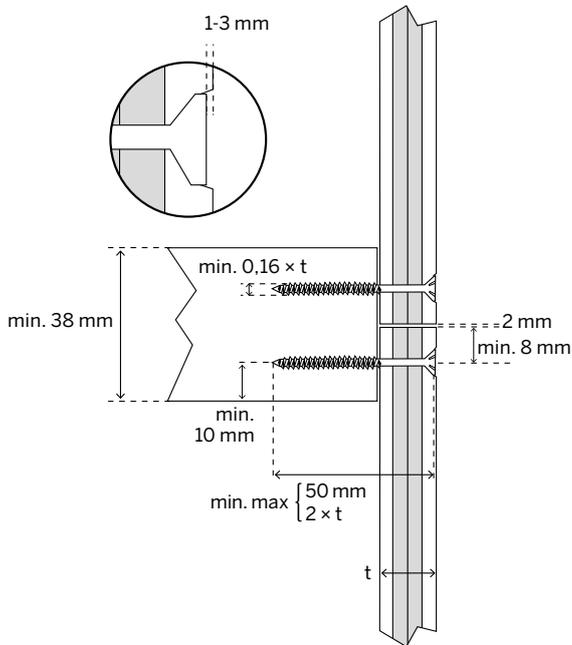


Figure 33. Fixing to wooden support by wood screws

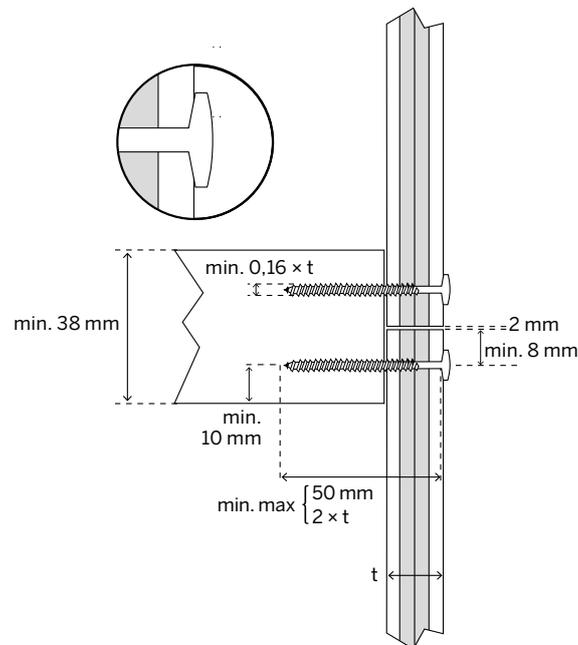


Figure 34. Fixing to wooden support by large head screws (recommended for Spruce Flex)

FASTENING

- Panel long edge should be placed in the middle of the support
- Spruce plywood does not require predrilling since its characteristic density is less than 500 kg/m³. Any need for predrilling comes from the requirements of the fasteners
- Fastener edge distance is a minimum of 8 mm
- Maximum fastener distance is 150 mm at the panel edges and 300 mm within the panel
- Panel joints can be filled with elastic putty, this is especially recommended for Spruce Flex in agricultural buildings
- When fasteners are an essential part of the structural system, e.g. plywood is used as a bracing panel or plywood acts as a buckling support for studs, the boundary conditions according to EN 1995-1-1 should be taken into account which may affect the dimensions presented in the below drawings (see Chapter 11)

FASTENERS

- Standard wood nails and screws can be used in dry and warm conditions (service class 1)
- Hot-dip galvanized or stainless steel fasteners should be used in unheated conditions (service class 2)
 - durability of the fasteners should be adjusted for the planned service life and actual corrosivity category
- Recommended fasteners
 - flat headed countersunk screws and flat headed annular ring nails
 - smooth shank screws allow tight joints
 - self tapping screws should be used when fixing panels to metal supports
- Minimum fastener length is at least 2 times the panel thickness or 50 mm (which is greater)
- Minimum fastener diameter is 0,16 times the panel thickness
- Heads of the fasteners should be countersunk by 1-3 mm below the panel surface
- Spruce Flex is recommended to be fastened with large head screws (no countersunk)

EXPANSION GAPS

- Fastened panels should have a minimum of 1 mm/m expansion gap between the panels to allow moisture movements
 - between short edges 2-3 mm
 - between long edges 1-2 mm

6. RENOVATION

Renovation is one of the main areas in the construction market. Spruce plywood is a high quality construction panel with excellent performance in versatile renovation projects due to its light weight, strength and stiffness, and ease of machining. Metsä Wood Spruce plywood can be used in many renovation applications, such as walls, floors, roofs and attics.

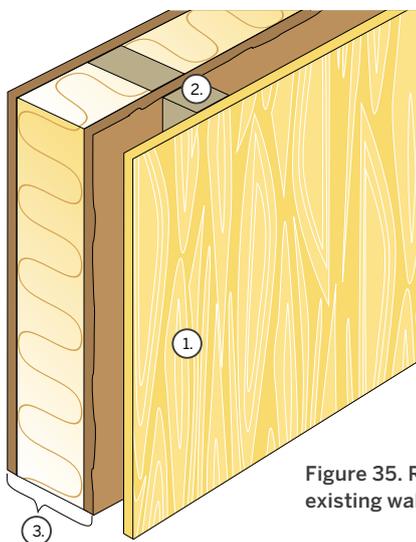


KEY ADVANTAGES OF METSÄ WOOD SPRUCE PLYWOOD IN RENOVATION:

- Light-weight panels can easily be transported and carried to cramped spaces
- Panels can be cut, drilled, glued and treated with ease
- Suitable for combining with various overlay materials and treatments
- Can be fastened to other materials such as metal and concrete
- Old structures may be utilized as part of the renovated structure

6.1 WALL RENOVATION

Spruce plywood can be used in renovation of existing walls since it can easily be fastened to several materials such as wood, metal and concrete. Old structures can be utilized as part of the renovated structures. For example old uneven or damaged wall paneling can be covered with additional battens and Spruce plywood to create a new smooth surface. Spruce plywood has good impact resistance and it provides an excellent base for hanging heavy objects.



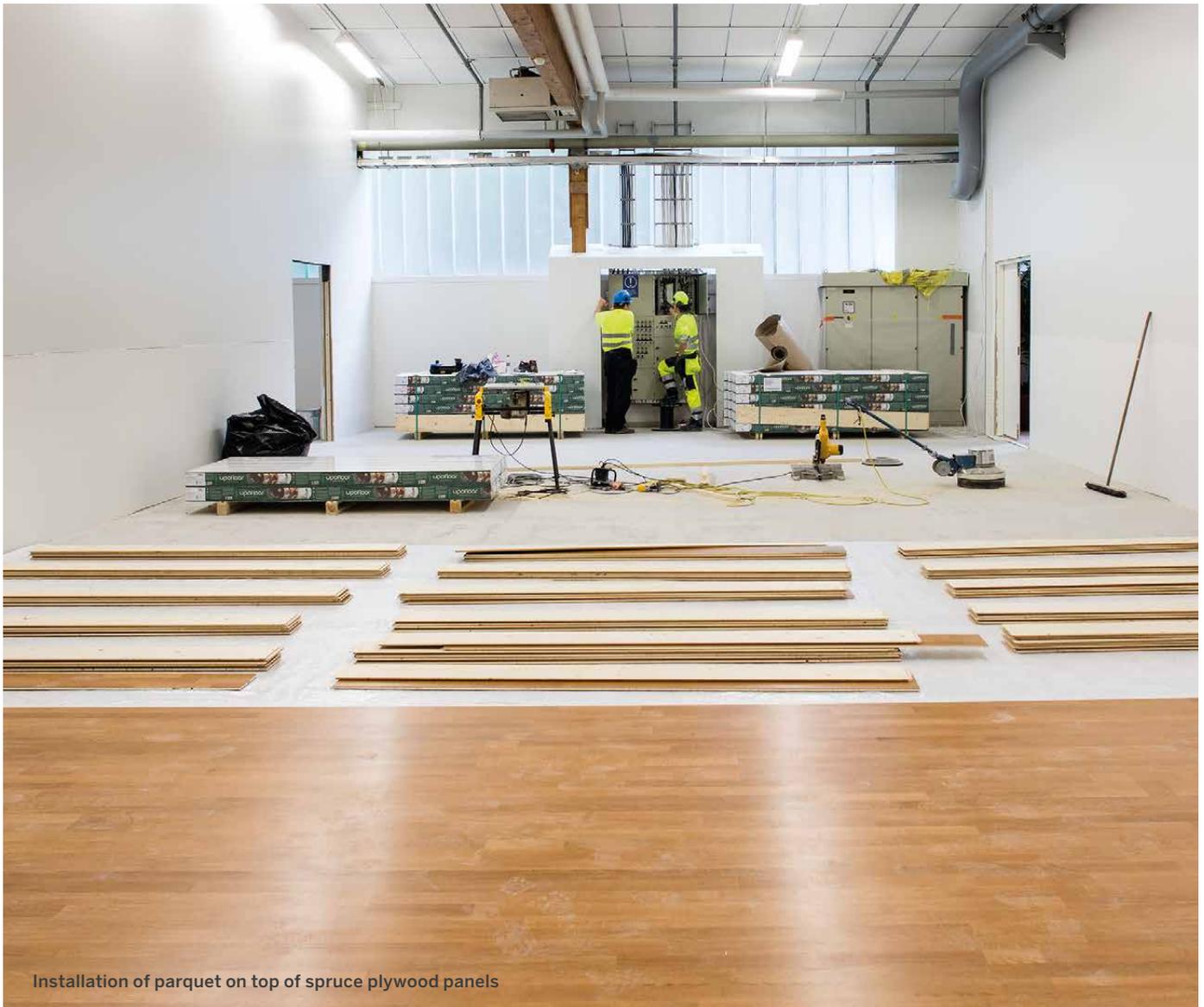
1. Spruce plywood
2. Batten
3. Old wall structure

Figure 35. Renovation of an uneven existing wall structure

A non-load-bearing, light-weight partition wall provides multi-purpose solutions for all types of buildings. The simplest way to build a partition wall is to install spruce plywood panels on both sides of a framework. Traditional material for the framing is wood, but also steel and aluminium are possible materials. Installation of this type of partition wall can be done quickly at construction site. Openings, fixings and panel finishing can easily be done using traditional woodworking tools and materials.

Chapters 5 and 11 provide more information on the wall applications and technical properties.

6.2 FLOOR RENOVATION



Installation of parquet on top of spruce plywood panels

Metsä Wood Spruce plywood is a strong, rigid and durable flooring panel, well suited for use as an assembly substrate for different surface materials, or as a ready-made floor panel.

Spruce plywood flooring panels have a good load-bearing capacity and the light-weight panels can be easily installed on top of old structures. Especially with four sides tongue and grooved panels large floor areas can be mounted quickly. Metsä Wood also provides half size panels which are easier to handle on renovation sites and they fit to cramped spaces.

Chapters 2 and 11 provide more information on the flooring applications and technical properties.

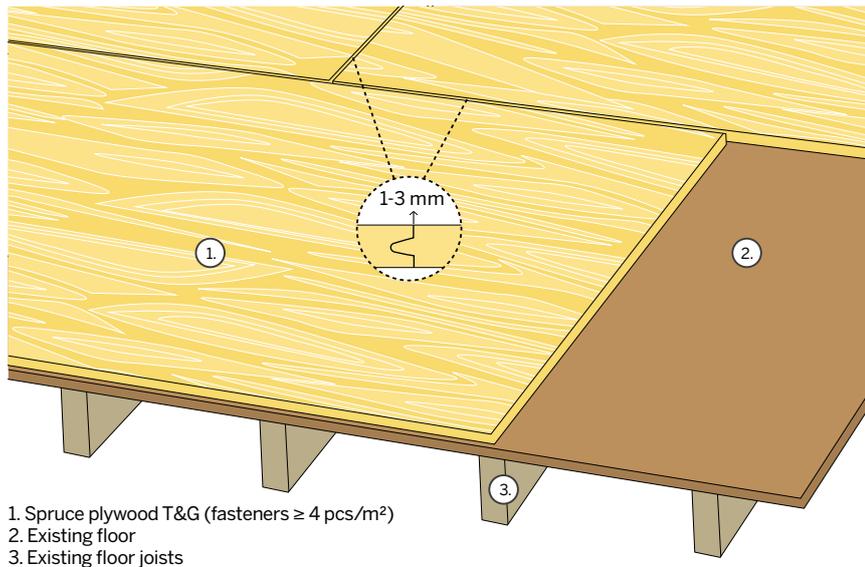
NOTE: The load-bearing capacity of the existing structure needs to be checked separately due to the additional load coming from the added materials.

IMPROVING STRENGTH AND RIGIDITY

The load-bearing capacity and rigidity of a floor can be improved by installing Metsä Wood Spruce plywood directly on top of the old floor structure. The required panel thickness depends on the quality of the existing structure.

Spruce plywood panels should be fastened to the structure below using at least 4 fasteners per square meter (4 pcs / m²). To avoid problems with creaking glue can be added in the panel joints.

The old floor paneling can also be removed and replaced with spruce plywood. This solution keeps the total height of the floor structure smaller. Plywood panels should be fastened according to the installation instructions given in Chapter 2.



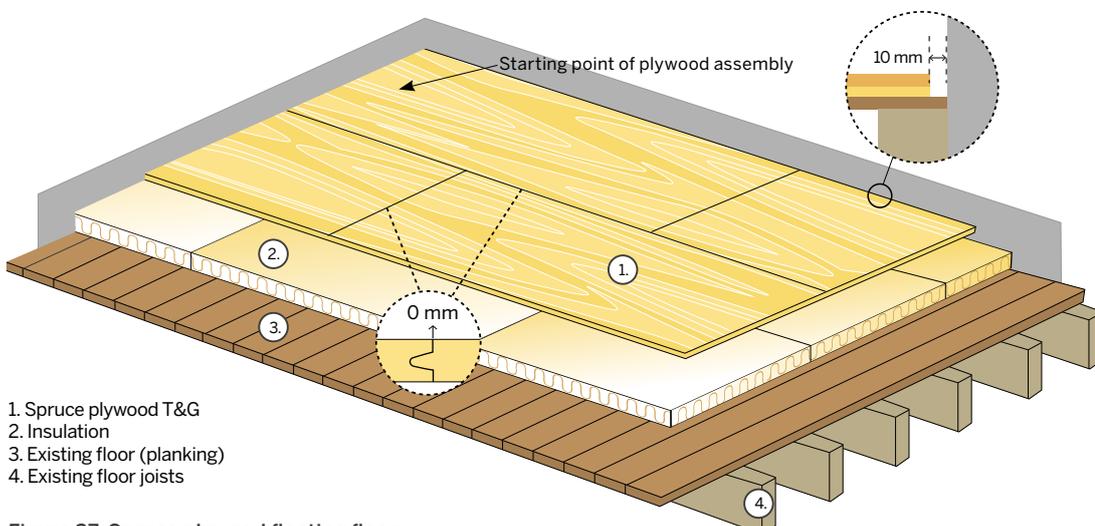
1. Spruce plywood T&G (fasteners ≥ 4 pcs/m²)
2. Existing floor
3. Existing floor joists

Figure 36. Spruce plywood installed directly on top of an existing floor

REDUCING IMPACT SOUND TRANSMISSION

Floating floor structure with Metsä Wood Spruce plywood panels reduce the impact sound transmission through the structure. A suitable rigid insulation material designed for the end use should be used under the panels. Floating floor paneling should not be fastened

to the existing floor. A minimum of 10 mm expansion gap should be left between the floor paneling and adjoining structure. The gap should be filled with elastic putty.



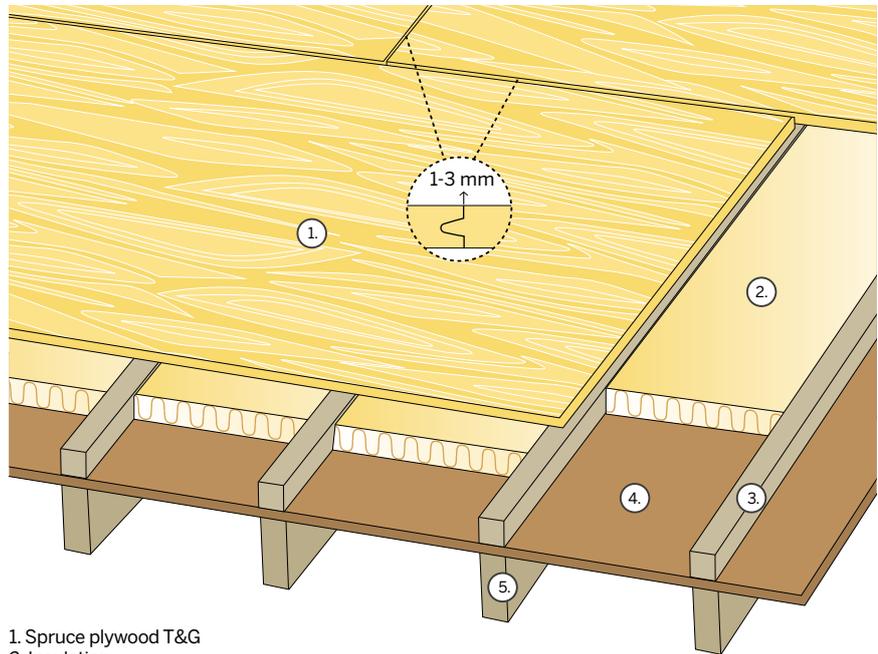
1. Spruce plywood T&G
2. Insulation
3. Existing floor (planking)
4. Existing floor joists

Figure 37. Spruce plywood floating floor

REPAIRING INCLINED OR UNEVEN FLOORS

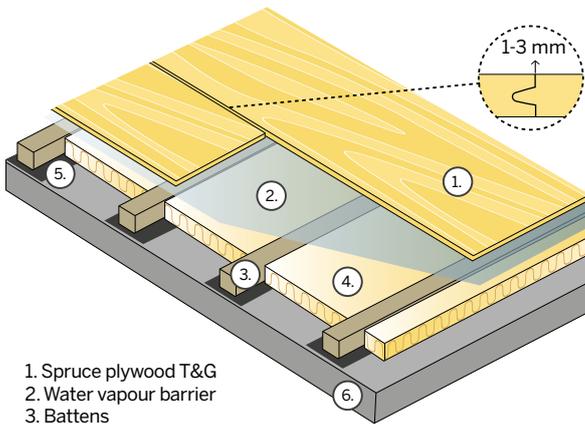
Buildings may sometimes subside which can cause inclination of floors. Small inclinations may be repaired using battens and spruce plywood on top of the existing floor surface. Insulation can be installed in the cavity to improve airborne sound insulation. The structural stability of the building should be checked in case of significant floor inclinations.

Spruce plywood is also suitable material to repair uneven floor surfaces. Depending on the magnitude of the floor deflections battens may be needed to support the new panels. Smaller deformations may be repaired by installing spruce plywood panels directly on top of the existing floor or a soft insulation layer may be added under the panels to even out the existing floor surface.



1. Spruce plywood T&G
2. Insulation
3. Battens (individual batten dimensions according to floor inclination)
4. Existing floor with pitch
5. Existing floor joists

Figure 38. Inclined floor repaired with battens and spruce plywood (battens may be placed in any direction depending on the inclination direction)



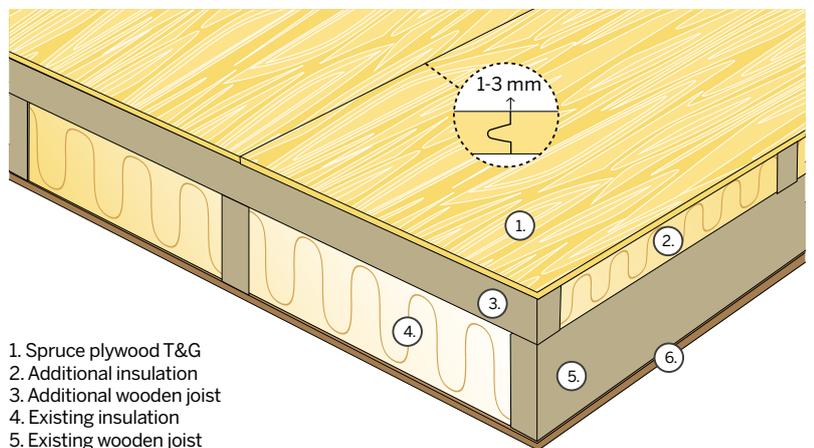
1. Spruce plywood T&G
2. Water vapour barrier
3. Battens
4. Insulation
5. Damp-proof membrane/primer (only base floor)
6. Uneven screed/concrete

Figure 39. Uneven layer of screed repaired with battens and spruce plywood

ADDITIONAL INSULATION FOR BASE FLOOR

In order to enhance the energy efficiency of an existing base floor structure or to make floor surface feel more comfortable, an additional insulation layer is usually needed. New insulation layer and new joists are placed on top of the existing insulation layers after removing the old surface materials. Also the existing insulation can be replaced. New joists are installed crosswise to the existing joists. Spruce plywood is used as a new floor panel and a new surface material is installed on top of the panels.

NOTE. Building physics design should be done for each individual case separately.



1. Spruce plywood T&G
2. Additional insulation
3. Additional wooden joist
4. Existing insulation
5. Existing wooden joist
6. Existing structural panel

Figure 40. Additional insulation for base floor

6.3 ROOF RENOVATION

Strong and rigid Metsä Wood Spruce plywood is an excellent substrate for different roofing materials. The light and dimensionally stable panels are easy to fit together and they can also be used as a safe working surface during the installation of the roofing.

Metsä Wood Spruce MouldGuard is an ideal roof decking panel to be used in unheated spaces with relative humidity temporarily exceeding 75 % to reduce the risk of mould growth.

Chapters 3 and 11 provide more information on the roofing applications and technical properties.

NOTE. The load-bearing capacity of the existing structure needs to be checked separately due to the additional load coming from the added materials.

NOTE. Building physics design should be done for each individual case separately.

ROOF SURFACE STRUCTURE RENEWAL

In a roofing renovation the old roofing material is replaced. If the substrate material is in poor condition or the new roofing material requires solid surface Spruce MouldGuard plywood is an excellent solution. Plywood panels should be fastened according to the installation instructions given in Chapter 3.

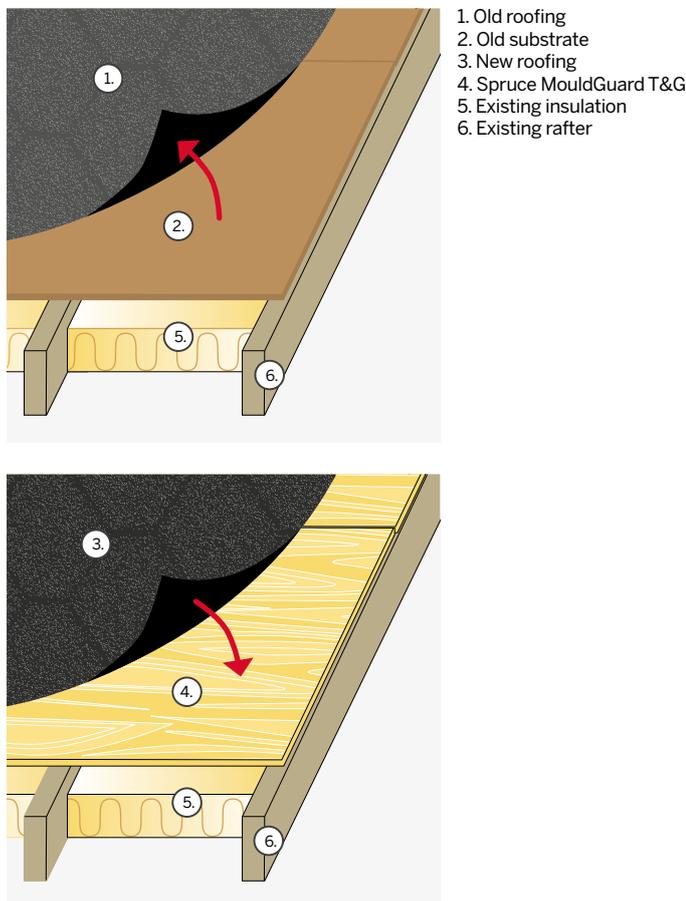


Figure 41. Replacing old surface structures of a roof

ROOFING RENEWAL

When it is not necessary to remove the old roofing and the substrate material is still in good condition, the new roofing structure can be placed on top of the old roofing (roofing felt or steel sheets). Battens are installed on top of the existing roof and the Spruce MouldGuard plywood is fastened on top of the battens. Roofing is placed on top of the plywood.

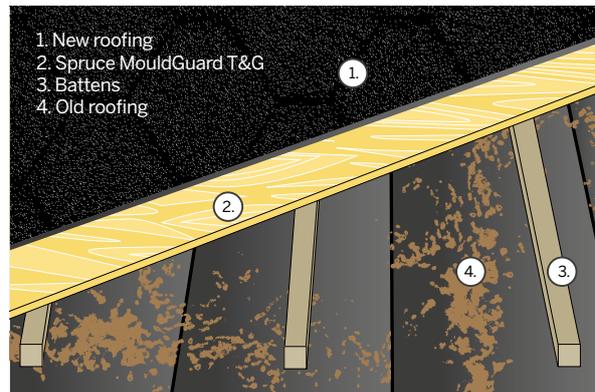


Figure 42. New roofing structure on top of old roofing

ADDITIONAL INSULATION OF ROOF

In order to enhance the energy efficiency of existing roof structure, additional insulation layer is usually needed. New insulation layer and new beams are placed on top of the existing insulation layers after removing the old roof surface structure. Also the existing insulation can be replaced. New beams are installed on top to the existing rafters. Spruce MouldGuard plywood is used as a new substrate panel and new roofing is installed on top of the panels.

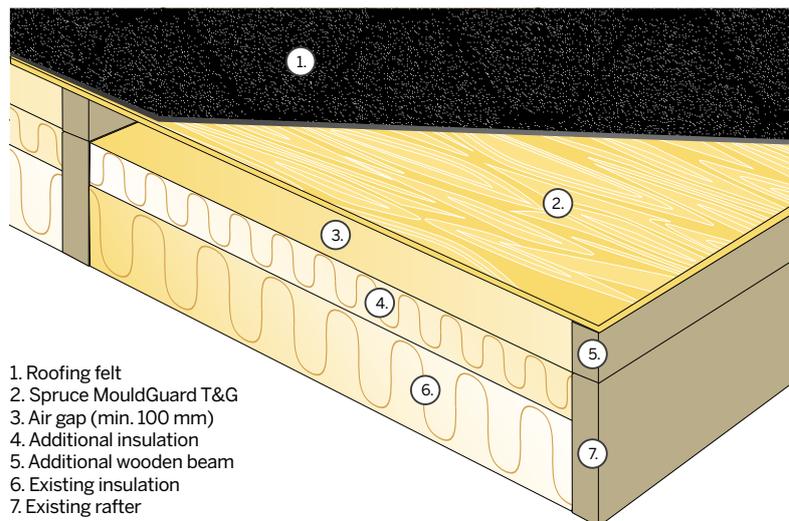


Figure 43. Additional insulation for roof

INCREASING ROOF PITCH

More information in Chapter 6.4 Attic renovation.

6.4 ATTIC RENOVATION

Roof space is located between the pitched roof and the ceiling structure and it is a cold ventilated space. Roof spaces can be converted into habitable attics by renewing the existing load-bearing roof structures. If the roof space is large enough attic conversion can be done without changing the outer dimensions of the building.

It is always recommended to use qualified architect and structural designer in attic renovations due to the complexity of the projects. The load-bearing capacity of the remaining structures including foundations must be verified taking into account the additional loads.

CONVERSION OF ROOF SPACE

Large roof spaces can be modified into attics by building inside new floor, wall and ceiling structures. Spruce plywood can be used as paneling material.

INCREASING ROOF PITCH

When the roof pitch is small or the building has a flat roof more space can be added by increasing the roof pitch. Kerto LVL can be used in the A shaped trusses. Spruce plywood can be used as the gusset plates of the trusses, and as floor, wall and ceiling panels. Spruce MouldGuard can be used as substrate panel for roofing.

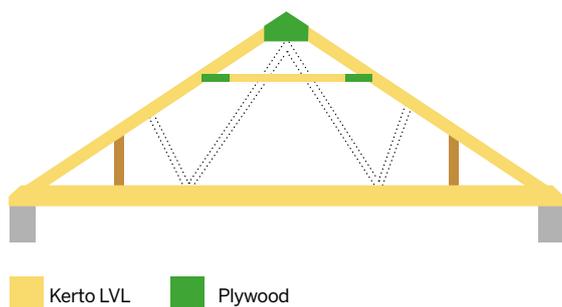


Figure 45. New Kerto LVL frame



Figure 44. Plywood in attic renovations

BUILDING AN ADDITIONAL FLOOR

Additional floors can be built using Kerto LVL joists and rafters and it can cover the whole roof area or only part of it. Spruce plywood can be used as a floor, wall and ceiling panel. Spruce MouldGuard can be used as a substrate panel for roofing.

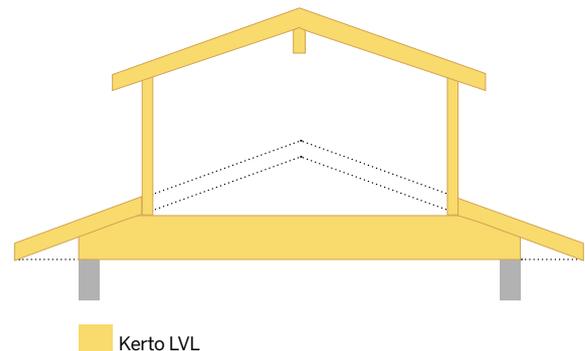


Figure 46. Additional floor



DORMER

A dormer is generally used to increase the feel of space and amount of sun light in attic rooms. Spruce MouldGuard plywood can be used as paneling in the dormer structures.



Increased roof pitch



Additional floor

7. MOULD PROTECTION

Metsä Wood Spruce MouldGuard is a surface impregnated softwood plywood panel, significantly reducing the risk of mould growth compared to unprotected softwood plywood panels.



There is always a risk of mould growth on the surface of untreated wood products when they are located in high relative humidity conditions or in an unheated space where the humidity of the air may be high and condensation may occur from time to time. In end use applications, such as a roofing panel, Metsä Wood recommends the use of Metsä Wood Spruce MouldGuard plywood.

Spruce MouldGuard provides a ready to use surface for humid conditions. The panels have a light brown colour and the surface can be further treated with paints, lacquers and varnishes applicable on wood products. The compatibility of the surface treatment is recommended to be confirmed from the supplier.

Spruce MouldGuard has M1 emission class for building materials and formaldehyde emissions are far below the class E1 requirements. The treatment has no influence on the corrosion properties of the fasteners. Direct contact with foodstuffs, animal feed or similar must be avoided.

Spruce MouldGuard is surface impregnated with a wood preservative at the mill. The spreading of the anti-mould agent is carefully controlled to guarantee an even spread and sufficient amount of the anti-mould agent. Spruce MouldGuard production is part of the mill quality control system overseen by a third party certifier.

PRODUCT	THICKNESS [mm]	MAX SIZE [mm]	APPROVAL	QUALITY CONTROL	RANGE OF USE
MouldGuard	12 – 30	2500 × 1250	CE-marked	VTT Expert Services Ltd	Weather protected areas



KEY ADVANTAGES OF METSÄ WOOD SPRUCE MOULDGUARD PLYWOOD:

- MouldGuard treatment provides up to 5 times improved resistance to mould and blue stain compared to untreated panels
- Ready to use surface saves time at construction site
- Off-cuts are classified as biofuel and they can be disposed by burning.
 - due to preservative treatment the correct combustion conditions and suitable waste burning plants should be checked locally

TESTED PERFORMANCE

Spruce MouldGuard is a general purpose construction panel for conditions where the air relative humidity may exceed 75%. Spruce MouldGuard can be used in the same way as standard Spruce plywood panels, but it should be protected from direct rain and UV radiation.

A field test performed by VTT clearly shows that mould and blue stain grow much slower on untreated spruce than on untreated pine. The mould and blue stain resistance of the Metsä Wood Spruce can be significantly further enhanced with MouldGuard treatment.

There is always a risk of mould growth if there is organic material on the panel surface, for example, dust and dirt can cause mould growth even if the product itself is protected.

OUTSIDE FIELD TEST OF 16 WEEKS

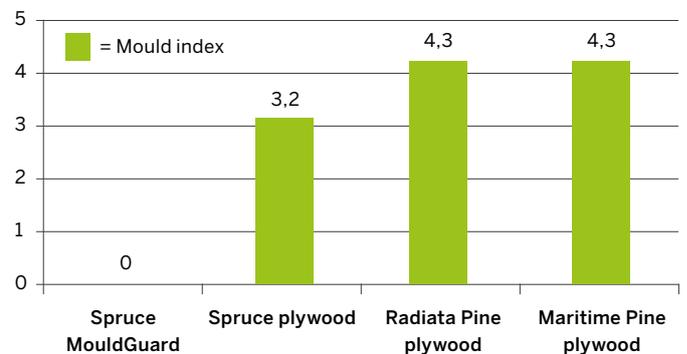
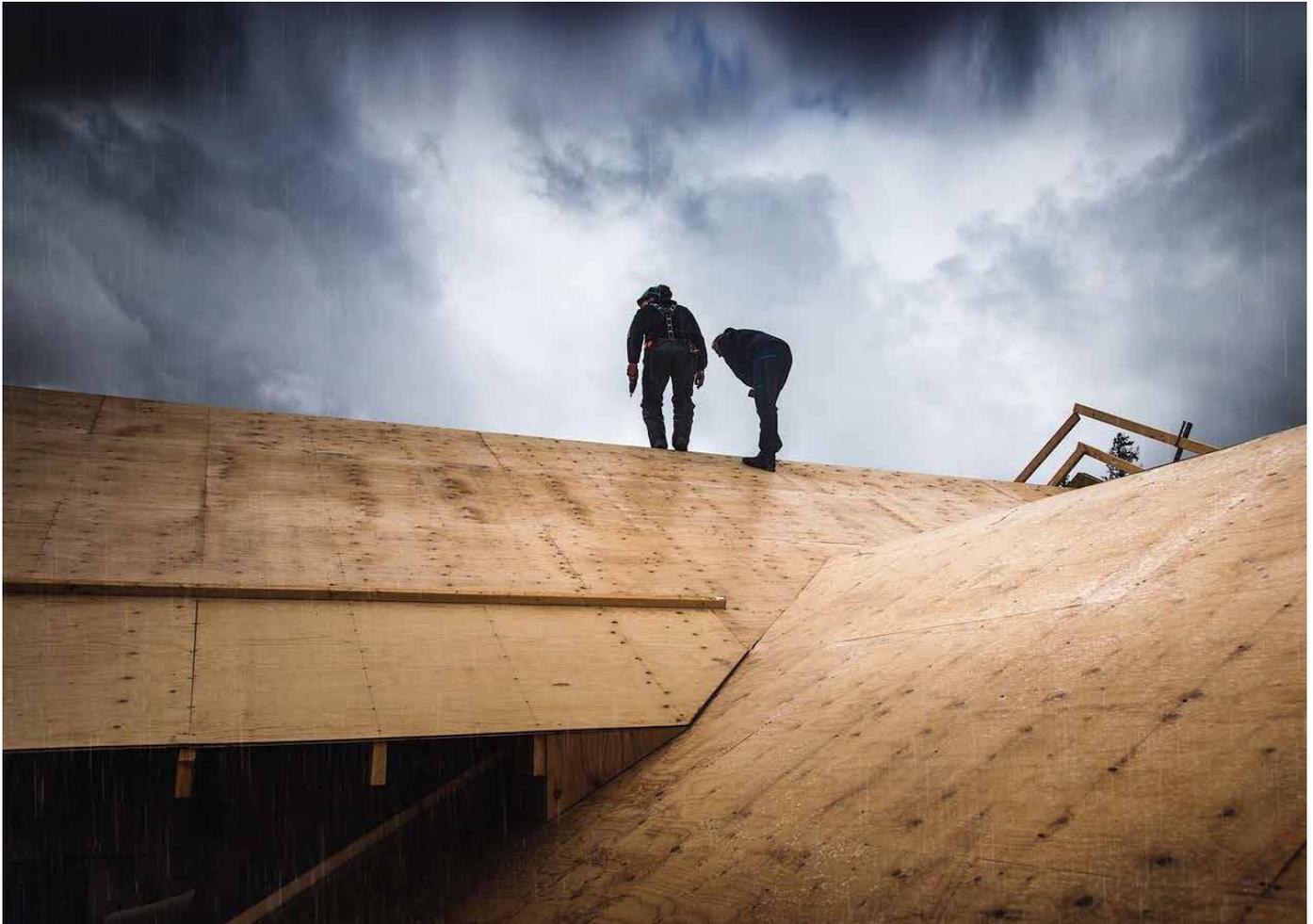


Figure 47. Results of the outdoor field test by VTT (VTT-R-10360-10), mould index describes the occurrence of mould growth on the panel surface

8. WEATHER PROTECTION

Metsä Wood Spruce WeatherGuard is a spruce plywood panel with a hydrophobic surface. The surface rejects rain-water and therefore reduces the amount of water absorbed by the panel during construction work. At the same time the surface allows the panel to breathe and water vapour to move freely.



During construction, it is common for building materials to get wet because of rain, and reasonable amounts of wetness can be expected during a typical construction. It is essential to allow wood-based components to dry before the components are fitted into the final structure. Otherwise moisture can lead to mould growth. Good construction site planning takes protection from the rain into account, and protects all moisture-sensitive building materials.

The colour of WeatherGuard treatment is transparent. The surface can be further treated with standard paints, lacquers, vanishes and protection treatments applicable to wood products. Also, carpets, linoleum, tiles etc. can be glued to the surface. Compatibility of the glue or surface treatment must be confirmed from the supplier. Before treating or gluing large areas, it is recommended to test with small sample.

PRODUCT	THICKNESS [mm]	MAX SIZE [mm]	APPROVAL	RANGE OF USE
Spruce Weather-Guard	12 – 30	2500 × 1250	CE-marked	On-site construction

KEY ADVANTAGES OF METSÄ WOOD SPRUCE WEATHERGUARD PLYWOOD:

- Reduced moisture intake and swelling
 - up to 60 % reduction of water intake in rain
 - better dimensional stability results in enhanced assembly tolerances
 - shorter drying period before closing structures ⇒ faster building time and energy savings
 - lower risk of damage caused by wet structures
- The hydrophobic surface temporarily protects the product from rain during construction period
 - treatment does not block water vapour movements
- WeatherGuard treatment does not affect the strength properties, slip resistance, reaction to fire and corrosion of the fasteners compared to untreated spruce plywood



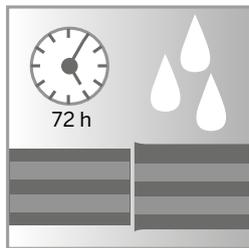
TESTED PERFORMANCE

During field tests in typical construction site settings, full size panels of Spruce WeatherGuard were placed horizontally to simulate roof and/or floor structures. The 72-hour test demonstrated that Spruce WeatherGuard panels absorbed only half of the amount of water compared to untreated spruce plywood. Due to the lower moisture content of Spruce WeatherGuard also the needed drying period is shorter. In the tests the difference of the drying period duration was 48 hours.

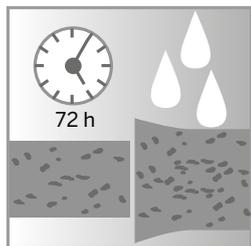
Plywood is a hygroscopic material and the moisture content is dependent on the relative humidity and temperature of the ambient atmosphere. It is recommended that before installation plywood is conditioned to a moisture content corresponding to the conditions of the end-use application.



Shorter drying period



Thickness swelling of spruce plywood 4-8 %



Thickness swelling of OSB 15-28 %

Weathering Test
Moisture Uptake – Horizontal Samples

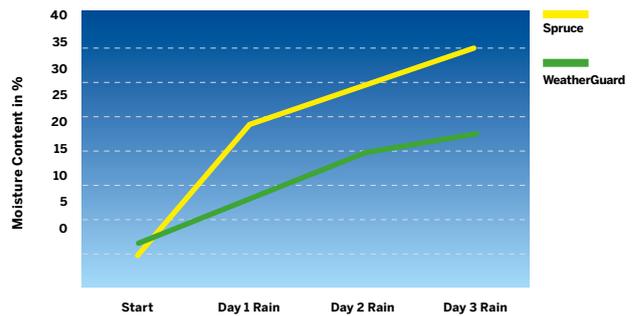


Figure 48. Water absorption of Spruce WeatherGuard and untreated spruce plywood measured by Metsä Wood.

Weathering Test
Drying time – Horizontal Samples

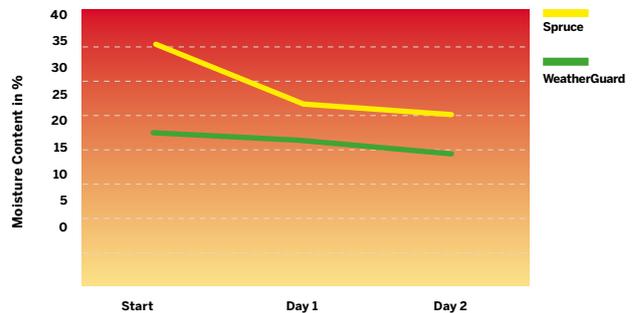


Figure 49. Drying time of Spruce WeatherGuard and untreated spruce plywood measured by Metsä Wood.

9. FIRE SOLUTIONS

Metsä Wood Spruce FireResist is a plywood product with enhanced fire performance. The product has been tested according to EN 13501-1 and it has the highest European reaction to fire classification possible for wood products (Class B).



Spruce FireResist is suitable for use as wall, floor and ceiling panel and it offers a visible wood surface. Additional coatings are not recommended for Metsä Wood Spruce FireResist as coatings might affect the fire performance of the plywood. The compatibility of the surface treatment should be confirmed from the paint or varnish supplier.

Standard Metsä Wood Spruce reaction to fire classification, fire protection ability of a covering and charring rates are described in technical information (Chapter 11).

THE MAIN APPLICATIONS ARE:

- Wall, ceiling and flooring structures with fire performance requirements (for example public buildings, technical rooms, garages etc.)
- Partition walls
- Suitable also for bearing and stiffening structures

PRODUCT	THICKNESS [mm]	MAX SIZES [mm]	REACTION TO FIRE CLASS*	FIRE PROTECTION ABILITY OF A COVERING (K-CLASS)**	END USE CONDITIONS (STRUCTURAL USE)
FireResist	15 – 21	2500 × 1250	B-s1, d0 B _{fi} -s1	K ₂ 10 and K ₁ 10	Dry (interior)
FireResist	24 – 30	2500 × 1250	B-s1, d0 B _{fi} -s1	K ₂ 30	Dry (interior)

* Field of application of the European reaction to fire classes are described in the following chapters

** Field of application of the K-classes are described in technical information (Chapter 11)



KEY ADVANTAGES OF METSÄ WOOD SPRUCE PLYWOOD WITH ENHANCED FIRE PERFORMANCE:

- Enhanced fire safety
- European reaction to fire class B
 - very limited contribution to fire
 - decreased need for structural protection with gypsum board
 - enables load-bearing panel structures
- CE marked
- Quality controlled manufacturing process
- Strong, rigid and light-weight panel
- Easy to machine and install by using conventional woodworking tools and fasteners
 - panel is impact resistant and does not crumble
 - good base for fasteners

9.1 SPRUCE FIRERESIST



Spruce FireResist is painted and used in combination with gypsum board to enhance the impact resistance of the wall

Metsä Wood Spruce FireResist is a surface impregnated softwood plywood panel with enhanced fire performance. Spruce FireResist remains visually and physically stable in interior applications where wetting does not occur. Suitable applications for the product are interior applications in service class 1 (EN 1995-1-1).

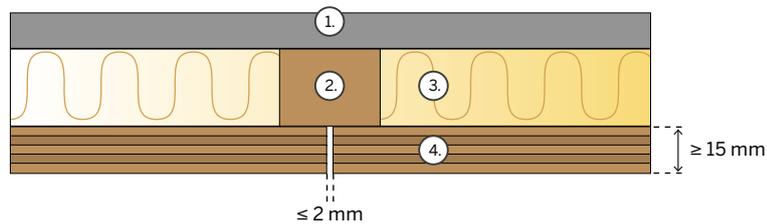
Spruce FireResist does not contain heavy metals, boron or halogenated compounds. The product contains nothing classified as hazardous waste and the product is classified as biofuel. Additional coatings are not recommended for Metsä Wood Spruce FireResist as coatings might affect the fire performance of the plywood. The compatibility of the surface treatment should be confirmed from the paint or varnish supplier.

KEY ADVANTAGES OF METSÄ WOOD SPRUCE FIRERESIST PLYWOOD:

- Surface impregnated softwood plywood panel with enhanced fire performance (B-s1, d0)
 - enables visible wood surface
- Strong, rigid and light-weight panel
- Easy to machine and install by using conventional wood-working tools and fasteners
 - panel is impact resistant and does not crumble
 - good base for fasteners
- Does not contain heavy metals, boron or halogenated compounds
- Classified as biofuel (EN 14961-1)

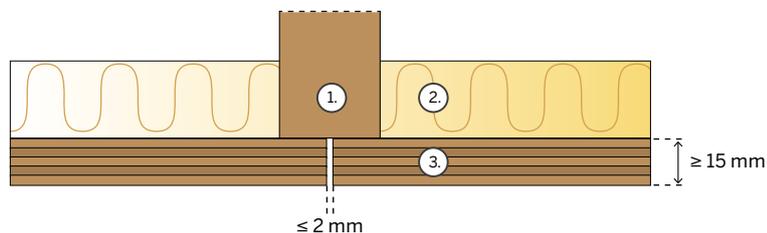
FIELD OF APPLICATION OF THE SPRUCE FIRERESIST EUROPEAN REACTION TO FIRE CLASSIFICATION B-s1, d0 (EXCLUDING FLOORINGS):

- Minimum panel thickness is 15 mm
- With substrates of at least class A2-s1,d0 with a density of at least 30 kg/m³ (e.g. insulation)
- With or without an air gap between the product and the substrate of at least class A2-s1,d0 and density of at least 525 kg/m³ (e.g. gypsum board)
- Maximum of 2 mm gap between the panels with frame support under the joints
- Fixed mechanically to wooden or metallic frames



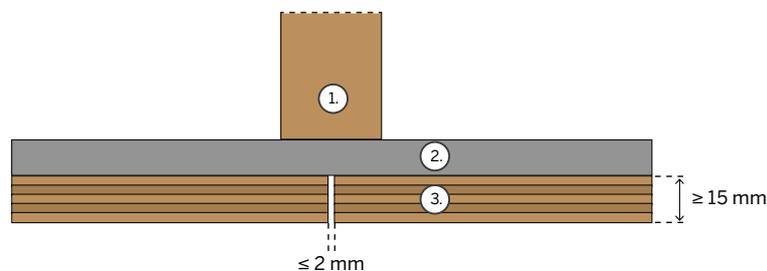
1. Substrate, no demands, e.g. plywood, concrete
2. Wood frame (or optionally metal frame)
3. Insulation at least class A2-s1, d0 ≥ 30 kg/m³, e.g. glass wool or stone wool
4. Spruce FireResist

Figure 50. Wall or ceiling structure with thermal insulation



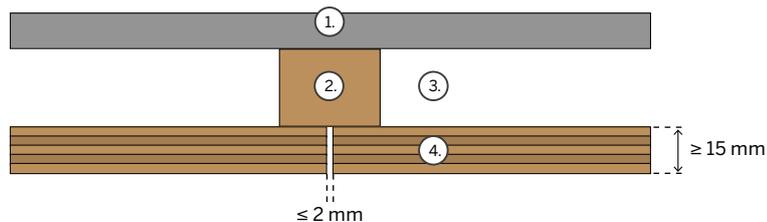
1. Wood frame (or optionally metal frame)
2. Insulation at least class A2-s1, d0 ≥ 30 kg/m³, e.g. glass wool or stone wool
3. Spruce FireResist

Figure 51. Ceiling structure with thermal insulation



1. Wood frame (or optionally metal frame)
2. Substrate at least class A2-s1, d0 ≥ 30 kg/m³, e.g. concrete, in walls gypsum board
3. Spruce FireResist

Figure 52. Wall or ceiling structure with Spruce FireResist fixed to the substrate



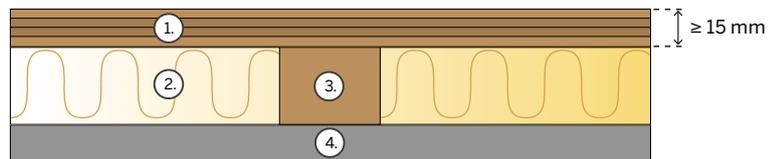
1. Substrate at least class A2-s1, d0 ≥ 525 kg/m³, e.g. gypsum board, concrete
2. Wood frame (or optionally metal frame)
3. Air gap
4. Spruce FireResist

Figure 53. Wall or ceiling structure with air gap



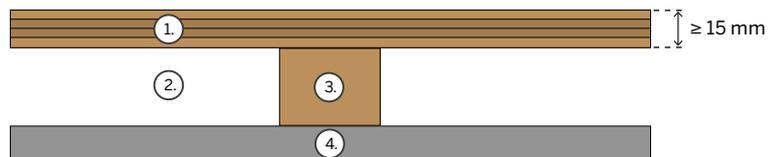
FIELD OF APPLICATION OF THE SPRUCE FIRERESIST EUROPEAN REACTION TO FIRE CLASSIFICATION B_{fl}-s1 FOR FLOORINGS:

- Minimum panel thickness is 15 mm
- With or without an air gap between the product and
 - wood based substrate with density of at least 470 kg/m³
 - class A1 or A2-s1, d0 substrate with density of at least 470 kg/m³
- Without an air gap between the product and plywood substrate with density of at least 400 kg/m³
- With thermal insulation of class A1 or A2-s1, d0 and density of at least 23 kg/m³ and wood based substrate with density of at least 470 kg/m³
- Panels may have joints (tongue and groove joints or square edged panels with frame support under the joints)



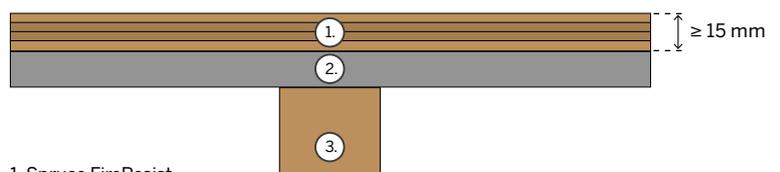
1. Spruce FireResist
2. Insulation, Class A1 or A2-s1, d0 ≥ 23 kg/m³, e.g. glass wool or stone wool
3. Batten
4. Wood based substrate, ≥ 470 kg/m³, e.g. wood based panel

Figure 54. Floor structure with thermal insulation



1. Spruce FireResist
2. Air gap
3. Batten
4. Substrate
 - wood based substrate ≥ 470 kg/m³, e.g. wood based panel or
 - class A1 or A2-s1,d0 substrate ≥ 470 kg/m³, e.g. gypsum board, concrete

Figure 55. Floor structure with air gap



1. Spruce FireResist
2. Substrate
 - plywood substrate ≥ 400 kg/m³ or
 - wood based substrate ≥ 470 kg/m³, e.g. wood based panel or
 - class A1 or A2-s1,d0 substrate ≥ 470 kg/m³, e.g. gypsum board, concrete
3. Batten

Figure 56. Floor structure with Spruce FireResist fixed to the substrate

9.2 FIRE COMPARTMENT WALLS

Fire compartment structures divide a building into smaller sections in order to delay the spread of fire through the whole building. Fire compartment walls can be built of glass or stone wool, Kerto LVL studs and Metsä Wood plywood as paneling material. Suitable products for the paneling are Spruce FireResist and Spruce, and also birch plywood products are possible.

FIRE COMPARTMENTS WALLS ARE RATED WITH THE FOLLOWING SYMBOLS:

- R for load-bearing capacity
- E for integrity
- I for insulation

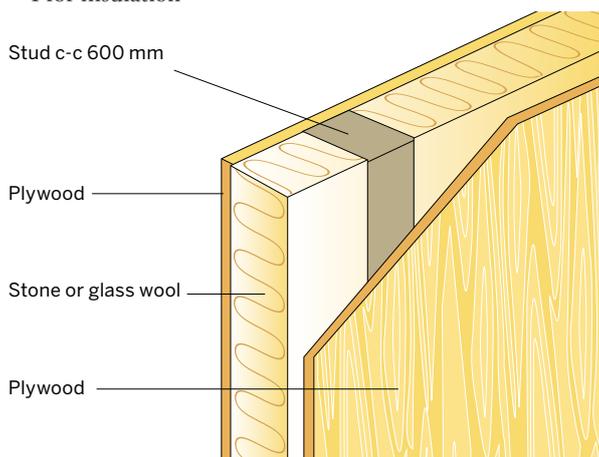


Figure 57. Example of a fire rated structure for a compartment wall

NON-LOAD-BEARING FIRE COMPARTMENT WALLS

Non-load-bearing fire compartment walls do not carry any external loads in case of fire. Their function is only to separate the fire compartments.

WALL STRUCTURE	STUDS (mm)	MAX. WALL HEIGHT (mm)	FIRE RATING	MATERIAL LAYERS
	45 x 45	3000	EI 15	1. Spruce plywood, min. 15 mm 2. Kerto LVL studs 3. Cavity 4. Spruce plywood, min. 15 mm
	45 x 70	3000	EI 30	1. Spruce FireResist plywood, min. 15 mm 2. Kerto LVL studs 3. Stone wool, min. 70 mm and 30 kg/m³ 4. Spruce FireResist plywood, min. 15 mm
	45 x 150	3000	EI 60	1. Spruce FireResist plywood, min. 18 mm 2. Kerto LVL studs 3. Stone wool, min. 150 mm and 30 kg/m³ 4. Spruce FireResist plywood, min. 18 mm

- Panel joints supported on studs
- Openings through the panels not allowed
- National limitations for wall height may exist

Figure 58. Fire rated structures for non-load-bearing wood stud wall

LOAD-BEARING FIRE COMPARTMENT WALLS

Load-bearing fire compartment walls separate the fire compartments while acting as a load-bearing structure for external loads in case of fire. Load-bearing fire compartment walls should be designed case by case.



Door opening in a compartment wall

10. PRODUCT INFORMATION



NATURAL STRENGTH AND RIGIDITY

Metsä Wood spruce plywood products are excellent general purpose construction panels. They are ideal for both interior and exterior construction work and any other application which requires strength, dimensional stability and light-weight versatility.

Spruce plywood is manufactured from a long-grained, straight fiber, homogeneous Nordic conifer. The veneer structure gives the versatile softwood plywood panel considerable strength and rigidity. Spruce plywood panels are light, and easy to machine and install using conventional wood-working tools and fasteners. As well as being beautifully light in colour, spruce plywood is also up to 30 % lighter than many alternatives with similar load-carrying capacity and stiffness.

Metsä Wood Spruce is uncoated softwood plywood glued with weather and boil-proof phenolic resin adhesive (WBP, BFU, AW, exterior). The nominal thicknesses of the veneers used in the manufacturing process is 3,0 mm. Spruce plywood is manufactured at Suolahti plywood mill with automatic production lines.

COMPARISON WITH OTHER WOOD-BASED PANELS

Metsä Wood Spruce plywood, radiata pine plywood, OSB/3 and particleboard P5 are all suitable materials, for example, for flooring applications. Metsä Wood Spruce has a good weight-strength ratio. The panel thicknesses required to carry the same load and fulfill the same deflection limitation, and the corresponding panel weights are shown in Table 10.1.

Table 10.1 Comparison of wood based panels with similar load-bearing capacities

PRODUCT	PANEL THICKNESS (mm)	CHAR. PANEL WEIGHT (kg / m ²)	CHAR. MATERIAL DENSITY (kg / m ³)
MW Spruce plywood	18	7,2	400
Radiata Pine plywood	21	9,5	450
OSB/3	22	12,1	550
Particleboard P5	25	13,8	550

Material information for OSB and particleboard taken from standard EN 12369-1 and for radiata pine plywood from Arauco ITT report by DTI



Plywood pallets in a plastic wrapping

Table 10.2 Comparison design calculations

IMPOSED UNIFORM LOAD 500 kg / m ² (5 kN/m ²)				
MINIMUM PANEL THICKNESS (mm)				
Span	MW Spruce	Radiata Pine	OSB/3	Particleboard P5
400 mm	12	12	15	18
600 mm	18	21	22	25

Design calculations according to Eurocode (EN 1990, EN 1991-1-1, EN 1995-1-1), loaded area category A: residential areas, permanent load 0.3 kN/m² includes the weight of the panel, service class 2, medium-term load-duration class, plywood $k_{mod} = 0,8$ $k_{def} = 1,0$, OSB $k_{mod} = 0,55$ $k_{def} = 2,25$, particleboard $k_{mod} = 0,45$ $k_{def} = 3,0$, consequences/reliability class 2 $K_{FI} = 1,0$, $\gamma_M = 1,2$ (1,3 for particleboard), $\gamma_G = 1,35$, $\gamma_Q = 1,5$, $\psi_2 = 0,3$, combination of actions (6.10), characteristic combination, multispan panels, net final deflection $w_{net,fin} \leq L/200$.

The natural durability of wood varies between different wood species. Durability classes for different species are given in EN 350-2 or natural durability can be tested according to EN 350-1. Neither Nordic spruce, Elliotis pine, maritime pine nor radiata pine are classified as durable wood species. Spruce plywood is suitable for end uses in use class 2 (EN 335). Panels are marked in technical class EN 636-2.

Field tests clearly show that mould and blue stain grow much slower on the natural surface of Nordic spruce than on Elliotis pine, maritime pine or radiata pine. Never the less exterior use or high relative humidity conditions (e.g. unheated spaces) may cause mould growth on the plywood surface. Metsä Wood Spruce MouldGuard is recommended for applications in humid conditions (not exposed to direct weathering).

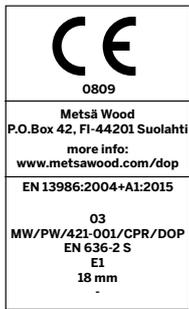


Figure 59. CE marking on the package (Metsä Wood Spruce)



Figure 60. CE marking on the panel (Metsä Wood Spruce)

QUALITY CONTROL, CE-MARKING AND APPROVALS

Metsä Wood spruce plywood products are CE-marked and classified as structural panels. In addition to internal quality control, VTT Expert Services Ltd oversees production operations and the internal quality control at Metsä Wood plywood mills. External plywood quality control is conducted according to standard EN 13986 and its CE-marking rules in cooperation with VTT, which is the Notified Production Control and Certification Body (No. 0809) for the CE-marking system. Assessment and verification of constancy of performance (AVCP) system is 2+ for plywood. CE-marking is printed on the packages and on the reverse side of the uncoated panels. Metsä Wood Declaration of Performance (DoP) documents can be found from the website www.metsawood.com/dop. Spruce plywood products meet also the requirements of the plywood specification standard EN 636.

EN ISO 9001 Quality Management System and EN ISO 14001 Environmental Management System are also applied. In addition to CE-marking there are several national approvals available.



Figure 61. EN ISO 9001 Quality Management System and EN ISO 14001 Environmental Management System are certified by Bureau Veritas



PANEL DIMENSIONS

METSÄ WOOD SPRUCE IS AVAILABLE IN SIZES:

- 2400 / 2440 / 2500 mm × 1200 / 1220 / 1250 mm
- 2400 / 2440 mm × 600 / 610 mm

The first measurement indicates the orientation of the surface veneer grain.

Other sizes are available on request.

Metsä Wood spruce plywood products can be delivered with square edges or tongue and groove edge profile either on two sides (TG2) or on four sides (TG4). Tongue and groove machining decreases the net panel size by 10 mm.

Spruce plywood panels are available sanded and unsanded. Tongue and grooved panels and Spruce FireResist panels are always sanded.

Spruce plywood panels can also be machined according to customer specification on special request.

Table 10.3 Thickness tolerances, lay-up and weight of Metsä Wood spruce plywood

NOMINAL THICKNESS (mm)	TOLERANCE THICKNESS (mm)		NUMBER OF VENEERS	LAY-UP	APROX. WEIGHT (kg/m ²)	PANELS PER PACKAGE PCS.
	MIN.	MAX.				
9	8,8	9,5	3	- -	4,1	110
12	11,5	12,5	4	- -	5,5	85
15	14,3	15,3	5	- - -	6,9	65
18	17,1	18,1	6	- --- -	8,3	55
21	20,0	20,9	7	- - - -	9,7	45
24	22,9	23,7	8	- ----- -	11,0	40
27	25,2	26,8	9	- - - - -	12,4	35
30	28,1	29,9	10	- - --- - -	13,8	30

The nominal veneer thickness is 3,0 mm.

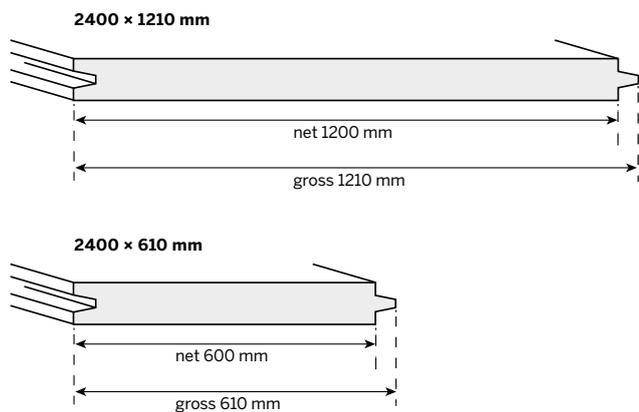
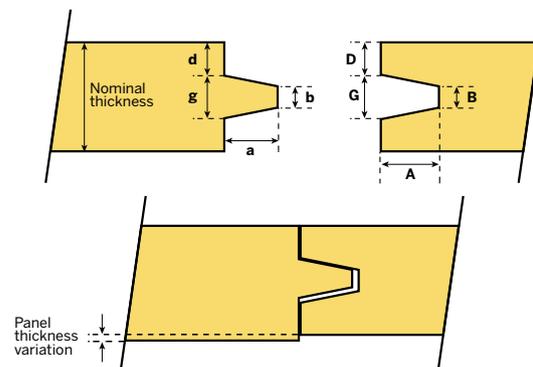


Figure 62. Spruce plywood panel dimension of tongue and grooved panels



Nominal thickness of the plywood	TONGUE				GROOVE			
	a	b	g	d	A	B	G	D
12	10	2	5	3,5	11	2,5	5,5	3,5
15	10	2	7,5	3,7	11	3,0	8,5	3,7
18	10	2	7,5	5,1	11	3,0	8,5	5,1
21	10	2	7,5	6,5	11	3,0	8,5	6,5

Figure 63. Dimensions of standard tongue and grooved profiles

SURFACE VENEER GRADES

Table 10.4 Description of surface veneer grades

SPRUCE PLYWOOD SURFACES	TYPICAL PROPERTIES
II	Sound surface, might be repaired with filler. Unrepaired defects with a ϕ max. 5 mm are permitted
III+	Open defects repaired with filler
III	Standard quality, with open defects such as knot holes and veneer checks

Primary grade combinations are II/III and III/III.
Metsä Wood Spruce FireResist grade combination is II/III.

Classification of the Metsä Wood Spruce surface grade meets the EN 635 requirements.

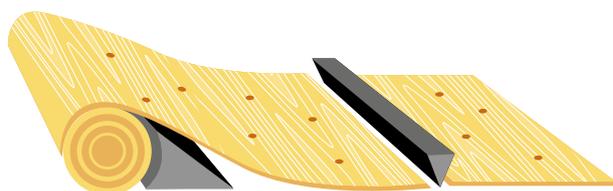


Figure 64. Veneer peeling



Figure 65. Surface veneer quality II



Figure 66. Surface veneer quality III

11. TECHNICAL INFORMATION

GLUING

Metsä Wood spruce plywood panels are bonded with a weather and boil-resistant phenolic resin adhesive (WBP, BFU, AW, exterior). The gluing meets the requirements of the following international standards:

- EN 314-2 / Class 3 (exterior)
- JAS / Structural plywood / Class 2
- DIN 68705-3 / BFU 100 (former class)
- BS 6566 Part 8 / WBP (former class)

PANEL TOLERANCES

Measured in accordance with standard EN 324, the plywood size and squareness tolerances meet EN 315 requirements.

LENGTH/WIDTH (MM)	TOLERANCE
< 1000	± 1 mm
1000-2000	± 2 mm
> 2000	± 3 mm
Squareness of the panel	± 0,1 % or ± 1 mm/m
Straightness of the panel	± 0,1 % or ± 1 mm/m

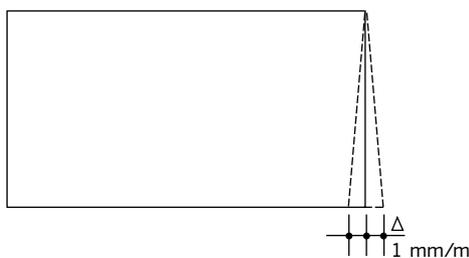


Figure 67. Straightness of a panel edge

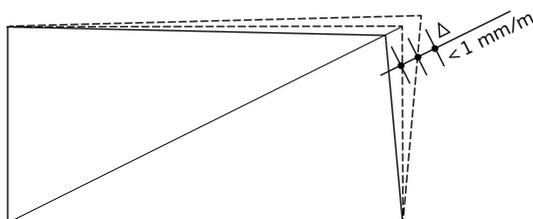


Figure 68. Squareness of a panel

DIMENSIONAL CHANGES CAUSED BY MOISTURE AND TEMPERATURE

MOISTURE BEHAVIOUR

The moisture content of spruce plywood panels is 7–9 % when leaving the mill. Plywood moisture content changes according to the surrounding conditions.

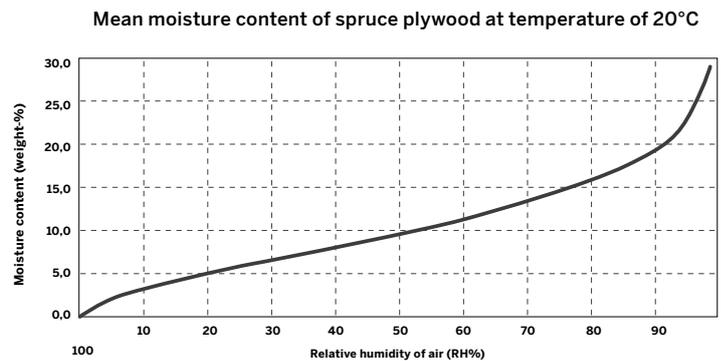


Figure 69. Mean equilibrium moisture content of spruce plywood

DIMENSIONAL CHANGES

DIRECTION	DIMENSIONAL CHANGE
Length	0,01 % / MC%
Across	0,01 % / MC%
Thickness	0,31 % / MC%

Change in the moisture content can cause warping and twisting of the panel

EXAMPLE CALCULATION OF DIMENSIONAL CHANGE

Standard panel of 2400 mm × 1200 mm × 18 mm
 Moisture content of spruce plywood after production is 8 %.
 Moisture content increases to 12 %.
 Change of moisture content is 12 - 8 = 4 %

Dimensional changes:

- Length = $4 \times 0,01 \% \times 2400 \text{ mm} = + 1,0 \text{ mm}$
- Width = $4 \times 0,01 \% \times 1200 \text{ mm} = + 0,5 \text{ mm}$
- Thickness = $4 \times 0,31 \% \times 18 \text{ mm} = + 0,2 \text{ mm}$

THERMAL EXPANSION OF PLYWOOD

Compared to metals and plastics the thermal expansion of plywood is minimal and it can generally be disregarded, unlike swelling due to moisture. The coefficient of thermal expansion in the direction of wood fibers is in the range of $(3,5 \dots 5) \times 10^{-6} / ^\circ\text{C}$.

USAGE TEMPERATURE OF PLYWOOD

Metsä Wood Spruce plywood can be used in a very wide range of temperatures. Standard spruce plywood can be used continuously at a temperature of 100 °C and temporarily up to 120 °C. Spruce plywood resists cold even better than heat and can be used at temperatures down to -200 °C.

STRUCTURAL VALUES

The given strength and elasticity values are design values according to EN 789, EN 1058 and EN 13986 and they are to be used for structural calculations with EN 1995 (Eurocode 5). The values are based on tested veneer values and they are given for the full cross-section of the panel in relative humidity 65 % and temperature of 20 °C corresponding to moisture content of 10 ± 2 %.

Mean density $\rho_{mean} = 460 \text{ kg/m}^3$
 Characteristic density $\rho_k = 400 \text{ kg/m}^3$

Table 11.1. Thickness, structure and section properties of sanded Metsä Wood Spruce plywood

NOMINAL THICKNESS	STRUCTURE	NUMBER OF PLYS	MEAN SANDED THICKNESS	AREA	SECTION MODULUS	MOMENT OF INERTIA
t			t	A	W	I
mm			mm	mm ² /mm	mm ³ /mm	mm ⁴ /mm
9	- -	3	8,5	8,5	12,0	51,2
12	- -	4	11,5	11,5	22,0	126,7
15	- - -	5	14,5	14,5	35,0	254,1
18	- -- -	6	17,5	17,5	51,0	446,6
21	- - - -	7	20,5	20,5	70,0	717,9
24	- ---- -	8	23,5	23,5	92,0	1081,5
27	- - - - -	9	26,5	26,5	117,0	1550,8
30	- - --- - -	10	29,5	29,5	145,0	2139,4

Nominal thickness of the veneers is 3,0 mm.

Table 11.2. Characteristic strength values of sanded Metsä Wood Spruce plywood

NOMINAL THICKNESS	NO. OF PLYS	BENDING		COMPRESSION		TENSION		PANEL SHEAR		PLANAR SHEAR	
		$f_{mk \parallel}$	$f_{mk \perp}$	$f_{ck \parallel}$	$f_{ck \perp}$	$f_{tk \parallel}$	$f_{tk \perp}$	$f_{vk \parallel}$	$f_{vk \perp}$	$f_{rk \parallel}$	$f_{rk \perp}$
mm		N/mm ²	N/mm ²								
9	3	22,9	3,0	15,5	8,5	9,3	5,1	3,50	3,50	1,42	-
12	4	20,6	6,5	11,5	12,5	6,9	7,5	3,50	3,50	0,94	-
15	5	23,1	11,1	17,6	12,4	10,6	7,4	3,50	3,50	1,63	0,87
18	6	21,5	12,3	19,7	10,3	11,8	6,2	3,50	3,50	1,76	0,64
21	7	20,7	12,7	16,8	13,2	10,1	7,9	3,50	3,50	1,41	1,18
24	8	20,5	12,4	22,3	7,7	13,4	4,6	2,60	2,60	2,15	-
27	9	19,4	13,4	16,4	13,6	9,8	8,2	3,50	3,50	1,46	1,12
30	10	18,9	13,7	17,8	12,2	10,7	7,3	3,50	3,50	1,50	0,72

|| = along the face veneer grain direction

⊥ = across the face veneer grain direction

Table 11.3. Mean modulus of elasticity and modulus of rigidity values of sanded Metsä Wood Spruce plywood

NOMINAL THICKNESS	NO. OF PLYS	BENDING		COMPRESSION		TENSION		PANEL SHEAR		PLANAR SHEAR	
		$E_{m \parallel}$	$E_{m \perp}$	$E_{c \parallel}$	$E_{c \perp}$	$E_{t \parallel}$	$E_{t \perp}$	$G_{v \parallel}$	$G_{v \perp}$	$G_{r \parallel}$	$G_{r \perp}$
mm		N/mm ²									
9	3	9178	422	6212	3388	6212	3388	350	350	45,1	-
12	4	8237	1363	4591	5009	4591	5009	350	350	35,5	-
15	5	9237	2763	7034	4966	7034	4966	350	350	50,5	29,1
18	6	8615	3385	7886	4114	7886	4114	350	350	71,4	24,9
21	7	8277	3723	6732	5268	6732	5268	350	350	51,8	37,4
24	8	8205	3795	8936	3064	8936	3064	350	350	142,9	24,6
27	9	7752	4248	6566	5434	6566	5434	350	350	52,1	41,3
30	10	7558	4442	7119	4881	7119	4881	350	350	63,2	35,2

|| = along the face veneer grain direction

⊥ = across the face veneer grain direction

PERFORMANCE IN CASE OF FIRE

The values are to be used for structural calculations with EN 1995 (Eurocode 5).

Table 11.4. One-dimensional charring rate and failure time

ONE-DIMENSIONAL CHARRING RATE AND FAILURE TIME OF METSÄ WOOD SPRUCE PLYWOOD PRODUCTS

NOMINAL THICKNESS [mm]	CHARRING RATE β_0 [mm/min]		FAILURE TIME t_f (EN 1995-1-2) [min]	
	WITHOUT MINERAL WOOL IN THE CAVITY BEHIND THE PANEL	WITH MINERAL WOOL IN THE CAVITY BEHIND THE PANEL	WITHOUT MINERAL WOOL IN THE CAVITY BEHIND THE PANEL	WITH MINERAL WOOL IN THE CAVITY BEHIND THE PANEL
9	0,74	1,26	7,5	2,7
12	0,72	1,23	12,0	5,3
15	0,71	1,16	16,4	8,5
18	0,70	1,12	21,0	11,6
21	0,69	1,07	25,7	15,2
24	0,68	1,02	30,6	19,0
27	0,67	0,97	35,6	23,3
30	0,66	0,94	40,7	27,4

Table 11.5. European reaction to fire classification

REACTION TO FIRE OF METSÄ WOOD SPRUCE

END USE CONDITION	MINIMUM THICKNESS (mm)	CLASS (EXCLUDING FLOORING)	CLASS (FLOORINGS)
Without an air gap behind the panel - mounted directly against class A1 or A2-s1,d0 products with minimum density of 10 kg/m ³ or at least class D-s2,d2 products with minimum density of 400 kg/m ³ - 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 - a vapour barrier with a thickness up to 0,4 mm and a mass up to 200 g/m ² can be mounted in between the wood-based panel and a substrate if there are no air gaps in between	9	D-s2, d0	Dfi-s1
With a closed or an open air gap of not more than 22 mm behind the panel - mounted with an air gap behind, the reverse face of the cavity shall be at least class A2-s1,d0 products with minimum density of 10 kg/m ³	9	D-s2, d2	-
With a closed air gap - mounted with an air gap behind, the reverse face of the cavity shall be at least class D-s2,d2 products with minimum density of 400 kg/m ³	15	D-s2, d1	Dfi-s1
With an open air gap - mounted with an air gap behind, the reverse face of the cavity shall be at least class D-s2,d2 products with minimum density of 400 kg/m ³	18	D-s2, d0	Dfi-s1

REACTION TO FIRE OF METSÄ WOOD SPRUCE FIRERESIST

END USE CONDITION	MINIMUM THICKNESS (mm)	CLASS (EXCLUDING FLOORING)	CLASS (FLOORINGS)
With substrates of at least class A2-s1,d0 with a density of at least 30 kg/m ³ (e.g. insulation) With or without an air gap between the product and the substrate of at least class A2-s1,d0 and density of at least 525 kg/m ³ (e.g. gypsum board) Maximum of 2 mm gap between the panels with frame support under the joints Fixed mechanically to wooden or metallic frames	15	B-s1, d0	-
With or without an air gap between the product and - wood based substrate with density of at least 470 kg/m ³ - class A1 or A2-s1, d0 substrate with density of at least 470 kg/m ³ Without an air gap between the product and plywood substrate with density of at least 400 kg/m ³ With thermal insulation of class A1 or A2-s1, d0 and density of at least 23 kg/m ³ and wood based substrate with density of at least 470 kg/m ³ Panels may have joints (tongue and groove joints or square edged panels with frame support under the joints)	15	-	Bfl-s1

B-s1, d0

WALL OR CEILING STRUCTURE WITH THERMAL INSULATION

1. Substrate, no demands, e.g. plywood, concrete
2. Wood frame (or optionally metal frame)
3. Insulation at least class A2-s1, d0 ≥ 30 kg/m³, e.g. glass wool or stone wool
4. Spruce FireResist

CEILING STRUCTURE WITH THERMAL INSULATION

1. Wood frame (or optionally metal frame)
2. Insulation at least class A2-s1, d0 ≥ 30 kg/m³, e.g. glass wool or stone wool
3. Spruce FireResist

WALL OR CEILING STRUCTURE WITH SPRUCE FIRERESIST FIXED TO THE SUBSTRATE

1. Wood frame (or optionally metal frame)
2. Substrate at least class A2-s1, d0 ≥ 30 kg/m³, e.g. concrete, in walls gypsum board
3. Spruce FireResist

WALL OR CEILING STRUCTURE WITH AIR GAP

1. Substrate at least class A2-s1, d0 ≥ 525 kg/m³, e.g. gypsum board, concrete
2. Wood frame (or optionally metal frame)
3. Air gap
4. Spruce FireResist

Bfl-s1

FLOOR STRUCTURE WITH THERMAL INSULATION

1. Spruce FireResist
2. Insulation, Class A1 ≥ 23 kg/m³, e.g. rock wool
3. Battens
4. Wood based substrate, ≥ 470 kg/m³, e.g. wood based panel

FLOOR STRUCTURE WITH AIR GAP

1. Spruce FireResist
2. Air gap
3. Battens
4. Substrate
 - wood based substrate ≥ 470 kg/m³, e.g. wood based panel or
 - class A1 or A2-s1,d0 substrate ≥ 470 kg/m³, e.g. gypsum board, concrete

FLOOR STRUCTURE WITH SPRUCE FIRERESIST FIXED TO THE SUBSTRATE

1. Spruce FireResist
2. Substrate
 - plywood substrate ≥ 400 kg/m³ or
 - wood based substrate ≥ 470 kg/m³, e.g. wood based panel or
 - class A1 or A2-s1,d0 substrate ≥ 470 kg/m³, e.g. gypsum board, concrete
3. Battens

Table 11.6. Fire protection ability of a covering (K-class)

FIRE PROTECTION ABILITY OF A COVERING

PRODUCT AND END USE CONDITIONS	MINIMUM THICKNESS (mm)	K-CLASS
Metsä Wood Spruce - horizontal, vertical and sloped applications - without a cavity or cavities behind the covering - on all substrates - K ₁ 10 on substrates with density of at least 300 kg/m ³ - butt-jointed and tongue and grooved panels	12	K ₂ 10 and K ₁ 10
Metsä Wood Spruce FireResist - horizontal, vertical and sloped applications - without a cavity or cavities behind the covering - on all substrates - K ₁ 10 on substrates with density of at least 300 kg/m ³ - butt-jointed and tongue and grooved panels	15	K ₂ 10 and K ₁ 10
Metsä Wood Spruce and Spruce FireResist - horizontal, vertical and sloped applications - without a cavity or cavities behind the covering - on all substrates - tongue and grooved panels	24	K ₂ 30

THERMAL CONDUCTIVITY

Thermal conductivity of spruce plywood through the thickness of the panel is:

- $\lambda = 0,11$ W/(m K) for dry panels (MC 10 %)
- $\lambda = 0,13$ W/(m K) for wet panels (MC 25 %)

SOUND ABSORPTION

Sound absorption coefficient of spruce plywood is:

- $\alpha = 0,10$ in frequency range 250 – 500 Hz
- $\alpha = 0,30$ in frequency range 1000 – 2000 Hz

WATER VAPOUR PERMEABILITY

Vapour resistance factor of spruce plywood is:

- $\mu = 190$ dry cup value
 - apply when the mean relative humidity across the panel < 70 %
 - panel inside of an insulation layer in heated buildings
- $\mu = 66$ wet cup value
 - apply when the mean relative humidity across the panel \geq 70 %
 - panel outside of an insulation layer in heated buildings

FORMALDEHYDE EMISSIONS

Determined according to EN 717-1, the formaldehyde emitted by Metsä Wood spruce plywood products falls far below the Class E1 requirement of $\leq 0,100$ ppm and fulfils also the most stringent requirements in the world ($\leq 0,030$ ppm). The formaldehyde emission of Metsä Wood Spruce is approximately 0,018 ppm.

AIR TIGHTNESS

Air permeability of 9 mm (3 ply) and thicker spruce plywood is so low that the air flow rate through the specimen could not be measured.

FASTENING (EN 1995-1-1)



When fasteners are an essential part of the structural system, e.g. plywood is used as a bracing panel or plywood acts as a buckling support for studs, the boundary conditions according to EN 1995-1-1 should be taken into account.

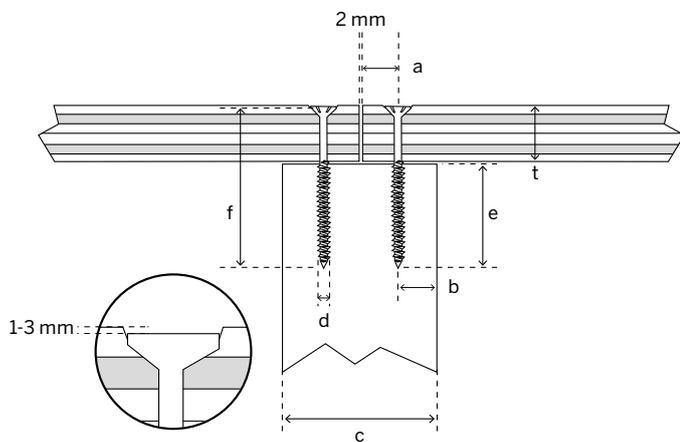


Figure 70. Fixing of square edge panels to wooden supports according to EN 1995-1-1

Table 11.7. Boundary conditions for fasteners according to EN 1995-1-1

FASTENER	d	t	a max $\begin{cases} 3 \times d \\ 8 \text{ mm} \end{cases}$	b (Kerto) $7 \times d$	b (timber) $5 \times d$	c (Kerto) $2 \times (a+b) + 2$	c (timber) $2 \times (a+b) + 2$	e $8 \times d$	f max $\begin{cases} e + t \\ 2 \times t \\ 50 \text{ mm} \end{cases}$
Screw	Ø 4,0 mm	18 mm	12,0 mm	28,0 mm	20,0 mm	82 mm	66 mm	32 mm	50 mm
Screw	Ø 5,0 mm	18 mm	15,0 mm	35,0 mm	25,0 mm	102 mm	82 mm	40 mm	58 mm
Nail	Ø 2,5 mm	18 mm	8,0 mm	17,5 mm	12,5 mm	53 mm	43 mm	20 mm	50 mm
Nail	Ø 3,1 mm	18 mm	9,3 mm	21,7 mm	15,5 mm	64 mm	52 mm	25 mm	50 mm

12. SUSTAINABILITY

Wood raw material for premium-quality Metsä Wood plywood is sourced from PEFC-certified forests belonging to Metsä Group's Finnish forest owner members, ensuring that the origin of the material conforms to the principles of sustainable forestry.



AN ECO-EFFICIENT BUILDING MATERIAL

Wood products are based on fully renewable raw materials and, especially when they are sourced from sustainably managed forests, they offer an excellent opportunity for ecological construction with fewer emissions. Wood is a highly eco-efficient building material throughout its entire life cycle. Production consumes less energy and results in fewer emissions than other building materials. The products are light-weight, which means that transportation has a small environmental impact.

The manufacture of wood products is mainly based on renewable energy. Moreover, the energy and material efficiency of the wood's production process is constantly being improved. Compared with

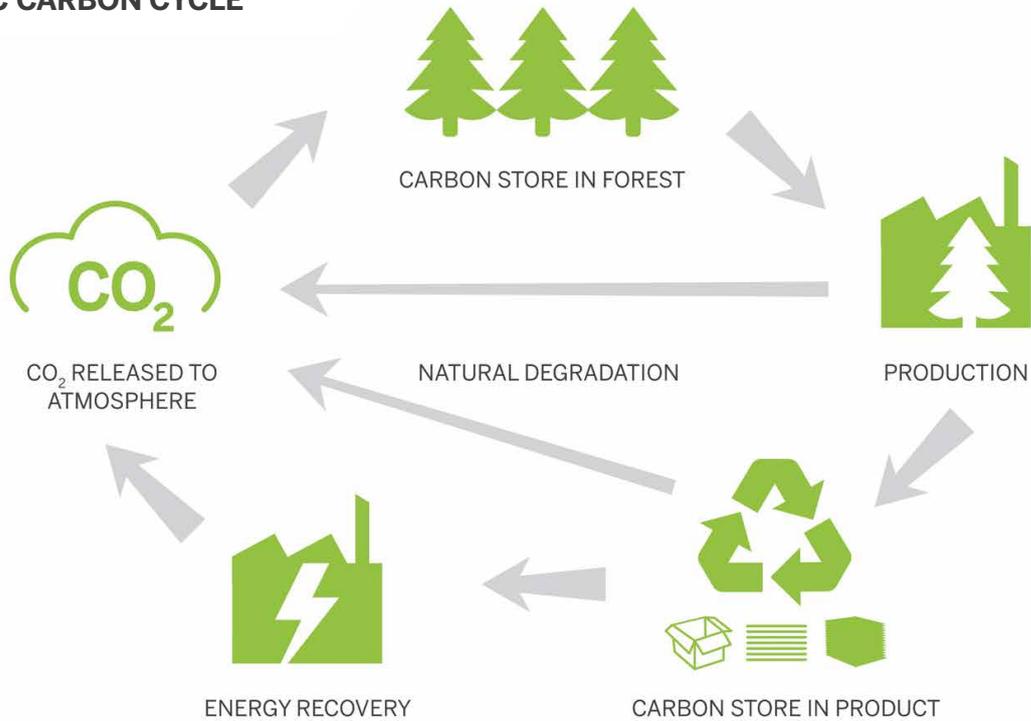
competing materials, wood products have by far the smallest carbon footprint. Wood not only binds atmospheric carbon during its growth phase, but it also continues to act as carbon storage in the completed building. When used to replace other building materials, wood indirectly reduces the consumption of fossil fuels.

Metsä Wood is a leading supplier of eco-efficient wood-based solutions, and by using Metsä Wood products, customers can promote the quality of their built environment.



CARBON FOOTPRINT

BIOGENIC CARBON CYCLE



Carbon dioxide (CO₂) emissions are the main cause of the greenhouse effect and global warming. Carbon footprint shows carbon dioxide emissions of the process behind the product. Carbon footprint shows the magnitude of the environmental effect caused by a certain activity. Forests and forestry are involved in the natural circulation of carbon. Sustainably managed forests can act as carbon sinks. The climate change mitigation effect can also be reached by using forest residuals and by-products in energy production.

Carbon footprint of Metsä Wood spruce plywood (cradle to gate):

CARBON EMISSION AS kg CO ₂ / m ³ OF PRODUCT		BIOGENIC CARBON STORAGE AS kg CO ₂ / m ³ OF PRODUCT	
Raw material supply	-686	Carbon stored in the product	754
Transport ¹	21	The greenhouse effect of carbon stored in the product depends on the life time of the product and selected calculation time period.	
Manufacturing ²	32		
Total emission	-633		
Transportation from the mill to (additional)			
• Brussels, Belgium	34		
• Frankfurt am Main, Germany	31		
• London, UK	36		
• Stockholm, Sweden	12		

¹ Including transports to the mill

² Including energy, fuels, packaging materials and waste handling



13. INSTRUCTIONS

INSTRUCTIONS FOR USING PLYWOOD

STORAGE

- Plywood products should be stored under cover, in dry conditions
- Protect the panels from contact with water and direct sunlight, which might cause the panels to twist and/or cup
- Avoid very dry and hot storage areas
- Store the panels in packages, avoid loose panels
- Packages and loose panels should always be stored flat, above ground. The base under the panel stack must be level and durable, with adequate support

When temporarily stored outside or in a humid area:

- Cover plywood packages with a waterproof covering
- If the package has strappings, please remove them to prevent damage caused by swelling

HANDLING

- Use protective gloves when handling spruce plywood
- Plastic wrapping in packages can easily be opened with a knife - all Metsä Wood packaging materials are recyclable
- You can also remove only a few plywood panels from the plastic wrapping. Please close the package top again after removing the panels.
- Avoid handling open packages with a forklift

PROCESSING

Plywood panels can easily be cut, shaped, drilled and fastened with nails, screws, staples by using standard woodworking tools

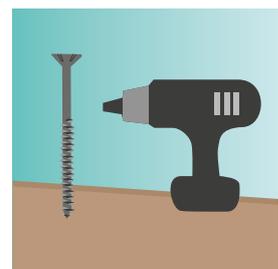
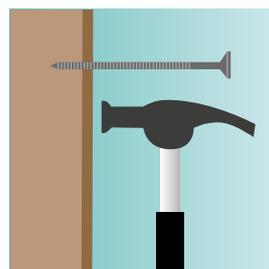
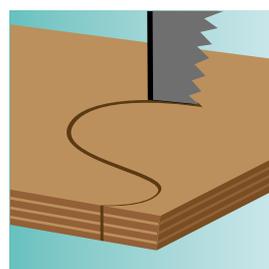
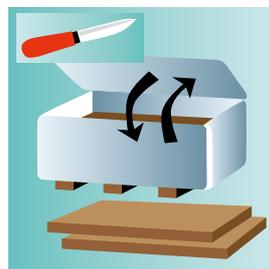
PAINTING

Painting visible plywood parts is recommended when better visual performance is required or better durability in humid conditions is required. A single topcoat is adequate over the primer, but a second topcoat will extend the lifetime of the panel. For a good visual and durable surface two topcoats are required.

Plywood surface should be treated with a colourless acrylic primer for a transparent finish, and the final finishing should be done twice with tinted transparent paint.

For an opaque finish, plywood should be primed with an acrylic or oil-base primer. For primers, use acrylic latex or alkyd oil and follow the recommendations of paint manufacturers. Acrylic paints and alkyd paints intended for outside use are recommended as topcoats.

The compatibility of the paint and primer with plywood is recommended to be confirmed from the supplier. Test coating is always recommended to confirm the adhesion.



INSTRUCTIONS FOR DISPOSAL

Spruce plywood products can be disposed in several ways. It should be noted that the instructions for disposal may vary by country depending on the current legislation.

Recycling of spruce plywood products by utilizing them in other applications is always preferred.

METSÄ WOOD SPRUCE, SPRUCE WEATHER-GUARD AND SPRUCE FLEX

Spruce plywood can be safely burnt when the combustion temperature is at least 850°C and correct combustion conditions are maintained (combustion air and gases are well mixed, the retention time of the combustion gases in the furnace is over 2 seconds, and the residual oxygen content of the flue gases over 6 %). The flue gases are identical to the gases produced in burning untreated wood.

Spruce plywood can also be composted but the panels have to be chipped and the long duration of the composting process has to be taken into consideration. In addition, the products can be taken to a refuse dump, although plywood products will degrade very slowly.

Spruce plywood contains nothing classified as hazardous waste.

METSÄ WOOD SPRUCE MOULDGUARD

Spruce MouldGuard plywood can be considered as biofuel (EN 14961-1) and it can be safely burnt when the combustion temperature is at least 850°C and correct combustion conditions are maintained. Due to preservative treatment the correct combustion conditions and suitable waste burning plants should be checked locally.

Preservative treatment of Spruce MouldGuard contains following materials, which should be taken in to account when choosing the suitable combustion plant: Nitrogen < 0,007 %, Chlorine < 0,01%, Iodine < 0,007% calculated as percentage of weight.

METSÄ WOOD SPRUCE FIRERESIST

Spruce FireResist plywood can be considered as biofuel (EN 14961-1) and it can be safely burnt when the combustion temperature is at least 850°C and correct combustion conditions are maintained (combustion air and gases are well mixed, the retention time of the combustion gases in the furnace is over 2 seconds, and the residual oxygen content of the flue gases over 6 %). Due to fire retardant character of the product, panels are recommended to be chipped and mixed with easily combustible material to confirm favorable combustion. The flue gases are identical to the gases produced in burning untreated wood.

Spruce FireResist plywood can also be composted but the panels have to be chipped and the long duration of the composting process has to be taken into consideration.

Spruce FireResist plywood does not contain heavy metals, boron or halogenated compounds, or anything else classified as hazardous waste.



Metsä Wood provides competitive and environmentally friendly wood products for construction, industry and distributor partners. The products are manufactured from northern wood, a sustainable raw material of premium quality. Metsä Wood is part of Metsä Group.

For further information and sales contact

WWW.METSAWOOD.COM ➔

METSÄ WOOD
P.O.Box 50
02020 Metsä, Finland
Tel. +358 1046 05



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