VMG LIGNUM

VMG LIGNUM JOIST

CONTENTS

ABOUT US

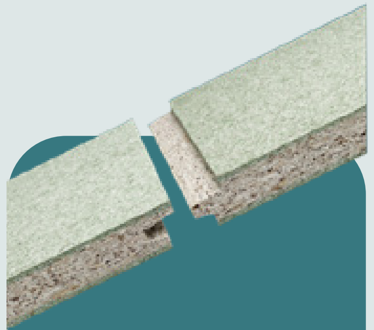
VMG LIGNUM COMPANIES SPECIALIZE IN THE PRODUCTION AND SUPPLY OF SUSTAINABLE ENGINEERED WOOD PRODUCTS FOR CONSTRUCTION.

VMG LIGNUM provides a unique opportunity to obtain three different products from a single source: LVL (laminated veneer lumber), I-joist and structural particle boards (P4-P7). All our high-quality engineered wood products are manufactured in Lithuania and can be ordered directly from our production centre in Naujoji Akmene. VMG LIGNUM develop the building system of prefabricated components for construction for new built projects, as well as renovation using engineered wood products. VMG LIGNUM also offers an extensive range of versatile building design, structural modelling, and consulting services.

PRODUCTION CAPABILITIES:

VMG LIGNUM JOIST
15 million m/year

VMG LIGNUM LVL
120,000 m³/year



VMG LIGNUM BOARD
200,000 m³/year

WE PROVIDE ADAPTABLE SOLUTIONS FOR COOPERATION:

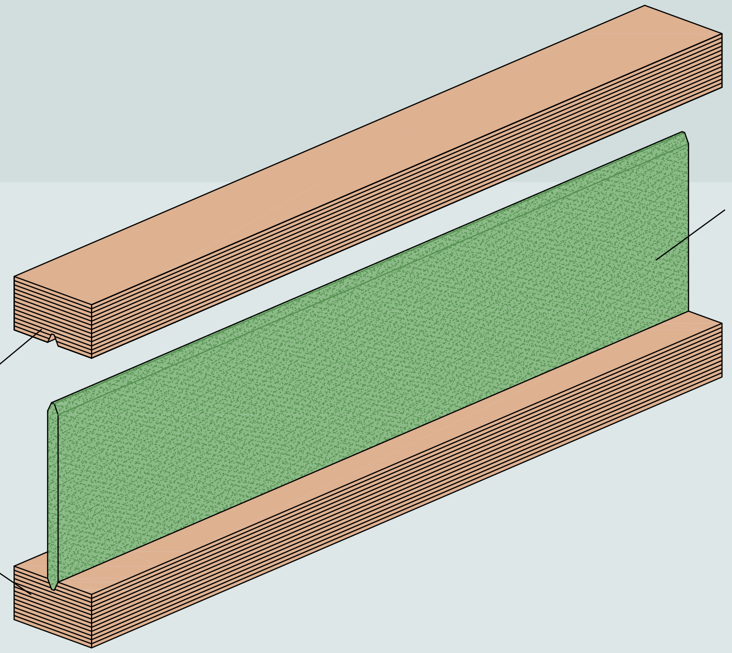
- Technical guidance throughout the production process
- Manufacturing of products in accordance with the specified dimensions
- Certified products that meet international quality requirements
- Production in small, medium and ultra-large volumes
- A comprehensive quality control procedure in our laboratory
- On-time delivery to the desired country and continent

WHAT IS AN I-JOIST?

VMG LIGNUM JOIST (also known as an I-joist or an I-beam) is an engineered wood product that can be used in a wide range of building structures. The I-joist is most commonly used for horizontal structures such as roof beams and floor joists, and less commonly used for vertical structures such as wall studs.

The name "I-joist" comes from its shape, which resembles the letter "I" (a cross-section of two T-shaped elements). The unit consists of two bars (the horizontal elements at the top and bottom of the I-joist) which are hereafter referred to as flanges, and a web, i.e. the vertical element that connects the flanges. The flanges are usually made of laminated veneer lumber (LVL) or solid wood. The web is typically made of oriented strand board (OSB) or structural particle boards (SPB).

VMG LIGNUM CONSTRUCTION produces VMG LIGNUM JOISTS made of VMG LIGNUM LVL flanges and VMG LIGNUM BOARD P5 structural particle boards or OSB3 web.



Timber I-joist and its components

THE EVOLUTION OF I-JOISTS

Timber I-joists were created to maximize the advantages of timber, leveraging its lightweight and robust characteristics, while mitigating the challenges associated with traditional timber joists, including bending, twisting, and splintering.

The "I" shape, also referred to as the "H" shape, of the joist was first introduced in 1849 when Alphonso Halbou of Forges de la Providence (Belgium) patented a steel I-joist. At various times and in different countries, efforts have been made to manufacture I-joists from timber by mechanically connecting the parts. Nonetheless, the breakthrough in timber I-joist development came with the invention of waterproof adhesives in 1934 by chemist Dr. James Nevin at Harbor Plywood (USA).

Even though it was feasible to produce I-joists using waterproof adhesives, the market was not yet ready for this advancement. In 1959, the Douglas Fir Plywood Association, the predecessor of the American Engineered Wood Association (APA), published a study on design recommendations for timber I-joists. Based on this study, the first timber joist was produced by Truss Joist Corporation (USA) in 1969.

The mass production of timber I-joists was driven by architectural trends of the time, as customers sought more spacious and open-plan dwellings. Their floors required longer spans, for which the traditional sawn timber joists were no longer suitable.

Laminated Veneer Lumber (LVL), a significantly stronger material, was introduced in 1977 to replace sawn timber for the flanges of the I-joists. In 1990, plywood, traditionally used for the web, was replaced by oriented strand board (OSB), a more cost-effective material with improved mechanical properties. Later, structural particle board (SPB), an even more efficient building material, was introduced.

THE ESSENTIAL PROPERTIES OF VMG LIGNUM JOISTS

- The product has a cross-section of two T-shaped elements and, due to the thin web, the cold bridging between the flanges is low. The thin wall also allows for better insulation of structures.
- The JOISTS are most commonly used for horizontal structures such as floor joists or roof beams, but can also be used for vertical structures such as wall studs.
- The JOISTS are significantly lighter than other engineered wood products, making them easy to install, drill, and cut.
- The JOISTS experience minimal dimensional changes due to humidity, allowing them to be precisely cut to the required dimensions, thereby reducing the time required on site.
- The JOISTS are constructed from wood, a renewable and easily recyclable raw material. The product also serves as a carbon sink for buildings. For instance, opting for one metre of I-JOIST (300 mm high) can help save up to 4.6 kg of CO_2 in the structure (source: The I-joist Handbook, Masonite Beams, 2022). By choosing this type of structure design, you contribute to preserving the environment and combating climate change.
- By using I-JOISTS instead of sawn timber, we can save up to 47% of wood biomass. This indicates that when using I-JOISTS, we can construct two houses from the same harvest of forest timber, whereas conventional sawn timber would only be adequate for a single place of habitation.

FIRE RESISTANCE OF JOISTS

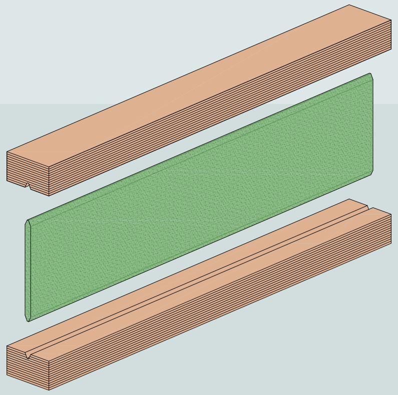
VMG LIGNUM JOISTS are composed of materials having a reaction to fire class D (s2, d0) or better. Fire resistance is not assessable.

Euroclass	Description	Contribution to fire	Behaviour of the product during testing
A1	Non-combustible materials	No contribution to fire at any stage of the fire	Non-flammable materials
A2	Non-combustible materials	Very limited contribution to fire	Non-flammable materials
B	Combustible materials	Limited contribution to a fire	Non-flammable materials
C	Combustible materials	Minor contribution to a fire	Inflammable after 10 minutes
D	Combustible materials, highly flammable	Medium contribution to a fire	Inflammable after 2-10 minutes
E	Combustible materials, moderately flammable	Stimulates combustion	Inflammable after less than 2 minutes
F	Combustible materials, easily flammable	Stimulates combustion or no data available	Inflammable above Class E or no data available

Class	Description	Class	Description
s1	Emissions absent or very little	d0	No burning droplets
s2	Emissions with average volume intensity	d1	Slow dripping droplets
s3	Emissions with high volume intensity	d2	High/Intense dripping droplets

PRODUCTION OF JOISTS

VMG LIGNUM JOIST is produced by connecting two LVL flanges to a web. VMG LIGNUM LVL 48P flanges are used for production of VMG LIGNUM JOISTS. The web of the JOIST can be made of OSB/3 or VMG LIGNUM BOARD P5. The flanges of VMG LIGNUM LVL contain a groove for the web. The edges of the web are processed so that they can be connected to the LVL flanges. The completed flanges and webs are connected and pressed in batches of three. Once the VMG LIGNUM JOISTS have been pressed and subjected to quality control, they go into a curing oven. The resulting product is rigid, strong and lightweight. More information on VMG LIGNUM products is available at www.vmg-lignum.eu.



The principle of JOIST production

An I-joist is a composite product made of the highest quality engineered wood. Its flanges are usually made of laminated veneer lumber (LVL), which has a higher load-bearing capacity than C24 wood. The LVL is an exceptionally strong material that maintains dimensional stability and is not susceptible to warping and shrinking. The web is positioned between the flanges during the pressing process. It is made of grade P5 structural particle board (SPB), engineered to withstand heavy loads and humid conditions. Adhesives that are resistant to outdoor conditions and environmentally friendly are utilised in the production process.

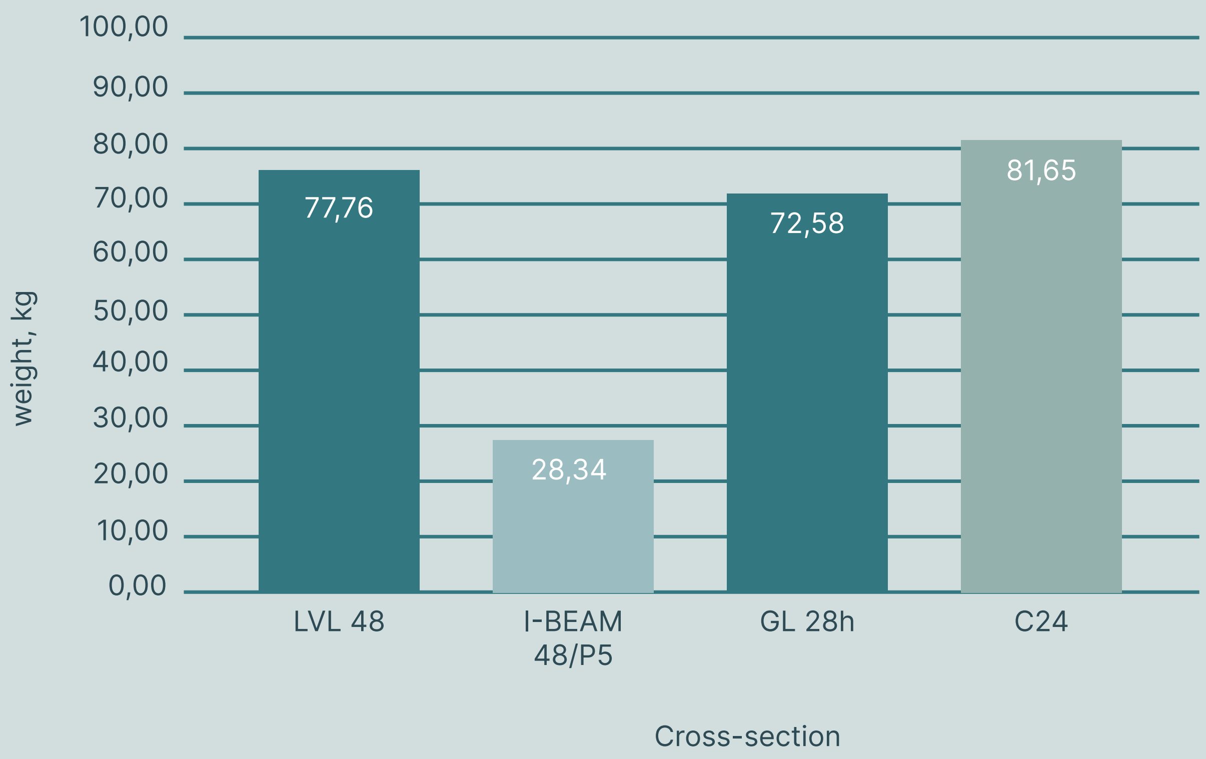
The production of our I-joists begins at the LVL flange production line. For more information on LVL production, please visit www.vmg-lignum.eu. Once produced, the flanges are cut into the specified lengths. A groove is milled along the entire length of their flat surface, which is immediately filled with adhesive and hardener. P5 SPBs are made in parallel to the production of LVL flanges. For more information on their properties and manufacturing process, please visit www.vmg-lignum.eu. OSB/3 can be used instead of P5 SPB. Once produced, the SPBs are cut in accordance with the specified dimensions. The two edges that will be connected to the flanges are cut off. The completed elements, i.e. the flanges and the web, are connected and pressed in batches of three. Quality control is carried out before the I-joists are transferred to the curing oven. The products are removed from the curing oven after about 20 minutes, then packaged and prepared for shipping.

HOW IS JOIST DIFFERENT FROM OTHER MATERIALS?

Because of their cross-sectional shape, I-joists are lighter than other engineered timber construction materials. Taking into account the cross-sectional mass of the different timber joists loaded with 2 kN/m constant load and 3 kN/m variable load, the VMG LIGNUM JOISTS 48/P5 of 6 m span are:

- 61% lighter than glued wood Gl28h;
- 63% lighter than laminated veneer lumber LVL48P;
- 65% lighter than sawn construction timber C24.

COMPARISON OF JOISTS, 6 m SPAN



WHY CHOOSE VMG LIGNUM JOIST?

As environmental regulations become stricter and energy costs rise, there is a growing motivation to select construction materials with greater care than in the past. It is becoming increasingly more crucial to take into account the eco-friendliness and energy efficiency of products employed in construction.

Timber I-joists provide most optimal utilisation of timber biomass in load-bearing structures among all load-bearing timber construction materials. They are especially suitable in situations where lightweight and efficient structural solutions are required.

VMG LIGNUM JOISTS are a unique product in that all their components are manufactured in the same geographical location. In VMG LIGNUM CONSTRUCTION's production facility in Naujoji Akmene (Lithuania), round logs of spruce and pine are transformed into VMG LIGNUM LVL laminated veneer lumber or VMG LIGNUM BOARD structural particle boards, and then assembled into VMG LIGNUM JOIST I-joists. After processing the timber, it is milled and converted into durable VMG LIGNUM BOARD structural particle boards, and some of it is further processed into VMG LIGNUM JOIST webs. This maximises the efficient use of timber biomass from the forest, resulting in extremely high wood processing efficiency.

VMG LIGNUM JOIST

DESCRIPTION

VMG LIGNUM JOISTS are produced out of VMG LIGNUM LVL 48P and VMG LIGNUM BOARD grade P5. OSB/3 can also be used as an alternative to VMG LIGNUM BOARD. The finished joists are efficiently utilised, thanks to their I-shaped cross-section, for both horizontal and vertical installation. The joists used for the floors are subjected to downward loads, causing compression of the top flange and tension of the bottom flange. The web is less loaded in its central part, thus making efficient use of the cross-section. The produced joists are cut into products with uniform standard dimensions. If needed, they can be cut according to the dimensions ordered by the customer.

ADVANTAGES OF USING VMG LIGNUM JOISTS

- Lighter when compared to other engineered wood joists
- Easy to process
- Dimensional stability (no twists, cracks or splinters)
- Easy to combine with other products
- Can be used for wide spans of up to 18m long
- Efficient use of materials
- Organic raw materials derived from natural sources
- Low cold bridge (due to I-shaped cross-section)
- Variety of dimensions, large sizes
- Stronger and straighter than traditional sawn timber

JOIST

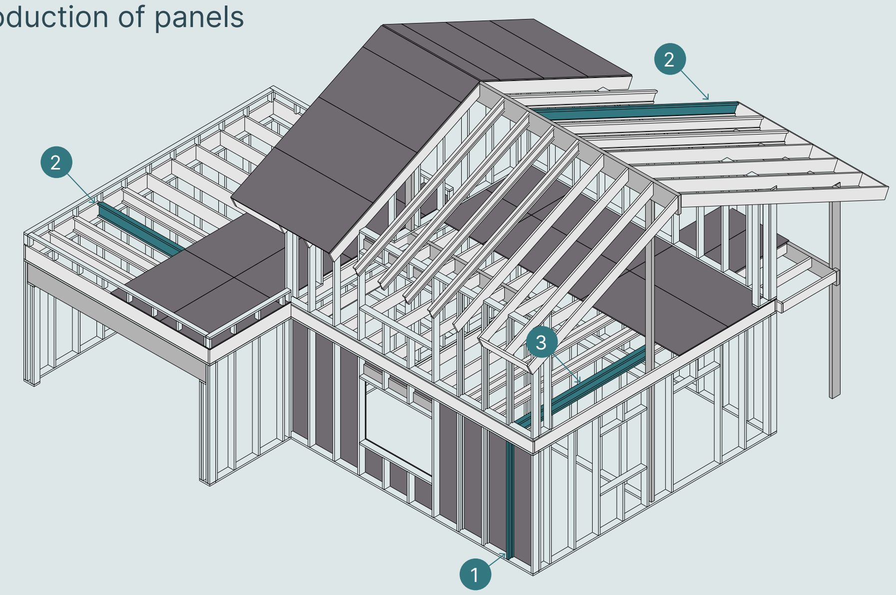
AREAS OF UTILISATION OF VMG LIGNUM JOISTS

VMG LIGNUM JOISTS can be used as single elements, as well as for the production of 2D (flat) wall and floor panels and 3D (volumetric) modules.

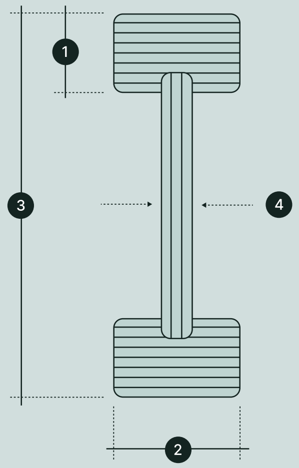
VMG LIGNUM JOISTS can be utilised for roofs, walls, and floors in new construction, renovation, or modernization projects. With appropriate storage, these joists can be employed for on-site construction as well as in the production of panels or modules in a factory setting.

In buildings of light structures, VMG LIGNUM JOIST is used:

1. wall studs
2. roof rafters
3. ceiling beams



STANDARD SIZES OF VMG LIGNUM JOISTS



1. Flange height: 39 mm
2. Flange width: 45/60/90 mm
3. Joist height: 200/220/240/250/300/360/400 mm (200 mm joist heights with 45 or 60 mm flange width)
4. Web thickness: 10 mm
5. Standard joist length: 13.6 m
6. Maximum joist length: 18 m

TECHNICAL SPECIFICATIONS

TABLE OF STRENGTHS

Characteristic values of LVL flanges used for VMG LIGNUM JOISTS

Property	
Bending strength	50
LVL48p tensile strength (along the fibre)	35
LVL48p compressive strength (along the fibre)	39
Characteristic modulus of elasticity	11 600
Average modulus of elasticity	14 000

Characteristic values of SPB webs used for VMG LIGNUM JOISTS

Property	
Tensile strength	9,4
Compressive strength	12,7
Shear strength, panel shear	7,0
Shear strength, planar shear	1,9
SPB modulus of elasticity	2 550
Average modulus of shear	960

Characteristic values of OSB/3 webs used for VMG LIGNUM JOISTS

Property	
Tensile strength	7,2
Compressive strength	12,9
Shear strength, panel shear	2,2
Shear strength, planar shear	6,8
SPB modulus of elasticity	3 800
Average modulus of shear	1080

TABLE OF TOLERANCES

Nominal size	Maximum deviations
Overall height (h)	± 1,5
Length (L)	-/+10 mm
Flange width bf	± 1,5
Flange height hf	± 2
Web thickness tw	± 0.8

Cross section properties of VMG Lignum Joists

Width, mm	Height, mm	Joist depth H (mm)	Flange width B (mm)	Flange thickness h_w (mm)	Web thickness b_w (mm)	Flange area A_f (mm^2)	Web area A_w (mm^2)
45	**200**	200	45	39	10	1755	1220
	220	220	45	39	10	1755	1420
	240	240	45	39	10	1755	1620
	250	250	45	39	10	1755	1720
	300	300	45	39	10	1755	2220
	360	360	45	39	10	1755	2820
	400	400	45	39	10	1755	3220
60	**200**	200	60	39	10	2340	1220
	220	220	60	39	10	2340	1420
	240	240	60	39	10	2340	1620
	250	250	60	39	10	2340	1720
	300	300	60	39	10	2340	2220
	360	360	60	39	10	2340	2820
	400	400	60	39	10	2340	3220
90	**200**	200	90	39	10	3510	1220
	220	220	90	39	10	3510	1420
	240	240	90	39	10	3510	1620
	250	250	90	39	10	3510	1720
	300	300	90	39	10	3510	2220
	360	360	90	39	10	3510	2820
	400	400	90	39	10	3510	3220

Mechanical properties of VMG Lignum Joists

VMG Lignum Joist$_{PB}$	Characteristic values of capacities						Mean stiffness values	
	Bending moment M_k [1]	Shear V_k	End bearing [2]		Intermediate bearing [2]		Flexural rigidity EI_{mean}	Shear rigidity GA_{mean}
			45mm	90mm	45mm	90mm		
	kNm	kN	kN	kN	kN	kN	$x10^{12}$ Nmm^2	$x10^6$ Nmm^2
45-200	8,57	10,36	8,74	13,42	15,91	22,15	0,330	1,920
45-220	9,60	11,76	8,74	13,42	15,91	22,15	0,417	2,112
45-240	10,63	13,16	8,74	13,42	15,91	22,15	0,515	2,304
45-250	11,14	13,86	8,74	13,42	15,91	22,15	0,568	2,400
45-300	13,73	17,36	8,74	13,42	15,91	22,15	0,875	2,880
45-360	16,84	18,33	8,74	13,42	15,91	22,15	1,337	3,456
45-400	18,92	20,71	8,74	13,42	15,91	22,15	1,705	3,840
60-200	11,43	10,36	10,48	16,10	19,09	26,58	0,438	1,920
60-220	12,80	11,76	10,48	16,10	19,09	26,58	0,553	2,112
60-240	14,17	13,16	10,48	16,10	19,09	26,58	0,682	2,304
60-250	14,86	13,86	10,48	16,10	19,09	26,58	0,752	2,400
60-300	18,30	17,36	10,48	16,10	19,09	26,58	1,156	2,880
60-360	22,46	18,33	10,48	16,10	19,09	26,58	1,762	3,456
60-400	25,23	20,71	10,48	16,10	19,09	26,58	2,240	3,840
90-200	17,14	10,36	10,48	16,10	19,09	26,58	0,655	1,920
90-220	19,19	11,76	10,48	16,10	19,09	26,58	0,826	2,112
90-240	21,25	13,16	10,48	16,10	19,09	26,58	1,018	2,304
90-250	22,28	13,86	10,48	16,10	19,09	26,58	1,121	2,400
90-300	27,46	17,36	10,48	16,10	19,09	26,58	1,718	2,880
90-360	33,68	18,33	10,48	16,10	19,09	26,58	2,610	3,456
90-400	37,84	20,71	10,48	16,10	19,09	26,58	3,312	3,840

[1] The flange which is under compresson stress is laterally restrained in max c/c 500mm spacing.

[2] Bearing capacies for support lengths between the support lengths in the table may be interpolated.

Axial compression capacity of VMG Lignum Joists as a wall stud for centric axial loading (no eccentricity). Stud height is max 3000 mm and it has lateral restraints at every 1000 mm of the height.

VMG Lignum Joist$_{PB}$	Axial compression F_k
	kNm
45-200	52,7
45-220	52,7
45-240	52,7
45-250	52,8
45-300	52,9
45-360	53,0
45-400	53,1

VMG Lignum Joist$_{PB}$	Axial compression F_k
	kNm
60-200	112,3
60-220	112,6
60-240	112,9
60-250	113,0
60-300	113,6
60-360	114,3
60-400	114,7

VMG Lignum Joist$_{PB}$	Axial compression F_k
	kNm
90-200	221,8
90-220	222,8
90-240	223,7
90-250	224,2
90-300	226,5
90-360	229,3
90-400	231,2

DESIGN GUIDELINES

CALCULATIONS

The strength and stiffness of timber elements are influenced by load duration and moisture content, factors that need to be considered in calculations. Calculations of the maximum joist spans take into account the duration of the average load. The available load duration classes are displayed in the table.

Load duration classes (LST EN 1995-1-1, table 2.1)

LOAD DURATION CLASS	CHARACTERISTIC LOAD CUMULATIVE TIME SERIES
Permanent	Over 10 years
Long-term	From 6 months to 10 years
Medium-term	From 1 week to 6 months
Short-term	Less than one week
Instantaneous	

VMG LIGNUM JOISTS can be used in service classes 1 and 2. The calculations meet the requirements for service class 1. The service classes in accordance with LST EN 1995-1-1:

SERVICE CLASS 1

characterised by a moisture content in the materials corresponding to a temperature of 20°C and the relative humidity of the surrounding air only exceeding 65% for a few weeks per year.

SERVICE CLASS 2

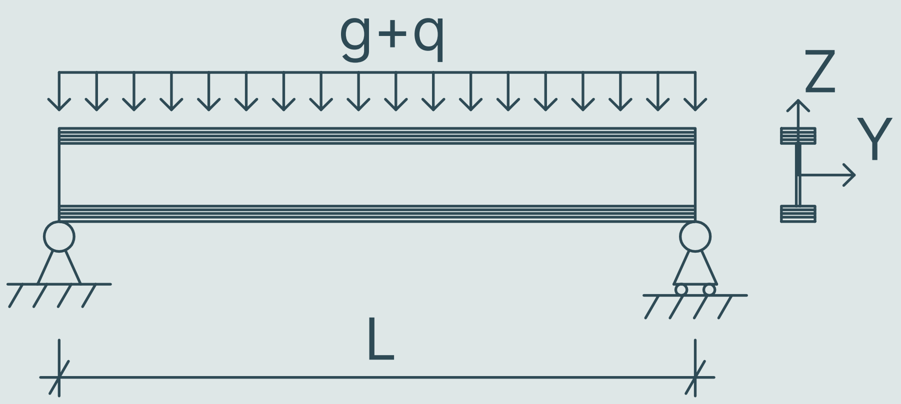
characterised by a moisture content in the materials corresponding to a temperature of 20°C and the relative humidity of the surrounding air only exceeding 85% for a few weeks per year.

SERVICE CLASS 3

due to climatic conditions, is characterised by higher moisture contents than service class 2.

CALCULATIONS OF THE MAXIMUM JOIST SPANS OF VMG LIGNUM JOISTS

The bearing power of VMG LIGNUM JOISTS has been calculated in accordance with LST EN 1995-1-1. Calculation scheme:



The calculation scheme of VMG LIGNUM JOISTS

Where:
g – permanent load;
q – variable load.

The design strength value of the material Xd is calculated according to formula 2.14 of LST EN 1995-1-1:

$$X_d = \frac{k_{mod} \cdot X_k}{\gamma_m}$$

Where:
X_k – characteristic value of the strength property;
γ_m – partial coefficient of the strength property Recommended coefficient value of LVL is 1,2, SPB - 1,3, OSB -1,2;
k_{mod} – a correction factor to take account of the effects of load duration and moisture on the structure. According to LST EN 1995-1-1 3.1 table, under medium-term load and conditions of service class 1: LVL - k_{mod}= 0,8, SPB - 0,65, OSB - 0,7.

The serviceability Limit State (SLS) must be assessed when performing calculations of the maximum joist spans (LST EN 1995-1-1, Chapter 7. The maximum allowable deflection of the joist is L/250. The limiting value of the natural oscillation frequency of the joists is f_{lim} = 8 Hz. The stiffness of the floor structure in the direction perpendicular to the joists has not been taken into account in the calculations.

For the purpose of considering the serviceability limit states, the final average modulus of elasticity $E_{m,fin}$, which is used to calculate the final deformation value, must be calculated in accordance with formula 2.7 of LST EN 1995-1-1:

$$E_{m,\,fin} = \frac{E_m}{1+k_{def}}$$

Where:
E_m – average modulus of elasticity;
k_{def} – creep deformation coefficient to be selected according to the service class of the structure. According to LST EN 1995-1-1 3.2 table, the value of k_{def} for service class 1: LVL – 0,6, SPB – 2,25, OSB – 1,5.

- Beam supports are asummed to be 90 mm length.
- The calculations are based on the assumption that the lateral displacements of the joists are restrained: the joists are restrained by ties at the supports and at intervals of at least 500 mm along the length of the joist. The vibration calculations for the joists have not taken into account the effect of tie stiffness.
- The span tables have been developed for different combinations of applied loads: variable loads q_k 1,5;2,0 and 2,5 kN/m² (Load capacities have been selected taking into account the variations of service loads given in EN 1991-1-1) and permanent loads g_k from 0,5 and 2,0 kN/m².

Table 1. I joist beams maximum spans, when permanent load gk equal 0,5 kN/m² and variable load qk equal 1,5 kN/m² (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 0,5kPA, ik=1,5 kPa)			
Width, mm	**Height, mm**	**LVL48P (h=39mm) c/c300**	**LVL48P (h=39mm) c/c600**
		Max span L (m)	**Max span L (m)**
45	**200**	4,70	3,60
	220	5,10	3,90
	240	5,50	4,20
	250	5,70	4,40
	300	6,32	5,10
	360	6,98	5,90
	400	7,40	6,40
60	**200**	5,20	3,90
	220	5,60	4,30
	240	5,90	4,60
	250	6,03	4,80
	300	6,68	5,60
	360	7,38	6,43
	400	7,82	6,81
90	**200**	5,76	4,40
	220	6,09	4,90
	240	6,40	5,20
	250	6,55	5,40
	300	7,25	6,30
	360	8,02	6,95
	400	8,50	7,36

Table 2. I joist beams maximum spans, when permanent load gk equal 1,0 kN/m² and variable load qk equal 1,5 kN/m² (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 1,0kPA, ik=1,5 kPa)			
Width, mm	**Height, mm**	**LVL48P (h=39mm) c/c300**	**LVL48P (h=39mm) c/c600**
		Max span L (m)	**Max span L (m)**
45	**200**	4,30	3,20
	220	4,60	3,50
	240	5,00	3,80
	250	5,14	3,90
	300	5,68	4,60
	360	6,28	5,30
	400	6,65	5,80
60	**200**	4,60	3,50
	220	5,05	3,80
	240	5,31	4,10
	250	5,43	4,30
	300	6,01	5,00
	360	6,64	5,79
	400	7,04	6,13
90	**200**	5,18	3,90
	220	5,48	4,30
	240	5,75	4,60
	250	5,89	4,80
	300	6,52	5,60
	360	7,22	6,25
	400	7,65	6,62

Table 3. I joist beams maximum spans, when permanent load gk equal 1,5 kN/m² and variable load qk equal 1,5 kN/m² (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 1,5kPA, ik=1,5 kPa)			
Width, mm	**Height, mm**	**LVL48P (h=39mm) c/c300**	**LVL48P (h=39mm) c/c600**
		Max span L (m)	**Max span L (m)**
45	**200**	3,90	2,90
	220	4,20	3,20
	240	4,60	3,40
	250	4,70	3,60
	300	5,28	4,20
	360	5,83	4,90
	400	6,18	5,30
60	**200**	4,30	3,20
	220	4,60	3,50
	240	4,93	3,70
	250	5,04	3,90
	300	5,58	4,60
	360	6,17	5,30
	400	6,54	5,69
90	**200**	4,80	3,50
	220	5,09	3,90
	240	5,34	4,20
	250	5,47	4,40
	300	6,06	5,10
	360	6,70	5,81
	400	7,10	6,15

Table 4. I joist beams maximum spans, when permanent load gk equal 2,0 kN/m² and variable load qk equal 1,5 kN/m² (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 2,0kPA, ik=1,5 kPa)			
Width, mm	**Height, mm**	**LVL48P (h=39mm) c/c300**	**LVL48P (h=39mm) c/c600**
		Max span L (m)	**Max span L (m)**
45	**200**	3,60	2,70
	220	3,90	2,90
	240	4,30	3,20
	250	4,40	3,30
	300	4,98	3,90
	360	5,51	4,50
	400	5,53	4,90
60	**200**	3,90	2,90
	220	4,30	3,20
	240	4,60	3,50
	250	4,76	3,60
	300	5,27	4,20
	360	5,83	4,90
	400	6,17	5,37
90	**200**	4,40	3,20
	220	4,80	3,60
	240	5,05	3,90
	250	5,17	4,00
	300	5,72	4,70
	360	6,33	5,49
	400	6,64	5,81

Table 5. I joist beams maximum spans, when permanent load gk equal 0,5 kN/m² and variable load qk equal 2,0 kN/m² (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 0,5kPA, ik=2,0 kPa)			
Width, mm	**Height, mm**	**LVL48P (h=39mm) c/c300**	**LVL48P (h=39mm) c/c600**
		Max span L (m)	**Max span L (m)**
45	**200**	4,50	3,40
	220	4,80	3,70
	240	5,20	4,00
	250	5,40	4,20
	300	6,11	4,90
	360	6,76	5,60
	400	7,16	6,10
60	**200**	4,90	3,70
	220	5,30	4,10
	240	5,69	4,40
	250	5,83	4,60
	300	6,45	5,30
	360	7,14	6,10
	400	7,57	6,59
90	**200**	5,56	4,20
	220	5,87	4,60
	240	6,17	5,00
	250	6,32	5,20
	300	7,00	6,00
	360	7,75	6,72
	400	8,21	7,11

Table 6. I joist beams maximum spans, when permanent load gk equal 1,0 kN/m² and variable load qk equal 2,0 kN/m² (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 1,0kPA, ik=2,0 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	4,00	3,00
	220	4,40	3,30
	240	4,70	3,60
	250	4,90	3,70
	300	5,54	4,30
	360	6,13	5,00
	400	6,24	5,40
60	200	4,40	3,30
	220	4,80	3,60
	240	5,10	3,90
	250	5,30	4,00
	300	5,86	4,70
	360	6,48	5,50
	400	6,87	5,90
90	200	4,90	3,70
	220	5,34	4,00
	240	5,62	4,30
	250	5,75	4,50
	300	6,37	5,30
	360	7,04	6,10
	400	7,46	6,46

Table 7. I joist beams maximum spans, when permanent load gk equal 1,5 kN/m² and variable load qk equal 2,0 kN/m² (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 1,5kPA, ik=2,0 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,70	2,80
	220	4,00	3,00
	240	4,40	3,30
	250	4,50	3,40
	300	5,18	4,00
	360	5,42	4,60
	400	5,42	5,00
60	200	4,00	3,00
	220	4,40	3,30
	240	4,70	3,50
	250	4,90	3,70
	300	5,48	4,30
	360	6,06	5,00
	400	6,42	5,50
90	200	4,60	3,30
	220	4,99	3,70
	240	5,25	4,00
	250	5,37	4,10
	300	5,95	4,90
	360	6,50	5,70
	400	6,50	6,04

Table 8. I joist beams maximum spans, when permanent load gk equal 2,0 kN/m² and variable load qk equal 2,0 kN/m² (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 2,0kPA, ik=2,0 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,50	2,60
	220	3,80	2,80
	240	4,10	3,00
	250	4,20	3,20
	300	4,79	3,70
	360	4,79	4,30
	400	4,79	4,70
60	200	3,80	2,80
	220	4,10	3,00
	240	4,40	3,30
	250	4,60	3,40
	300	5,19	4,00
	360	5,74	4,70
	400	5,75	5,10
90	200	4,20	3,08
	220	4,60	3,40
	240	4,97	3,70
	250	5,09	3,80
	300	5,64	4,50
	360	5,75	5,30
	400	5,75	5,72

Table 9. I joist beams maximum spans, when permanent load gk equal 0,5 kN/m² and variable load qk equal 2,5 kN/m² (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 0,5kPA, ik=2,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	4,10	3,10
	220	4,50	3,40
	240	4,80	3,70
	250	5,00	3,80
	300	5,80	4,40
	360	6,10	5,10
	400	6,10	5,60
60	200	4,50	3,40
	220	4,90	3,70
	240	5,30	4,00
	250	5,40	4,10
	300	6,24	4,80
	360	6,89	5,60
	400	7,30	6,10
90	200	5,10	3,80
	220	5,50	4,20
	240	5,97	4,50
	250	6,11	4,70
	300	6,77	5,50
	360	7,32	6,30
	400	7,32	6,87

Table 10. I joist beams maximum spans, when permanent load gk equal 1,0 kN/m^2 and variable load qk equal 2,5 kN/m^2 (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 1,0kPA, ik=2,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,80	2,80
	220	4,10	3,10
	240	4,40	3,40
	250	4,60	3,50
	300	5,31	4,10
	360	5,31	4,70
	400	5,31	5,20
60	200	4,10	3,10
	220	4,50	3,40
	240	4,90	3,70
	250	5,00	3,80
	300	5,73	4,40
	360	6,34	5,20
	400	6,38	5,60
90	200	4,70	3,40
	220	5,10	3,80
	240	5,49	4,10
	250	5,62	4,30
	300	6,22	5,00
	360	6,38	5,80
	400	6,38	6,30

Table 11. I joist beams maximum spans, when permanent load gk equal 1,5 kN/m^2 and variable load qk equal 2,5 kN/m^2 (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 1,5kPA, ik=2,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,50	2,60
	220	3,90	2,90
	240	4,20	3,10
	250	4,30	3,20
	300	4,71	3,80
	360	4,71	4,40
	400	4,71	4,71
60	200	3,90	2,80
	220	4,20	3,10
	240	4,50	3,40
	250	4,70	3,50
	300	5,38	4,10
	360	5,65	4,80
	400	5,65	5,20
90	200	4,30	3,03
	220	4,70	3,44
	240	5,10	3,80
	250	5,28	3,90
	300	5,65	4,60
	360	5,65	5,36
	400	5,65	5,65

Table 12. I joist beams maximum spans, when permanent load gk equal 2,0 kN/m^2 and variable load qk equal 2,5 kN/m^2 (flange height 39 mm, web from P5, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB P5 (10 mm)SPAN TABLES (LOADS gk= 2,0kPA, ik=2,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,30	2,40
	220	3,60	2,70
	240	3,90	2,90
	250	4,10	3,00
	300	4,23	3,60
	360	4,23	4,20
	400	4,23	4,23
60	200	3,60	2,60
	220	4,00	2,90
	240	4,30	3,20
	250	4,40	3,30
	300	5,07	3,90
	360	5,07	4,50
	400	5,07	4,90
90	200	4,10	2,72
	220	4,50	3,09
	240	4,80	3,45
	250	5,00	3,64
	300	5,07	4,30
	360	5,07	5,81
	400	5,07	5,07

I joist beams maximum spans, when permanent load gk equal 0,5 kN/m^2 and variable load qk equal 1,5 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 0,5kPA, ik=1,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	4,80	3,70
	220	5,20	4,00
	240	5,59	4,40
	250	5,72	4,50
	300	6,34	5,20
	360	7,01	6,10
	400	7,43	6,49
60	200	5,30	4,10
	220	5,62	4,40
	240	5,91	4,80
	250	6,04	4,90
	300	6,69	5,70
	360	7,41	6,46
	400	7,85	6,84
90	200	5,77	4,60
	220	6,09	5,00
	240	6,40	5,40
	250	6,55	5,60
	300	7,26	6,31
	360	8,04	6,97
	400	8,52	7,38

Table 2. I joist beams maximum spans, when permanent load gk equal 1,0 kN/m^2 and variable load qk equal 1,5 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 1,0kPA, ik=1,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	4,30	3,30
	220	4,70	3,60
	240	5,03	3,90
	250	5,15	4,10
	300	5,70	4,70
	360	6,31	5,50
	400	6,69	5,84
60	200	4,79	3,60
	220	5,06	4,00
	240	5,31	4,30
	250	5,44	4,40
	300	6,02	5,20
	360	6,66	5,81
	400	7,06	6,15
90	200	5,19	4,10
	220	5,48	4,50
	240	5,76	4,80
	250	5,90	5,00
	300	6,53	5,67
	360	7,23	6,27
	400	7,66	6,64

Table 3. I joist beams maximum spans, when permanent load gk equal 1,5 kN/m^2 and variable load qk equal 1,5 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 1,5kPA, ik=1,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	4,00	3,00
	220	4,40	3,30
	240	4,67	3,60
	250	4,78	3,70
	300	5,29	4,30
	360	5,86	5,00
	400	6,21	5,42
60	200	4,40	3,30
	220	4,70	3,60
	240	4,93	3,90
	250	5,05	4,10
	300	5,59	4,70
	360	6,19	5,39
	400	6,56	5,71
90	200	4,82	3,70
	220	5,09	4,10
	240	5,35	4,40
	250	5,48	4,60
	300	6,07	5,27
	360	6,71	5,82
	400	7,12	6,16

Table 4. I joist beams maximum spans, when permanent load gk equal 2,0 kN/m^2 and variable load qk equal 1,5 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 2,0kPA, ik =1,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,70	2,80
	220	4,10	3,10
	240	4,40	3,30
	250	4,50	3,50
	300	5,00	4,00
	360	5,53	4,70
	400	5,53	5,10
60	200	4,10	3,10
	220	4,40	3,40
	240	4,66	3,60
	250	4,77	3,80
	300	5,28	4,40
	360	5,85	5,09
	400	6,20	5,39
90	200	4,55	3,50
	220	4,81	3,80
	240	5,05	4,10
	250	5,17	4,20
	300	5,73	4,98
	360	6,34	5,50
	400	6,64	5,82

Table 5. I joist beams maximum spans, when permanent load gk equal 0,5 kN/m^2 and variable load qk equal 2,0 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 0,5kPA, ik=2,0 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	4,50	3,40
	220	4,80	3,70
	240	5,20	4,00
	250	5,40	4,20
	300	6,11	4,90
	360	6,76	5,60
	400	7,16	6,10
60	200	4,90	3,70
	220	5,30	4,10
	240	5,69	4,40
	250	5,83	4,60
	300	6,45	5,30
	360	7,14	6,10
	400	7,57	6,59
90	200	5,56	4,20
	220	5,87	4,60
	240	6,17	5,00
	250	6,32	5,20
	300	7,00	6,00
	360	7,75	6,72
	400	8,21	7,11

Table 6. I joist beams maximum spans, when permanent load gk equal 1,0 kN/m^2 and variable load qk equal 2,0 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 1,0kPA, ik=2,0kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	4,10	3,10
	220	4,20	3,40
	240	4,80	3,70
	250	5,00	3,80
	300	5,56	4,40
	360	6,15	5,20
	400	6,24	5,60
60	200	4,50	3,40
	220	4,90	3,70
	240	5,18	4,00
	250	5,31	4,20
	300	5,88	4,80
	360	6,50	5,60
	400	6,89	6,00
90	200	5,06	3,80
	220	5,35	4,20
	240	5,62	4,50
	250	5,75	4,70
	300	6,37	5,50
	360	7,06	6,12
	400	7,48	6,48

Table 7. I joist beams maximum spans, when permanent load gk equal 1,5 kN/m^2 and variable load qk equal 2,0 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 1,5kPA, ik=2,0 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,80	2,90
	220	4,10	3,20
	240	4,50	3,40
	250	4,60	3,50
	300	5,20	4,10
	360	5,42	4,80
	400	5,42	5,20
60	200	4,20	3,10
	220	4,50	3,40
	240	4,84	3,70
	250	4,96	3,90
	300	5,49	4,50
	360	6,07	5,20
	400	6,44	5,61
90	200	4,70	3,50
	220	5,00	3,90
	240	5,25	4,20
	250	5,37	4,30
	300	5,96	5,10
	360	6,50	5,71
	400	6,50	6,05

Table 8. I joist beams maximum spans, when permanent load gk equal 2,0 kN/m^2 and variable load qk equal 2,0 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 2,0kPA, i =2,0 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,60	2,70
	220	3,90	3,00
	240	4,20	3,20
	250	4,40	3,30
	300	4,79	3,90
	360	4,79	4,50
	400	4,79	4,79
60	200	3,90	2,90
	220	4,30	3,20
	240	4,59	3,50
	250	4,70	3,60
	300	5,20	4,20
	360	5,75	4,90
	400	5,75	5,30
90	200	4,40	3,30
	220	4,74	3,60
	240	4,98	3,90
	250	5,10	4,10
	300	5,65	4,80
	360	5,75	5,42
	400	5,75	5,74

Table 9. I joist beams maximum spans, when permanent load gk equal 0,5 kN/m^2 and variable load qk equal 2,5 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 0,5kPA, ik=2,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	4,20	3,20
	220	4,30	3,50
	240	4,90	3,80
	250	5,10	3,90
	300	5,90	4,60
	360	6,10	5,30
	400	6,10	5,70
60	200	4,60	3,50
	220	5,00	3,80
	240	5,40	4,10
	250	5,60	4,30
	300	6,25	5,00
	360	6,92	5,80
	400	7,32	6,30
90	200	5,20	4,00
	220	5,69	4,30
	240	5,98	4,70
	250	6,12	4,80
	300	6,78	5,60
	360	7,32	6,50
	400	7,32	6,89

Table 10. I joist beams maximum spans, when permanent load gk equal 1,0 kN/m^2 and variable load qk equal 2,5 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 1,0kPA, ik=2,5kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,90	3,00
	220	4,20	3,20
	240	4,60	3,50
	250	4,70	3,60
	300	5,31	4,20
	360	5,31	4,90
	400	5,31	5,30
60	200	4,30	3,20
	220	4,60	3,50
	240	5,00	3,80
	250	5,19	3,90
	300	5,75	4,60
	360	6,36	5,30
	400	6,38	5,80
90	200	4,80	3,60
	220	5,20	4,00
	240	5,50	4,30
	250	5,63	4,40
	300	6,23	5,20
	360	6,38	5,98
	400	6,38	6,33

Table 11. I joist beams maximum spans, when permanent load gk equal 1,5 kN/m^2 and variable load qk equal 2,5 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

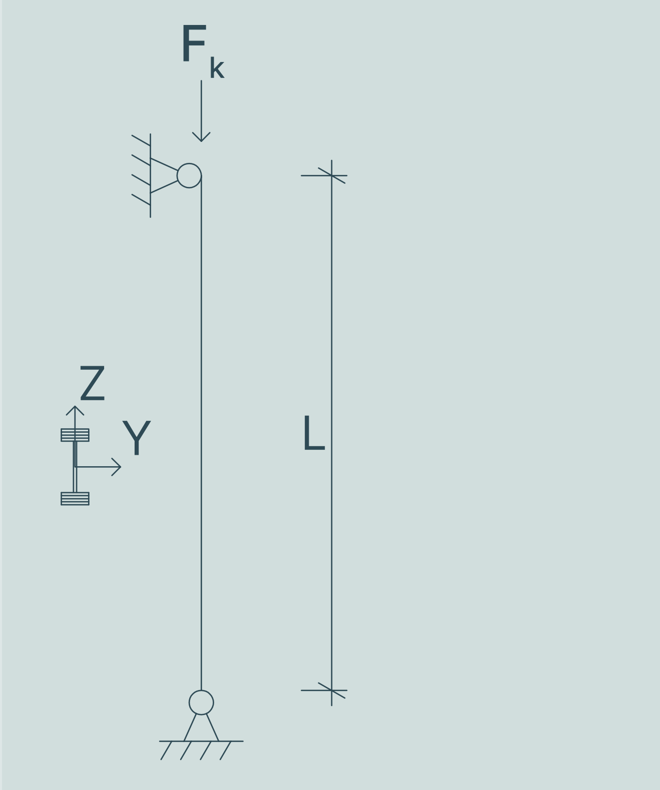
I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 1,5kPA, ik=2,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,60	2,80
	220	4,00	3,00
	240	4,30	3,30
	250	4,40	3,40
	300	4,71	3,90
	360	4,71	4,60
	400	4,71	4,71
60	200	4,00	3,00
	220	4,30	3,30
	240	4,70	3,50
	250	4,80	3,70
	300	5,40	4,30
	360	5,65	5,00
	400	5,65	5,40
90	200	4,50	3,40
	220	4,90	3,70
	240	5,16	4,00
	250	5,28	4,10
	300	5,65	4,80
	360	5,65	5,60
	400	5,65	5,65

Table 12. I joist beams maximum spans, when permanent load gk equal 2,0 kN/m^2 and variable load qk equal 2,5 kN/m^2 (flange height 39 mm, web from OSB/3, 10 mm thickness)

I JOIST BEAM WITH FLANGE LVL48P AND WEB OSB/3 (10 mm)SPAN TABLES (LOADS gk= 2,0kPA, i =2,5 kPa)			
Width, mm	Height, mm	LVL48P (h=39mm) c/c300	LVL48P (h=39mm) c/c600
		Max span L (m)	Max span L (m)
45	200	3,50	2,60
	220	3,80	2,80
	240	4,10	3,10
	250	4,20	3,20
	300	4,23	3,70
	360	4,23	4,23
	400	4,23	4,23
60	200	3,80	2,80
	220	4,10	3,10
	240	4,40	3,30
	250	4,60	3,50
	300	5,07	4,10
	360	5,07	4,70
	400	5,07	5,07
90	200	4,30	3,08
	220	4,60	3,50
	240	4,91	3,70
	250	5,02	3,90
	300	5,07	4,60
	360	5,07	5,07
	400	5,07	5,07

CALCULATIONS OF THE BEARING POWER OF VMG LIGNUM JOIST WALL STUDS

The calculations of the bearing power of VMG LIGNUM JOIST wall studs must be carried out accordance with LST EN 1995-1-1 standard. Calculation scheme:



Where:

F_k = g+q – axial force;

It is assumed that the LVL wall studs are subjected to axial force and bending moment.

The relative slenderness ratios are calculated in accordance with LST EN 1995-1-1 formulae 6.21 and 6.22:

$$\lambda_{rel,y} = \frac{\lambda_y}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0,05}}} \qquad \lambda_{rel,z} = \frac{\lambda_z}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0,05}}}$$

Where:

λ_y – lslenderness ratio around the y-axis;
λ_z – slenderness ratio around the z-axis;
$f_{(c,0,k)}$ – characteristic compressive strength along the fibre;
$E_{0,05}$ – the fifth percentile value of the modulus of elasticity.

If $\lambda_{rel,z} \leq 0,3$ and $\lambda_{rel,y} \leq 0,3$, the stresses must comply with the conditions in accordance with LST EN 1995-1-1 formulae 6.19 and 6.20:

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m\frac{\sigma_{m,z,d}}{f_{m,z,d}} \leq 1,0$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m\frac{\sigma_{m,z,d}}{f_{m,z,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} \leq 1,0$$

Where:

$\sigma_{c,0,d}$ – derived compressive stress along the fibre;
$f_{c,0,d}$ – derived compressive strength along the fibre;
$\sigma_{m,y,d}$ – derived bending stress around the principal y-axis;
$f_{m,y,d}$ – derived bending strength around the principal y-axis;
$\sigma_{m,z,d}$ – derived bending stress around the principal z-axis;
$f_{m,z,d}$ – derived bending strength around the principal z-axis;
k_m – a coefficient to take account of the redistribution of bending stresses in the cross-section. The value of the coefficient must be taken as 0.7 for rectangular cross-sections and 1.0 for cross-sections of other shapes.

In all other cases, (when λ_rel>0,3) the stresses must comply with the following conditions in accordance with LST EN 1995-1-1 formulae 6.23 and 6.24:

$$\frac{\sigma_{c,0,d}}{k_{c,y}f_{c,0,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} + k_m\frac{\sigma_{m,z,d}}{f_{m,z,d}} \leq 1$$

$$\frac{\sigma_{c,0,d}}{k_{c,z}f_{c,0,d}} + k_m\frac{\sigma_{m,z,d}}{f_{m,z,d}} + \frac{\sigma_{m,y,d}}{f_{m,y,d}} \leq 1$$

Where:

$k_{c,y}$ ir $k_{c,z}$ – coefficients of variation.

The coefficient of variation is calculated in accordance with LST EN 1995-1-1 formulae 6.25, 6.26, 6.27 and 6.28:

$$k_{c,y} = \frac{1}{k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}} \qquad k_{c,z} = \frac{1}{k_z + \sqrt{k_z^2 - \lambda_{rel,z}^2}}$$

$$k_y = 0,5(1+\beta_c(\lambda_{rel,y}-0,3)+\lambda_{rel,y}^2) \qquad k_z = 0,5(1+\beta_c(\lambda_{rel,z}-0,3)+\lambda_{rel,z}^2)$$

β_c – the coefficient to be applied to elements with straightness limits defined as follows, according to LST EN 1995-1-1 formula 6.29:

$$\beta_c = \begin{cases} 0,2\text{-solid timber} \\ 0,1\text{-glued laminated timber and LVL} \end{cases}$$

Where:

$\lambda_{rel,y}$ – slenderness ratio corresponding to bending about the y-axis (deflection towards z);
$\lambda_{rel,z}$ – slenderness ratio corresponding to bending about the z-axis (deflection towards y).

The relative slenderness ratios are calculated as follows:

$$\lambda_{rel,y} = \frac{\lambda_y}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0,k}}} \qquad \lambda_{rel,z} = \frac{\lambda_z}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0,k}}}$$

Where:

λ_y and λ_z – slenderness ratios;
$E_{0,k}$ – modulus of elasticity (towards the fibre).

Other assumptions used in the calculations, the results of which are presented in the following tables:

- The weight of the wall stud is considered as part of the permanent load.
- The calculations for wall studs in a frame house are presented in the tables below.
- The maximum bearing power is calculated according to EN 1995-1-1 for a stronger cross-sectional axis (towards z).
- The assessment of the buckling of the wall stud around the weak axis (towards y) is conducted under the assumption that the sides of the wall studs are restrained at least every 1 metre along their height.
- The height of the calculated wall stud is 3 metres.

Table 13. Characteristic stud buckling load capacity when stud spacing in the wall is 600 mm, height is 3000 mm, it has lateral restraints at every 1000 mm of height (flange height 39 mm, web from P5, 10 mm thickness)

LVL/P5 (10mm), h_f=39 mm		Maximum characteristic axial force
b, mm	h, mm	F_k, kN
45	200	52,65
	220	52,70
	240	52,74
	250	52,76
	300	52,87
	360	52,98
	400	53,05
60	200	112,34
	220	113,60
	240	112,86
	250	112,98
	300	113,59
	360	114,28
	400	114,71
90	200	221,83
	220	222,77
	240	223,72
	250	224,19
	300	226,53
	360	229,33
	400	231,18

Characteristic stud buckling load capacity when stud spacing in the wall is 600 mm, height is 3000 mm, it has lateral restraints at every 1000 mm of height (flange height 39 mm, web from OSB/3, 10 mm thickness)

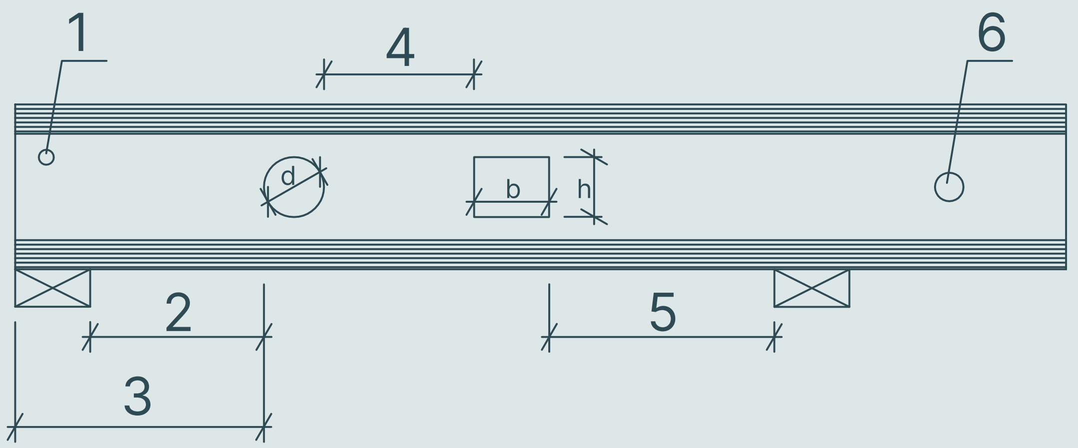
LVL/OSB/3 (10mm), h_f=39 mm		Maximum characteristic axial force
b, mm	h, mm	F_k, kN
45	200	52,72
	220	52,78
	240	52,83
	250	52,85
	300	52,97
	360	53,11
	400	53,19
60	200	112,75
	220	113,06
	240	113,37
	250	113,52
	300	114,24
	360	115,04
	400	115,55
90	200	223,29
	220	224,47
	240	225,65
	250	226,24
	300	229,16
	360	232,64
	400	234,95

HOLE DRILLING METHODS AND CALCULATIONS

Do not drill or cut holes in the flange.

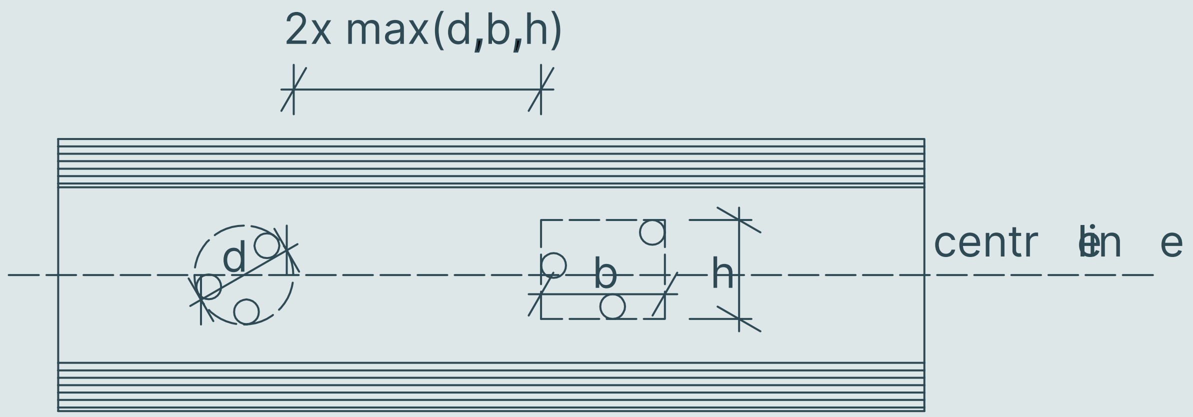
Holes must be drilled in the horizontal axis, except for smaller holes when the diameter of the circle is ≤20mm and the sides of the rectangle are ≤20mm.

1. 20mm holes can be drilled according to requirements, subject to minimum distances from the edges.
2. The minimum distance from the edge of the support to the edge of the circular hole must be at least h/2 (half the height of the joist).
3. For holes of diameter ≤38mm, the distance is measured from the edge of the joist to the edge of the hole.
4. The minimum distance between two holes must be twice the maximum dimension (2d, 2b, 2h).
5. The minimum distance between the edge of the support and the rectangular hole is 300mm.
6. Do not cut or drill into the bracket.



Possible holes in the web (d - diameter, b - width, h - height, 1-6 see above).

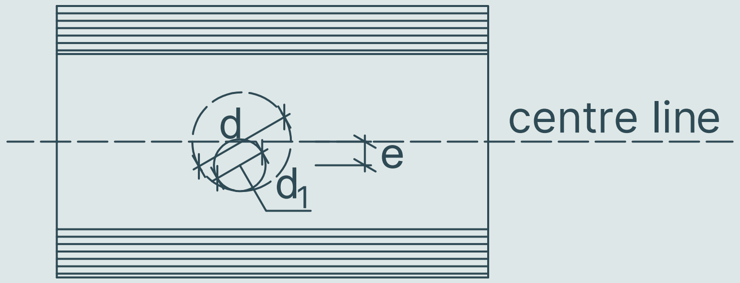
The distance between the two holes must be at least twice the maximum dimension (d,b,h). Otherwise, the holes are grouped together and treated as one large hole, defined as a circle or rectangle.



The theoretical size of the hole that defines groups of holes.

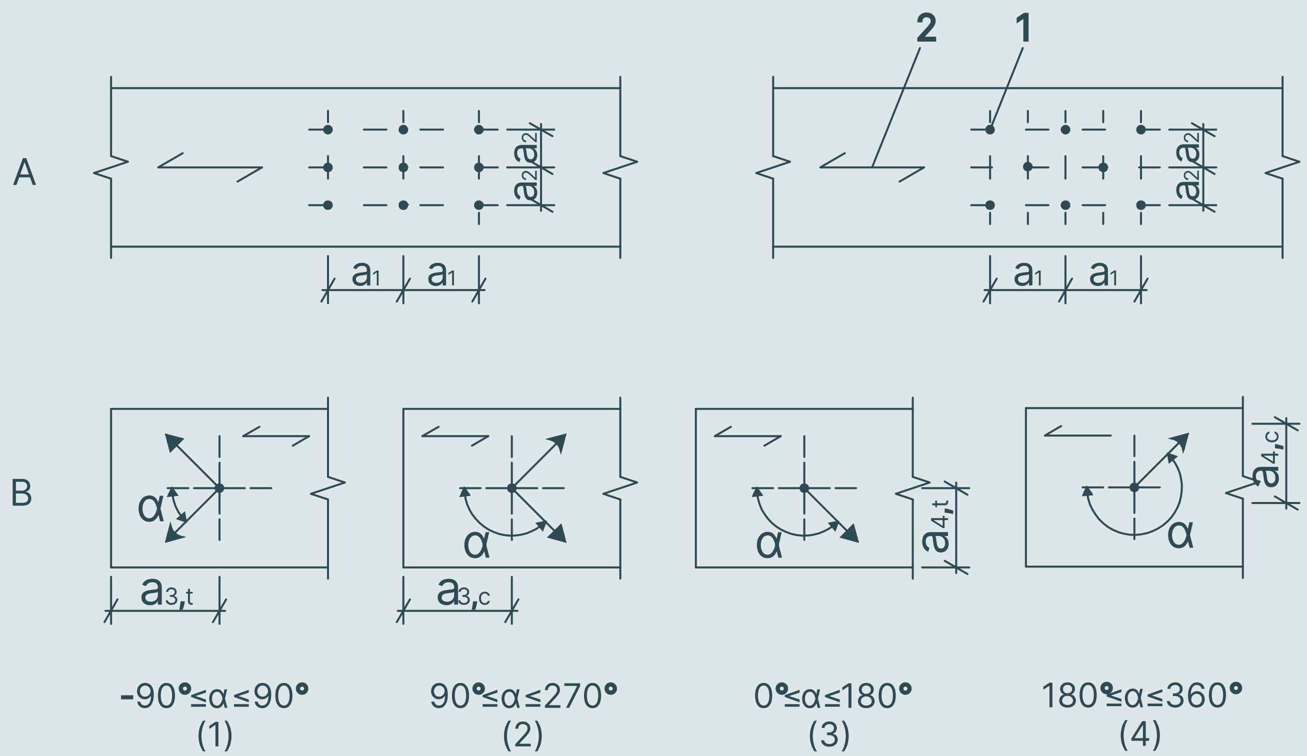
Holes whose centre does not coincide with the centre line of the wall are treated as holes of larger dimensions with a diameter equal to d1+2e, where d1 is the diameter of the hole and e is the eccentricity.

$d=d_1+2\cdot e$



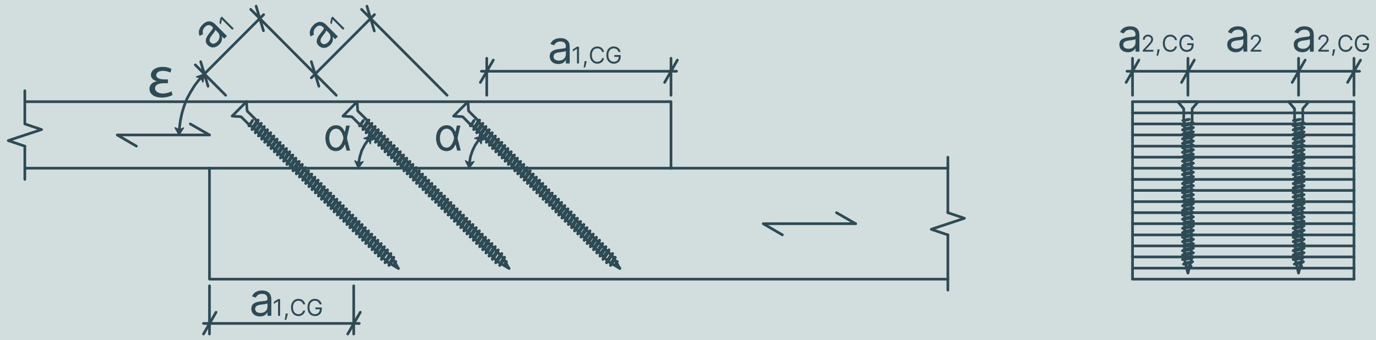
The theoretical size of the hole when the hole is eccentric.

SPACING AND DISTANCES BETWEEN FASTENERS



Spacing and distances from the end and the edge when the fasteners are subjected to a transverse force (1 - connectors, 2 - direction of the fibre (LST EN 1995-1-1 Figure 8.7))

(A) Distances of fasteners in a row along and perpendicular to the fibre;
(B) Distances from the end and the edge, (1) loaded end, (2) loadless end, (3) loaded edge, (4) loadless edge.



Spacing and distances from the end and the edge when the fasteners are subjected to axial force.

α angle between the shear plane and the axis of the bolt,
ε angle between the axis of the bolt and direction of the fibre.

Minimum spacing of transversely loaded nails and screws and their distances from the edge and the end (LST EN 1995-1-1, table 8.2):

Spacing or distance	Angle α	Undrilled holes		Drilled holes
		Flat surface	Edge	
a_1(parallel to the fibre)	0°≤α≤360°	d<5 mm: (5+5|cos α|)d; d≥5mm: (5+7|cos α|)d;	(7+8|cos α|)d;	(4+|cos α|)d
a_2(perpendicular to the fibre)	0°≤α≤360°	5d	7d	(3+|sin α|)d
$a_{3,t}$(to the loaded end)	-90°≤α≤90°	(10+5 cos α)d	(15+5 cos α)d	(7+5 cos α)d
$a_{3,c}$(to the loadless end)	90°≤α≤270°	10d	15d	7d
$a_{4,t}$(to the loaded end)	0°≤α≤180°	d<5 mm: (5+2 sin α)d; d≥5mm: (5+5 sin α)d;	d<5 mm: (7+2 sin α)d; d≥5mm: (7+5 sin α|)d;	d<5 mm: (3+2 sin α)d; d≥5mm: (3+4 sin α)d;
$a_{4,c}$(to the loadless end)	180°≤α≤360°	5d	7d	3d

Minimum spacing of axially loaded screws and their distances from the edge (LST EN 1995-1-1, table 8.6):

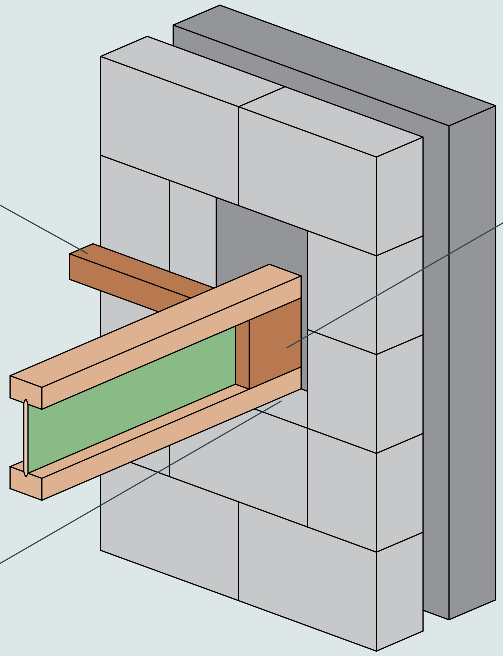
Screw-in screws	Minimum spacing	Minimum distance from the edge
At right angle to the fibre	4d	4d
At the end of the fibre	4d	2,5d

EXAMPLES OF APPLICATION

Support of load-bearing structures in a masonry wall:

A beam with a minimum cross-section of 38x38 must be secured to the joist using fasteners. The beam must be 35-75 mm away from the wall

All load-bearing structures must be supported by a minimum of 90 mm. It is necessary to ensure that the supports are flat and level and that the supported structures are vertical



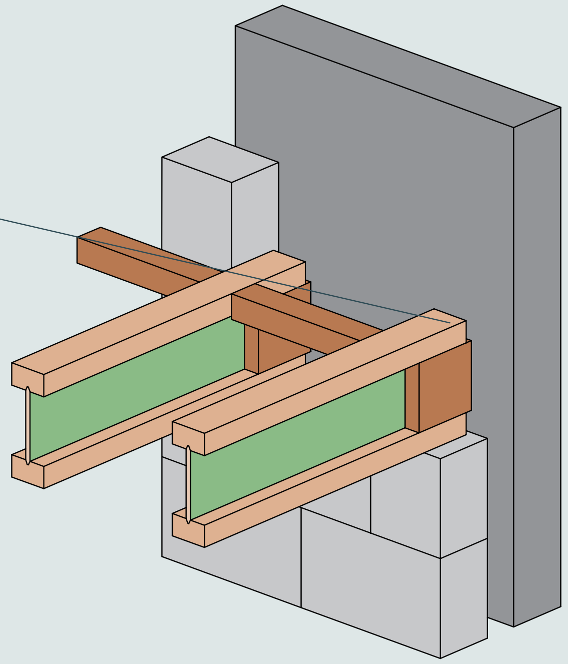
Sienelės sąstanda yra pritaikyta pagal siją. Sandūra tarp sienos ir sijos turi būti pritvirtinama su silikono mastika

Additional restraint of the joists is required when the building is two storeys high, or when the joist support is less than 90 mm

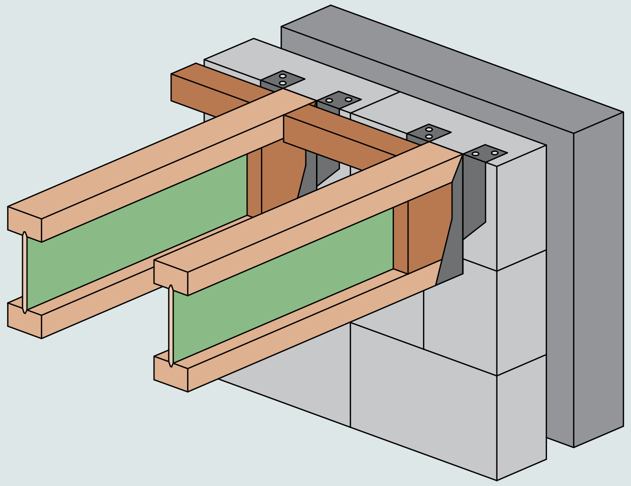
Support of load-bearing structures in a masonry wall:

To prevent the transmission of internal force to the wall, it is essential to ensure that the joist is 10 mm shorter than the length of the support when load-bearing structures are supported on a masonry wall

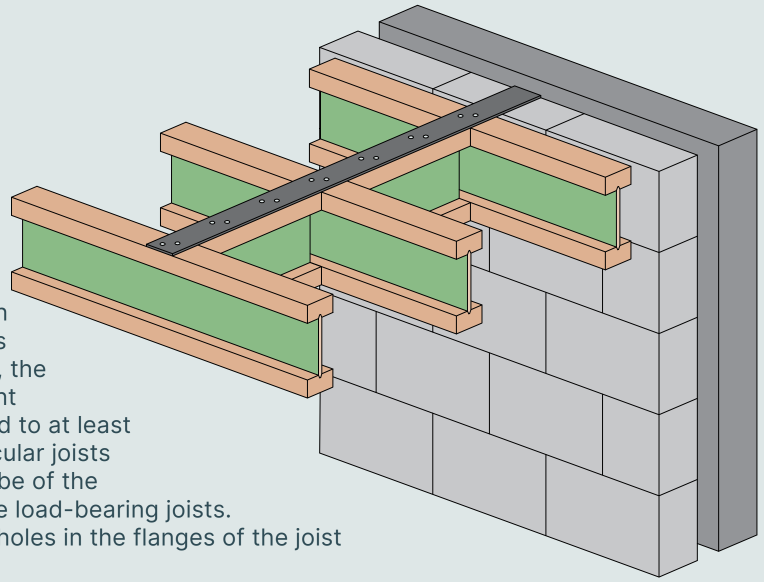
It is necessary to ensure that all supports are flat and level so that the joist is vertical



Supporting of load-bearing structures in masonry:



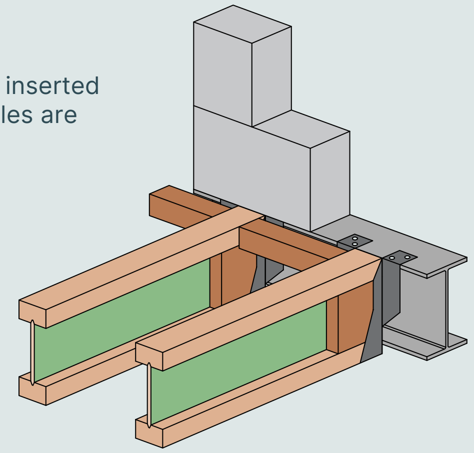
Restraint of load-bearing structures by a joist connected to a masonry wall:



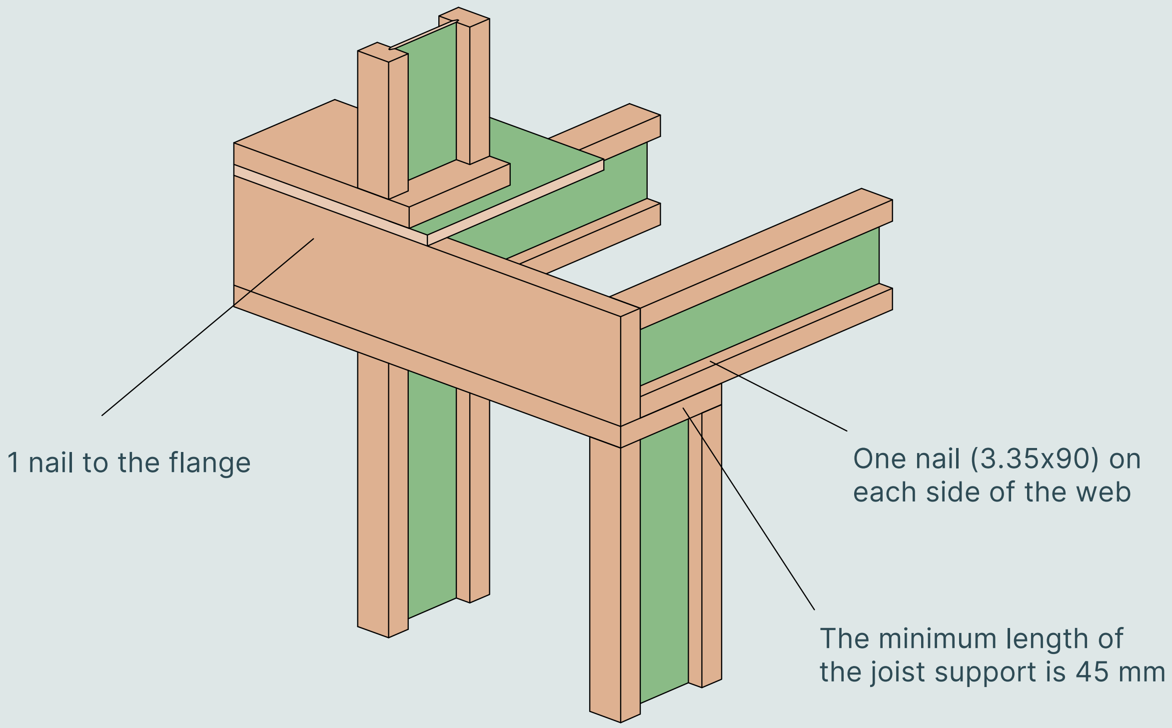
In accordance with the manufacturer's recommendations, the galvanised restraint must be connected to at least 3 joists. Perpendicular joists for restraint must be of the same height as the load-bearing joists. Do not drill or cut holes in the flanges of the joist

Suspension of load-bearing structures on a metal joist and a masonry wall on top of it:

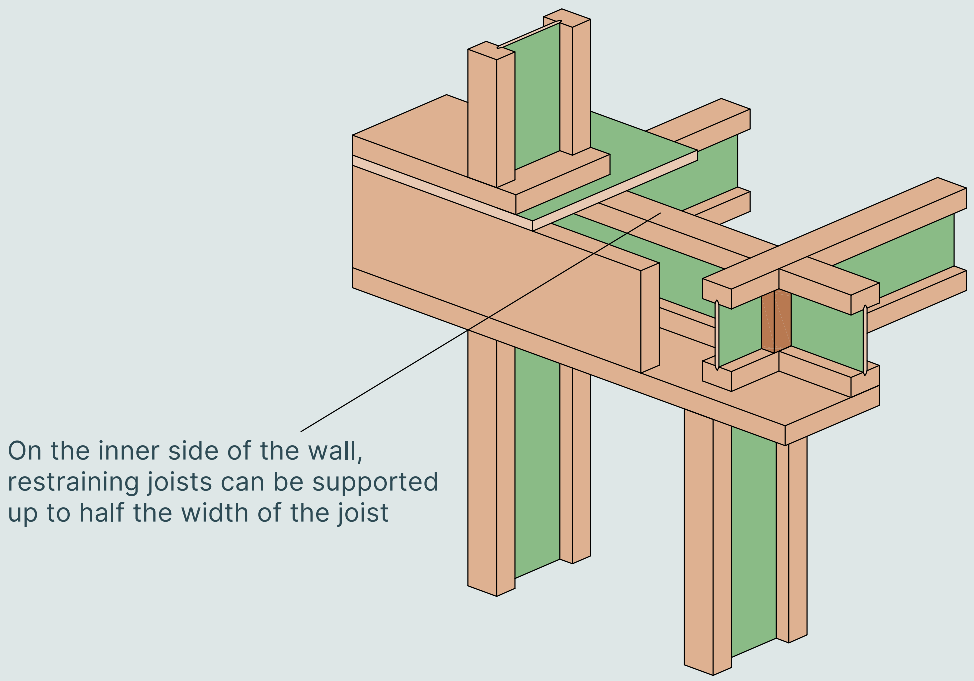
If the joist is securely inserted into the bracket, staples are not necessary



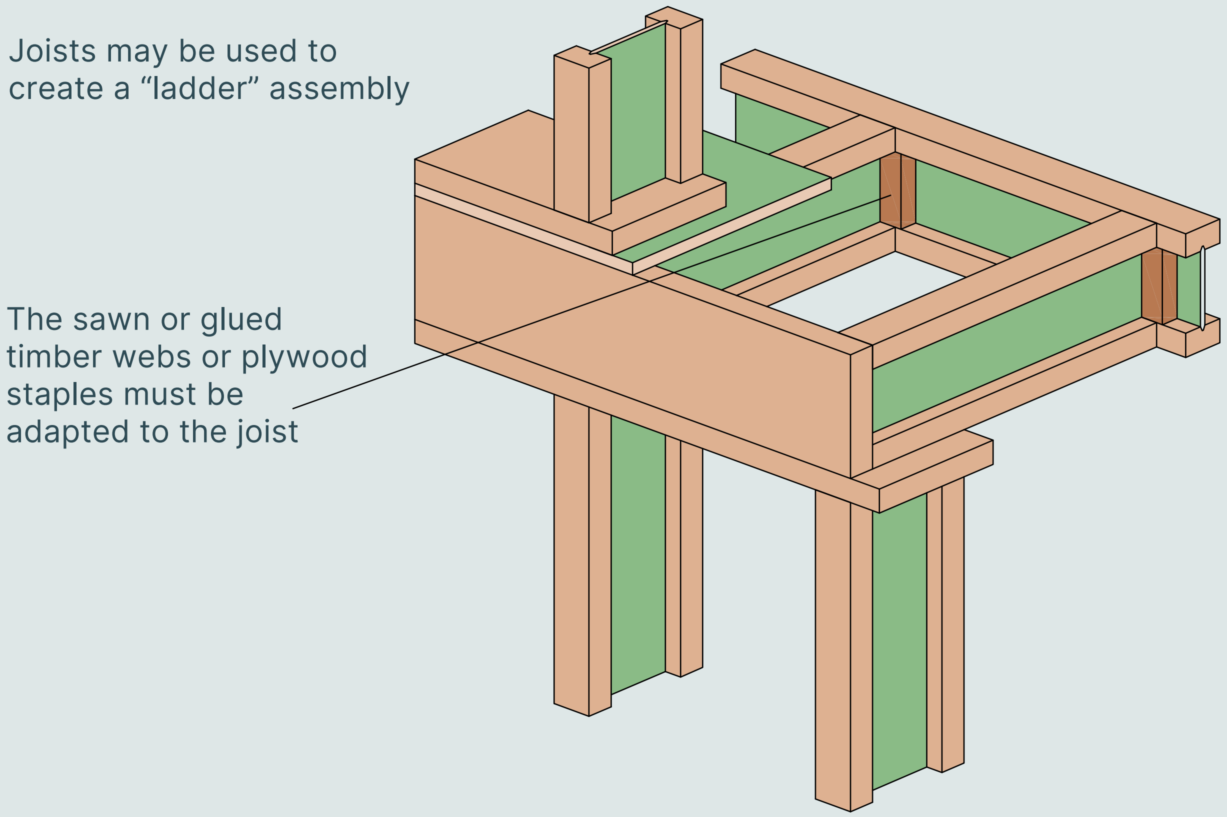
Floor framing joist assembly:



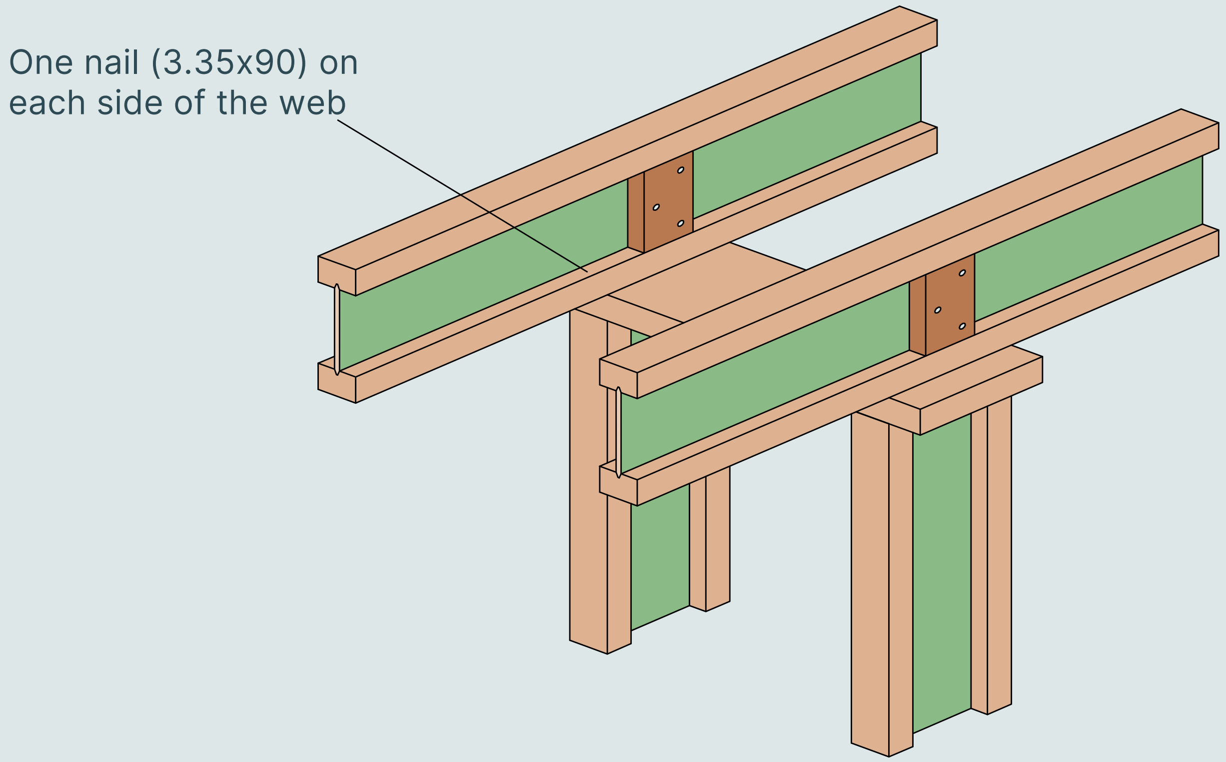
Floor framing joist assembly with the restraining joist:



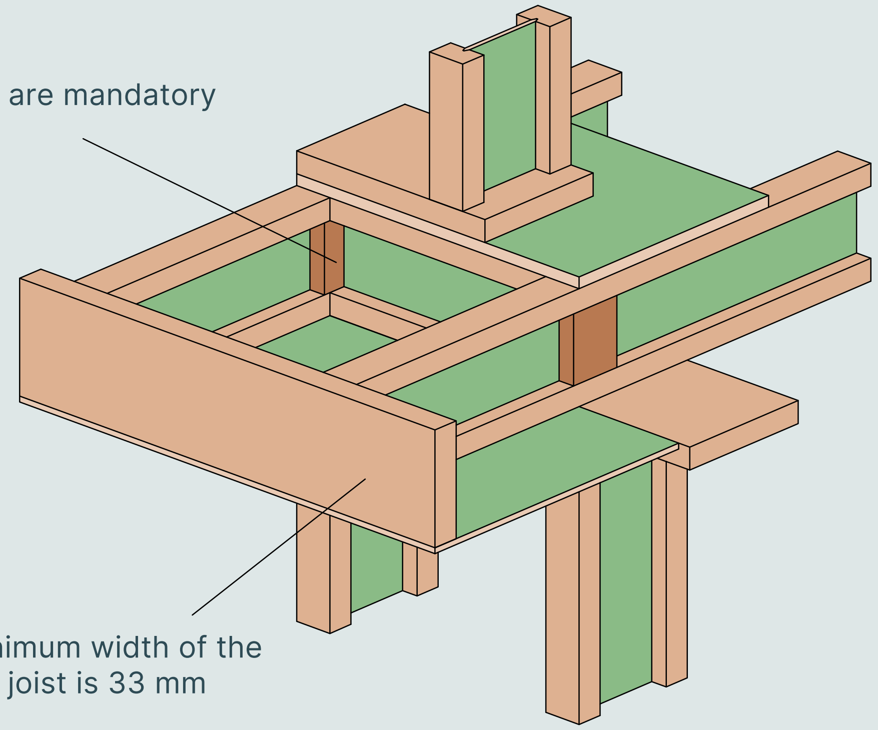
An external web assembly where the joists are perpendicular to the wall:



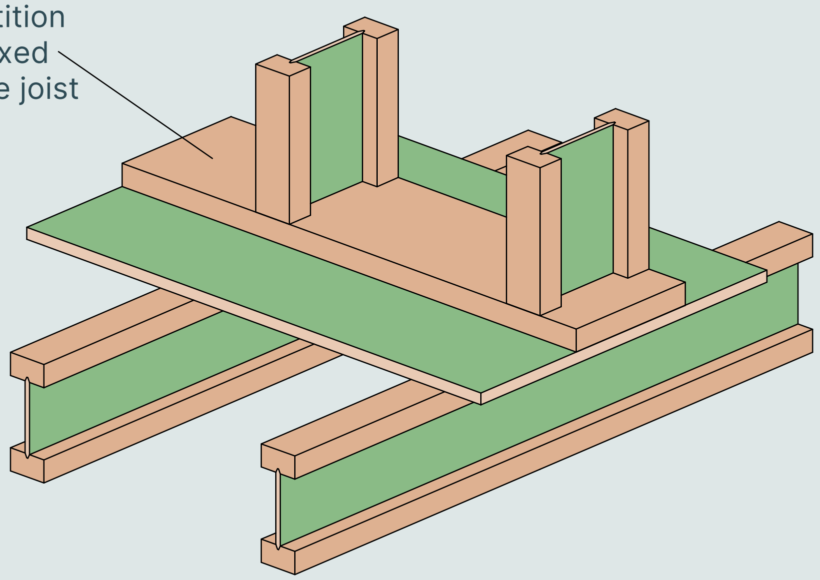
Intermediate support of a whole joist:



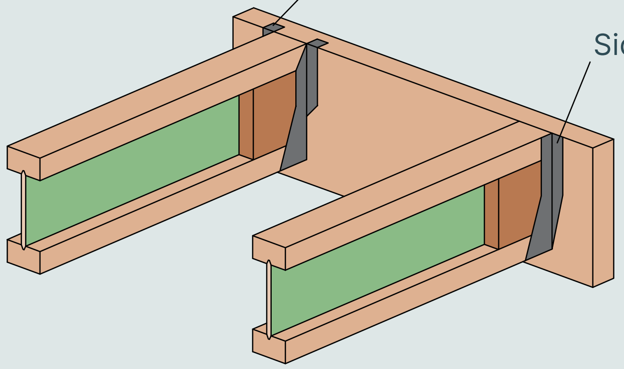
Cantilever assembly:



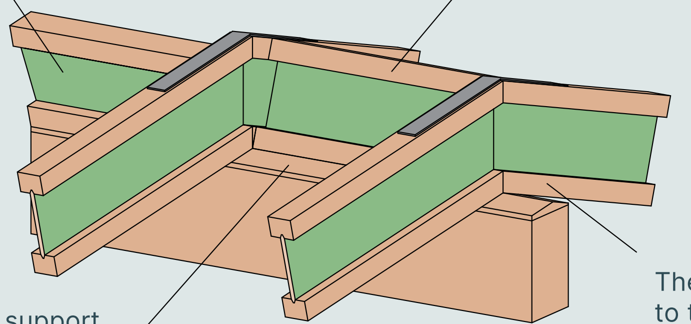
Wall framing on joists perpendicular to the wall:



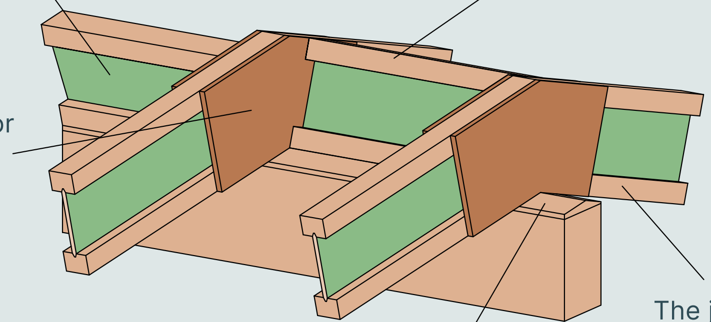
Different brackets:



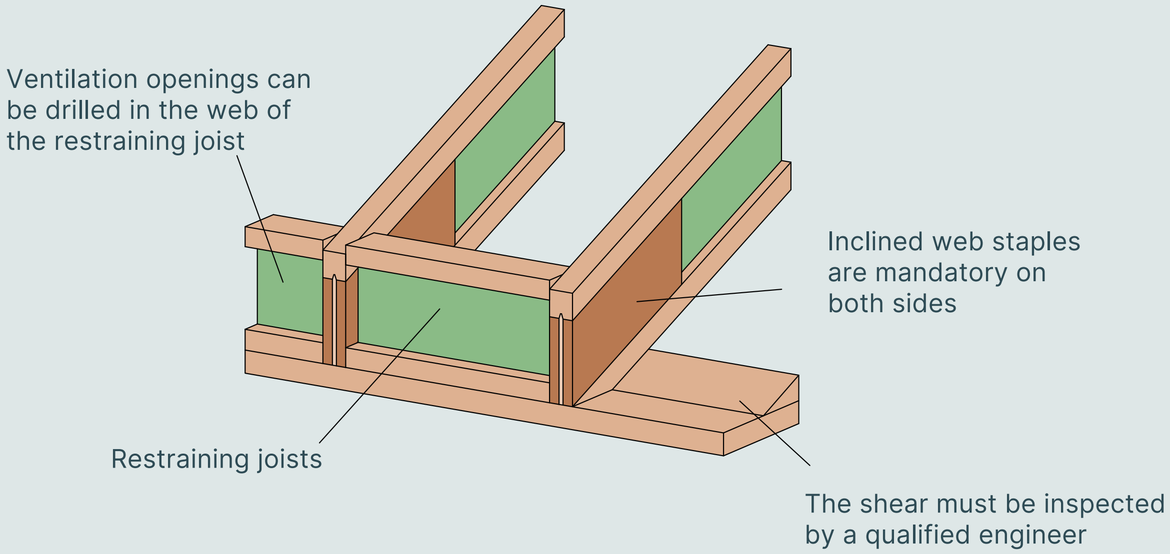
Ridge joist with inclined joist assembly:



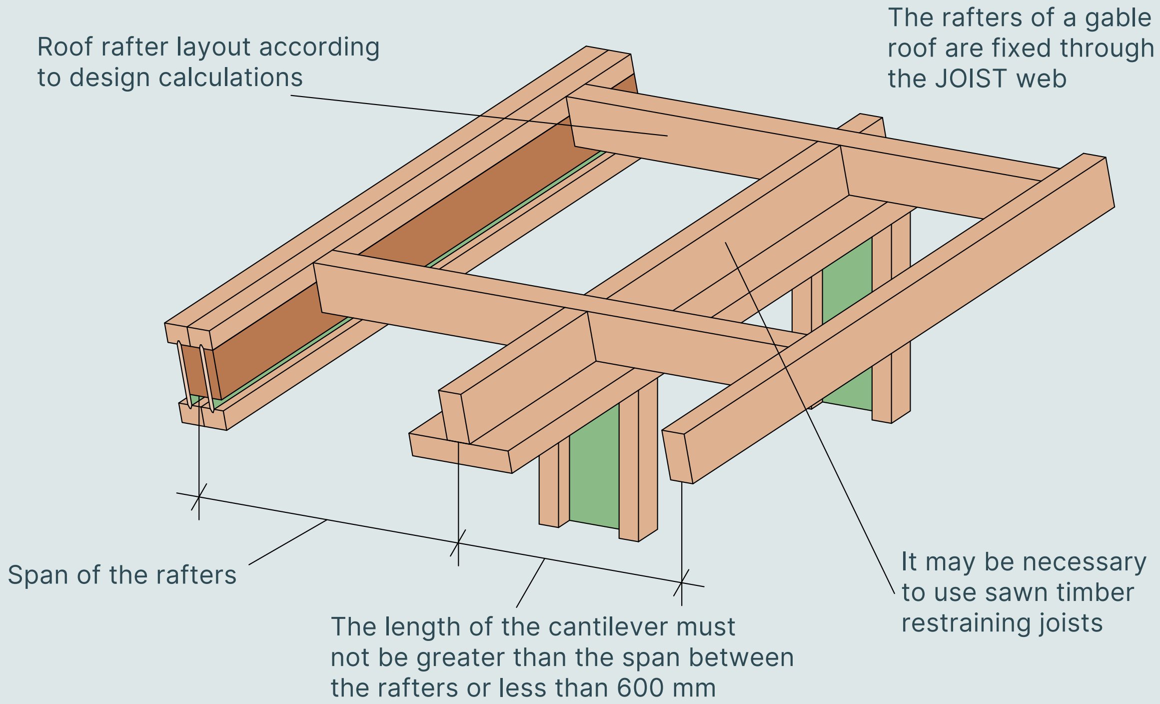
Ridge joist with inclined joist assembly:



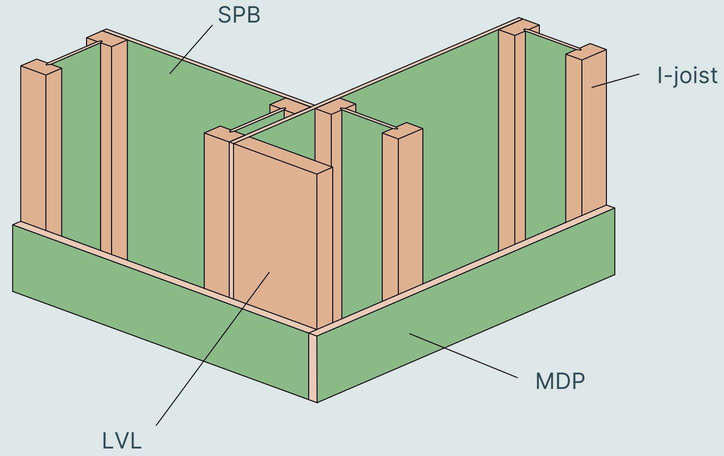
Roof eaves joist shear assembly:



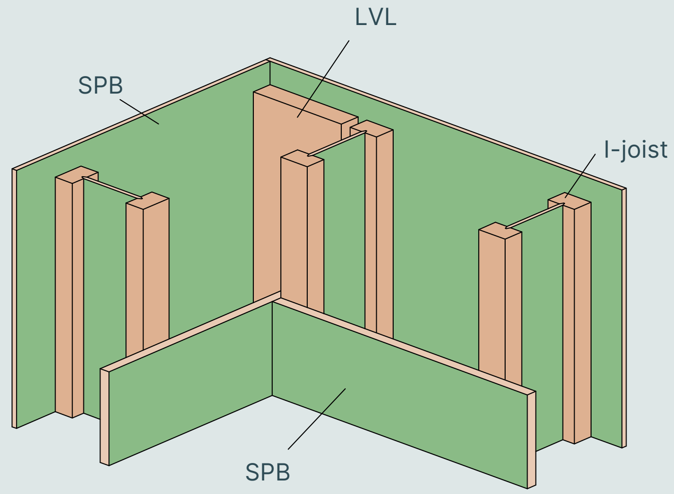
Gable roof structure:



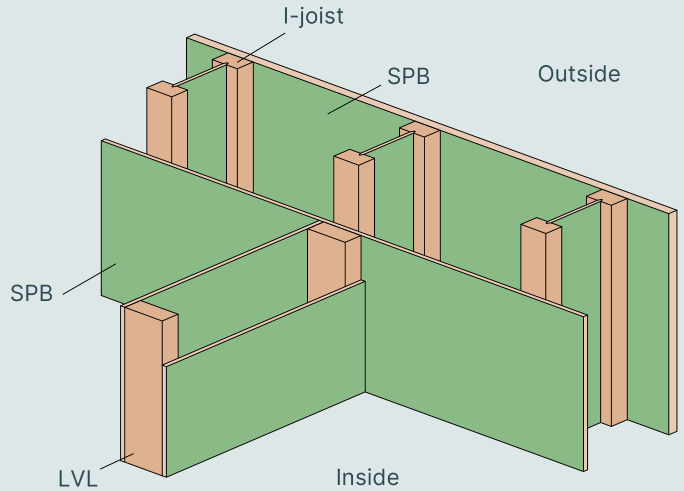
Outer wall corner assembly:



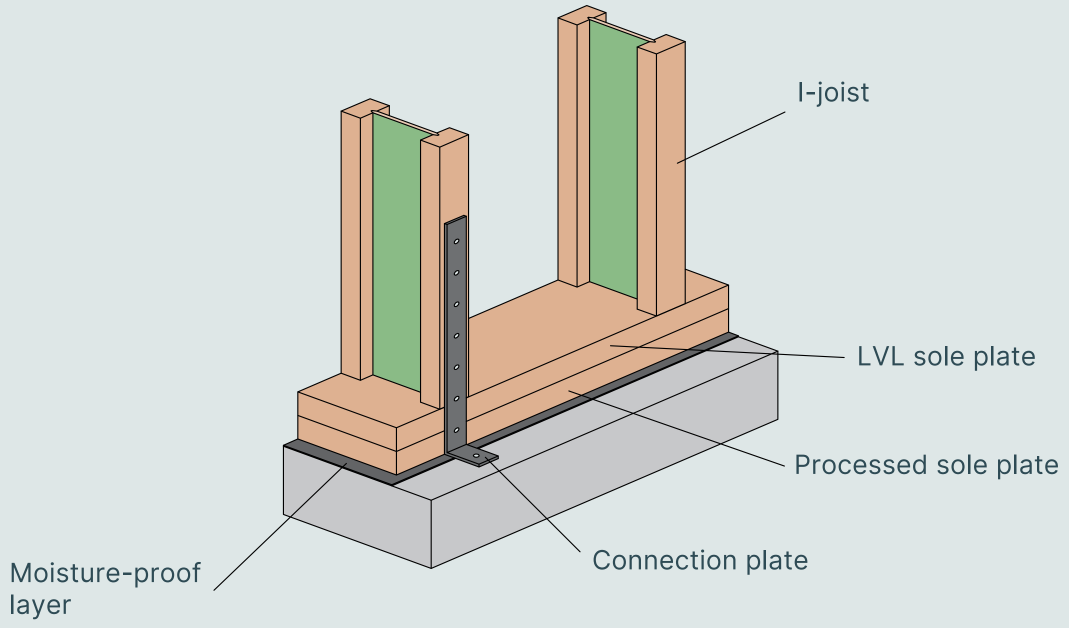
Inner wall corner assembly:



External and partition wall assembly:

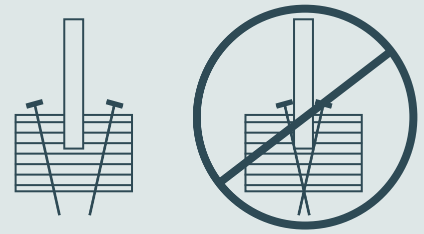


Wall to concrete connection assembly:



INSTALLATION RECOMMENDATIONS

- Before installation, it is important to inspect the products for any damage that may have occurred during transport and storage. Any damaged articles must be replaced.
- Do not use VMG LIGNUM JOISTS if they are damaged.
- Do not install VMG LIGNUM JOISTS in the event of direct precipitation. Cover is required.
- Except for cutting lengthwise, no holes must ever be cut or drilled in JOIST flanges.
- JOISTS are not stable until they are fully assembled and do not bear loads until they are completely connected.
- Workers are prohibited from walking on JOISTS that have not been installed. There is no storage or placement of other materials possible on joists that have not been installed.
- Temporary anchorages should be used to install restraints for the compression flange during installation. Bending moments must be permitted when the compressible webs are restrained.
- The length of the support must be a minimum of 35 mm for end supports and a minimum of 45 mm for intermediate supports, but the necessary anchorages must be calculated.
- Recommended assembly guidelines must be followed for reinforcing the web.
- When applying additional floor layers to the VMG LIGNUM JOIST frame, make sure that the brackets or other fixings with the specified width and height are properly positioned and secured using the required wooden studs or nails as per the design specifications.
- VMG LIGNUM JOISTS must be installed vertically. The maximum difference between the verticality of the top and bottom flange is up to 2 mm.
- Avoid attaching any unintended objects to the bottom flange of the JOIST, as this may create an excessively high point load. When applying point loads from above or below, ensure that the fixing is done through both the top and bottom flanges at these locations. If necessary, fill in these JOIST areas and at web level on both sides.
- Do not hammer nails or drive wooden studs into JOIST flanges closer than 5 mm from the web on either side.



DO NOT:

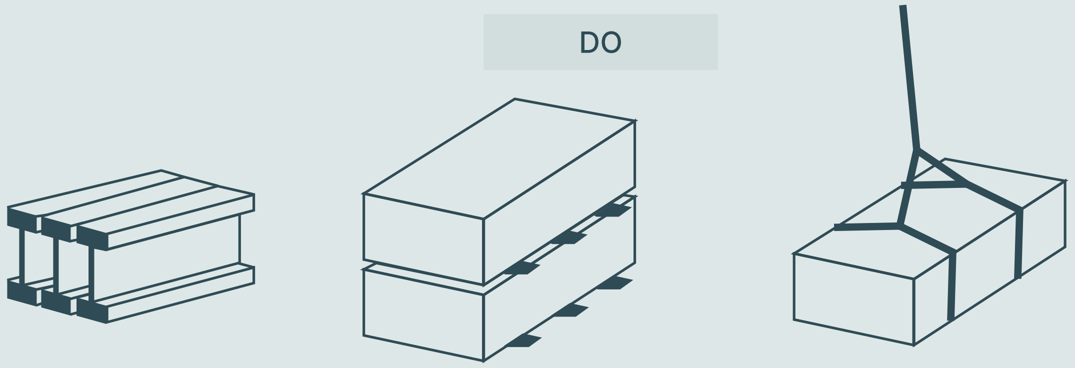
- Drill holes above the support.
- Cut flanges or drill holes in them.
- Use sawn timber for edge wedging.
- Use a hammer to make holes

STORAGE AND TRANSPORTATION

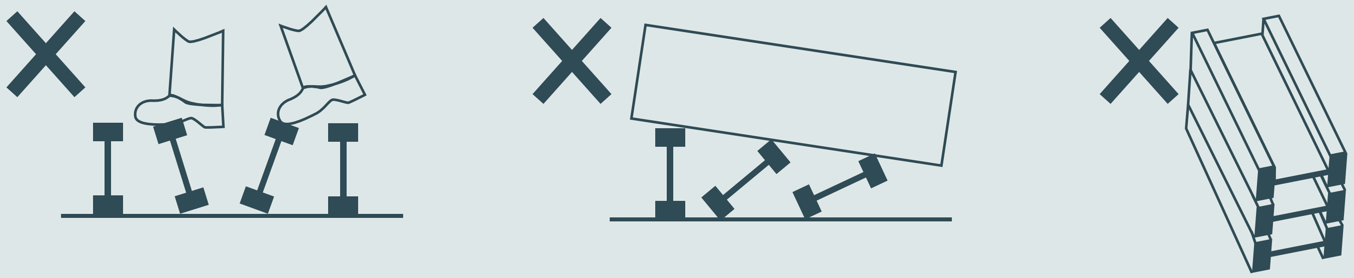
Store all joists horizontally on a pallet or a dry flat surface, either indoors or outdoors. Cover them on at least three sides, leaving the underside exposed to allow for ventilation, and protect them from direct exposure to sunlight and precipitation. The height of the pallets must be at least 30 cm when stored outdoors and a minimum of 10 cm when stored indoors. If the distance between the pallets is not more than 3 metres, the minimum width of the pallets must be 45 mm.

If the original packaging is removed, both the film and the strapping, safe storage must be ensured. Do not store other construction materials on non-original VMG LIGNUM JOIST packaging. Standard VMG LIGNUM JOIST packages weigh up to 2 tonnes, therefore it is necessary to have the necessary loading equipment on site, i.e. loaders, cranes. The package must be lifted from the bottom, and under no circumstances should it be suspended from the top flange.

DO

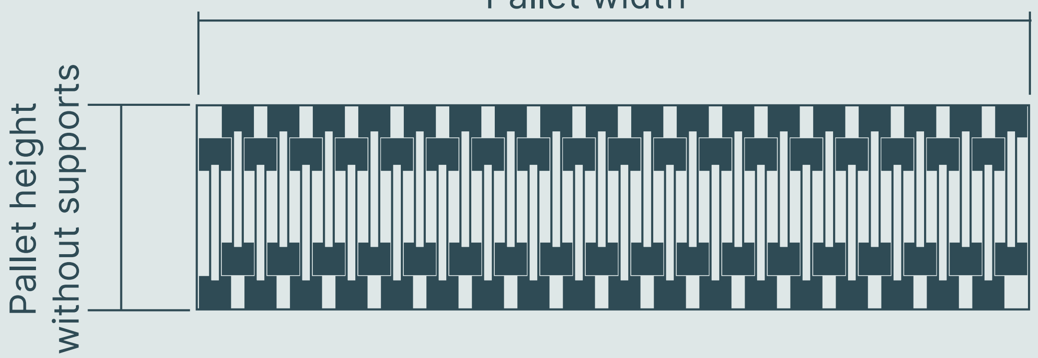


DO NOT



PACKAGING FORMATS

Standard VMG LIGNUM JOIST packaging scheme:



The height of the package depends directly on the height of the product. Package lengths can range from 6.0 to 13.0 metres, depending on the lengths ordered.

The maximum weight of the package may be 2.0 tonnes.

CERTIFICATES

VMG LIGNUM JOISTS are certified in accordance with the current EAD documents and have a European technical approval (ETA) certificate under which CE marking is permitted.

VMG LIGNUM JOISTS are also FSC and PEFC certified. All VMG LIGNUM products will also have an EPD certificate.

CE ETA 24/0806

PEFC PEFC/01-32-1177

FSC www.fsc.org FSC® C166244 The mark of responsible forestry

EPD®

WE DELIVER OUR JOIST PRODUCTS TO CLIENTS ALL OVER EUROPE

The main countries to which we export our production are: Norway, Finland, Sweden, Estonia, Denmark, United Kingdom, Poland, Germany, France, Spain, and other countries

COMPANY STRUCTURE:

VMG LIGNUM

Engineered wood product sales and distribution

VMG LIGNUM CONSTRUCTION

Engineered wood product manufacturing

VMG LIGNUM SYSTEMS

Structural engineering design and consultancy services

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