Connectors and Fasteners for
Cross-Laminated Timber Structures

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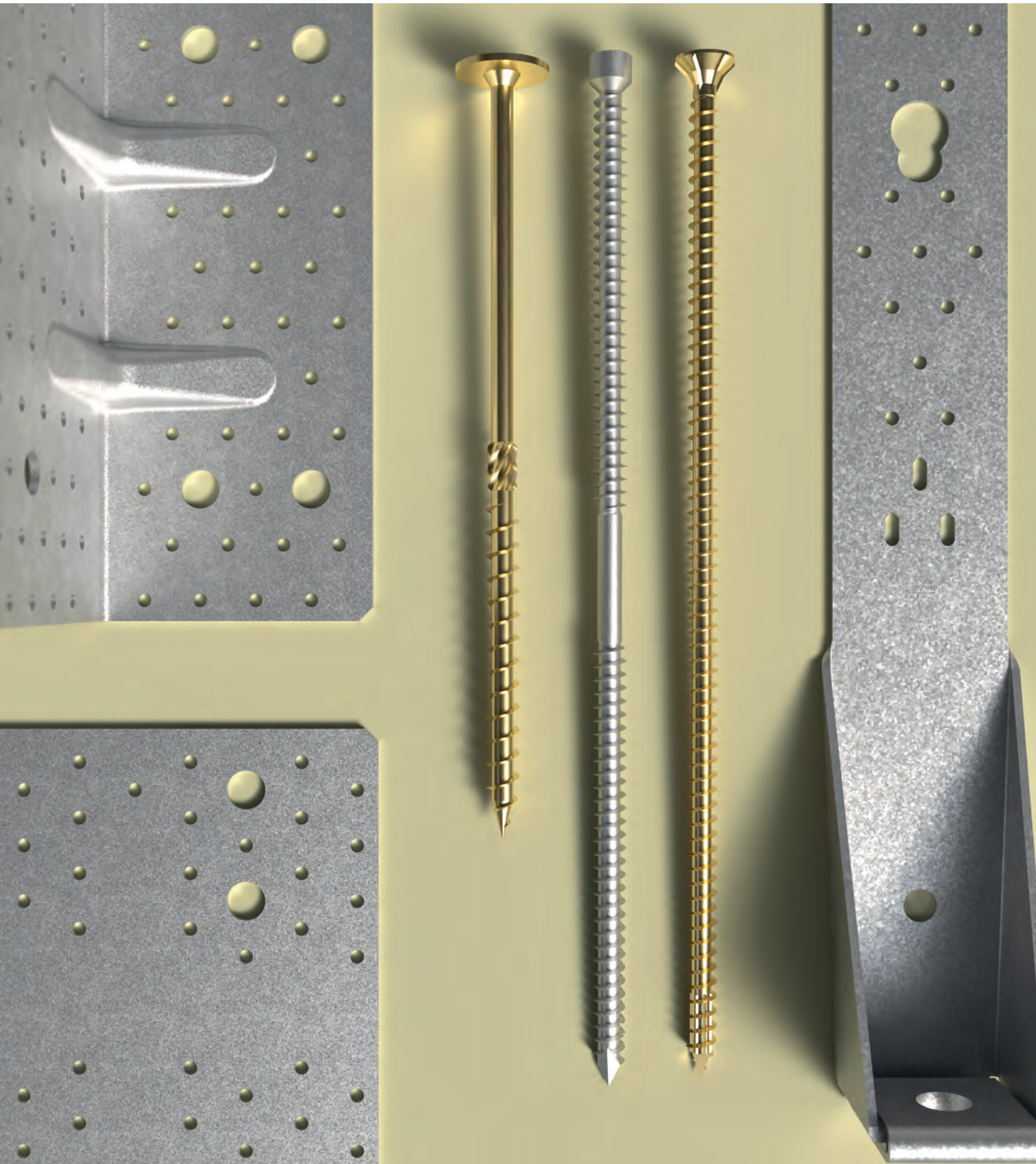
SIMPSON Strong-Tie



In Odense, Denmark, the Cobot Hub project showcased the innovative use of CLT and Simpson Strong-Tie's structural screws as a crucial connection element in cross-laminated timber (CLT) construction.

Scan the QR code to watch the video

Bringing a Legacy of Service and Innovation to CLT

With over 60 years of leadership in structural engineering, Simpson Strong-Tie is proud to offer smart solutions for CLT and mass timber. Embracing the challenge, we're leveraging our dual passions of service and innovation to meet this industry's unique demands.

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Solution Finder

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Hold downs, brackets and structural screws for anchoring timber structures to concrete.

CLT Wall to CLT Wall
Pages: **68-89**

Structural screws and angle brackets for connecting CLT walls at corner and T and L junctions.

CLT Wall to CLT Floor
Pages: **90-117**

Structural screws and angle brackets for connecting CLT walls to CLT floors and ceilings.

CLT Floor to CLT Floor
Pages: **118-141**

Structural screws and nail plates for connecting CLT floor panels to each other to create floor diaphragms.

CLT wall to CLT wall
Pages: **142-155**

Hold downs, structural screws and plates for connecting CLT walls along the same vertical plane.

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Solution Finder

CLT Floor to CLT Wall
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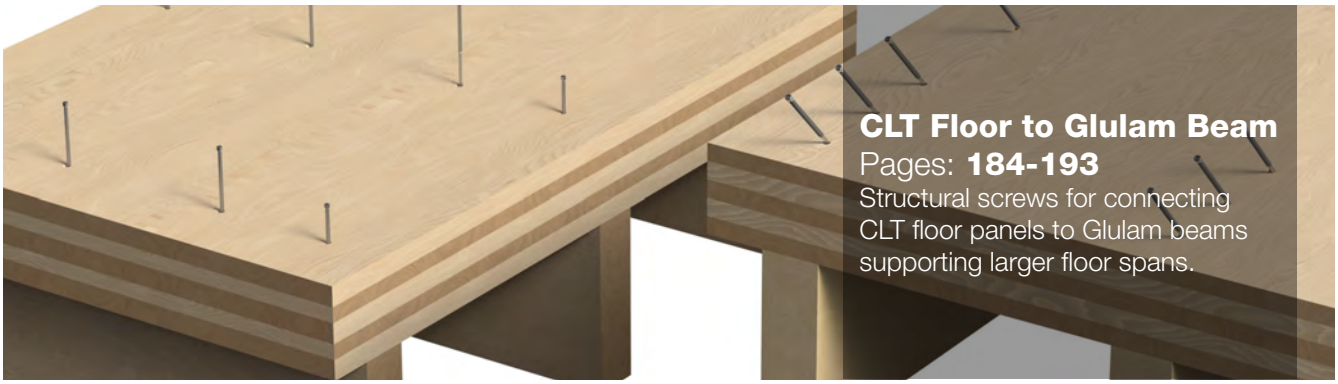
Structural screws for connecting CLT floors to walls via an intermediate timber or steel support.



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CLT Floor to Steel Profile
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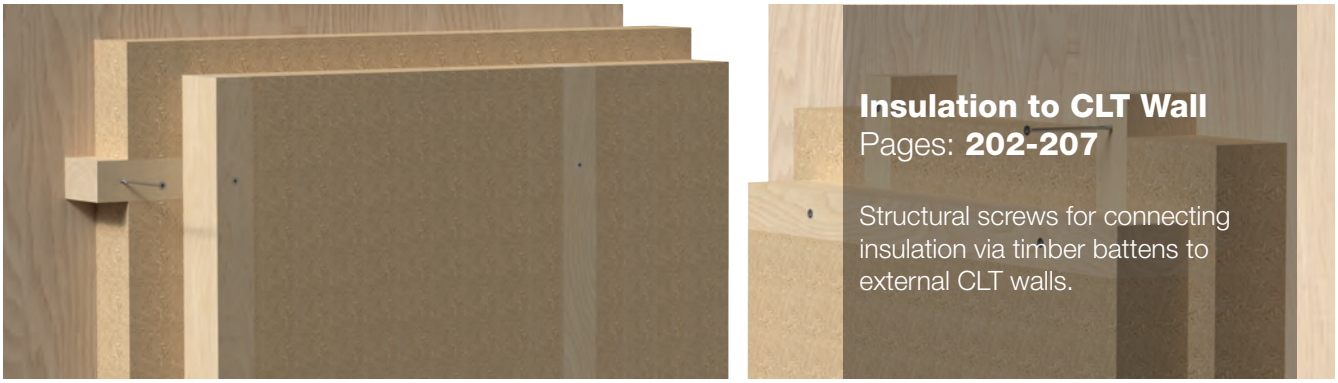
Structural screws for connecting CLT floor panels to steel beams supporting larger floor spans



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Structural screws for connecting insulation via timber battens to external CLT walls.

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Read more about the Simpson Strong-Tie fasteners and anchors used in this catalogue here and find their characteristic parameters.

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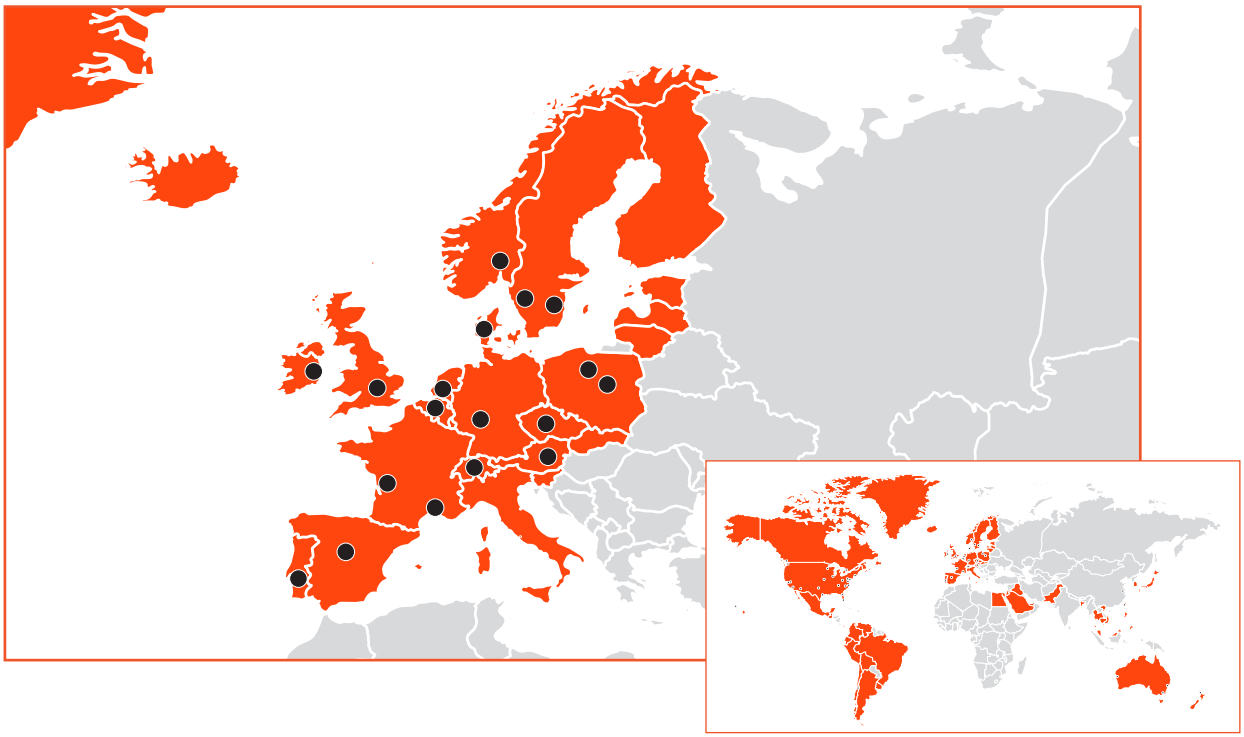
Company Information

For more than 60 years, Simpson Strong-Tie® has focused on creating structural products that help people build safer and stronger homes and buildings. A leader in structural systems research and technology, Simpson Strong-Tie® is one of the largest suppliers of structural building products in the world. Our commitment to product development, engineering, testing and training is evident in the consistent quality and delivery of our products and services.

For more information, visit the company's website at **strongtie.eu**



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■ Distribution in Australia, Canada, Chile, Western Europe, part of Eastern Europe, Middle East, Egypt, Japan, Korea and other Asian countries, Mexico, New Zealand, UK, part of South America and USA

European Fastener Manufacturing

Simpson Strong-Tie® has several manufacturing facilities placed strategically across the European continent, to ensure a high degree of product availability and a strong understanding of the local markets. We have fastener manufacturing in various locations across Europe and our close-knit logistical network ensures that there is always a Simpson Strong-Tie warehouse or distributor near you.

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The Simpson Strong-Tie® Company Inc. "No Equal" Pledge Includes:

- Quality products value-engineered for the lowest installed cost at the highest-rated performance levels
- Most thoroughly tested and evaluated products in the industry
- Strategically located manufacturing and warehouse facilities
- National code agency listings
- Largest number of patented connectors in the industry
- European locations with an international sales team
- In-house R&D and tool and die professionals
- In-house product testing and quality control engineers

Quality Policy

We help people build safer structures economically. We do this by designing, engineering and manufacturing "No Equal" structural connectors and other related products that meet or exceed our customers' needs and expectations.

Everyone is responsible for product quality and is committed to ensuring the effectiveness of the Quality Management System. Simpson Strong-Tie® is an ISO 9001 registered company. ISO 9001 is an internationally recognised quality management system standard, which lets our customers know that they can count on the consistent quality of Simpson Strong-Tie's products and services.

Mike Olosky
Chief Executive Officer

Testing Laboratory Accreditation

The Andris Peterson European Test Laboratory, located in the UK in Tamworth, Staffordshire, is the first manufacturer's facility to achieve third party accreditation to the international standard BS EN ISO/IEC 17025.

The world-class facility now conducts around 10,000 product tests annually and has recently benefited from a significant investment, which will enable double productivity. The fact that we extensively test our products give you the reassurance that they will perform in the toughest conditions. We strive to ensure that our products are compliant with the latest European requirements for construction products.

We Are ISO 9001-2015 Registered

Simpson Strong-Tie is an ISO 9001-2015 registered company. ISO 9001-2015 is an internationally-recognized quality assurance system which lets our domestic and international customers know that they can count on the consistent quality of Simpson Strong-Tie® products and services.

ISO 14001

Our Swedish, French (St. Gemme la Pleine) and UK facilities are ISO 14001 certified. This standard states the requirements for an environmental management system, and applies to the environmental aspects over which our company has control and can be expected to have an influence.

OHSAS 18001

Our Tamworth, UK facility is OHSAS 18001 certified. This certification reflects an internationally applied British Standard for occupational health and safety management systems.

To learn more about these certifications and organizations, please visit ISO.org, ICCSafe.org and bsigroup.com.

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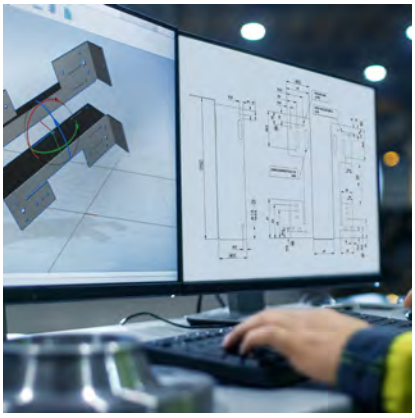
Online Tools & Support for Engineers

Technical Support

Experts in structural wood engineering, Simpson Strong-Tie is always at your side, making life easier with complete solutions, effective support, tools and advice.

With our proven track-record for service and support, peace of mind comes built-in. It's part of an engineer's DNA to plan for the unexpected. We've already spent over six decades doing just that.

We are with you every step of the way; from planning and tendering to site-build, we have people on the ground to support the process and to give further guidance. Our Technical Support team is on hand to answer your questions and provide some sound installation advice, from making sure you have the most suitable product, to the best ways to go about installing them.



CAD/BIM Library

Any 2D and 3D model of our Solid-Drive fasteners can be immediately integrated into building designs and design software.

We know how useful the drawings of our fasteners can be for you. That is why we offer our drawings in the following formats for free download:

- 2D / 3D DWG
- SAT
- 2D / 3D Revit
- XML
- BIM

Please note that you will need at least CAD software to open some of the files. You can get a free file reader at: Autodesk Review.

DoP/ETA Library

Our entire library of DoP (Declaration of Performance) and ETA documentation is available online. Here we provide DoP's in all main European languages.

If you know the name of the product family, you can search on each of our websites, or — alternatively— browse the products section as the relevant DoP and ETA file can also be found on each individual product's detail page.

Go to **strongtie.eu** to find more.

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Solid Wood Fastener Dimensioning Software

SW Solid Wood

In just four simple steps, Solid Wood guides you through the calculation and selection of fastening solutions suitable for the specific wood structure at hand, all according to Eurocode 5 and our ETA.

Try Solid Wood today.

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The Simpson Difference

With our proven track-record for service and support, peace of mind comes built-in

It's part of an Engineers DNA to plan for the unexpected. We've already spent over six decades doing just that. So you can be confident that by specifying our connectors and fasteners, you have reliability and trust built-in to everything they touch. We are with you every step of the way; from planning and tendering to site-build, we have people on the ground to support the process and to give further guidance if ever the unexpected occurs.

Tried, tested and documented connectors and fasteners

Although mass timber construction methods are a relatively recent focus area for many engineers, the connectors and fastenings they need as part of the assembly have similarities to those used in more familiar construction settings. Whether connecting CLT floors, walls or ceilings to each other (or to concrete foundations); we have tried, tested and simple to use solutions to what might usually be considered an unfamiliar or complex practice.

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Calculation and Design

In the following pages we will go through the basics of how to calculate and design connections. There are a number of factors to take into consideration when calculating your connections. For example the direction and duration of the loads. The characteristics of the wood and other materials and of course the impact of the environment in which the connection is placed.

Load Duration Classes

The design load capacity depends on the duration of the load. In the case of a combination of loads with different load durations, the class of the load with the shortest duration is selected.

For example, in the case of a load combination of dead weight (load duration class P) and wind load (load duration class S), the load duration is S.

Load Duration		
Load duration		**Duration of characteristic load**
P	Permanent	More than 10 years. For example, the self-weight of the structure
L	Long term	6 months - 10 years. For example, useful load in warehouse
M	Medium term	1 week - 6 months. For example, payload
S	Short term	Less than 1 week. For example, snow load
I	Instantaneous	For example, accident load and wind load

Design Load Capacities

The design load carrying capacity $F_{R,d}$ is calculated by correcting the characteristic load carrying capacity $F_{R,k}$ by the factor k_{mod} and γ_m.

$$F_{R,d} = k_{mod} \frac{F_{R,k}}{\gamma_m}$$

γ_m is the partial factor for connections.

k_{mod} is a modification factor taking into account the effect of the duraction of load and moisture content.

Note: The values given in this document are the characteristic capacities except when other is communicated.

k_{mod}					
Service Class	**Load Duration**				
	P	**L**	**M**	**S**	**I**
1	0,6	0,7	0,8	0,9	1,1
2	0,6	0,7	0,8	0,9	1,1
3	0,5	0,55	0,65	0,7	0,9

γ_m	
Solid wood	1,3 *
Glulam	1,3 *
CLT	1,3 *

* Note: In Denmark the safety factor is 1,35.

Service Classes

When connecting timber structures, the dimensional load-bearing capacity is influenced by the effect of moisture. The requirements for the corrosion protection of the fittings depend on the climate class in which the fastener or connector is used.

Service Class	Description	Examples
1	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.	Warm roof, intermediate floors, timber frame walls – internal and party walls.
2	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.	Cold roof, ground floors, timber frame walls – external walls where member is protected from direct wetting.
3	Climatic conditions leading to higher moisture contents than in service class 2.	External uses – fully exposed.

Service classes according to Eurocode 5: Definition of the service classes environment are given within the EN1995-1-1.

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Timber Grades

Timber Grades - Characteristic Densities (k_{dens} factor)

In this document, all values for **solid timber** are given for a C24 timber.

In case of **glulam** they are given for a GL24h glulam.

In case of **CLT**, the characteristic density used is $\rho_k = 350\ kg/m^3$.

For **boards**, the characteristic density used is $\rho_k = 380\ kg/m^3$.

For **plywood**, the charcateristic density used is $\rho_k = 490\ kg/m^3$.

It is possible to change the timber class by multiplying the characteristic values by the k_{dens} factor.

with: $$k_{dens} = \left(\frac{\rho_k}{\rho_a}\right)^{0.8}$$

ρ_k the target characteristic density according to EN 338
ρ_a the characteristic density of the timber according to EN 338

k_{dens} factor can only be used to reduce the density. If the density is higher, the load capacities remain unchanged.

so, for solid timber the equation is:

$$k_{dens} = \left(\frac{\rho_k}{350}\right)^{0.8}$$

In this catalogue you will find the characteristic values for our products on C24 solid timber or GL24h glulam or CLT with density $\rho_k = 350\ kg/m^3$.

For all other timber- and glulam grades and CLT densities you will find the characteristic values in Solid Wood.

solidwood.strongtie.eu

Solid Timber –
The table below allows to go from C24 to other solid timber classes:

Timber grade		C14	C16	C18	C20	C22	C24
ρ_k	[kg/m³]	290	310	320	330	340	350
k_{dens}	[-]	0,86	0,91	0,93	0,95	0,98	1,00

For glulam the equation is:

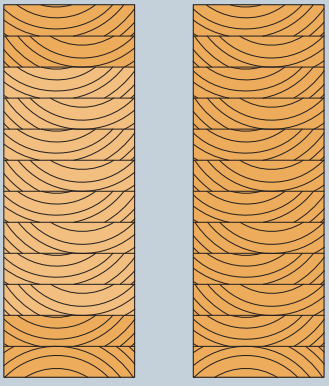
$$k_{dens} = \left(\frac{\rho_k}{385}\right)^{0.8}$$

Glulam –
The table below allows to go from GL24h to other glulam classes:

Glulam grade		GL20h	GL20c	GL22h	GL22c	GL24h
ρ_k	[kg/m³]	340	355	370	355	385
k_{dens}	[-]	0,91	0,94	0,97	0,94	1,00

Difference between GLT c and GLT h

Glued Laminated Timber made from one type wood grade planks is indicated with symbol h. The c mark indicate beams with different layers, where the wood of a better quality is used in the outer layers, while the planks of a lower class are used inside.



GLT c GLT h

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Mass Timber

Mass timber construction basically means the use of large, prefabricated slabs or panels of engineered wood products (EWP) for walls, floors, diaphragms, roofs, and more in the design and construction of buildings. ("Diaphragm" in this context refers to a flat structural unit, usually horizontal, creating a partition between spaces, as a floor-ceiling unit does between stories of a building. Mass timber diaphragms typically consist of panels joined by metal splines or straps, or by lap joints fastened by dowels or structural screws.)

There are several kinds of mass timber, of which the best known may be cross-laminated timber, or CLT. Lamination in this context simply means bonding material together in layers, or laminae (or lamellae) for greater strength or rigidity. The bonding can use either adhesive (glues) under intense compression (using hydraulic or vacuum presses), or mechanical means such as screws, nails, or other solid fasteners.

Advantages of Using Mass Timber

- Environmentally-friendly construction material
- Healthy and comfortable indoor climate
- Maximum architectural freedom
- Easy planning of individual homes and residential buildings
- Effective use of the available land area through slim-line modules
- Superior mechanical performance
- Short building times, dry construction and quick occupation
- High precision with numerically controlled cutting
- Prefabricated elements delivered straight to the construction site
- Lightweight elements compared to masonry and concrete elements
- Technically endorsed construction product featuring the CE marking

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Type of Mass Timber

CLT

History

Wood is clearly a material for the future, as evidenced by its growing popularity in the construction industry. During the 1990s, wood engineers in Austria and Germany achieved a breakthrough with a new construction system known as CLT (Cross-Laminated Timber). Nowadays, CLT is widely used across Europe and is beginning to gain traction in the United States. CLT panels are favoured for residential and public-access buildings, but they can also be used in all types of construction projects, ranging from individual houses to high-rise buildings.

Sara Kulturhus, a 20 floors building in Sweden, is one of the most iconic constructions made from CLT. Cross-laminated timber is also used in engineered structures, such as Canada's 160-metre Mistissini Bridge, and all types of small residential buildings.

Manufacturing

CLT is made from gluing perpendicular layers of solid timber boards together. Each layer is rotated by 90° in relation to the previous layer to improve the panel's performance. The number of layers varies and depends on the application (generally between three and eight layers). Panels can be made in sizes up to 20 metres in length and 4 metres in height. Their thickness tends to vary between 60 mm and 320 mm

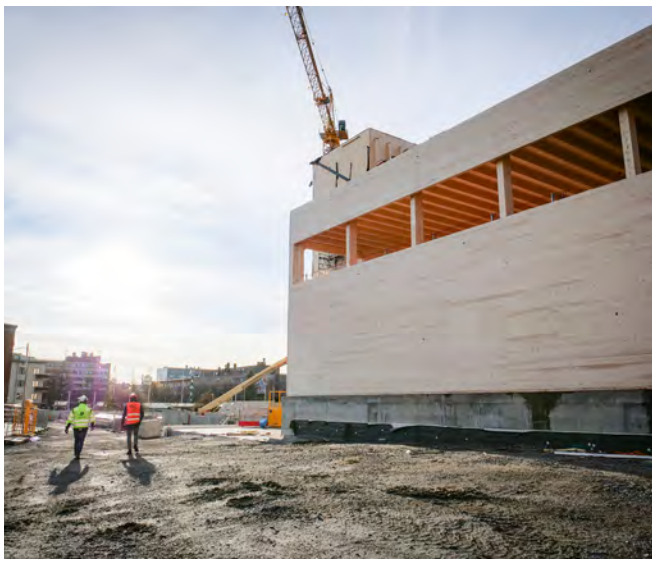
Other type of massive timber panels

If CLT is made from wood and glue, on the market other type of panel made of solid timber exist.

Though we can find DLT (Dowel Laminated Timber) and NLT (Nail Laminated Timber).

NLT

Unlike CLT, NLT has been around for more than a century. Used in conjunction with other forms of mass timber construction, however, it's experiencing a renaissance of late. NLT typically comprises dimensional lumber members fastened together on edge using aluminium nails. The smaller component members make NLT particularly pliable and well suited to curved roof designs, although it is also commonly used in floors and decking. The advantages to use aluminium nails is that it make it easy to cut the panel with standard timber saw.



DLT

DLT is a relatively new form of mass timber consisting of layers of softwood dimensional lumber laminated by means of hardwood dowels. No glue is used at all but only timber. The dowels are inserted totally dried and when they reach the equilibrium with the moisture of the boards after installation, they expand and lock totally the panel.

If these two material have benefits, they are more subjected to splitting than standard CLT as they have no glue to bond the different boards/ layers.

Glulam

Glulam is short for glued laminated timber. It is an industrial manufactured product used for load-bearing structures. It consists of at least three layers of dried softwood boards or board lamellas glued together with their fibers aligned parallel to each other. Glulam is versatile, ranging from simple, straight beams to complex, curved members.

Creating mass timber panels and beams not only ensures excellent mechanical strength, but also guarantees high dimensional stability. These two qualities give architects and building planners considerable freedom with their designs.

Mass Timber can easily be incorporated into hybrid construction projects, such as timber-concrete and timber-metal, and is also suited to projects combining different construction systems, whether posts, beams, or timber frames.

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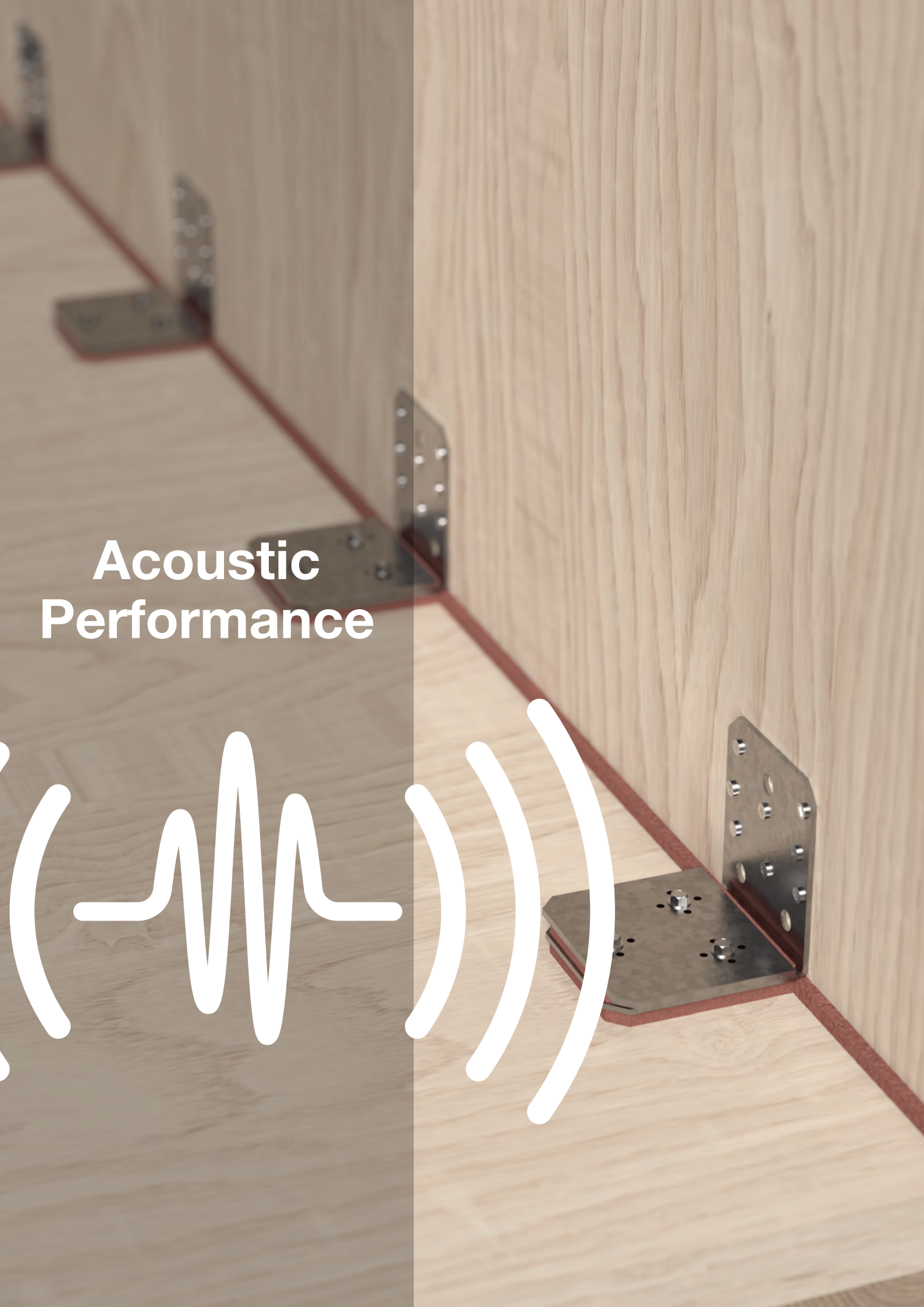
Acoustic Performance



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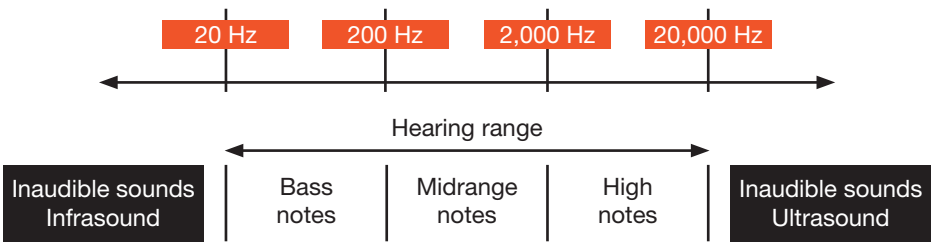
Sound

Sound is a wave that propagates through a transmission medium by causing the molecules to vibrate. These vibrations generate pressure on our eardrums, which we perceive as sound. There are several characteristics for defining sound. In this guide, we will focus our attention on two specific characteristics, namely frequency (expressed in hertz – Hz) and amplitude or intensity (measured in decibels – dB).

Audible frequency scale

A sound's frequency refers to the number of oscillations per second and determines whether the sound is low or high-pitched. The human ear is only capable of detecting sounds within a frequency band between 20 Hz and 20,000 Hz.



Definition of Sound Amplitude

Amplitude is what distinguishes between a quiet sound (whispering) and a loud sound (a jet plane taking off). There are two different types of sound level:

- L_w: the sound power level is the power required to generate sound waves
- L_p: the sound pressure level corresponds to the sound that we can hear

The sound levels can be defined using the following formulae:

$$L_p = 20 * \log(\frac{P_e}{P_0}) \quad | \quad L_w = 10 * \log\left(\frac{W_e}{W_0}\right) = L_p + 10 * log\ (\frac{S}{S_0})$$

Note that doubling the pressure increases the amplitude by 6 dB, whereas doubling the power of the sound source only increases the amplitude by 3 dB.

To understand why this happens, we are going to expand on the previous formulae:

If: $P_e = P_0$ then: $L_p = 20 * \log\left(\frac{P_0}{P_0}\right) = 20\log(1) = 0\ dB$

Consider sound pressure level L_{p1} for sound pressure P_e and sound power level L_{w1} for sound power W_e.

$$L_{p1} = 20 * \log\left(\frac{P_e}{P_0}\right) \quad | \quad L_{w1} = 10 * \log\left(\frac{W_e}{W_0}\right)$$

If sound pressure doubles, we obtain:

$$L_p = 20 * \log\left(\frac{2 * P_e}{P_0}\right) = 20 * \log\left(\frac{P_e}{P_0}\right) + 20 * \log(2) = L_{p1} + 6\ dB$$

Now if we double the power of the sound source, we obtain:

$$L_w = 10 * \log\left(\frac{2 * W_e}{W_0}\right) = 10 * \log\left(\frac{W_e}{W_0}\right) + 10 * \log(2) = L_{w1} + 3\ dB$$

Power level
= sound actually emitted

Pressure level
= perceived sound

(influenced by the external environment)

Key:

- P_e: actual sound pressure [Pa]
- P_0: reference sound pressure ($2{,}10^{-5}$ Pa)
- W_e: actual power [W]
- W_0 = 1pW = 10-12 W
- S_e: measurement surface area [m^2]
- S_0: reference surface area (1 m^2)

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Acoustics in Buildings

Noise in buildings has a direct effect on everyday health and quality of life. Standards and regulations have been implemented to guarantee the best level of acoustic comfort for building occupants and users.

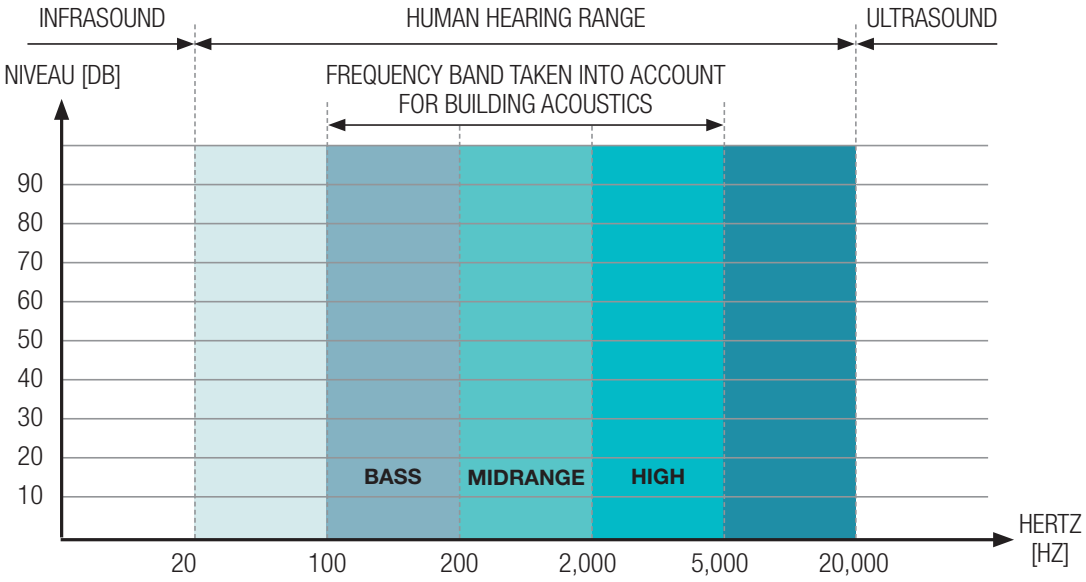
For example in France, sound insulation solutions in buildings need to meet various legal requirements. The New Acoustic Regulations (NRA) define a number of sound performance objectives for buildings that were granted planning permission after 1 January 2000. The Regulation of 30 June 1999 for the Housing and Construction Code, especially Article R.111-4, relating to the Regulation of 30 May 1996, specifies the required acoustic performance for new builds, roof lifts and extensions.

The minimum requirements stipulated in the NRA are as follows:

- *Insulation against external noise $D_{nTA,tr} \geq 30$ dB*
- *Insulation against internal noise $L_{n,w} \geq 53$ dB*
- *Impact noise $L'_{nT,w} \leq 58$ dB*

Designing a building that satisfies applicable regulations will not necessarily create pleasant conditions for the occupants. Regulations fail to take account of low-frequency noise below 100 Hz. This type of noise can be a significant nuisance, because low-frequency sound is hard to attenuate.

People perceive low frequencies in a different way to other frequencies. They cannot be heard at low amplitudes, but when they do become audible, the sensation of their amplitude increases faster than with other frequencies. A solution is available for overcoming this problem, which involves separating the construction elements to prevent low-frequency waves from spreading.



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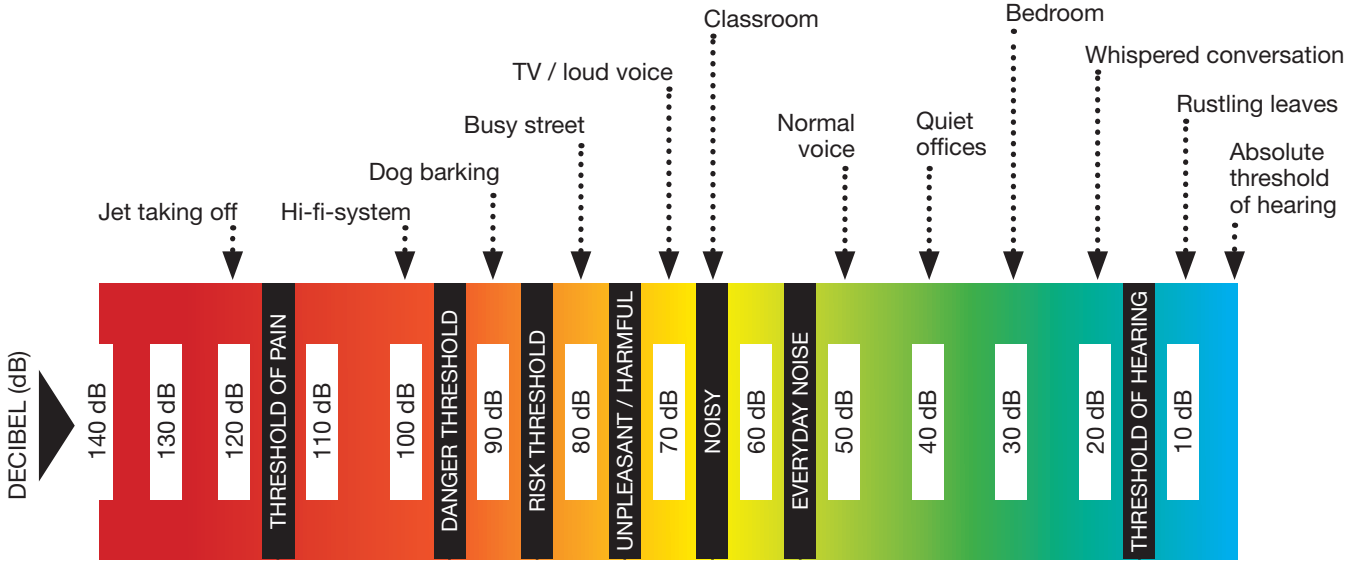
Decibel Scale



Acoustics in Mass Timber Buildings

To ensure a good level of acoustic insulation, a solution often used in the building industry involves increasing the mass of the dividing elements. The heavier the element, the harder it will be to make that element vibrate. This is commonly known as the mass law.

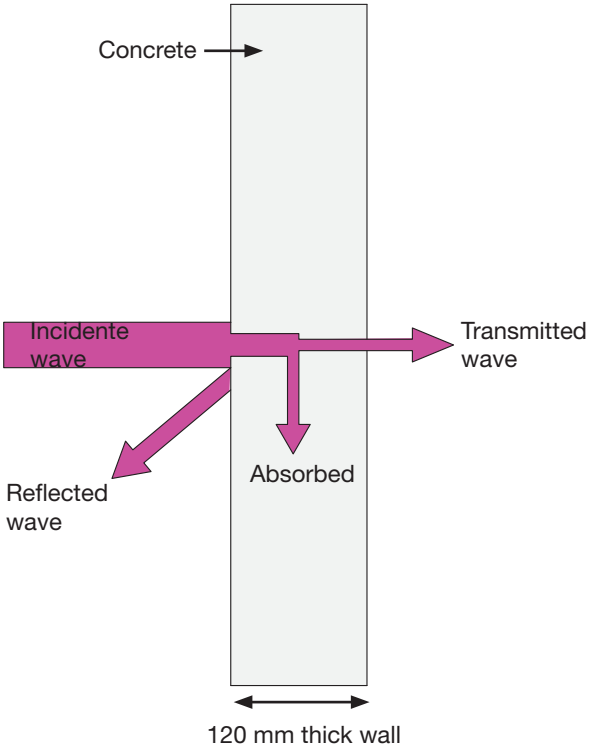
However, increasing the mass of a dividing element is sometimes easier said than done. That explains why the spring-mass system can be used, which involves separating two elements with a material that will act as a spring, such as air or insulation.

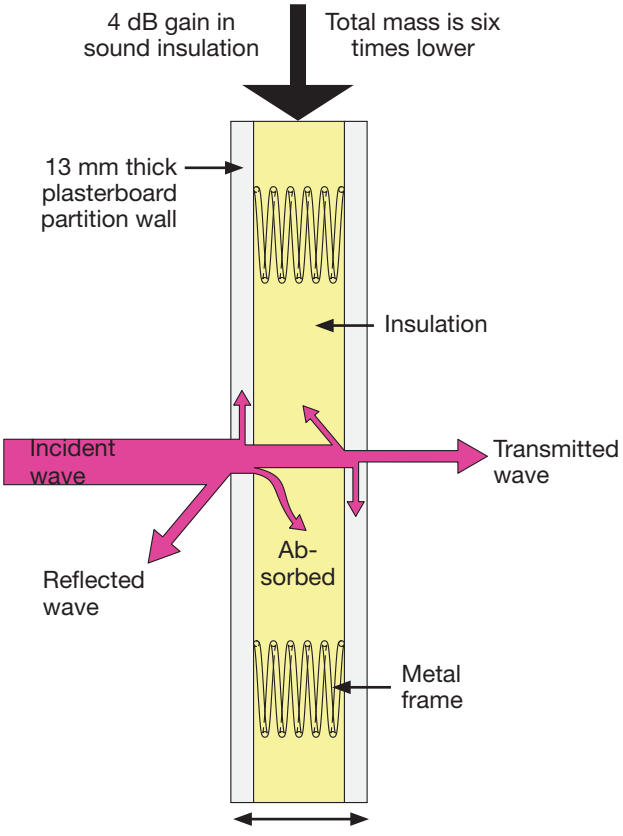
Increasing the thickness of the insulation between dividing elements will only affect the building's thermal performance and not its sound performance. Contrary to a popular misconception, increasing thermal insulation will not improve acoustic insulation.

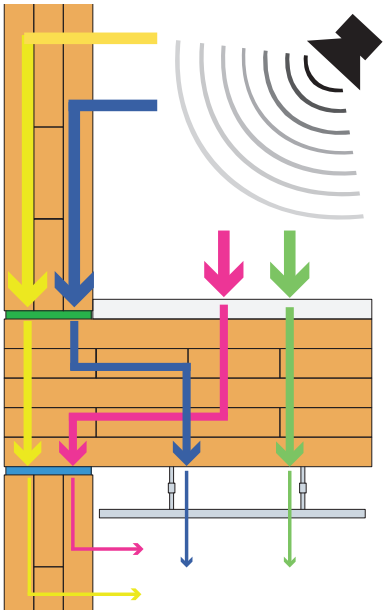
The last solution is to separate the different elements (discontinuous construction). If one element vibrates but not the next, sound will not be transmitted and will stay where it is.

Mass Rule: Spring-Mass System

For a given material, the higher its density, the better its sound insulation performance!







When the incident wave comes into contact with a material, part of the wave is reflected and absorbed, while the rest of the wave is transmitted into the adjacent room.

When it comes to a building's acoustics, the principle is straightforward, i.e. increasing the mass improves performance. One of the advantages with a timber building is its lightweight structure (~550 kg/m^3 for CLT compared to ~2.200 kg/m^3 for concrete), which represents a weakness in its acoustic performance according to the mass law. In this case, a combination of different methods is required to obtain the desired performance levels (insulation, extra mass and discontinuous construction).

Simpson Strong-Tie offers a number of solutions for discontinuous construction, especially for isolated dividing elements and airtight wall junctions.

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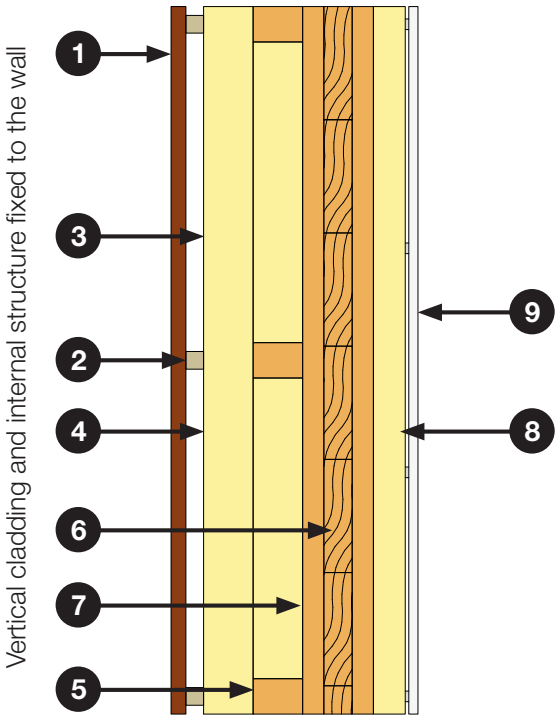
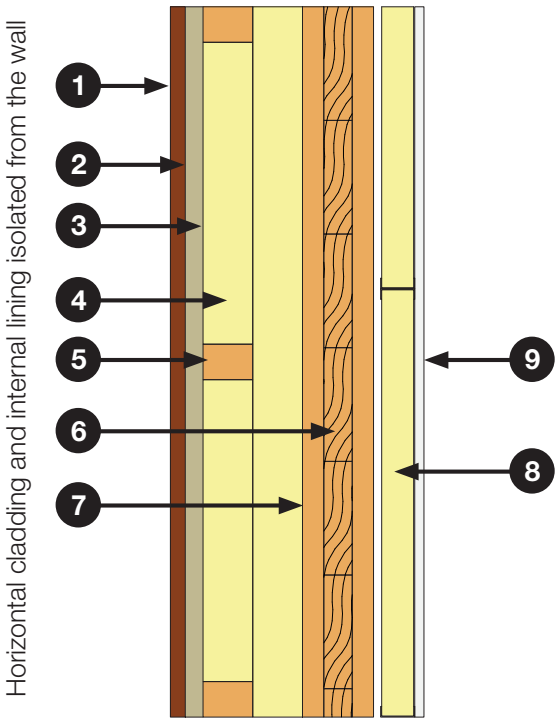
Example of the Performance Levels With Timber Walls

The ACOUBOIS study financed by CODIFAB provides the performance for isolated wall linings based on different parameters. The following example calculates the sound reduction index to external noise R_w+C_{tr}.

Front wall made from cross-laminated timber panels (CLT): $[R_w+C_{tr}]$ base = 39 dB





1. 21 mm timber cladding (tongue and groove)
2. Timber battens creating a cavity of at least 25 mm
3. Breather membrane
4. Double layer of rigid or semi-rigid mineral wool insulation (maximum of 70 mm) fitted between timber studs
5. 70x50 mm² timber studwork
6. CLT panel at least 93/94 mm thick (subject to technical approval)
7. Vapour control layer if necessary
8. Metal rails with intermediate supports, incorporating 45 mm mineral wool or bio-based insulation, or
   - Horizontal or vertical timber battens, incorporating 45 mm mineral wool or biobased insulation: $\Delta[R_w+C_{tr}]$ = - 5 dB
   - 48 mm metal studs separated from the timber frame, incorporating 45 mm mineral wool or bio-based insulation: $\Delta[R_w+C_{tr}]$ = + 1 dB
9. Wall lining with one layer of plasterboard, or
   - 1x13 mm acoustic plasterboard: $\Delta[R_w+C_{tr}]$ = + 4 dB
   - 1x18 mm plasterboard: $\Delta[R_w+C_{tr}]$ = + 4 dB

Three corrections can be combined. The sum will be capped at$\Delta[R_w+C_{tr}]$ = + 8 dB

The full ACOUBOIS study is available on the CODIFAB website (https://www.codifab.fr).

This example demonstrates the beneficial effects of:

- A discontinuous structure; separating the studs can improve performance by 1 dB,
- Adding extra mass; using 13 mm acoustic plasterboard (which is heavier) can improve performance by up to 4 dB.

Some designs can achieve even higher increases in performance.

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Parameters for Calculating Sound Propagation

Internal sound reduction index and impact sound level
Carrying out a study into the building's acoustic performance can provide a clearer understanding of how sound can spread between the building's different rooms.

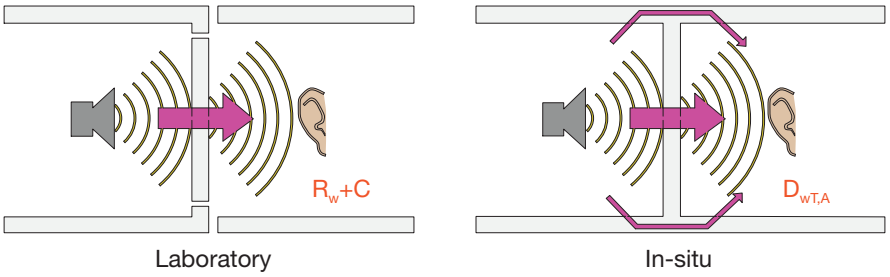
Several parameters have been defined for quantifying acoustic performance. Some parameters are used to assess the acoustic performance of dividing walls, such as the sound reduction index $R_w(C;C_{tr})$, while others evaluate the weighted pressure level of the standardised impact sound $L_{n,w}$.

Some building-specific parameters assess in-situ acoustic performance, namely the weighted standardised level difference $D_{nT,w}(C,C_{tr})$ and the weighted pressure level of the standardised impact sound $L'_{nT,w}$.

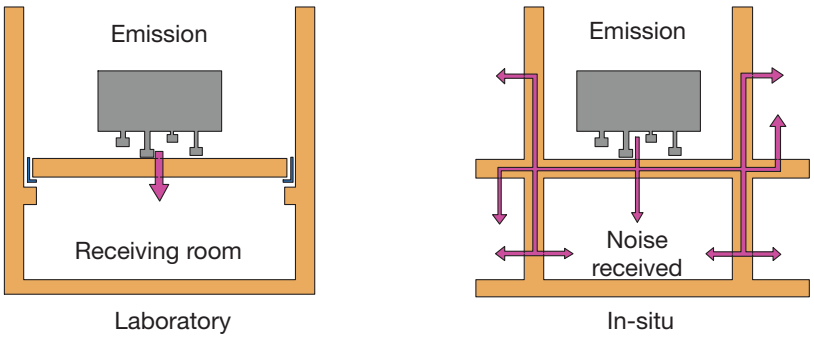
The R_w and $L_{n,w}$ values are used in laboratory tests, where the global level $L_{n,w}$ is calculated according to EN ISO 717-2 from spectrum L_n, and the sound pressure level in dB in the receiving room is measured in the laboratory according to EN ISO 10140-1 and 3.

These laboratory values are different to the field measurements, since the model used for the laboratory measurements cannot replicate the flanking transmission, defects and other differences in the building's construction.

Airborne sound



Impact sound



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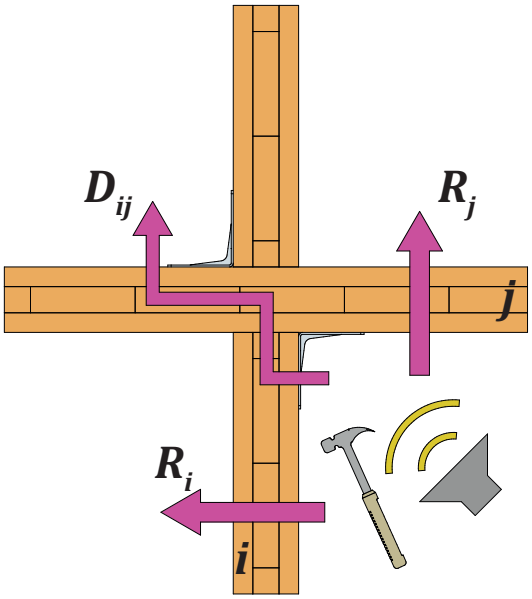
Calculating Flanking Transmission – Gerretsen Method (1986) – EN 12354-1

First published in 2000, EN 12354 contains calculation models for estimating the airborne sound insulation between adjacent rooms in buildings. The standard is based on the Gerretsen model and uses measured data that characterise direct or indirect flanking transmission by the participating building elements.

$$R_{ij} = \frac{R_i}{2} + \frac{R_j}{2} + \frac{D_{ij} + D_{ji}}{2} + 10 * \log(\frac{S_0}{\sqrt{S_i * S_j}})$$



Key:

R_{ij} is the flanking sound reduction index according to the transmission path from i to j

R_i and R_j are the sound reduction indices of elements i and j respectively

D_{ij} and D_{ji} are the vibration reduction factors of paths i to j and j to i

S_0 is the reference area, which is equal to 10 m²

S_i and S_j are the surface areas of elements i and j

The thing that interests us with this calculation method is that it takes account of the path travelled by the sound wave. In a timber frame building, Simpson Strong-Tie connectors are an integral part of the junctions between the different structural elements, meaning that they play a key role in the building's acoustic performance.

EN 12354 offers quantities for expressing the vibration reduction indices between two structural elements i and j: **Kij**, which can be found in the following equations:

$$D_{v,ij,n} = K_{ij} = \frac{D_{ij} + D_{ji}}{2} + 10 * \log(\frac{l_{ij} * l_0}{\sqrt{S_i * S_j}})$$

$$R_{ij} = \frac{R_i}{2} + \frac{R_j}{2} + K_{ij} + 10 * \log(\frac{S_0}{l_{ij} * l_0})$$

Key:

T_0 is the reference reverberation time (equal to 0.5 s)

V is the volume of the receiving room [m³]

S is the surface area of the element separating the two rooms [m²]

I_{ij} is the common length of the junction between elements i and j

This allows us to calculate the sound reduction index R_{ij} for each transmission path and thereby determine the apparent sound reduction index R':

$$R' = -10\log(10^{-\frac{R}{10}} + \sum_{ij} 10^{-\frac{R_{ij}}{10}})$$

R is the sound reduction index of the different elements.

The apparent sound reduction index R' lets us calculate the standardised level difference D_{nT}:

$$D_{nT} = R' - 10\log(\frac{V}{6T_0S_s})$$

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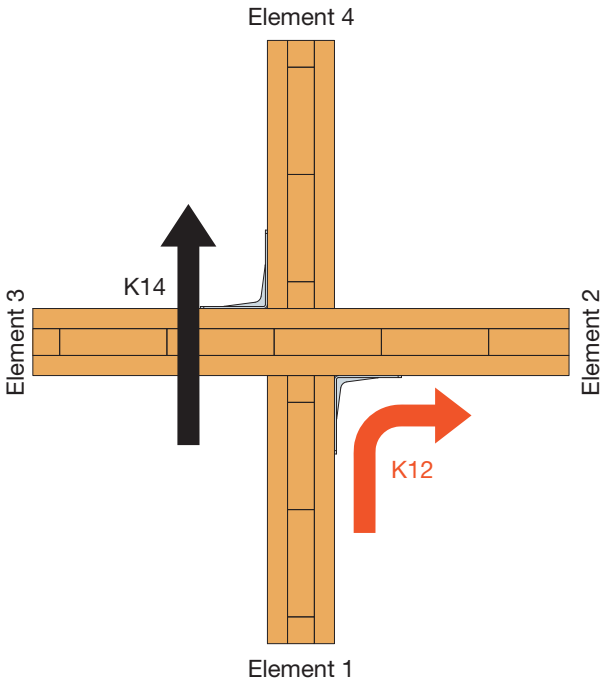
The Different Acoustic Solutions

The acoustic performance of the Simpson Strong-Tie range of products has been assessed by the BOIS HD laboratory (owned by the ESB Group). The results are available in report BHD18705 (version of 21/10/2019).

The values of the vibration reduction indices K_{ij} have been determined through testing in accordance with EN ISO10848-1:2017 and EN ISO 10848-4:2017, which specify the calculation methods for the vibration reduction index and the test methods respectively.

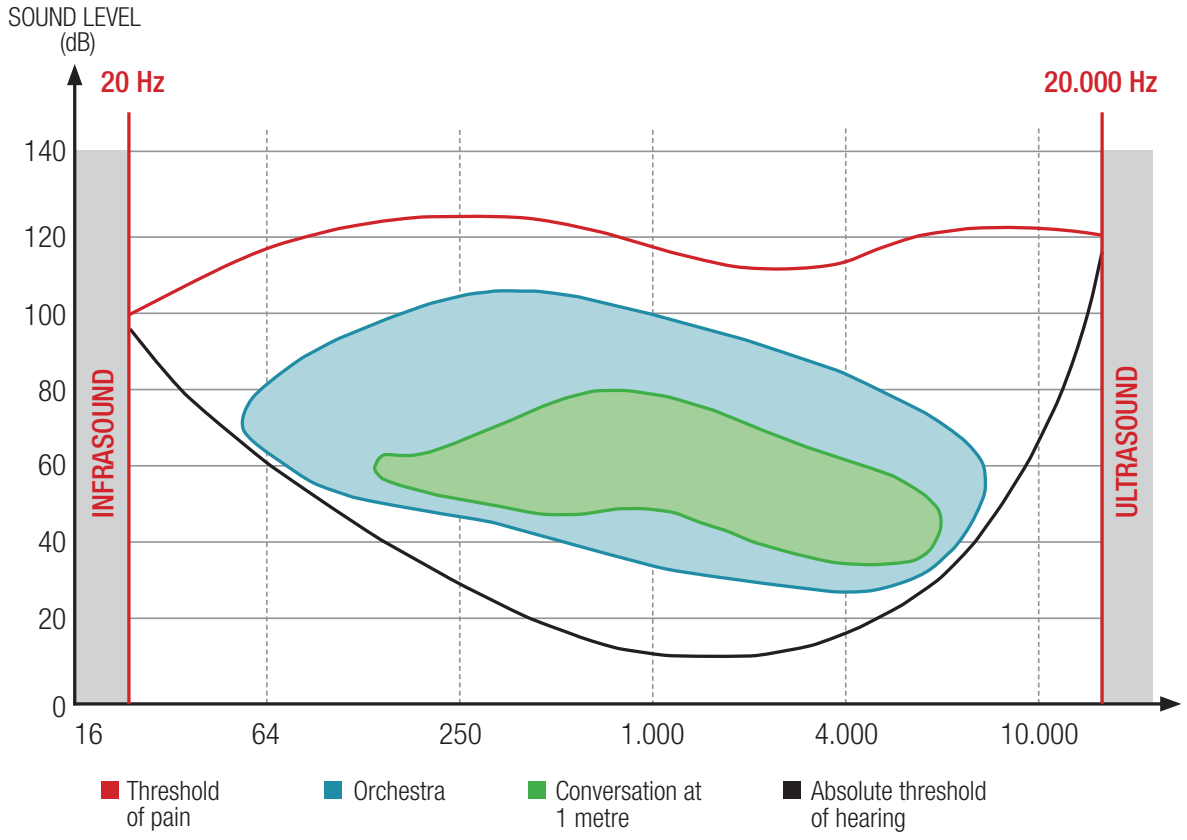
The configuration for this example shows an X-shaped junction with a dividing floor, and bare floors and walls. Two vibration transmission paths are identified in the following diagram: from element 1 to element 2, which represents the junction between the lower wall and the floor, and from element 1 to element 4, which shows the transmission path between two walls through the floor.



To ensure that the results in this guide are easier to understand, we are going to take a closer look at the concept of sound level perception with the associated hearing sensations.

Increasing the sound level by:	Multiplies the sound energy by:	Has the following influence on what we are hearing
3 dB	2	Slight change
5 dB	3	Significant change
10 dB	10	As if the sound were two times louder
20 dB	100	As if the sound were four times louder
50 dB	100.000	As if the sound were thirty times louder

Note that the sensitivity of the human ear to different frequencies also depends on the amplitude of that frequency.



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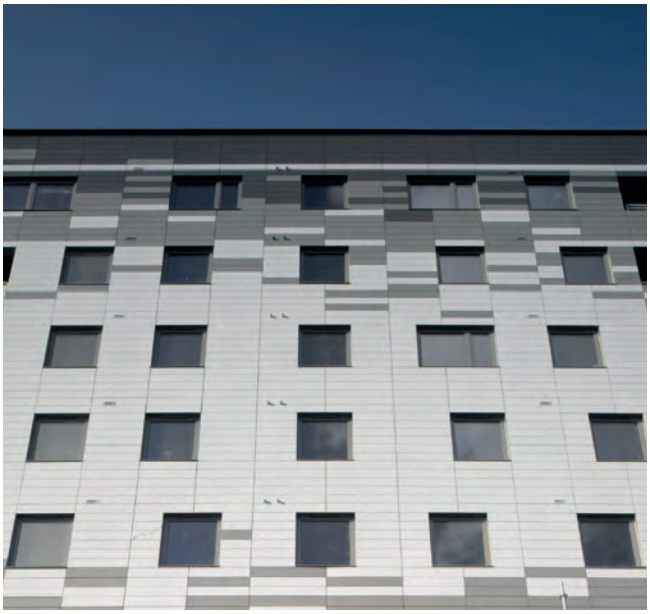
Paris Arboretum, France

Sara Cultural Centre, Sweden



Murray Grove Residential Building, UK

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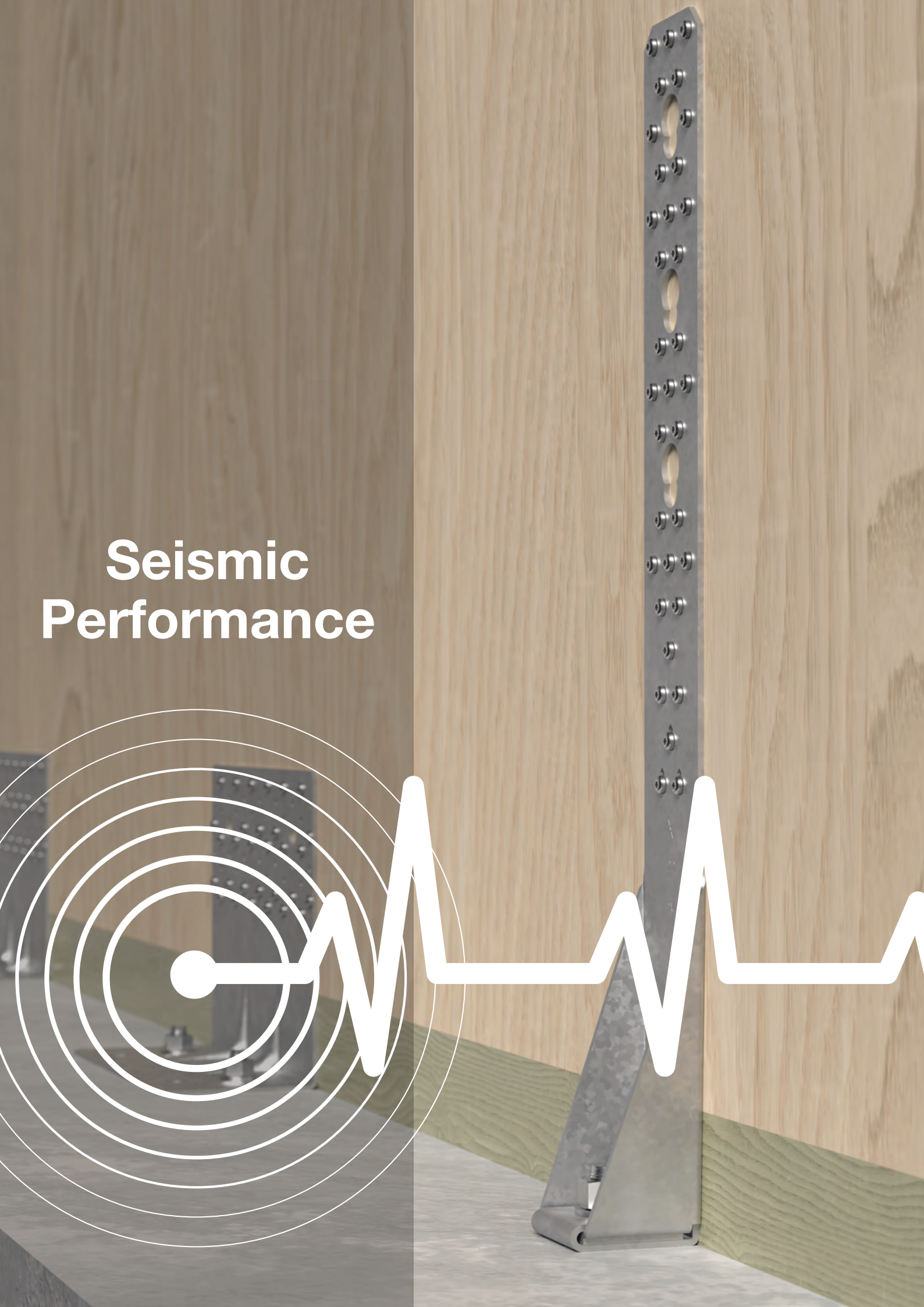
Seismic Performance



Seismic Activity and Timber Constructions

Evidence suggests that the use of timber for construction in seismic areas dates back to at least 10,000 years. Many of the buildings that still stand today provide clear evidence that timber and the associated construction systems are well suited to the forces and stresses caused by seismic events.

Until recently, Europe had experienced very few destructive earthquakes, unlike Japan and the United States, which have played a major role in understanding and developing a scientific approach towards assembly and connection methods in timber constructions.

The types of connectors used, and their materials, have undergone significant changes over the last few decades. Efforts were therefore needed to create an array of design calculations and regulations to understand the systemic behaviour of timber constructions.

Background

The whole process of designing timber structures in seismic areas is a complex issue and goes far beyond the metal connectors used.

Simpson Strong-Tie® connectors
The three-dimensional metal connectors used for timber constructions that have been CE certified according to EAD 130186-00-0603 and EN 14545 are not specifically tested in seismic conditions.

However, there are fixing accessories, such as anchors, that can be classed as C1 or C2 according to EAD 330232-01-0601.

When it comes to designing dissipative zones for the connectors and a continuous load transfer, Eurocode 8 specifies two approaches: distribution and dissipation. Where the behaviour factor q is considered to be greater than 1.5, cyclic tests according to EN 12512 can be carried out to determine the dissipative properties of a connector or part of the structure.

Seismic design: first tests in France
The first cyclic tests on E5 angle brackets were carried out by the FCBA laboratory in Bordeaux in 2005. The data gathered during testing were instrumental in incorporating E5 brackets into the SISBAT and SISMOB research projects aimed at analysing the behaviour of timber buildings during seismic events.

The tests performed during the research projects demonstrated that these brackets and the associated construction methods were capable of withstanding seismic stresses according to the French Regulation of 1 April 2011.

Simpson Strong-Tie® continued taking part in test programmes during the Woodrise Congress in 2017.

R&D laboratories and research
Simpson Strong-Tie® has spent several decades investing in internal test equipment and campaigns to improve the development of connectors, anchors and fasteners in seismic conditions. The vast majority of our products are tested in-house during development.

In an effort to gain a clearer insight into how connectors behave during seismic events, the Group acquired a host of cyclic test systems in the mid-1990s. Research focused on both connector behaviour and the systems with the aim of understanding how parts and components affect the behaviour of the systems and ratifying the regulatory options.

Tyrel Gilb Research Laboratory in Stockton, California
This laboratory was built in 2003 to test full-scale structures subjected to seismic events. Featuring an investment of close to $10 million, this laboratory simulates earthquakes according to the curves recorded during real seismic activity.

Buildings with up to three storeys can be tested, thereby allowing engineers to analyse the behaviour of the ground floor and intermediate floor. Specific loads can be applied to simulate the weight of several storeys. The laboratory team is led by Steve Pryor, who has been developing research activities for Simpson Strong-Tie® since 1997. He is a recognised expert in seismic timber design. He actively takes part in international programmes, including the NEES in Japan in 2009, which involved testing a seven-storey building.

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Seismic Activity and Timber Constructions

Andris Peterson Laboratory in Tamworth, UK
This laboratory was created in 1997 to support the development of connectors in Europe. The laboratory now focuses exclusively on timber connectors and fasteners, and already has the necessary equipment for carrying out cyclic tests.

Connectors, panel anchors, the Steel Strong-Wall™ and the system developed for Europe and France in particular are tested in this laboratory. This ensures that products are compliant with all applicable regulations, the supply of specific wood species to the target markets and interactivity with the design teams based in different countries.

New builds and renovations
Seismic design generally tends to apply to new builds that need to satisfy regulatory obligations. Discrepancies may arise between the recommended products and the solutions actually implemented due to a lack of knowledge.

The issues often reported are caused by the use of fasteners (nails or screws) that fail to conform to quality specifications (lack of certification) or generally the required quantities. The repercussions in the event of an earthquake could be the early slip of a connector leading to a critical deformation in the building's stability. You are advised to check this particular point.

Furthermore, a whole range of buildings has been built in accordance with the PS92 standards, which were highly concise for timber constructions, or the Eurocodes and the new seismic zoning regulations enacted in France on 1 May 2011.

The existing timber structure can easily be reinforced to withstand the stresses and forces laid down by the new regulations. Generally speaking, standard connectors and the associated fasteners are sufficient to achieve these objectives. A thorough inspection is recommended of the design and the execution of the metal connector zones considered to be dissipative, regardless of whether the structure is a new build or renovation.

Reinforcement of the connection with the foundation

Specific Features of Connectors

Connectors play an important role in enabling buildings to withstand seismic stresses and forces. Depending on the type of structure, it must fulfil a specific function:

Transfer the forces (distribution) or dissipate the energy (dissipation).

In all cases, it is important to use the connector so as to create a continuous load path.

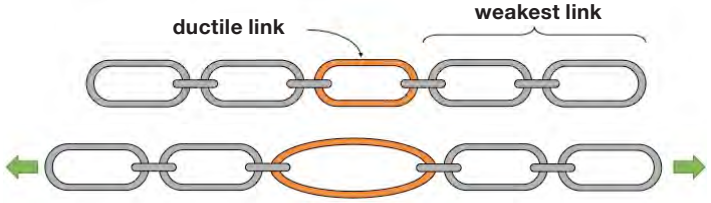
The structure must be designed in such a way that fragile elements are sufficiently resistant, so that any ductile elements flex before the fragile elements break.

Continuous load path
In terms of the application directions, seismic forces are often considered to be similar to wind forces. However, wind forces are exerted against the outer surfaces, whereas seismic forces are caused by the movement of the foundations, which displaces the mass constituting the structure. This means that all the rooms in the structure are required to move and not just the outer surfaces. In addition, the quick change in direction during an earthquake means that parts of the building may be required to displace several centimetres before returning to their initial position.

Seismic forces (both horizontal and vertical) depend on the mass of the element that displaces during the earthquake. Consequently, these forces occur in both the roof structure and the floors / walls. They increase as they get closer to the ground, since they tend to build up over time.

One of the key points in seismic design is to ensure that all forces are transferred to the building's foundations. To do so, you must create what is known as a continuous load path. This is a set of components that ensure that the forces are transferred to the foundations as directly as possible.

Connectors are partly important, since they will create a link between the different masses in movement and ensure that the resulting forces are exerted downwards.



Principle of conception

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Seismic Activity and Timber Constructions

Distribution

There are two possibilities for connectors: the first is called Distribution. In this case, the structure is fairly ductile. The aim is to use connectors to transfer the forces. In this scenario, they act as the weakest link.

This is typically the case with a timber frame house. This type of structure is quite flexible due to the many fixings between the sheathing, studs and rails. In some cases, sheathing may be required on both sides of the timber frame wall panel.

The connector is then responsible for preventing two phenomena that could occur: sliding and overturning.

There are several solutions to overcome this problem, such as anchoring the timber frame, using a continuous tie-down system (currently unavailable in Europe) or implementing a Steel StrongWall™ stability wall. Each solution addresses a specific need and offers different distribution performance levels.

For example, timber frame anchors are suitable for low seismic loads. This type of connector is fixed to the ends of the walls to prevent uplift. They can be reinforced with anchor plugs or pre-grouted rods for earthquake-prone areas (certification: C2 for anchors) to resist the shear forces along the sole plate. Timber frame anchors should not be too flexible, otherwise the studs could be wrenched away from the sole plate.

Where anchors are fitted to the external face of the walls, their behaviour varies according to whether the anchor is fixed to the sheathing or directly to the stud. The maximum load is reduced when timber frame anchors are fixed to the sheathing, but ductility and equivalent viscous damping are slightly improved.

Similarly, the length of the fasteners and the fact that fixings are asymmetric may cause early failure in the studs.

If fasteners are too short in comparison to the thickness of the stud (length of the fastener less than half the thickness of the stud), tensile failure may occur. To avoid this phenomenon, it may be worthwhile using longer fasteners or adding structural screws to the other side of the timber element.

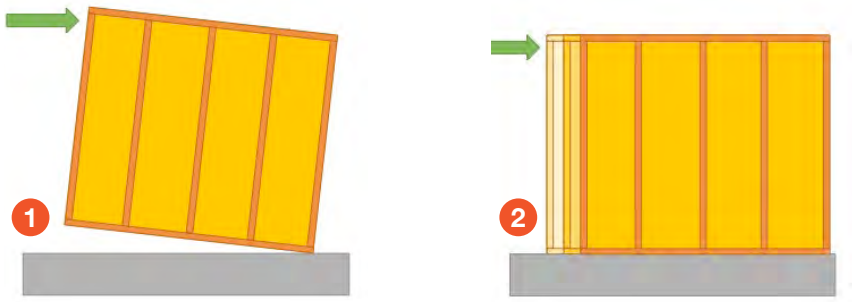
The second solution for distribution is to use a Strong-Wall™.

This product is especially suited to situations where space is at a premium and timber frame walls are unable to withstand the forces. The low footprint and rigid design of the Steel Strong-Wall™ system are invaluable in such cases.

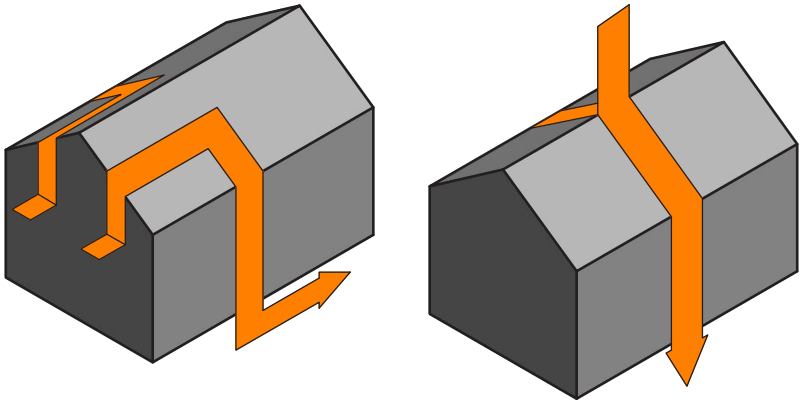
Steel Strong-Wall™ panels have been subjected to cyclic testing and have demonstrated effective behaviour, meaning that they can be used to withstand seismic forces. **Their behaviour factor is equivalent to a timber frame wall (q=3).**

If this type of solution is chosen, the concrete foundation is a critical element, meaning that special care must be taken, since high forces may be exerted on the anchors (> 60 kN in tensile).

It is important to remember that the walls are only part of the structure. The load path must be ensured in all the structural members and also between members. Fixing bands or retaining brackets may need to be added to the horizontal diaphragms or roof structure, so that forces are quickly transferred through all the elements within the structure.



Phenomena to be avoided:
overturning 1, sliding 2



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Dissipation

The other possibility is dissipation. This case is required if the structure is sufficiently rigid. The connector acts as a fuse in the structure and therefore represents the ductile link in the chain. This is the principle chosen for CLT structures. CLT elements are rigid enough to transfer the forces, but they lack flexibility. This is where the connector comes into play.

However, using ductile connectors in this type of structure is not enough to guarantee effective performance. Other parameters, such as the dimension ratio of the panels, also have an effect on design performance.

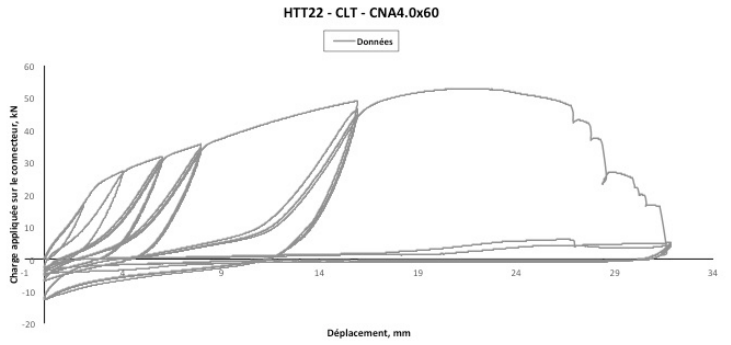
As with the timber frame, it may be worthwhile using specialised products for each force direction. That is why an effective solution is the combined use of wall anchors (HTT22E) and structural angle brackets (ABR255). HTT22E anchors absorb the uplift forces and are fitted at each end of the panel. AE116 structural brackets are placed at regular intervals along the panels and absorb the shear forces.

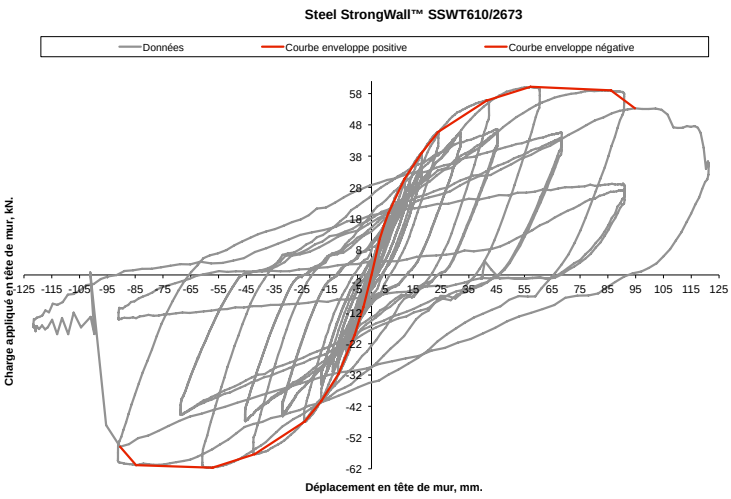
Other more versatile brackets, such as ABR100, can be used for their good performance in both force directions.

Conclusion

It is important to ensure the continuous force path when designing for buildings for earthquake resistance. Care must also be taken to ensure that all connection points are resistant enough to prevent the structure from partially or fully collapsing. With timber frame structures, connections can easily be made with the standard products that are already used for wind resistance. Whether standard tie straps or Steel Strong-Wall™, an end-to-end range of connectors is available in the market to address this particular issue (dissipation or distribution).

HTT22 subjected to Cyclic Loading





Steel Strong-Wall™ panels subjected to cyclic loading

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Fire Performance

Fire Resistance

Timber is an Excellent Thermal Insulator

There is a preconception that timber as a construction material presents a greater fire risk than steel or concrete. However, this is not the case. Timber is in fact an excellent thermal insulator with high heat resistant properties. In the event of a fire and the extreme temperatures generated, wood loses only 10-15% of its fire resistance.

Furthermore, while some materials may be less inclined to ignite when exposed to fire, they will still react to it in ways that present risk to a structure that are not associated with timber. For example, in response to intense temperatures, steel softens and eventually melts, concrete shatters.

To help you build safer structures and choose the right connectors, fasteners or anchors for your needs, Simpson Strong-Tie provides information on the fire resistance of its products.

Charring Rate: a Predictable Structural Behaviour

The first thing to know when designing structures with fire conditions in mind, is that the charring rate of timber is constant and depends on the type of timber used. This is a significant advantage, as the structural behaviour of timber under fire conditions is entirely predictable.

The charring rates according to Eurocode 5 (EN1995-1-2) are:

		Charring rate β_n [mm/min]
Softwood	Glulam ($\rho_k \geq 290$ kg/m^3)	0,7
	Solid Timber ($\rho_k \geq 290$ kg/m^3)	0,8
Hardwood	Glulam or Solid Timber ($\rho_k \geq 290$ kg/m^3)	0,7
	Glulam or Solid Timber ($\rho_k \geq 450$ kg/m^3)	0,55
LVL	($\rho_k \geq 480$ kg/m^3)	0,7

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Reaction to Fire vs Resistance to Fire

Reaction to fire
Reaction to fire indicates if a material is combustible and may therefore fuel a fire. This classification is based only on the materials used. The stated reactions according to EN13-501-1 have been determined via standardised tests carried out by an approved body. There are 7 categories:

- A1 and A2: non-combustible (e.g. concrete, steel);
- B: low-combustible (e.g. mineral slabs for false ceilings, PVC);
- C: combustible (e.g. particleboard);
- D: highly combustible (e.g. solid wood);
- E: highly flammable and flame-spreading (e.g. fibreboard with a density < 400 kg/m^3);
- F: not classified or not tested

Indices are included which define the ability of these materials to emit smoke (s1, s2 or s3) and debris (d0, d1 or d2).

Tests are not necessary for some materials as they are already defined in Annex 3 of the Order of 21 November 2002. For example, all S250GD+Z275 steel products are classified A1 – this classification covers all Simpson Strong-Tie connectors, mechanical or chemical anchors and fasteners. This classification is given in the ETA and/or DoP for the various products.

Please note that this parameter is not used to justify the fire resistance of a structure.

Resistance to fire
Where reaction to fire refers to the ability of products to perform their function in the event of a fire, fire resistance relates to the flammability of materials. In the case of connectors and fasteners, the aim is to guarantee the mechanical properties of the product in order to avoid the collapse of the structure. The justification of the fire resistance of timber structures is described in Eurocode 5 Part 2 (EN1995-1-2).

To prove the fire resistance of an assembly using product in its intended use, it is necessary to have a technical certification (type ETE, technical opinion, ...) or to carry out a specific study based on the Eurocode 5 Part 1-2 (EN1995- 1-2) and Eurocode 3 in addition (for steel elements).

The same material may be non-combustible but have poor fire resistance and vice versa.

For example: concrete blocks are non-combustible, so their reaction to fire will be excellent (classified A1) but their resistance to fire will be mediocre because of its friability at high temperature (a wall can collapse because it is weakened by heat).

Oak, on the other hand is combustible and will have an average reaction to fire (class D), but fairly good resistance to fire. A 35 mm oak door will resist fire for 30 minutes.

Simpson Strong-Tie certifies 30-minute fire resistance for GSE, GSI, GLE and GLI in 4 mm on timber, as well as concealed beam hangers and connectors using ETE06/0270 and ETE-07/0245.

For information about justification of fasteners, please see chapter 10.

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CLT Panel to Concrete Slab Solutions

Ground floor CLT wall panel to concrete connections have two important structural roles to play.

Firstly, they need to transfer loads from the structure above into the foundations of the building.

They’re also required to resist both horizontal shear loads and uplift arising from the rotation of racking walls.

The following section describes connection methods suitable for 90° and in-line CLT junctions with direct contact with the concrete, as well as a specific set of solutions for use where an intermediate timber plate has been added as a levelling aid.

CLT Panel to Concrete Slab Solutions

Hold Downs with Angle Brackets

Product Options:

HTT see page 39
ABR255 see page 40
AG922 see page 41
ABR100 see page 42

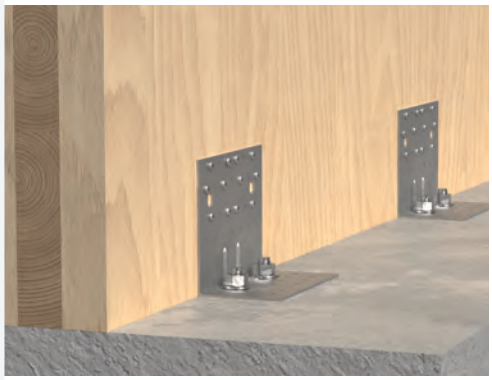
Get the best performance from a CLT racking wall, by combining hold downs at each end of the CLT panel to take care of uplift forces, with angle brackets providing support against shear (sliding) movement.

Angle Brackets

Product Options:

ABR255 see page 46
AG922 see page 47
ABR100 see page 48

In situations where the CLT panel is exposed, yet it is preferable to hide the connections in the floor zone layers, additional angle brackets can be used in place of the hold downs to resist both uplift and shear forces.



Tension Plates and Anchor Plates

Product Options:

NPB255 see page 50
NPB60400 see page 51
NPB100540 see page 51
NPB140540 see page 51

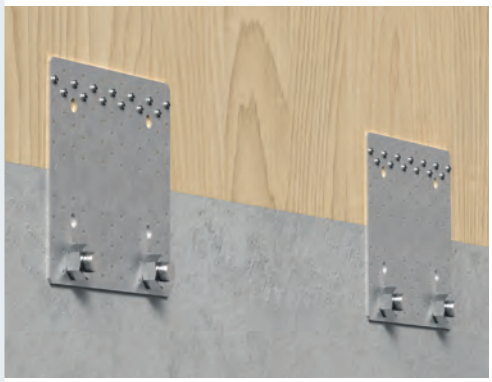
On the external face of structures where the CLT panel is connected to the edge of the foundation slab, this combination sees the tension plate providing uplift resistance, while the anchor plates handle shear forces. A good solution if it is not possible to conceal the connectors on the inner face of the CLT panel.

Anchor Plates

Product Options:

NPB255 see page 53

On the external face of structures where the CLT panel is connected to the edge of the foundation slab, here the tension plates are replaced with more anchor plates to accommodate uplift and shear forces. A good solution if it is not possible to conceal the connectors on the inner face of the CLT panel.



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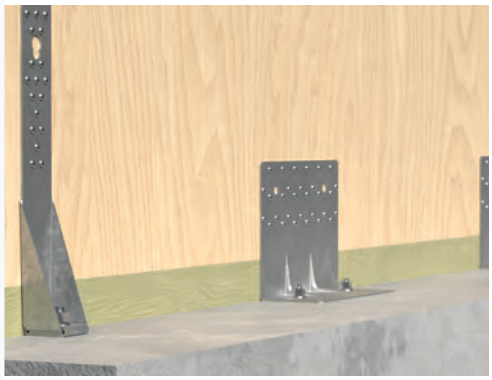
CLT Panel to Concrete Slab with Interlayer Solutions

Hold Downs with Angle Brackets

Product Options:

HTT see page 55
ABR255SO see page 56

Get the best performance from a CLT racking wall, by combining hold downs at each end of the CLT panel to take care of uplift forces, with angle brackets designed to span across timber plate supporting against shear (sliding) movement.

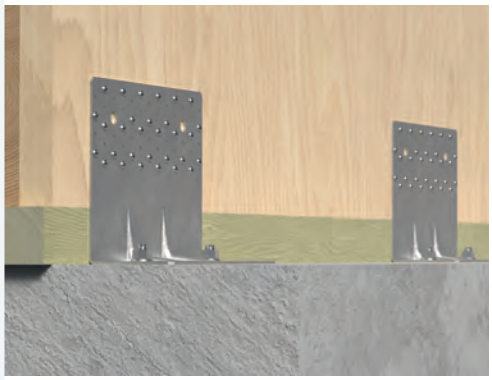


Angle Brackets

Product Options:

ABR255SO see page 58

In situations where the CLT panel is exposed, yet it is preferable to hide the connections in the floor zone layers, additional angle brackets designed to span across the timber plate can be used in place of the hold downs to resist both uplift and shear forces.



Screws and Through-bolts

Product Options:

SWD see page 60
FM 753 evo see page 62

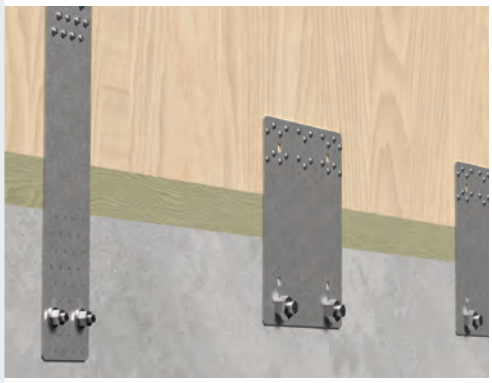
On the internal face of structures where the wall to floor connection is completely exposed, through-bolts to fix the sole plate down to the concrete, combined with structural screws connecting the CLT panel to the sole plate provide a completely hidden connection.

Tension Plates and Anchor Plates

Product Options:

NPB255SO see page 64
NPB100540 see page 65
NPB140540 see page 65

On the external face of structures where the CLT panel is connected to the edge of the foundation slab, this combination sees the tension plate providing uplift resistance, while the anchor plates handle shear forces. A good solution if it is not possible to conceal the connectors on the inner face of the CLT panel.

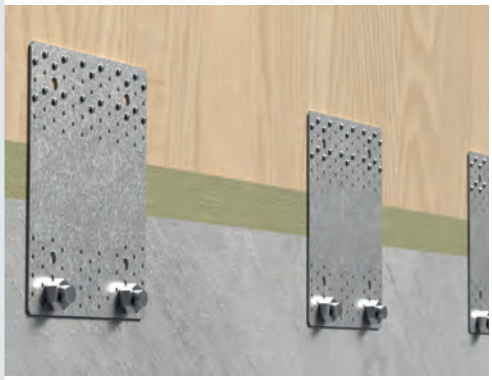


Anchor Plates

Product Options:

NPB255SO see page 67

On the external face of structures where the CLT panel is connected to the edge of the foundation slab, here the tension plates are replaced with more anchor plates to accommodate uplift and shear forces. A good solution if it is not possible to conceal the connectors on the inner face of the CLT panel.



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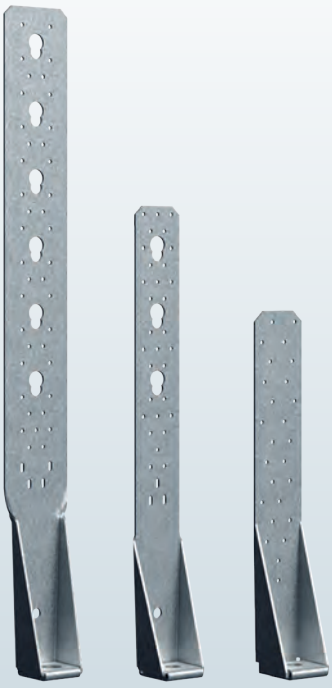
Hold Downs with Angle Brackets

Get the best performance from a CLT racking wall, by combining hold downs at each end of the CLT panel to take care of uplift forces, with angle brackets providing support against shear (sliding) movement.

Items Required

Hold Downs – Uplift Restraint
HTT



HTT31 HTT22E HTT5

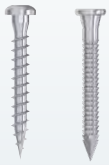
Angle Bracket – Shear Restraint
ABR255, AG922 or ABR100

ABR255

AG922

ABR100

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Concrete Fasteners
FM 753 evo Wedge Anchor or
AT-HP High Performance Resin +
LMAS Threaded Rod

FM 753 evo

AT-HP + LMAS

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Hold Downs with Angle Brackets

HTT – Heavy Duty Hold Down

Generally placed at each end of a CLT panel or at openings within them, the singlepiece HTT is especially suited to providing very high resistance to uplift forces. The seat is formed from a rolled edge for exceptional reinforcement at the anchoring point, while the fastener pattern is designed to optimise the load taken by each nail or screw used.

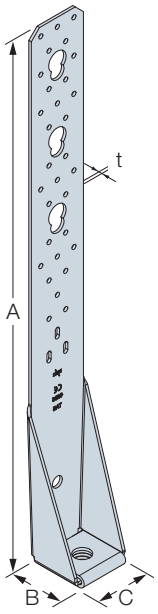
Advantages:

- Very high uplift resistance
- Reduces the number of angle brackets required to fix the CLT panel to concrete
- Variety of fixing and fastening options to suit the required balance of installation time and load capacity

ETA-07/0285

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B
	A	B	C	t	Screws or Nails	Bolts	Anchors
HTT5	403	62	64	2,8	26 Ø4,7	-	1 Ø17,5
HTT22E	558	60	63	3,0	31+3 Ø5	3 Ø21	1 Ø18
HTT31	790	60	90	3,0	41+4 Ø5	6 Ø21	1 Ø25



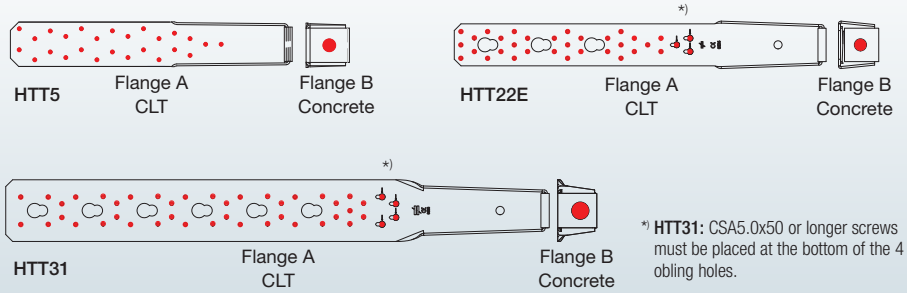
Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Hold Down

Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Flange A CLT	Flange B Concrete	$R_{1,k}$	$k_{ser,1,k}$
HTT5	26 CNA4.0x50	1 FM 753 evo M12 or AT-HP + 1 LMAS M12	24,7	2,2
	26 CNA4.0x60		31,0	2,6
HTT22E	29 CNA4.0x50 + 5 CSA5.0x50	1 FM 753 evo M16 or AT-HP + 1 LMAS M16	min (67,1 ; 57,5/k_{mod})	6,1
	29 CNA4.0x60 + 5 CSA5.0x50		min (73,2 ; 57,5/k_{mod})	6,8
	34 CSA5.0x50		min (80,2 ; 57,5/k_{mod})	8,3
	34 CSA5.0x80		min (106,7 ; 57,5/k_{mod})	8,4
HTT31	41 CNA4.0x50 + 4 CSA5.0x50	AT-HP + 2 LMAS M24	min (85,7 ; 85,1/k_{mod})	-
	41 CNA4.0x60 + 4 CSA5.0x50		min (85,7 ; 85,1/k_{mod})	-
	45 CSA5.0x50		min (85,7 ; 85,1/k_{mod})	24,3
	45 CSA5.0x80		min (85,7 ; 85,1/k_{mod})	24,3

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

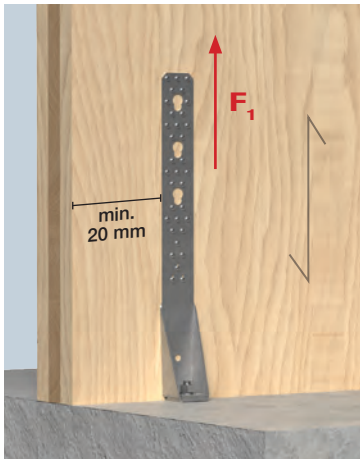
Fastening Pattern

*) **HTT22E:** CSA5.0x50 or longer screws must be placed in the 5 bottom holes (including 3 oblong holes).



*) **HTT31:** CSA5.0x50 or longer screws must be placed at the bottom of the 4 obling holes.

Red dots indicate holes filled with fasteners.



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Hold Downs with Angle Brackets

ABR255 – Reinforced Angle Bracket

Developed specifically for CLT construction, this reinforced angle bracket delivers high load capacities in all force directions and is capable of extremely high shear loads when anchoring CLT panels to concrete.

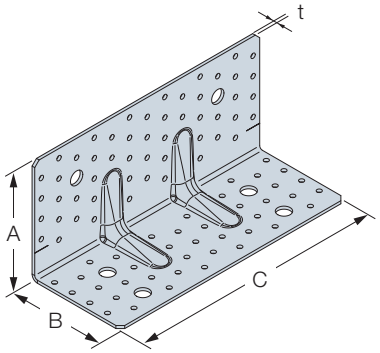
Advantages:

- High load performance in all force directions, especially shear
- Versatile fixing and fastener pattern choices
- Enables the use of fewer connectors per CLT panel

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
ABR255	120	100	255	3,0	52 Ø5	2 Ø14	41 Ø5	4 Ø14

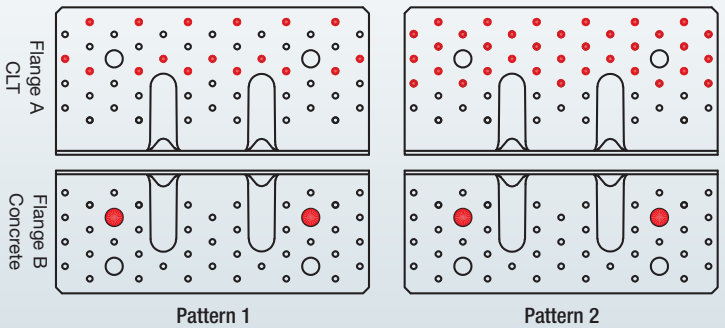


Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Angle Bracket

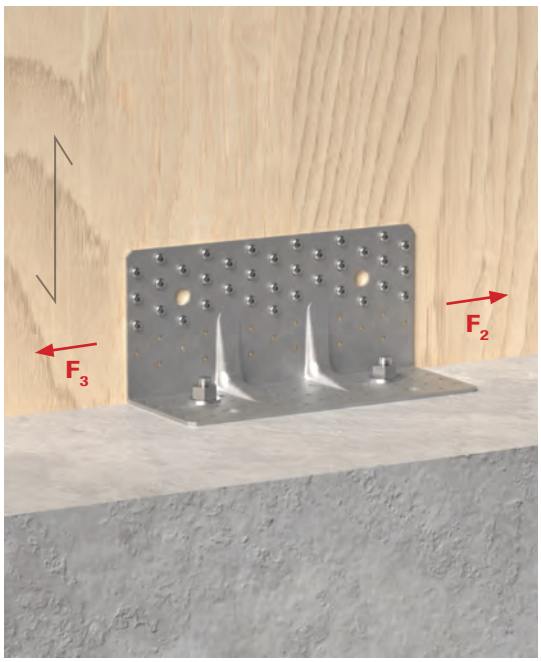
Model No.	Fasteners			Characteristic Values [kN]	Slip Modulus [kN/mm]
	Flange A CLT	Flange B Concrete	Fastening Pattern	Shear $R_{2,k} = R_{3,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
ABR2555	17 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	Pattern 1	24,9	4,5
	17 CNA4.0x60			26,5	4,8
	17 CSA5.0x50			26,5	4,8
	35 CSA5.0x50		Pattern 2	min (58,0 ; 57,6/k_{mod})	10,5

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Fastening Pattern



Red dots indicate holes filled with fasteners.



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Hold Downs with Angle Brackets

AG922 – Reinforced Angle Bracket

Providing good load capacity and stiffness. When used in conjunction with SSH connector screws, the AG922 can deliver equally high tensile and shear loads.

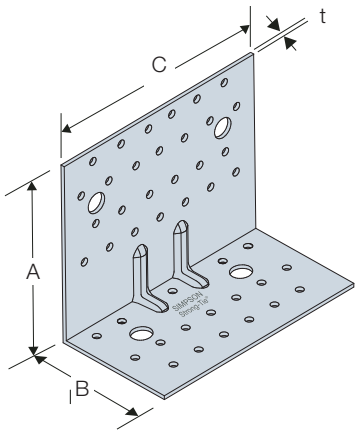
Advantages:

- High capacity and rigidity
- Versatile fastener and fastener pattern choices
- Flexible choice for CLT to CLT connections

ETA-06/0106

Dimensions

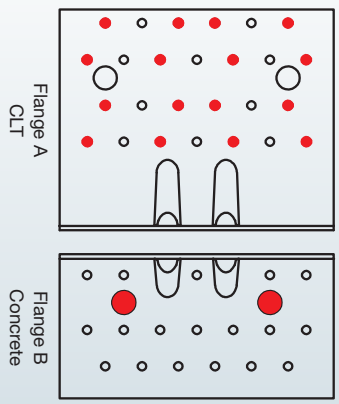
Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/Anchors	Screws or Nails	Bolts
AG922	121	79	150	2,5	26 Ø5	2 Ø13	18 Ø5	2 Ø13



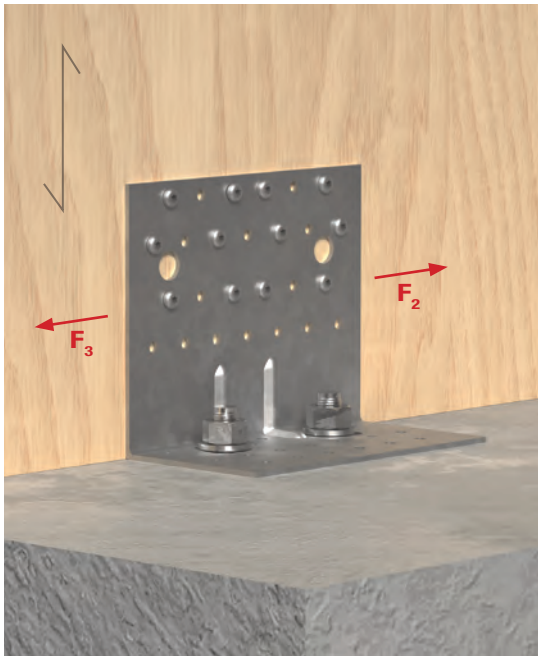
Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Angle Bracket

Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Flange A CLT	Flange B Concrete	Shear $R_{2,k} = R_{3,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
AG922	16 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	24,1	3,2
	16 CSA5.0x40		24,1	3,2

Fastening Pattern



Red dots indicate holes filled with fasteners.



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Hold Downs with Angle Brackets

ABR100 – Double Reinforced Angle Bracket

The rolled edge design of the ABR100 gives it impressive strength and stiffness considering its comparatively smaller form. The adapted fastener pattern recommended here is ideally suited to the grain direction of a CLT panel's outer layer.

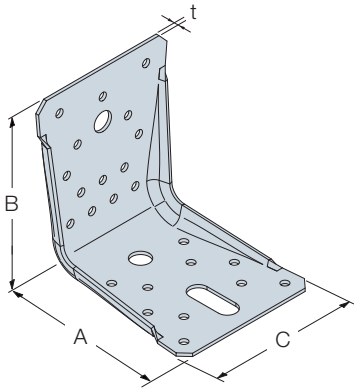
Advantages:

- High stiffness from a smaller form factor
- Optimised for high capacity in shear and uplift
- Fastener patterns adapted to CLT grain direction

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A			Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Obround	Screws or Nails	Bolts
ABR100	103	103	90	2,0	10 Ø5	1 Ø12	1 Ø12x32	14 Ø5	1 Ø12

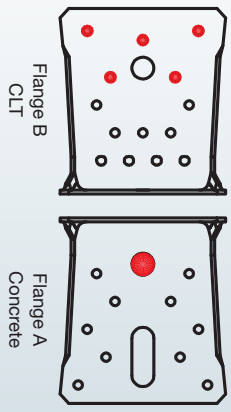


Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Angle Bracket

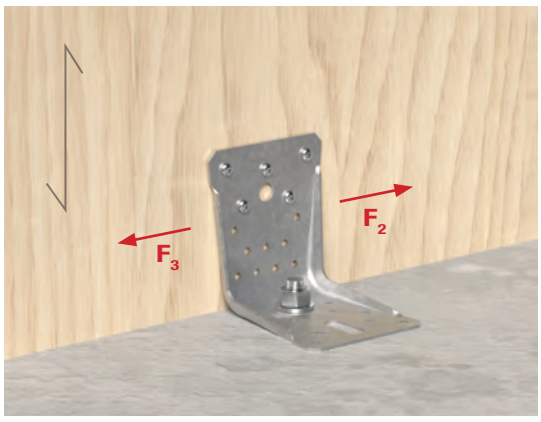
Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Flange A Concrete	Flange B CLT	Shear $R_{2,k} = R_{3,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
ABR100	1 FM 753 evo M10 or AT-HP + 1 LMAS M10	5 CNA4.0x50	4,1	1,5
		5 CSA5.0x40	4,1	1,5

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Fastening Pattern



Red dots indicate holes filled with fasteners.



HELPFUL TIP

Did you know that ABR100 may be used with upto 25 mm of interlayer under the CLT wall panel, with specified nail pattern?

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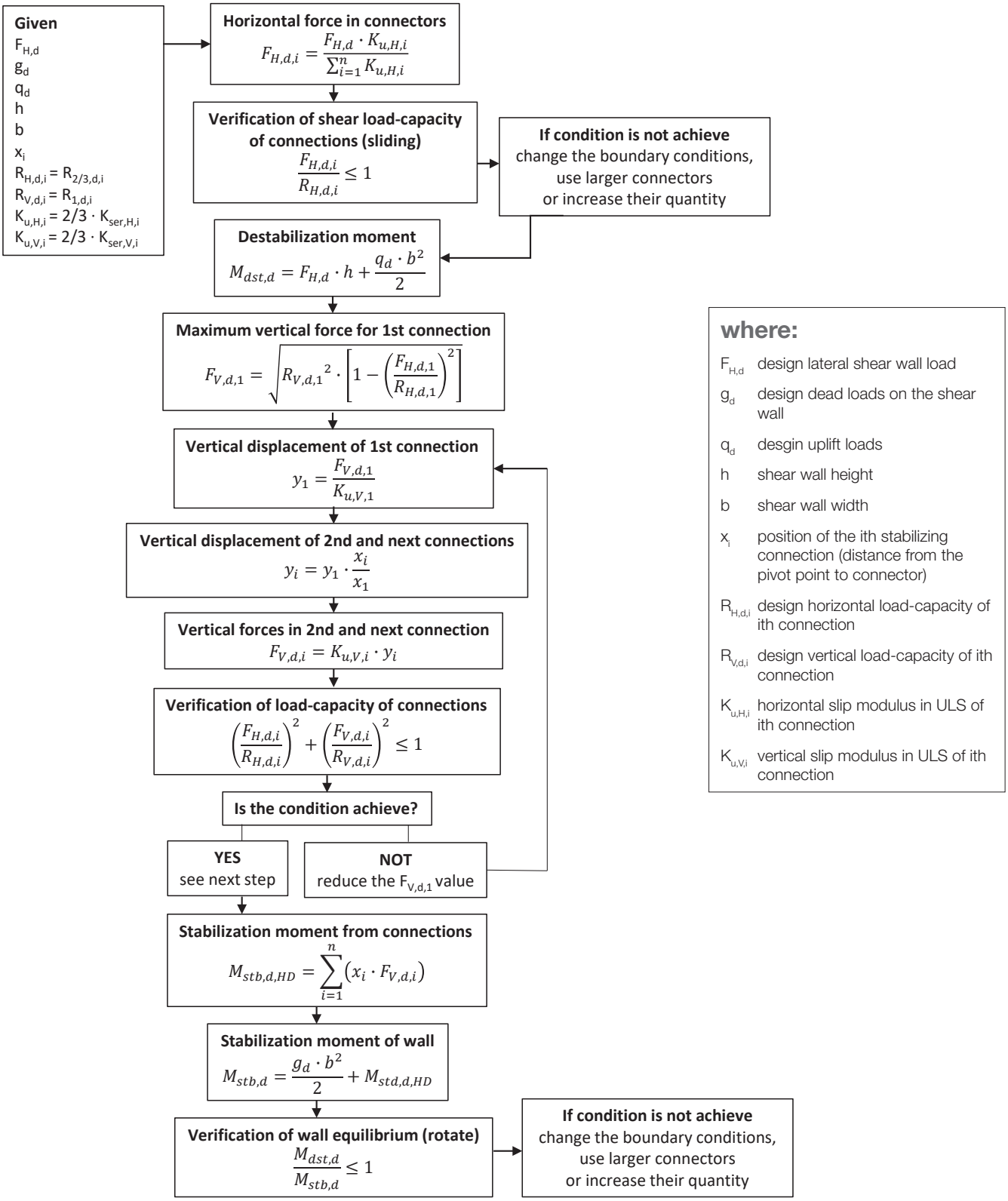
Method of Selection Stabilizing Connectors for CLT Shear Walls

Selection of stabilizing connectors for CLT shear walls should be prepare taking into account the vertical working of all connectors fixing the wall. Assuming separate work of hold downs only for vertical forces and angle brackets only for horizontal forces may result in excessive effort of the angle brackets.

The procedure for verifying the stabilizing connectors of the CLT shear wall is presented below in the form of a diagram. For better readability of the procedure, in the assumptions shown below, the pivot point was taken as the leeward edge of the shear wall. Due to the change of position the wall pivot point, resulting from a appropriate pressure zone to the member below, it may be reasonable to reduce the arm of forces for stabilizing connectors.



where:

- $F_{H,d}$ — design lateral shear wall load
- g_d — design dead loads on the shear wall
- q_d — desgin uplift loads
- h — shear wall height
- b — shear wall width
- x_i — position of the ith stabilizing connection (distance from the pivot point to connector)
- $R_{H,d,i}$ — design horizontal load-capacity of ith connection
- $R_{V,d,i}$ — design vertical load-capacity of ith connection
- $K_{u,H,i}$ — horizontal slip modulus in ULS of ith connection
- $K_{u,V,i}$ — vertical slip modulus in ULS of ith connection

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Comparison Between Hold Downs and Angle Brackets

Examples

To better illustrate the issue, two calculation examples are presented below. In the first one, only angle brackets were used to stabilize the wall. In the second a set of angle brackets and hold downs are working together. Calculations were made for the following boundary conditions.

Boundary conditions:

$F_{H,d}$ = 50 kN g_d = 10 kN/m q_d = 2 kN/m h = 3000 mm b = 2500 mm

Example A: angle brackets only

Example of verification calculation of the stabilizing connectors for a CLT shear wall with using only angle brackets.
The 9 ABR255 are spread all over the length of the wall.

Verification of shear load-capacity of connections (sliding)

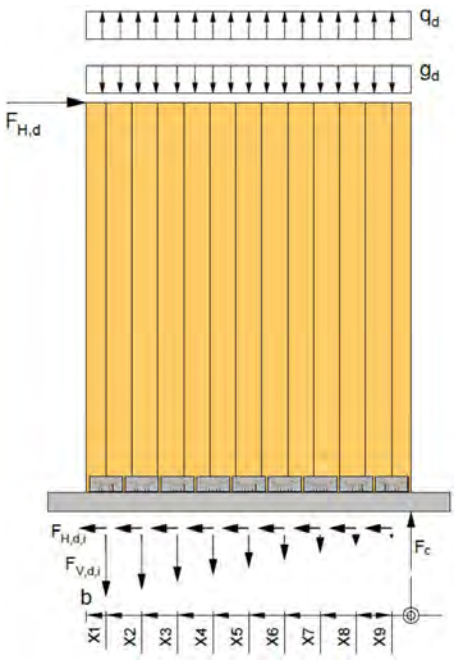
$$\frac{F_{H,d,1\div9}}{R_{H,d,1\div9}} = \frac{5{,}56\ kN}{18{,}3\ kN} = 0{,}30 < 1$$

Verification of wall equilibrium (rotate)

$$\frac{M_{dst,d}}{M_{stb,d}} = \frac{156{,}3\ kNm}{159{,}8\ kNm} = 0{,}98 < 1$$

The wall retains its stability. ✓

Totally:
9 x (ABR255 + 17 CNAx60 + 2 FM 753 evo M12)



Example B: Hold downs + angle brackets

Example of verification calculation of the stabilizing connectors for a CLT shear wall with using hold downs and angle brackets.
2 HTT31 + 3 ABR255 spread over the length of the wall.

Verification of shear load-capacity of connections (sliding)

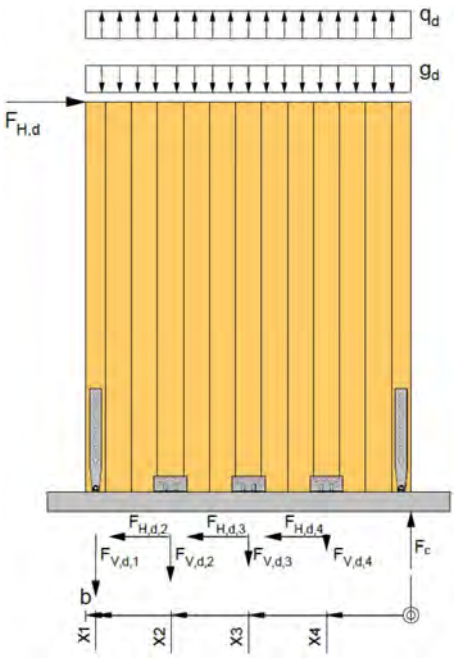
$$\frac{F_{H,d,2\div4}}{R_{H,d,2\div4}} = \frac{16{,}7\ kN}{18{,}3\ kN} = 0{,}91 < 1$$

Verification of wall equilibrium (rotate)

$$\frac{M_{dst,d}}{M_{stb,d}} = \frac{156{,}3\ kNm}{173{,}1 kNm} = 0{,}90 < 1$$

The wall retains its stability. ✓

Totally:
2 x (HTT31 + 42 CSA5,0x50 + 1 LMAS M24 + AT-HP)
3 x (ABR255 + 17 CNAx60 + 2 FM 753 evo M12)



Properties of ABR255 angle brackets

ABR255 connectors with 17 pcs. of CNA4.0x60 nails were used as angle brackets.

Load-capacity:

$R_{H,d,ABR255}$ = 18,3 kN
$R_{V,d,ABR255}$ = 16,9 kN

Slip modulus

$K_{u,H,ABR255}$ = 2/3 · $K_{ser,H,ABR255}$
= 2/3 · 4,8 kN/mm
= 3,2 kN/mm
$K_{u,V,ABR255}$ = 2/3 · $K_{ser,V,ABR255}$
= 2/3 · 4,5 kN/mm
= 3,0 kN/mm

ABR255

Properties of HTT31 hold downs

HTT31 connectors with 42 pcs. of CSA5.0x50 screws were used as hold down.

Load-capacity:

$R_{V,d,HTT31}$ = 65,4 kN

Slip modulus:

$K_{u,V,HTT31}$ = 2/3 · $K_{ser,V,HTT31}$
= 2/3 · 4,5 kN/mm
= 3,0 kN/mm

HTT31

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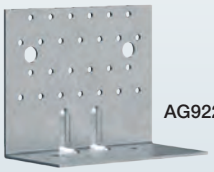
Angle Brackets

In situations where the CLT panel is exposed, yet it is preferable to hide the connections in the floor zone layers, additional angle brackets can be used in place of the hold downs to resist both uplift and shear forces.

Items Required

Angle Bracket – Uplift and Shear Restraint
ABR255, AG922 or ABR100

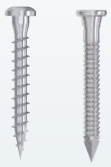
ABR255



AG922

ABR100

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Concrete Fasteners
FM 753 evo Wedge Anchor or
AT-HP High Performance Resin +
LMAS Threaded Rod

FM 753 evo

AT-HP + LMAS

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Angle Brackets

ABR255 – Reinforced Angle Bracket

Developed specifically for CLT construction, this reinforced angle bracket delivers high load capacities in all force directions and is capable of extremely high shear loads when anchoring CLT panels to concrete.

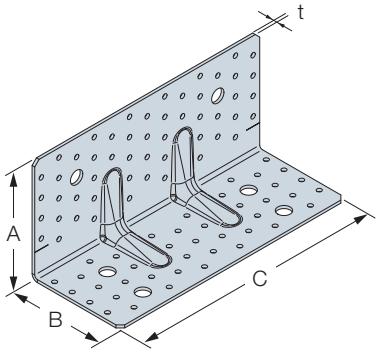
Advantages:

- High load performance in all force directions, especially shear
- Versatile fixing and fastener pattern choices
- Enables the use of fewer connectors per CLT panel

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
ABR255	120	100	255	3,0	52 Ø5	2 Ø14	41 Ø5	4 Ø14



Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Angle Bracket

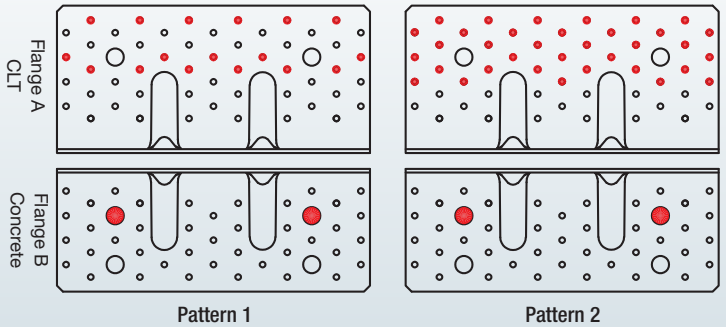
Model No.	Fasteners			Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B Concrete	Fastening Pattern	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
ABR2555	17 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	Pattern 1	min (23,4 ; 22/k_{mod})	24,9	3,8	4,5
	17 CNA4.0x60			min (27,3 ; 22/k_{mod})	26,5	4,5	4,8
	17 CSA5.0x50			min (27,3 ; 22/k_{mod})	26,5	4,5	4,8
	35 CSA5.0x50		Pattern 2	22/k_{mod}	min (58,0 ; 57,6/k_{mod})	13,2	10,5

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

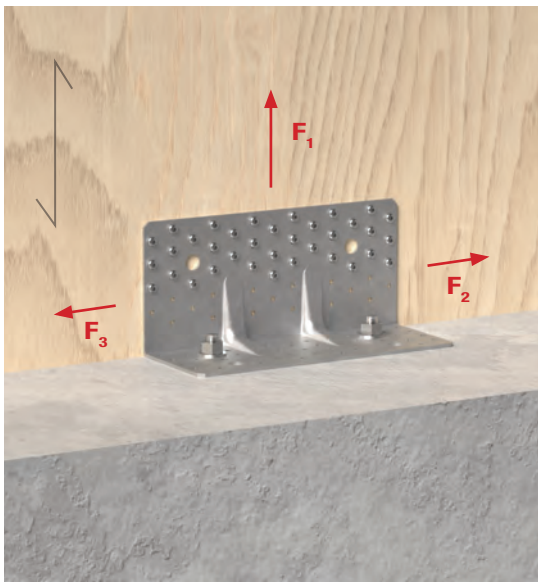
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



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Angle Brackets

AG922 – Reinforced Angle Bracket

Providing good load capacity and stiffness. When used in conjunction with SSH connector screws, the AG922 can deliver equally high tensile and shear loads.

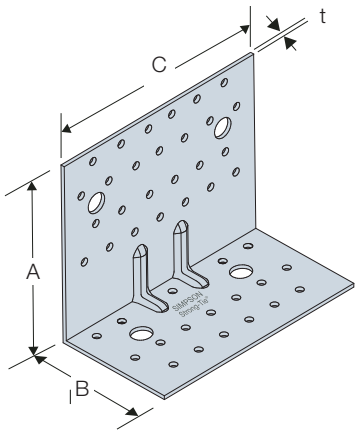
Advantages:

- High capacity and rigidity
- Versatile fastener and fastener pattern choices
- Flexible choice for CLT to CLT connections

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/Anchors	Screws or Nails	Bolts
AG922	121	79	150	2,5	26 Ø5	2 Ø13	18 Ø5	2 Ø13



Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Angle Bracket

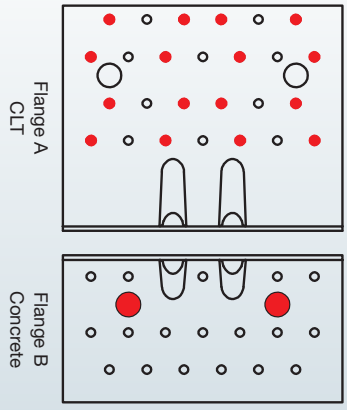
Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B Concrete	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
AG922	16 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	15,3	24,1	5,6	6,5
	16 CSA5.0x40		15,3	24,1	5,6	6,5

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

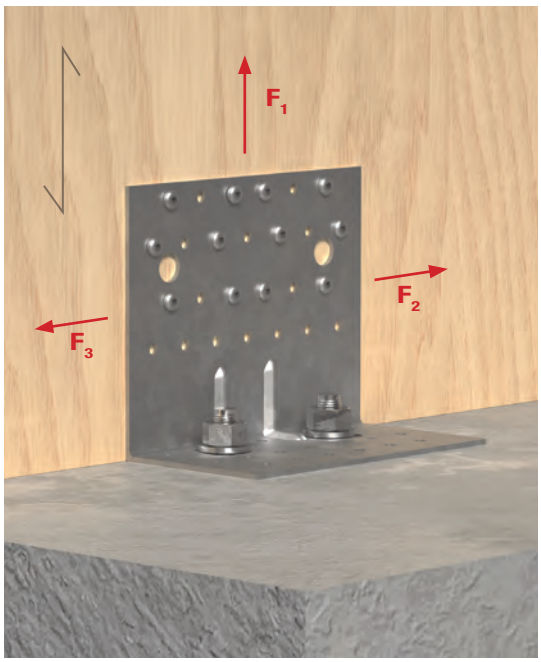
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



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ABR100 – Double Reinforced Angle Bracket

The rolled edge design of the ABR100 gives it impressive strength and stiffness considering its comparatively smaller form. The adapted fastener pattern recommended here is ideally suited to the grain direction of a CLT panel's outer layer.

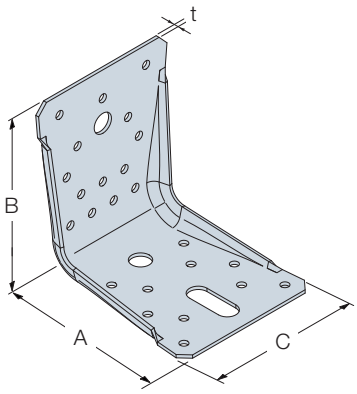
Advantages:

- High stiffness from a smaller form factor
- Optimised for high capacity in shear and uplift
- Fastener patterns adapted to CLT grain direction

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A			Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Obround	Screws or Nails	Bolts
ABR100	103	103	90	2,0	10 Ø5	1 Ø12	1 Ø12x32	14 Ø5	1 Ø12



Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Angle Bracket

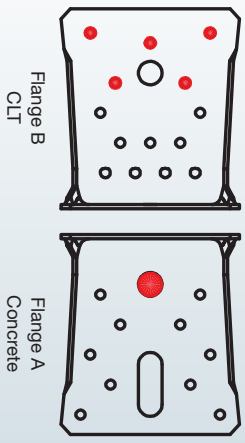
Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B Concrete	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
ABR100	1 FM754 evo M10 or AT-HP + 1 LMAS M10	5 CNA4.0x50	8,3	4,1	9,2	1,5
		5 CSA5.0x40	8,3	4,1	9,2	1,5

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

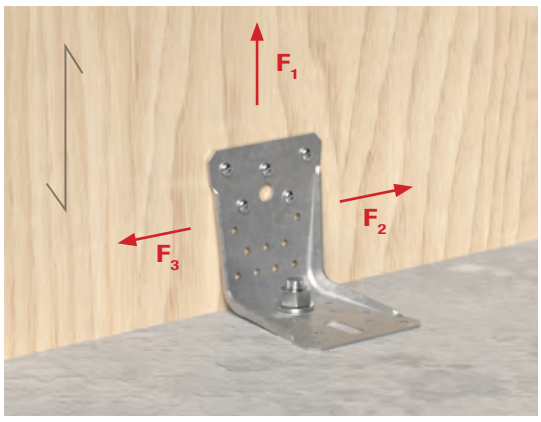
$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Note:
Please make sure proper angle bracket orientation:
Flange B – CLT,
Flange A – Concrete.

Red dots indicate holes filled with fasteners.



HELPFUL TIP

Did you know that ABR100 may be used with upto 25 mm of interlayer under the CLT wall panel, with specified nail pattern?

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Tension Plates and Anchor Plates

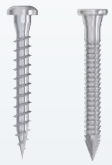
On the external face of structures where the CLT panel is connected to the edge of the foundation slab, this combination sees the tension plate providing uplift resistance, while the anchor plates handle shear forces. A good solution if it is not possible to conceal the connectors on the inner face of the CLT panel.

Items Required

Anchor Plate – Shear Restraint
NPB

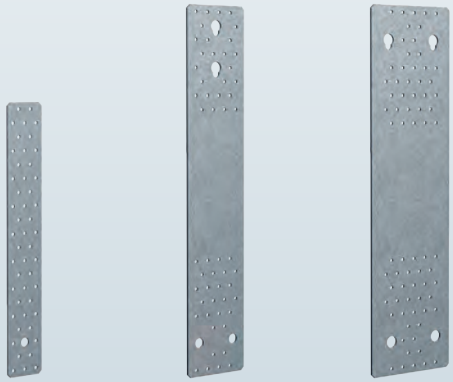
NPB255

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Tension Plate – Uplift Restraint
NPB



NPB60400 NPB100540 NPB140540

Concrete Fasteners
FM 753 evo Wedge Anchor or
AT-HP High Performance Resin +
LMAS Threaded Rod

FM 753 evo

AT-HP + LMAS

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Tension Plates and Anchor Plates

NPB – Anchor Plate

A 3 mm thick plate with a fastener pattern designed to accommodate timber and concrete fixings, the NPB255 is an excellent method for connecting CLT walls to concrete that meet along the same plane, as it can provide high load capacities in terms of shear and uplift forces.

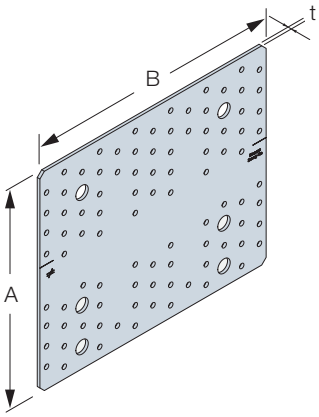
Advantages:

- High shear and uplift capacity
- Fast and simple connection between CLT and concrete along the same plane

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB255	214	255	3,0	93 Ø5	6 Ø14

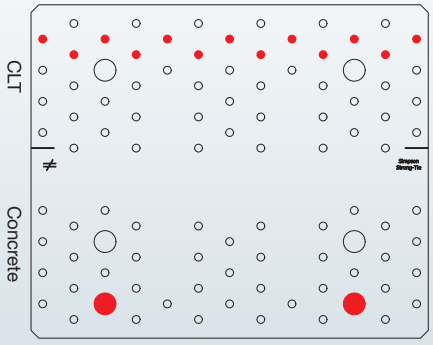


Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Anchor Plate

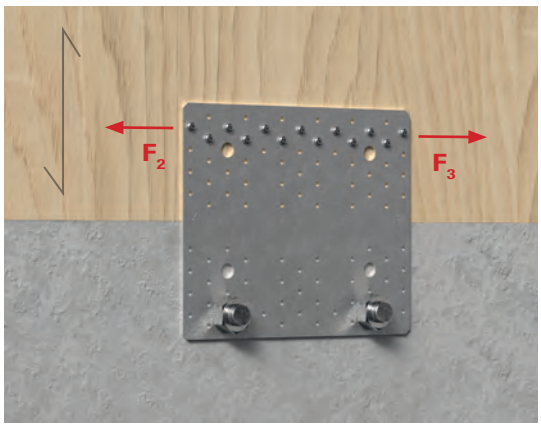
Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Upper Part	Bottom Part	Shear $R_{2,k} = R_{3,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
NPB255	13 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	min (21,1/k_{mod} ; 19,4)	2,5
	13 CNA4.0x60		min (21,1/k_{mod} ; 20,8)	2,7
	13 CSA5.0x50		min (21,1/k_{mod} ; 22,8)	4,4

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Fastening Pattern



Red dots indicate holes filled with fasteners.



HELPFUL TIP

Do you know that the NPB has an installation marking line to ensure the minimum distance between the edge of the concrete and the anchor is achieved?

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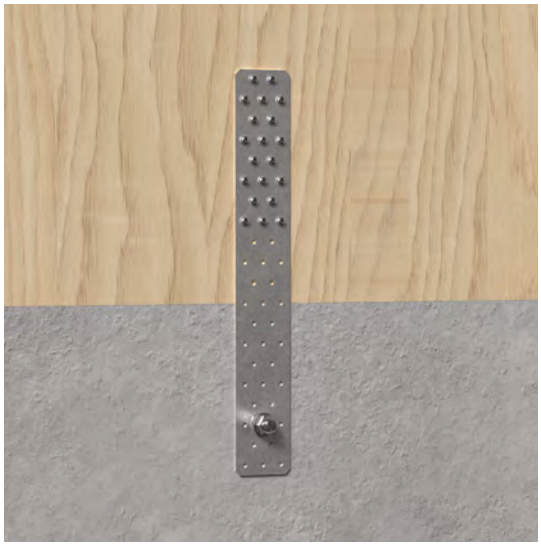
Tension Plates and Anchor Plates

NPB – Tension Plate

A 3 mm thick plate with a fastener pattern designed to accommodate timber and concrete fixings, the NPB is an excellent method for connecting CLT walls to concrete that meet along the same plane, including across intermediate timber layers. This variant of the NPB is able to resist very high uplift forces.

Advantages:

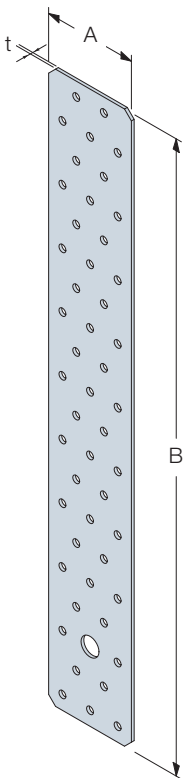
- Very high uplift capacity
- Fast and simple connection between CLT and concrete along the same plane
- Variety of fixing and fastening options to suit the required balance of installation time and load capacity



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB60400	60	400	2,0	49 Ø5	1 Ø13
NPB100540	100	540	3,0	54 Ø5	2 Ø14 + 2 Ø17
NPB140540	140	540	3,0	72 Ø5	4 Ø17

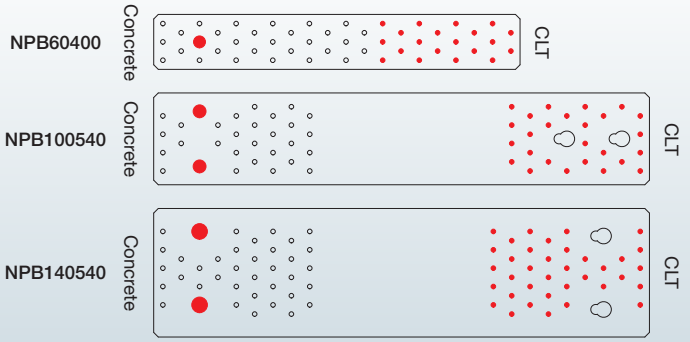


Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Tension Plate

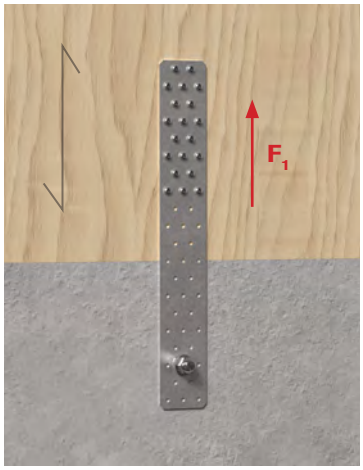
Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Upper Part	Bottom Part	Tensile $R_{1,k}$	Tensile $k_{ser,1,k}$
NPB60400	20 CNA4.0x50	1 FM 753 evo M12 or AT-HP + 1 LMAS M12	min (44,0 ; 20,6/k_{mod})	3,6
	20 CNA4.0x60		min (48,0 ; 20,6/k_{mod})	3,6
	20 CSA5.0x50		min (52,6 ; 20,6/k_{mod})	5,6
NPB100540	26 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	min (57,2 ; 58,8/k_{mod})	8,1
	26 CNA4.0x60		min (62,4 ; 58,8/k_{mod})	8,6
	26 CSA5.0x50		min (68,3 ; 58,8/k_{mod})	14,8
NPB140540	36 CNA4.0x50	2 FM 753 evo M16 or AT-HP + 2 LMAS M16	min (81,4 ; 82,4/k_{mod})	11,5
	36 CNA4.0x60		min (88,8 ; 82,4/k_{mod})	12,2
	36 CSA5.0x50		min (97,3 ; 82,4/k_{mod})	13,6

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Fastening Pattern



Red dots inticate holes filled with fasteners.



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Anchor Plates

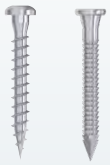
On the external face of structures where the CLT panel is connected to the edge of the foundation slab, here the tension plates are replaced with more anchor plates to accommodate uplift and shear forces. A good solution if it is not possible to conceal the connectors on the inner face of the CLT panel.

Items Required

Anchor Plate – Uplift and Shear Restraint
NPB

NPB255

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Concrete Fasteners
FM 753 evo Wedge Anchor or
AT-HP High Performance Resin +
LMAS Threaded Rod

FM 753 evo

or

AT-HP + LMAS

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Anchor Plates

NPB – Anchor Plate

A 3 mm thick plate with a fastener pattern designed to accommodate timber and concrete fixings, the NPB255 is an excellent method for connecting CLT walls to concrete that meet along the same plane, as it can provide high load capacities in terms of shear and uplift forces.

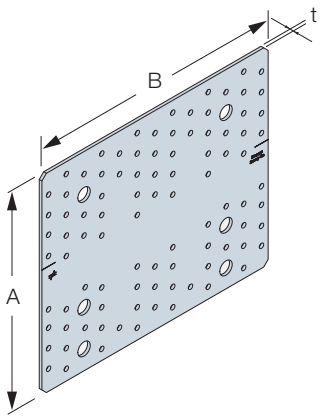
Advantages:

- High shear and uplift capacity
- Fast and simple connection between CLT and concrete along the same plane

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB255	214	255	3,0	93 Ø5	6 Ø14



Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Anchor Plate

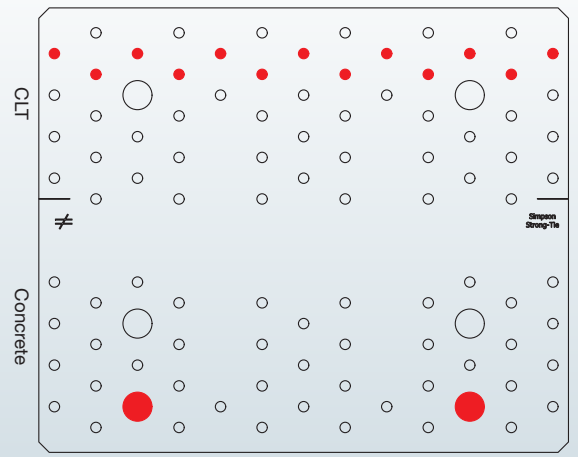
Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Upper Part	Bottom Part	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
NPB255	13 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	min (37,1/k_{mod}; 28,6)	min (21,1/k_{mod} ; 19,4)	4,0	2,5
	13 CNA4.0x60		min (37,1/k_{mod}; 31,2)	min (21,1/k_{mod} ; 20,8)	4,3	2,7
	13 CSA5.0x50		min (37,1/k_{mod}; 34,1)	min (21,1/k_{mod} ; 22,8)	7,1	4,4

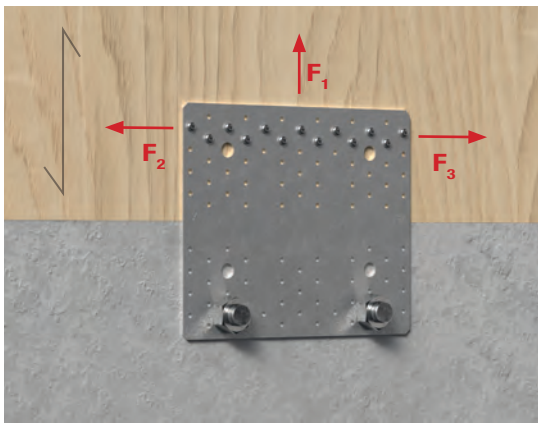
The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Anchor plates take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern





HELPFUL TIP

Do you know that the NPB has an installation marking line to ensure the minimum distance between the edge of the concrete and the anchor is achieved?

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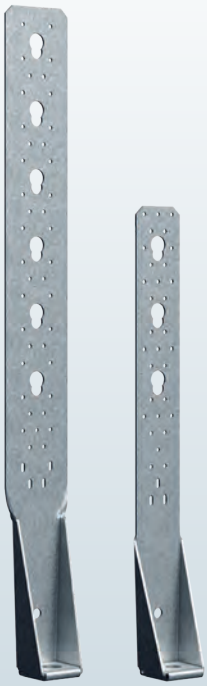
Hold Downs with Angle Brackets

Get the best performance from a CLT racking wall, by combining hold downs at each end of the CLT panel to take care of uplift forces, with angle brackets designed to span across timber plate supporting against shear (sliding) movement.

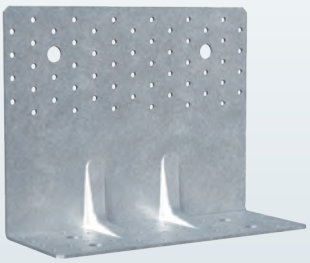
Items Required

Hold Downs – Uplift Restraint
HTT



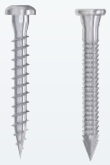
HTT31 HTT22E

Angle Bracket – Shear Restraint
ABR255SO



ABR255SO

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Concrete Fasteners
FM 753 evo Wedge Anchor or
AT-HP High Performance Resin +
LMAS Threaded Rod

FM 753 evo AT-HP + LMAS

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Hold Downs with Angle Brackets

HTT – Heavy Duty Hold Down

Generally placed at each end of a CLT panel or at openings within them, the singlepiece HTT is especially suited to providing very high resistance to uplift forces. The seat is formed from a rolled edge for exceptional reinforcement at the anchoring point, while the fastener pattern is designed to optimise the load taken by each nail or screw used.

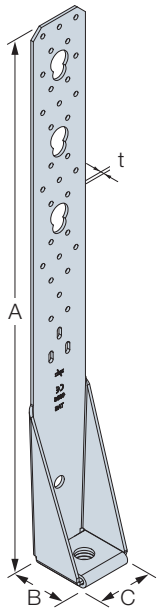
Advantages:

- Very high uplift resistance
- Reduces the number of angle brackets required to fix the CLT panel to concrete
- Variety of fixing and fastening options to suit the required balance of installation time and load capacity

ETA-07/0285

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B
	A	B	C	t	Screws or Nails	Bolts	Anchors
HTT22E	558	60	63	3,0	31+3 Ø5	3 Ø21	1 Ø18
HTT31	790	60	90	3,0	41+4 Ø5	6 Ø21	1 Ø25

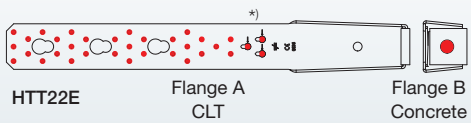


Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Hold Down

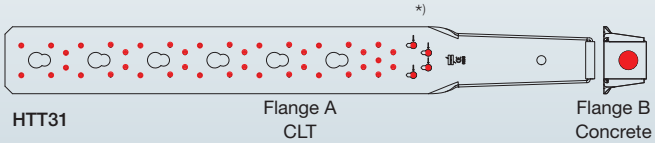
Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Flange A CLT	Flange B Concrete	$R_{1,k}$	$k_{ser,1,k}$
HTT22E	29 CNA4.0x50 + 3 CSA5.0x50	1 FM 753 evo M16 or AT-HP + 1 LMAS M16	min (67,1 ; 57,5/k_{mod})	6,1
	29 CNA4.0x60 + 3 CSA5.0x50		min (73,2 ; 57,5/k_{mod})	6,8
	34 CSA5.0x50		min (80,2 ; 57,5/k_{mod})	8,3
	34 CSA5.0x80		min (106,7 ; 57,5/k_{mod})	8,4
HTT31	41 CNA4.0x50 + 4 CSA5.0x50	AT-HP + 2 LMAS M24	min (85,7 ; 85,1/k_{mod})	-
	41 CNA4.0x60 + 4 CSA5.0x50		min (85,7 ; 85,1/k_{mod})	-
	45 CSA5.0x50		min (85,7 ; 85,1/k_{mod})	24,3
	45 CSA5.0x80		min (85,7 ; 85,1/k_{mod})	24,3

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Fastening Pattern

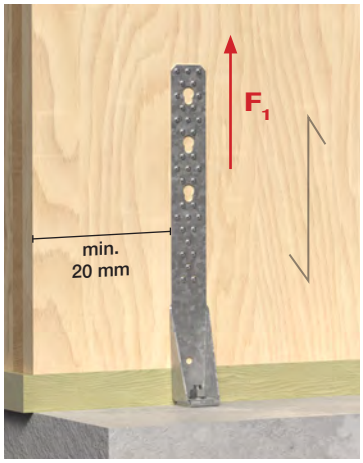


*) **HTT22E:** CSA5.0x50 or longer screws must be placed in the 5 bottom holes (including 3 oblong holes).



*) **HTT31:** CSA5.0x50 or longer screws must be placed at the bottom of the 4 obling holes.

Red dots indicate holes filled with fasteners.



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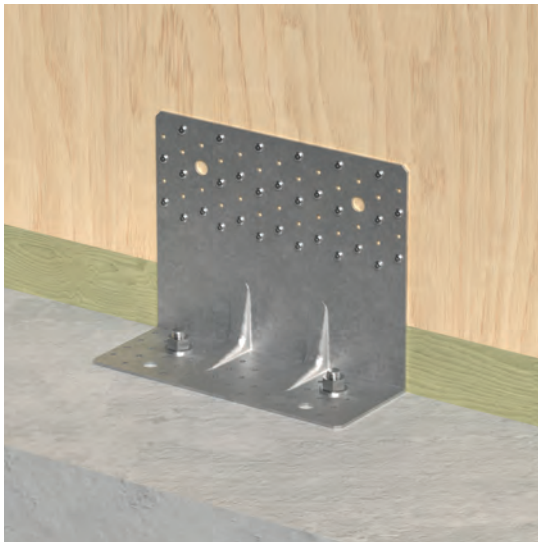
ABR255SO –
Extended Reinforced Angle Bracket

Developed specifically for connecting CLT wall panels to concrete via an 80 mm thick intermediate timber layer, this reinforced angle bracket delivers high load capacities in all force directions and is capable of extremely high shear loads. The face of the ABR255SO is marked with a guide to ensure fasteners are always installed with a minimum edge distance maintained.

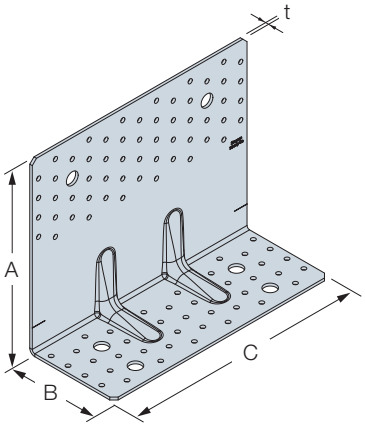
Advantages:
- High load performance in all force directions
- Versatile fixing and fastener pattern choices
- Enables the use of fewer connectors per CLT panel



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/Anchors	Screws or Nails	Bolts
ABR255SO	197	100	255	3,0	56 Ø5	2 Ø14	41 Ø5	4 Ø14

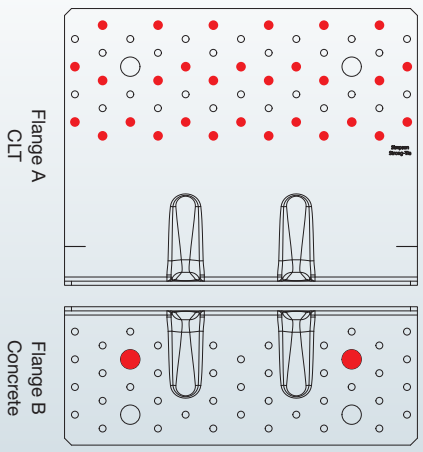


Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Angle Bracket

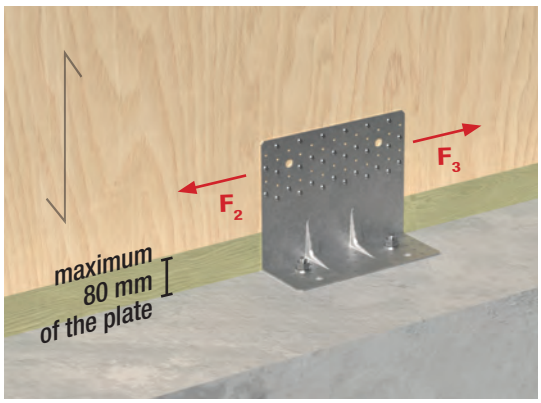
Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Flange A CLT	Flange B Concrete	Shear $R_{2,k} = R_{3,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
ABR255SO	30 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	26,1	5,3
	30 CSA5.0x50		35,3	5,8

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Fastening Pattern



Red dots indicate holes filled with fasteners.



HELPFUL TIP

Interlayer stick up to 80 mm can be used with ABR255SO. Do not exceed this limit, as minimum edge distance between fasteners and edge of CLT will not otherwise not be sufficient.

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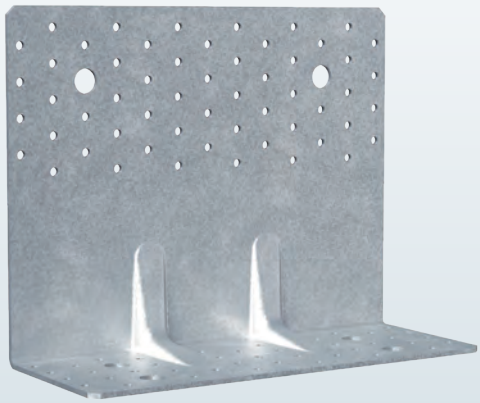
Angle Brackets

In situations where the CLT panel is exposed, yet it is preferable to hide the connections in the floor zone layers, additional angle brackets designed to span across the timber plate can be used in place of the hold downs to resist both uplift and shear forces.

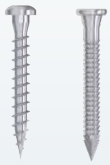
Items Required

Angle Bracket – Uplift and Shear Restraint
ABR255SO



ABR255SO

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Concrete Fasteners
FM 753 evo Wedge Anchor or
AT-HP High Performance Resin +
LMAS Threaded Rod

FM 753 evo or AT-HP + LMAS

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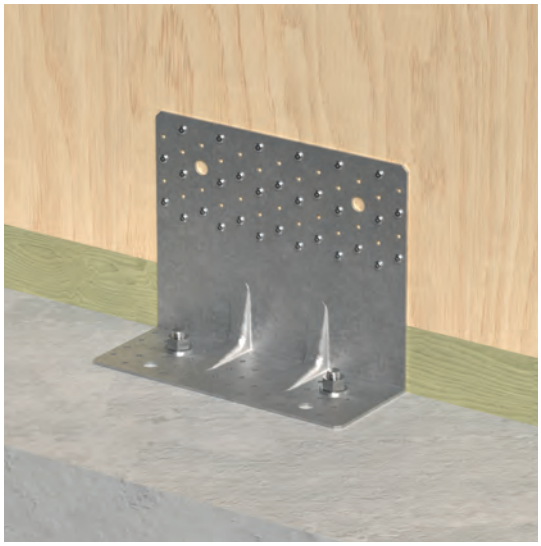
ABR255SO –
Extended Reinforced Angle Bracket

Developed specifically for connecting CLT wall panels to concrete via an 80 mm thick intermediate timber layer, this reinforced angle bracket delivers high load capacities in all force directions and is capable of extremely high shear loads. The face of the ABR255SO is marked with a guide to ensure fasteners are always installed with a minimum edge distance maintained.

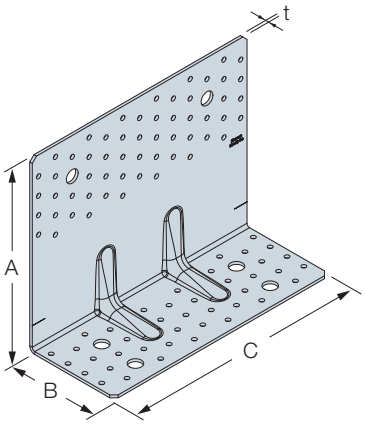
Advantages:
- High load performance in all force directions
- Versatile fixing and fastener pattern choices
- Enables the use of fewer connectors per CLT panel



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/Anchors	Screws or Nails	Bolts
ABR255SO	197	100	255	3,0	56 Ø5	2 Ø14	41 Ø5	4 Ø14



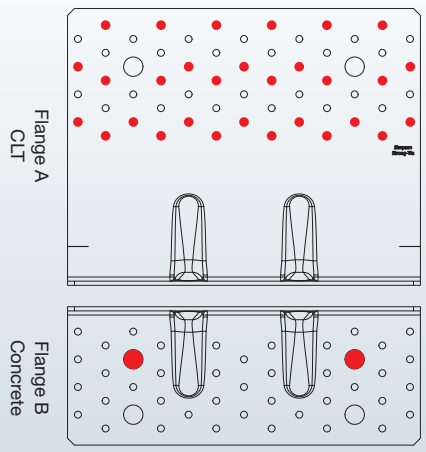
Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Angle Bracket

Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B Concrete	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
ABR255SO	30 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	$22,9/k_{mod}$	26,1	3,8	5,3
	30 CSA5.0x50		$22,9/k_{mod}$	35,3	3,9	5,8

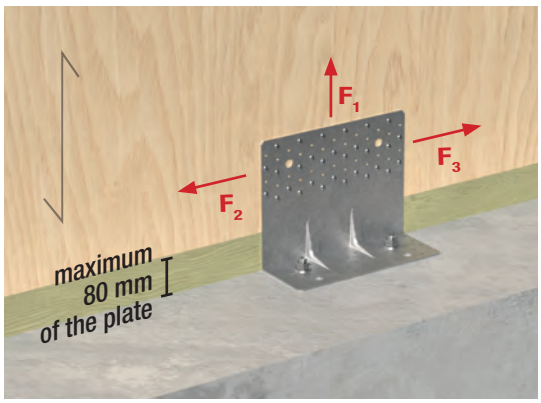
The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation: $\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$

Fastening Pattern



Red dots indicate holes filled with fasteners.



HELPFUL TIP

Interlayer stick up to 80 mm can be used with ABR255SO. Do not exceed this limit, as minimum edge distance between fasteners and edge of CLT will not otherwise not be sufficient.

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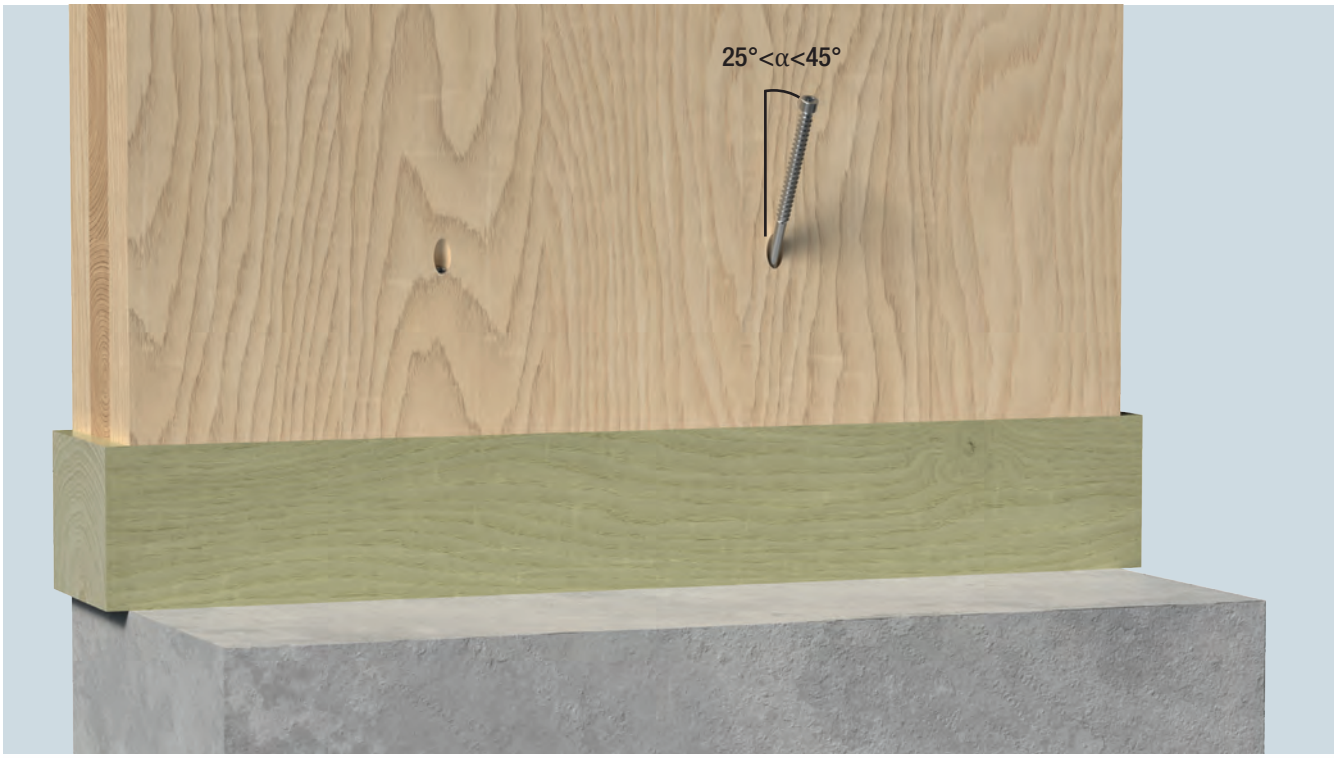
Screws and Through-bolts

On the internal face of structures where the wall to floor connection is completely exposed, through-bolts to fix the sole plate down to the concrete, combined with structural screws connecting the CLT panel to the sole plate provide a completely hidden connection.



Items Required

Double Threaded Screw
SWD

SWD

Wedge Anchor with Large Washer
FM 753 evo

FM 753 evo

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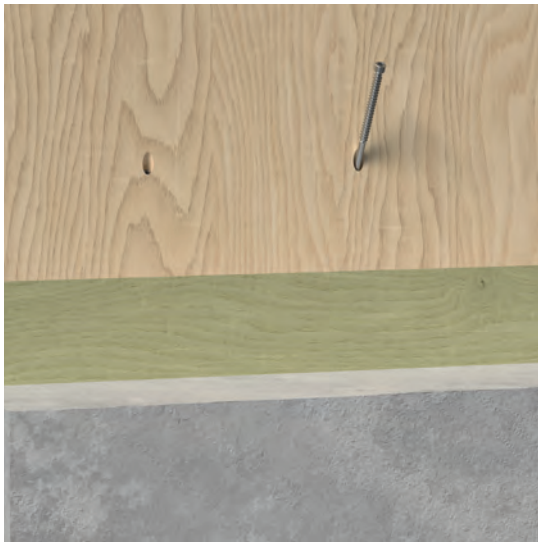
SWD – Double Threaded Screws

SWD is a double threaded structural screw designed to connect CLT and mass timber wood members. The screws are suitable for inclined installations and the chisel point makes it easy to install.

Advantages:

- Double threaded, pulls the two wood members together
- Small cylinder head for allowing hidden assemblies
- No pre-drilling required
- SWD double threaded screws provide a high strength hidden connection between the CLT panel and the timber plate



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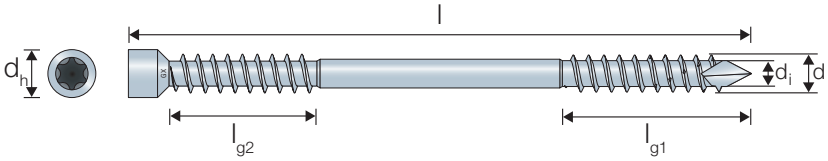

SWD – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_{g1}	l_{g2}	d_h	d_i
SWD6.5xℓ	6,5	65-220	40-95	33,5-88,5	8	4,0
SWD8.0xℓ	8,0	90-330	40-95	31,5-86,5	10	5,4

SWD – Fastener Dimensions & Characteristic Capacities – α = 25°, CLT, Bottom Plate (C24)

Product Reference	$w_{bp,min}$ [mm]	Bottom Plate thickness, t_{bp} [mm]																				
		70			75			80			90			100			120			140		
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]
SWD6.5x160	80	90	3,42	2,46	90	3,42	2,46	90	3,42	2,46	90	3,42	2,46	90	3,42	2,46	90	3,42	2,46	90	3,42	2,46
SWD6.5x190	90	-	-	-	-	-	-	105	3,96	2,66	95-105	3,96	2,66	90-105	3,96	2,66	90-105	3,96	2,66	90-105	3,96	2,66
SWD6.5x220	105	-	-	-	-	-	-	-	-	-	-	-	-	115-120	4,46	2,85	95-120	4,46	2,85	95-120	4,46	2,85
SWD8.0x220	105	-	-	-	-	-	-	-	-	-	-	-	-	115-120	5,6	3,93	110-120	5,6	3,93	110-120	5,6	3,93
SWD8.0x245	115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	120-130	6,09	4,11	110-130	6,09	4,11
SWD8.0x275	130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	145-160	6,09	4,11	125-160	6,09	4,11
SWD8.0x300	140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150-155	7,16	4,53
SWD8.0x330	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	175-185	7,16	4,53

The structural guide **GSCREW4560** can be used to ensure the correct angle during installation

HELPFUL TIP

The screw should be installed so that the smooth middle part ends up between the two wood members.

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Screws and Through-bolts

SWD – Fastener Dimensions & Characteristic Capacities – α = 35°, CLT, Bottom Plate (C24)

Product Reference	$w_{bp,min}$ [mm]	Bottom Plate thickness, t_{bp} [mm]														
		80			90			100			120			140		
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]
SWD6.5x190	120	90	3,58	2,66	85-90	3,58	2,66	85-90	3,58	2,66	85-90	3,58	2,66	85-90	3,58	2,66
SWD6.5x220	135	-	-	-	100-105	3,96	2,85	90-105	3,96	2,85	85-105	3,96	2,85	85-105	3,96	2,85
SWD8.0x220	140	-	-	-	105	5,14	3,93	105	5,14	3,93	105	5,14	3,93	105	5,14	3,93
SWD8.0x245	150	-	-	-	-	-	-	115	5,52	4,11	105-115	5,52	4,11	105-115	5,52	4,11
SWD8.0x275	170	-	-	-	-	-	-	140	5,52	4,11	120-140	5,52	4,11	105-140	5,52	4,11
SWD8.0x300	185	-	-	-	-	-	-	-	-	-	140	6,34	4,53	120-140	6,34	4,53
SWD8.0x330	200	-	-	-	-	-	-	-	-	-	165	6,34	4,53	145-165	6,34	4,53

SWD – Fastener Dimensions & Characteristic Capacities – α = 45°, CLT, Bottom Plate (C24)

Product Reference	$w_{bp,min}$ [mm]	Bottom Plate thickness, t_{bp} [mm]																	
		75			80			90			100			120			140		
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]
SWD6.5x220	165	90	3,56	2,85	85-90	3,56	2,85	85-90	3,56	2,85	85-90	3,56	2,85	85-90	3,56	2,85	85-90	3,56	2,85
SWD8.0x245	185	-	-	-	-	-	-	100	5,03	4,11	100	5,03	4,11	100	5,03	4,11	100	5,03	4,11
SWD8.0x275	205	-	-	-	-	-	-	115-120	5,03	4,11	105-120	5,03	4,11	100-120	5,03	4,11	100-120	5,03	4,11
SWD8.0x300	225	-	-	-	-	-	-	-	-	-	-	-	-	105-120	5,68	4,53	100-120	5,68	4,53
SWD8.0x330	245	-	-	-	-	-	-	-	-	-	-	-	-	125-140	5,68	4,53	105-140	5,68	4,53

Screws take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

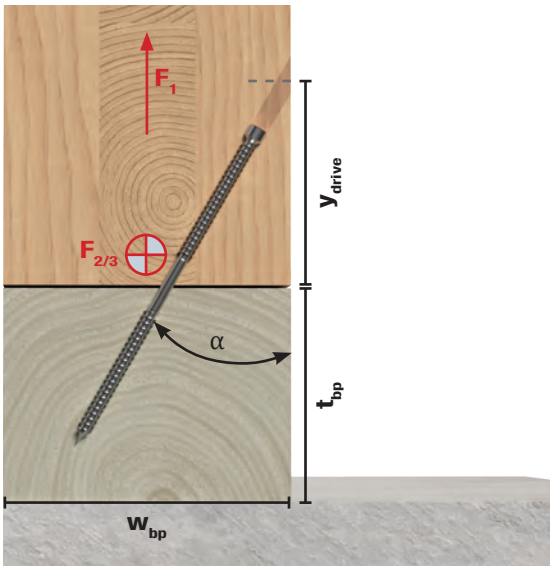
For F_1 and $F_{2/3}$:

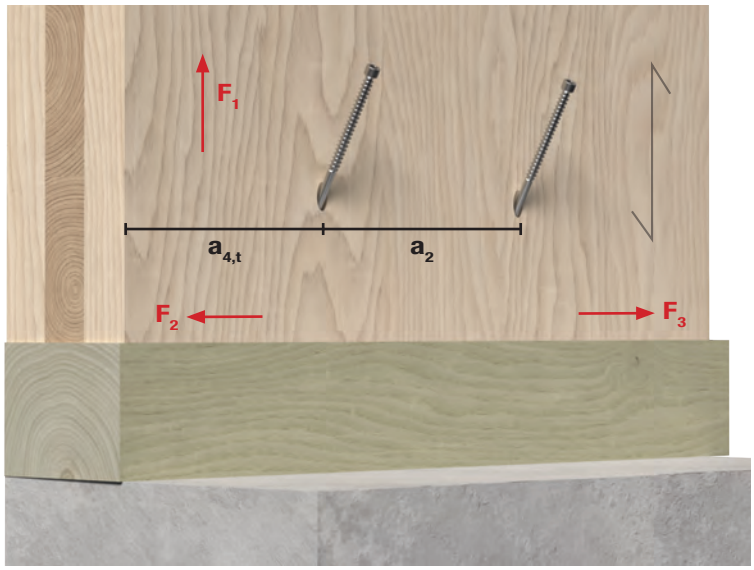
$$\left(\frac{F_{1.d}\cdot\sin(\alpha)}{R_{2.d}}\right)^2+\left(\frac{F_{2.d}}{R_{2.d}}\right)^2+\frac{F_{1.d}{}^2\cdot\cos(\alpha)^2\cdot\left(1-\frac{R_{1.d}{}^2\cdot\sin(\alpha)^2}{R_{2.d}{}^2}\right)}{R_{1.d}{}^2\cdot\cos(\alpha)^2}\leq 1$$

SWD – Minimum Spacings and Edge and End Distances

Spacing or distance [mm]	Ø6,5	Ø8,0
a_2*	78	96
$a_{4,t}$*	98	120

Note: Other min. spacing and edge distances requirements are fulfilled for the installation characteristics given in the load table. Both CLT and Softwood edge distances needs to be fulfilled. If the grain orientation is different the spacing defintion may change.





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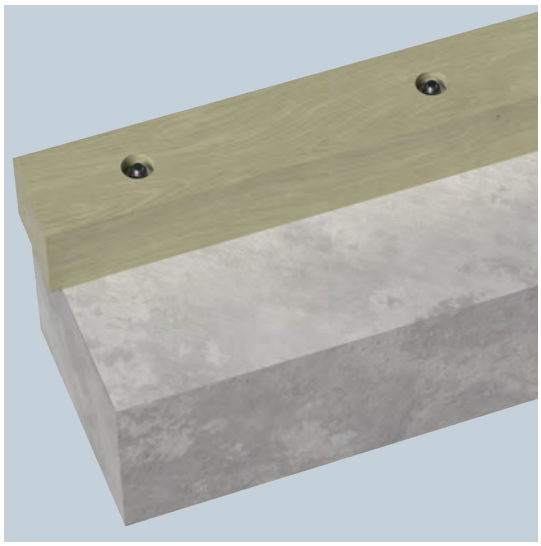
FM 753 evo – Heavy Duty Through Anchor

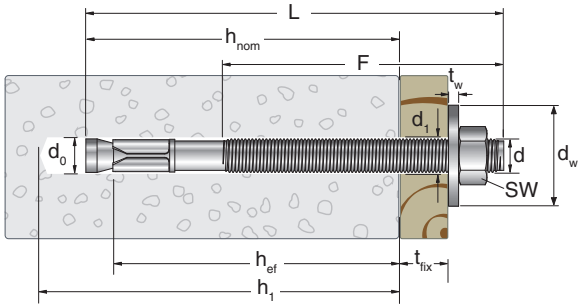
The combination of FM 753 evo wedge anchors and SWD double threaded screws are the easiest way to connect CLT panels to concrete via an intermediate timber layer when it is preferred that no connections are visible.

Advantages:

- Large washer to connect to timber
- High pull through resistance
- Small spacing and edge distances



ETA-22/0792



Wedge Anchor Dimensions

Product Reference	Item code	Dimensions [mm]									
		Thread diameter [d]	Length [L]	Washer diameter [d_w]	Washer thickness [t_w]	Max fixture thickness [t_{fix}]	Ø max. fixture hole [d_1]	Effective embedment depth [h_{ef}]	Ø drilled hole [d_0]	Min. depth of drilling hole [h_1]	Wrench size [SW]
FM 753 evo M10x123/50 LW	75343B1012300	10	123	34	3,0	50	12	50	10	70	17
FM 753 evo M10x173/100 LW	75343B1017300	10	173	34	3,0	100	12	50	10	70	17
FM 753 evo M12x149/50 LW	75343B1214900	12	149	44	4,0	50	14	65	12	90	19
FM 753 evo M12x219/120 LW	75343B1221900	12	219	44	4,0	120	14	65	12	90	19

HELPFUL TIP

According to EN1995-1-1 10.4.3 (2): Washers with a side length or a diameter of at least 3d and a thickness of at least 0,3d should be used under the head and nut. Washers should have a full bearing area.

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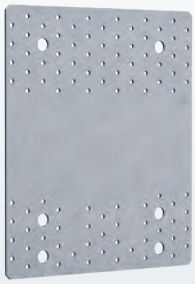
Tension Plates and Anchor Plates

On the external face of structures where the CLT panel is connected to the edge of the foundation slab, this combination sees the tension plate providing uplift resistance, while the anchor plates handle shear forces. A good solution if it is not possible to conceal the connectors on the inner face of the CLT panel.

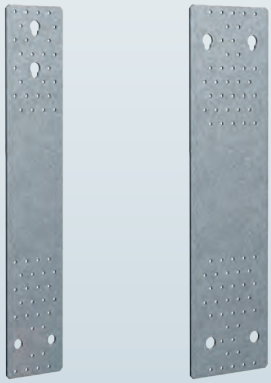
Items Required

Anchor Plate – Shear Restraint
NPB



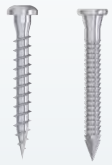
NPB255SO

Tension Plates – Uplift Restraint
NPB



NPB100540 NPB140540

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Concrete Fasteners
FM 753 evo Wedge Anchor or
AT-HP High Performance Resin +
LMAS Threaded Rod

FM 753 evo or AT-HP + LMAS

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NPB – Anchor Plate

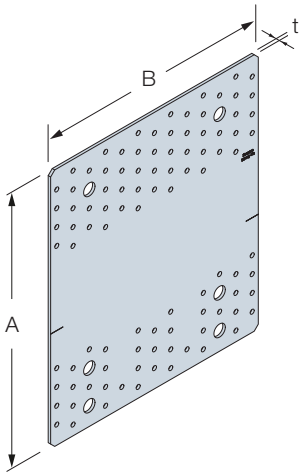
A 3 mm thick plate with a fastener pattern designed to accommodate timber and concrete fixings, the NPB255SO is an excellent method for connecting CLT walls to concrete that meet along the same plane via an 80 mm thick intermediate timber layer, as it can provide high load capacities in terms of shear and uplift forces. The face of the NPB255SO is marked with a guide to ensure fasteners are always installed with a minimum edge distance maintained.

Advantages:
- High shear and uplift capacity
- Fast and simple connection between CLT and concrete along the same plane

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB255SO	294	255	3,0	97 Ø5	6 Ø14

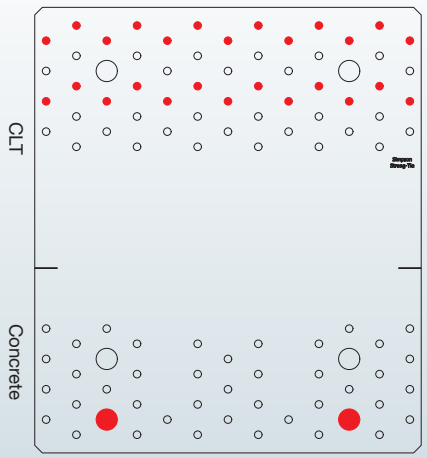


Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Anchor Plate

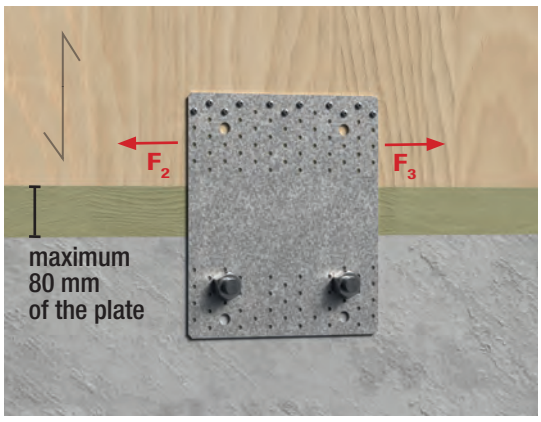
Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Upper Part	Bottom Part	Shear $R_{2,k} = R_{3,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
NPB255SO	26 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	21,5	2,5
	26 CSA5.0x50		24,8	4,4

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

Fastening Pattern



Red dots indicate holes filled with fasteners.



HELPFUL TIP

Do you know that the NPB has an installation marking line to ensure the minimum distance between the edge of the concrete and the anchor is achieved?

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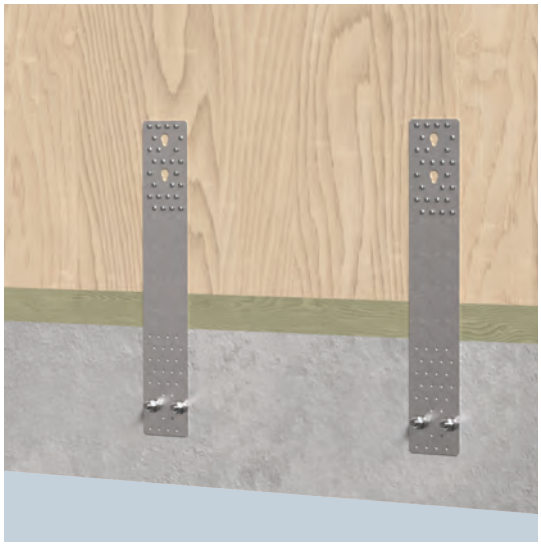
NPB – Tension Plate

A 3 mm thick plate with a fastener pattern designed to accommodate timber and concrete fixings, the NPB is an excellent method for connecting CLT walls to concrete that meet along the same plane, including across intermediate timber layers. This variant of the NPB is able to resist very high uplift forces.

Advantages:

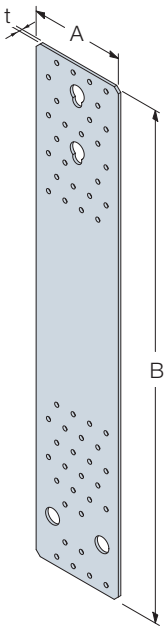
- Very high uplift capacity
- Fast and simple connection between CLT and concrete along the same plane
- Variety of fixing and fastening options to suit the required balance of installation time and load capacity



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB100540	100	540	3,0	54 Ø5	2 Ø14 + 2 Ø17
NPB140540	140	540	3,0	72 Ø5	4 Ø17



Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Tension Plate

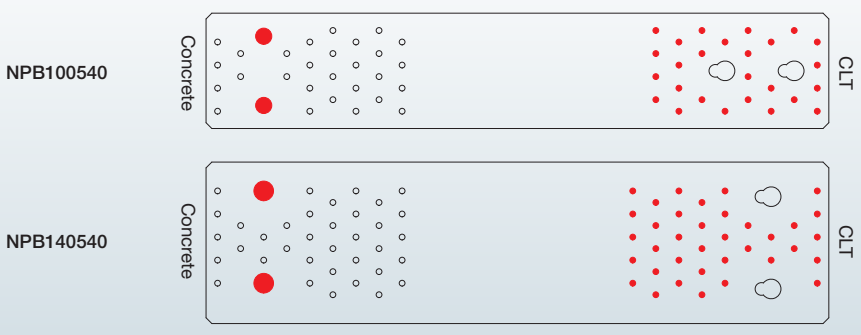
Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Upper Part	Bottom Part	Tensile $R_{1,k}$	Tensile $k_{ser,1,k}$
NPB100540	26 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	min (57,2 ; 58,8/k_{mod})	8,1
	26 CNA4.0x60		min (62,4 ; 58,8/k_{mod})	8,6
	26 CSA5.0x50		min (68,3 ; 58,8/k_{mod})	14,8
NPB140540	36 CNA4.0x50	2 FM 753 evo M16 or AT-HP + 2 LMAS M16	min (81,4 ; 82,4/k_{mod})	11,5
	36 CNA4.0x60		min (88,8 ; 82,4/k_{mod})	12,2
	36 CSA5.0x50		min (97,3 ; 82,4/k_{mod})	13,6

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

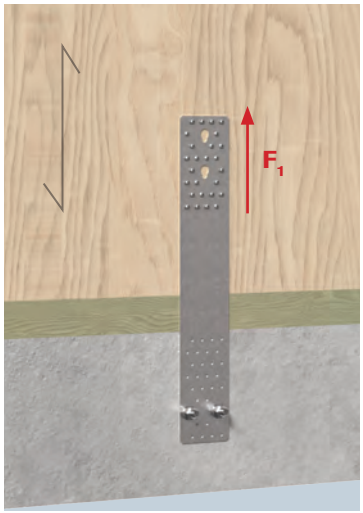
HELPFUL TIP

Min. anchor edge distance:
for NPB100540: 70 mm
for NPB140540: 90 mm

Fastening Pattern



Red dots indicate holes filled with fasteners.



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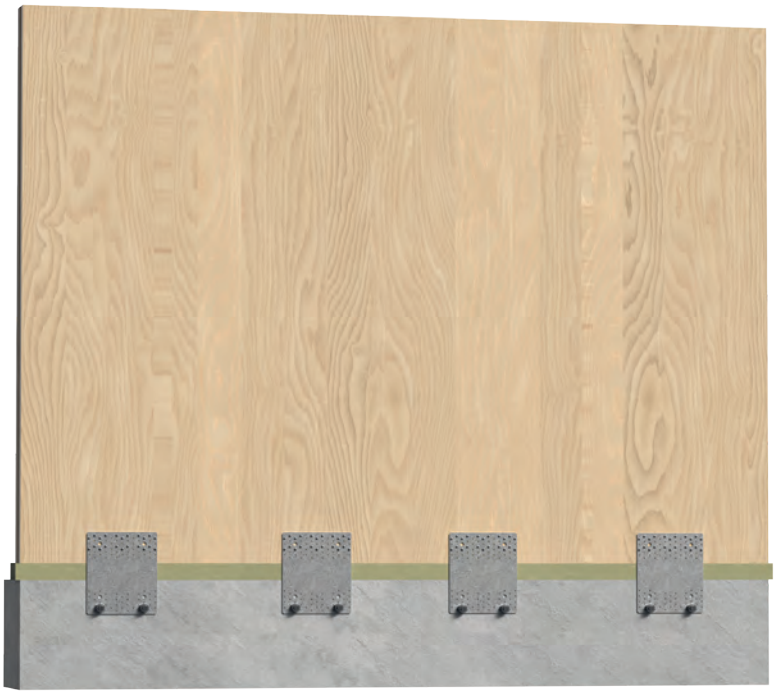
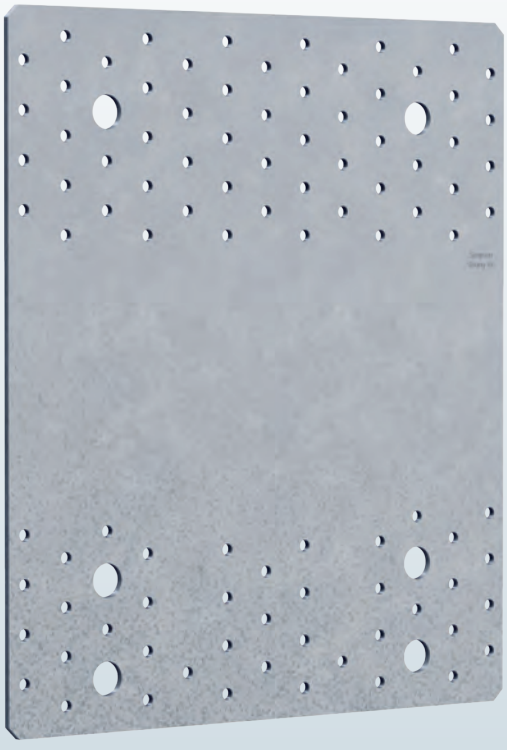
Anchor Plates

On the external face of structures where the CLT panel is connected to the edge of the foundation slab, here the tension plates are replaced with more anchor plates to accommodate uplift and shear forces. A good solution if it is not possible to conceal the connectors on the inner face of the CLT panel.



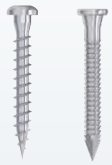
Items Required

Nail Plate – Uplift and Shear Restraint
NPB



NPB255SO

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Concrete Fasteners
FM 753 evo Wedge Anchor or
AT-HP High Performance Resin +
LMAS Threaded Rod

FM 753 evo

AT-HP + LMAS

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Anchor Plates

NPB – Anchor Plate

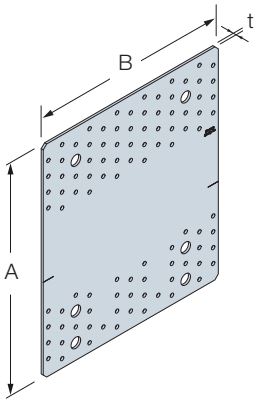
A 3 mm thick plate with a fastener pattern designed to accommodate timber and concrete fixings, the NPB255SO is an excellent method for connecting CLT walls to concrete that meet along the same plane via an 80 mm thick intermediate timber layer, as it can provide high load capacities in terms of shear and uplift forces. The face of the NPB255SO is marked with a guide to ensure fasteners are always installed with a minimum edge distance maintained.

Advantages:
- High shear and uplift capacity
- Fast and simple connection between CLT and concrete along the same plane

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB255SO	294	255	3,0	97 Ø5	6 Ø14



Characteristic Capacity and Slip Modulus – CLT to Concrete – 1 Anchor Plate

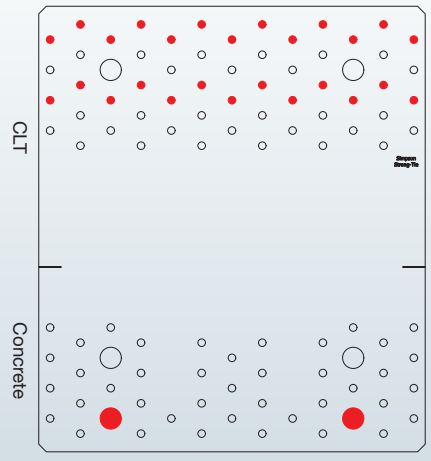
Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Upper Part	Bottom Part	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k}=k_{ser,3,k}$
NPB255SO	26 CNA4.0x50	2 FM 753 evo M12 or AT-HP + 2 LMAS M12	56,6	21,5	8,4	2,5
	26 CSA5.0x50		65,3	24,8	14,1	4,4

The performance of the anchor has to be checked by the designer considering concrete edge distance and potentially other base material parameters using Anchor Designer software.

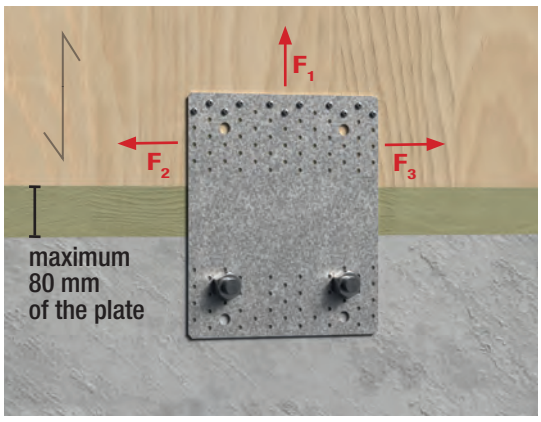
Anchor Plates take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



HELPFUL TIP

Do you know that the NPB has an installation marking line to ensure the minimum distance between the edge of the concrete and the anchor is achieved?

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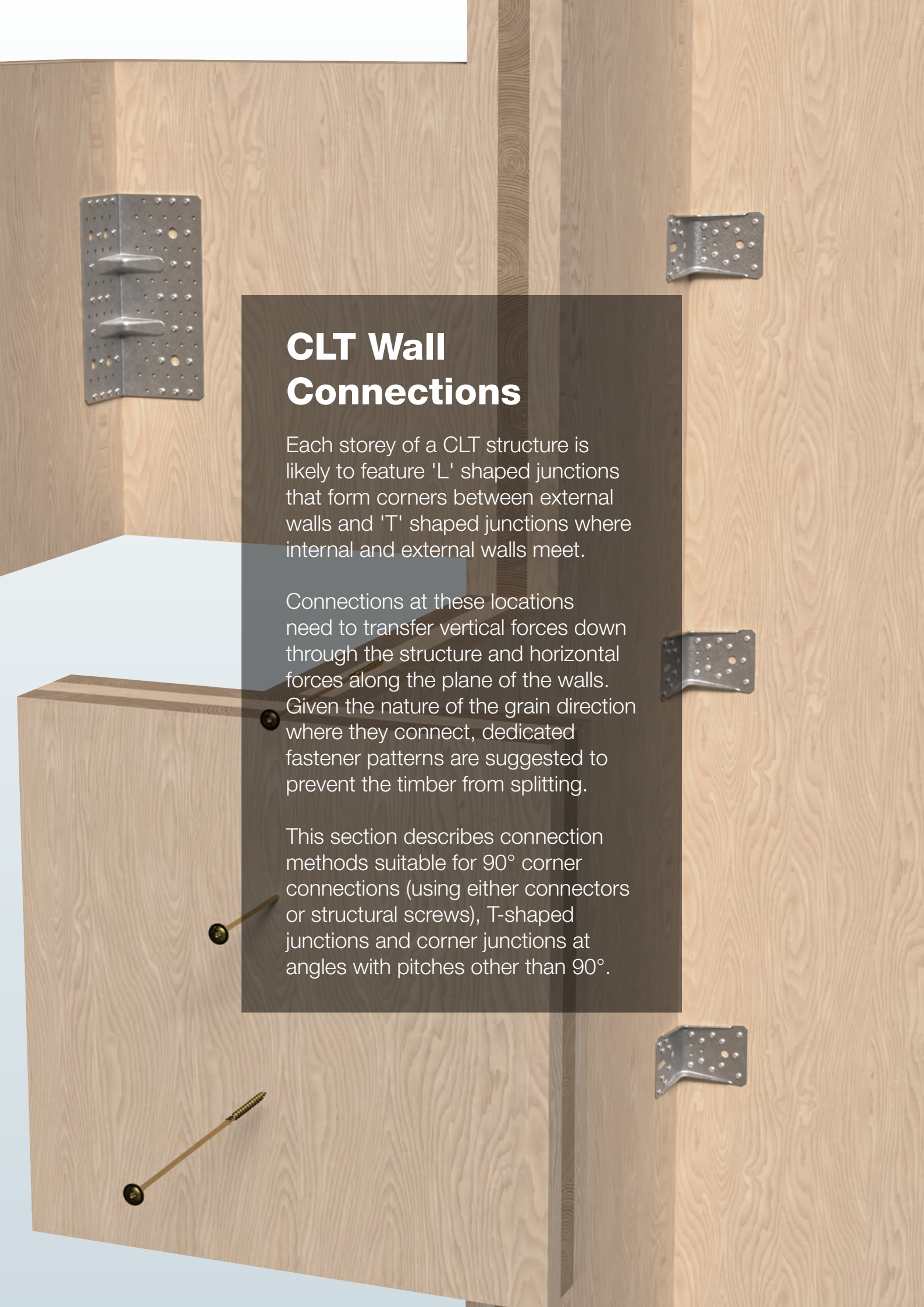

CLT Wall Connections

Each storey of a CLT structure is likely to feature 'L' shaped junctions that form corners between external walls and 'T' shaped junctions where internal and external walls meet.

Connections at these locations need to transfer vertical forces down through the structure and horizontal forces along the plane of the walls. Given the nature of the grain direction where they connect, dedicated fastener patterns are suggested to prevent the timber from splitting.

This section describes connection methods suitable for 90° corner connections (using either connectors or structural screws), T-shaped junctions and corner junctions at angles with pitches other than 90°.

CLT Wall to CLT Wall Solutions

Structural Angle Brackets
for 90° Corner / T-Connection

Product Options:

ABR255 see page 71
AE116 see page 72
AG922 see page 73
ABR100 see page 74
ABR9020 see page 75

Performance tested structural connectors provide a strong and reliable connection for CLT walls connected at 90° to each other, and can be pre-installed to CLT panels to reduce assembly time on-site.

Structural Fasteners
for 90° Corner / T-Connection and L-Connection

Product Options:

SWW 90° see page 77
SWC 90° see page 80
SWD 45°
Cross Pairs see page 83
Inclined see page 85

Structural screws are an easy and fast way to connect CLT panels together as they require no pre-drilling. They provide a clean, hidden connection where aesthetic values are paramount.

Structural Fasteners
for Corner Connections Other Than 90°

Product Options:

SWW see page 87
SWC see page 87

For CLT wall junctions with angles other than 90°, structural screw installation inclines can be adapted to the required plane for a secure and discrete connection.

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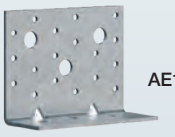
Structural Angle Brackets

Performance tested structural connectors provide a strong and reliable connection for CLT walls connected at 90° to each other, and can be pre-installed to CLT panels to reduce assembly time on-site.

Items Required

Angle Brackets – Tension and Shear Restraint
ABR255, AE116, AG922, ABR100 or ABR9020

ABR255



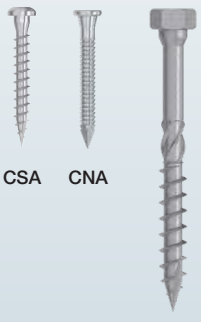
AE116

AG922

ABR100

ABR9020

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail,
SSH Hex-Head Connector Screw



CSA CNA

SSH

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Structural Angle Brackets

ABR255 – Reinforced Angle Bracket

Developed specifically for CLT construction, this reinforced angle bracket delivers high load capacities in all force directions and can be installed in a variety of fastener patterns to meet the required characteristic and slip modulus performance values in CLT to CLT installations.

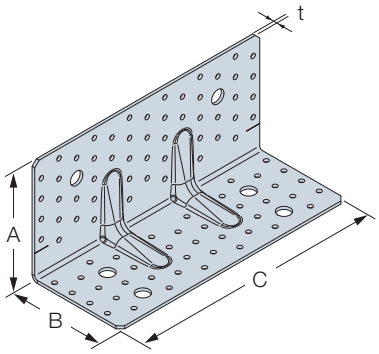
Advantages:

- High load performance in all force directions
- Versatile fixing and fastener pattern choices
- Enables the use of fewer connectors per CLT panel

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
ABR255	120	100	255	3,0	52 Ø5	2 Ø14	41 Ø5	4 Ø14



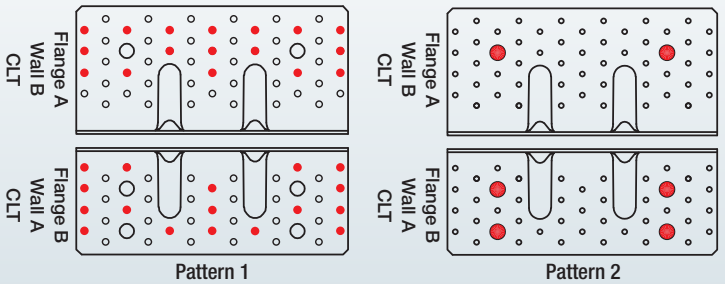
Characteristic Capacity and Slip Modulus – CLT to CLT – Wall Connection – 1 Angle Bracket

Model No.	Fasteners			Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Fastening Pattern	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
ABR255	17 CNA4.0x50	17 CNA4.0x50	Pattern 1	$13{,}1/k_{mod}^{0,4}$	20,9	6,4	2,9
	17 CNA4.0x60	17 CNA4.0x60		$15/k_{mod}^{0,4}$	22,9	7,4	3,1
	17 CSA5.0x50	17 CSA5.0x50		$\min \begin{cases} 27{,}2/k_{mod}^{0,4} \\ 26{,}2/k_{mod} \end{cases}$	26,1	13,4	3,6
	2 SSH12.0x80	4 SSH12.0x80	Pattern 2	13,4	18,4	1,8	2,7

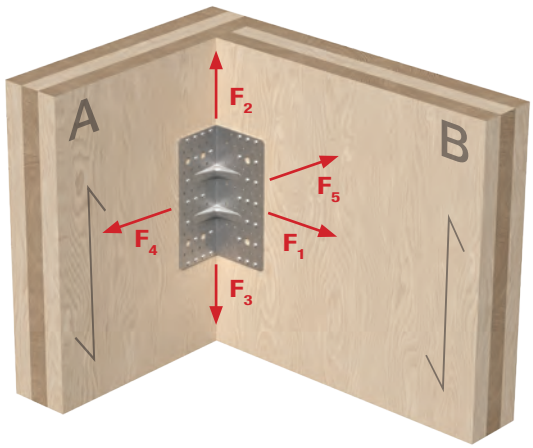
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



Note: F_4 and F_5 given in ETA.

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AE116 – Reinforced Angle Bracket

With a more discrete (48 mm) return, the AE116 form combines good load capacity with a fast and simple installation process – especially paired with SSH connector screws.

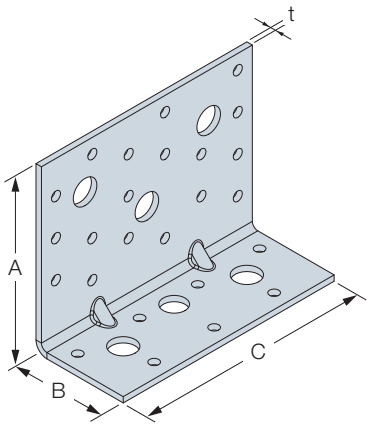
Advantages:

- A good balance between connector size and shear load capacity
- Versatile fixing and fastener pattern choices
- Improved capacity when installed with SSH screws

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
AE116	90	48	116	3,0	18 Ø5	3 Ø13	7 Ø5	3 Ø13



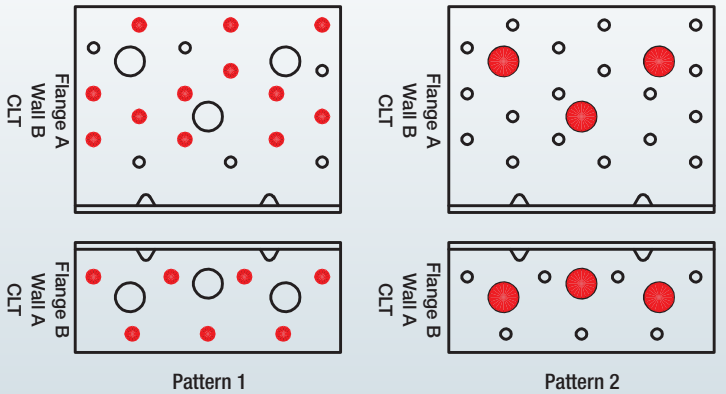
Characteristic Capacity and Slip Modulus – CLT to CLT – Wall Connection – 1 Angle Bracket

Model No.	Fasteners			Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Fastening Pattern	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
AE116	12 CNA4.0x50	7 CNA4.0x50	Pattern 1	3,9	9,9	1,3	1,9
	12 CNA4.0x60	7 CNA4.0x60		4,9	11,5	1,7	2,2
	12 CSA5.0x50	7 CSA5.0x50		4,9	11,5	1,7	2,2
	3 SSH12.0x80	3 SSH12.0x80	Pattern 2	16,5	14,2	1,8	2,3

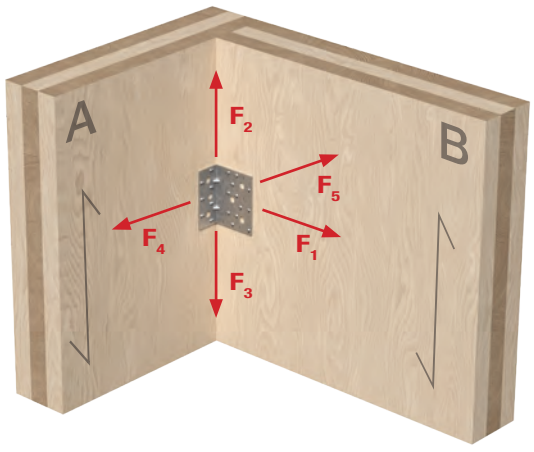
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



Note: F_4 and F_5 given in ETA.

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Structural Angle Brackets

AG922 – Reinforced Angle Bracket

Providing good load capacity and stiffness. When used in conjunction with SSH connector screws, the AG922 can deliver equally high tensile and shear loads.

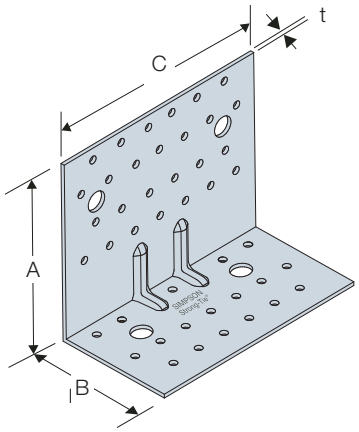
Advantages:

- High capacity and rigidity
- Versatile fastener and fastener pattern choices
- Flexible choice for CLT to CLT connections

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
AG922	121	79	150	2,5	26 Ø5	2 Ø13	18 Ø5	2 Ø13



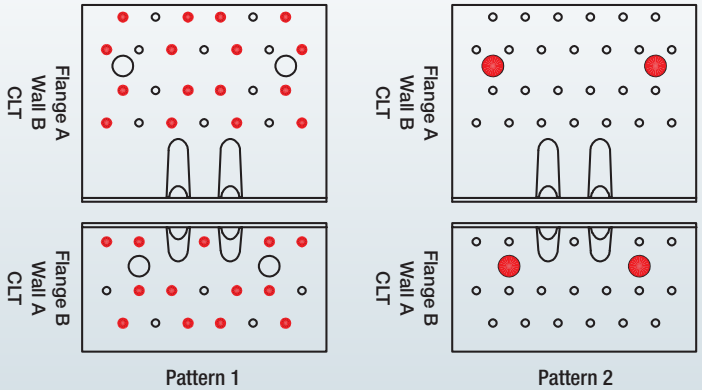
Characteristic Capacity and Slip Modulus – CLT to CLT – Wall Connection – 1 Angle Bracket

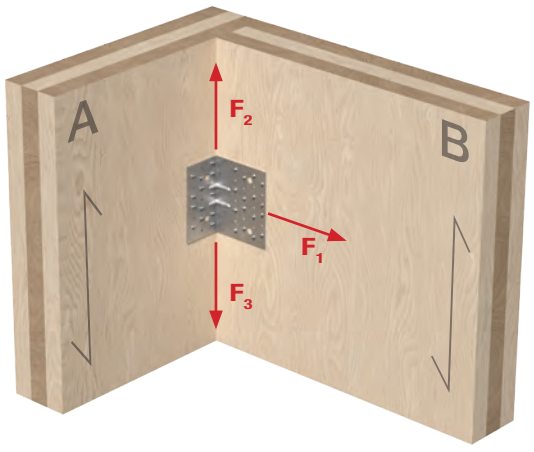
Model No.	Fasteners			Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Fastening Pattern	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
AG922	16 CNA4.0x50	13 CNA4.0x50	Pattern 1	9,2	14,7	2,7	2,0
	16 CSA5.0x40	13 CSA5.0x40		9,2	14,7	2,7	2,0
	2 SSH12.0x80	2 SSH12.0x80	Pattern 2	11,5	11,5	1,4	1,5

Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern





Red dots indicate holes filled with fasteners.

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ABR100 – Double Reinforced Angle Bracket

The rolled edge design of the ABR100 gives it impressive strength and stiffness considering its comparatively smaller form. The adapted fastener pattern recommended here is ideally suited to the grain direction of a CLT panel's outer layer.

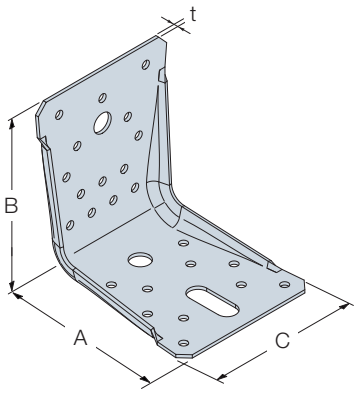
Advantages:

- High stiffness from a smaller form factor
- Optimised for high capacity in shear and uplift
- Fastener patterns adapted to CLT grain direction

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A			Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Obround	Screws or Nails	Bolts
ABR100	103	103	90	2,0	10 Ø5	1 Ø12	1 Ø12x32	14 Ø5	1 Ø12



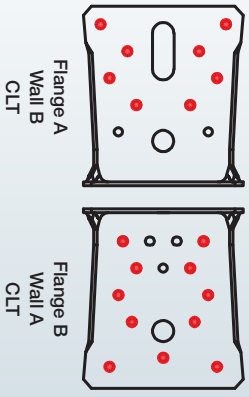
Characteristic Capacity and Slip Modulus – CLT to CLT – Wall Connection – 1 Angle Bracket

Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
ABR100	8 CNA4.0x50	11 CNA4.0x50	7,9	8,7	2,6	0,9
	8 CSA5.0x40	11 CSA5.0x40	7,9	8,7	2,6	0,9

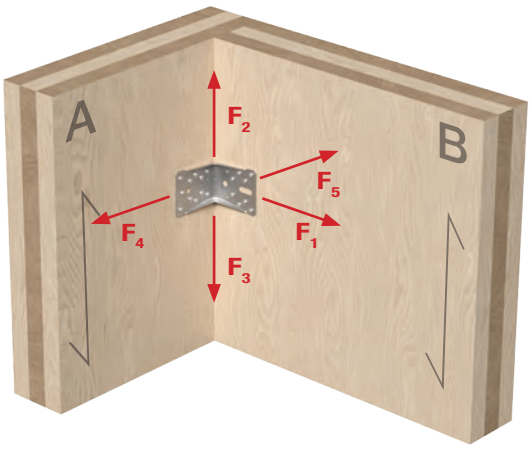
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



Note: F_4 and F_5 given in ETA.

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ABR9020 – Reinforced Angle Bracket

The smallest form factor and the fastest to install due to the reduced fastener count required, the ABR9020 features a large reinforcing rib that significantly improves its capacity and stiffness. The adapted fastener pattern recommended here is ideally suited to the grain direction of a CLT panel's outer layer.

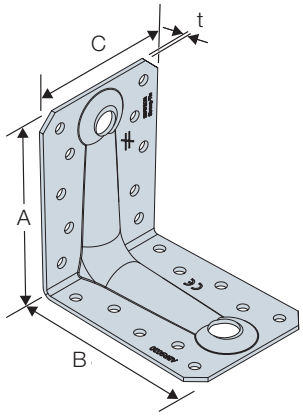
Advantages:

- Small and versatile
- Good load performance from a small form factor
- Fast installation – just 10 fasteners

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
ABR9020	88	88	65	2,0	10 Ø5	1 Ø11	10 Ø5	1 Ø13



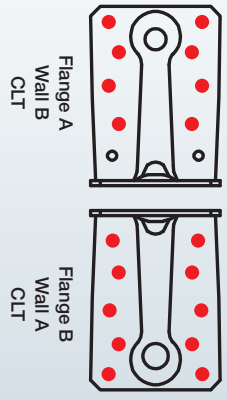
Characteristic Capacity and Slip Modulus – CLT to CLT – Wall Connection – 1 Angle Bracket

Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,1,k}$	Shear $k_{ser,2,k} = k_{ser,3,k}$
ABR9020	8 CNA4.0x50	10 CNA4.0x60	6,4	5,8	2,5	0,7
	8 CNA4.0x60	10 CNA4.0x60	7,4	6,5	2,9	0,8
	8 CSA5.0x40	10 CSA5.0x40	7,3	6,1	2,9	0,8

Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

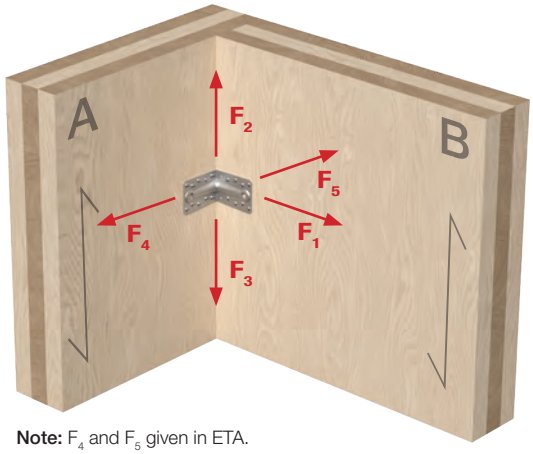
Fastening Pattern



Red dots indicate holes filled with fasteners.

HELPFUL TIP

For a more efficient installation the CSA screws are available in our collated screw system Quik Drive. If you prefer CNA connector nails we have several collated versions suitable for the most common tools.



Note: F_4 and F_5 given in ETA.

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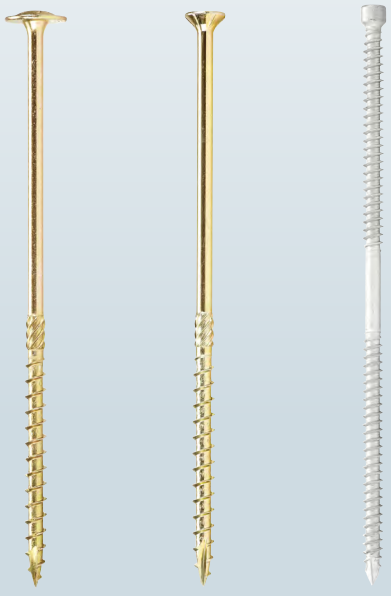
Structural Fasteners

Structural screws are an easy and fast way to connect CLT panels together as they require no pre-drilling. They provide a clean, hidden connection where aesthetic values are paramount.

Items Required

Timber Fasteners
SWW Washer-Head Screw,
SWC Countersunk Screws,
SWD Double Threaded Screw



SWW SWC SWD

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Structural Fasteners

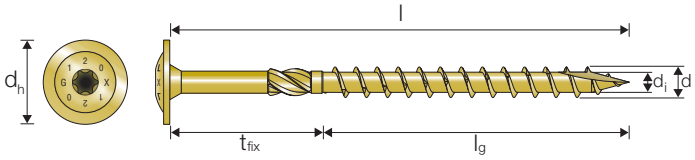
SWW – Washer-Head Screw

In wall to wall connections the SWW washer-head screw is recommended to use due to the high head-pull through resistance. The washer head also pulls the wall elements together, creating a firm assembly.

Advantages:

- High head-pull through resistance
- Pulls the wood members together
- No pre-drilling required

ETA-21/0670



SWW – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
SWW6.0xℓ	6,0	60 - 300	42 - 70	14	3,9	18 - 230
SWW8.0xℓ	8,0	80 - 400	50 - 80	22	5,2	30 - 320
SWW10.0xℓ	10,0	100 - 400	50 - 80	25	6,2	50 - 320

CLT to CLT – Wall Connection - SWW Screws at 90°

Product Reference	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Panel [kN] – Screws at 90°																					
	Head side CLT panel thickness t_{CLT} [mm]																					
	80		100		120		140		160		180		200		220		240		260		280		300	
SWW6.0X160	3,16	2,23 2,14	3,16	- -	2,32	- -	1,24	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWW6.0X180	3,16	2,23 2,14	3,16	2,23 2,14	3,16	- -	2,32	- -	1,24	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWW6.0X200	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	- -	2,32	- -	1,24	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWW6.0X220	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	- -	2,32	- -	1,24	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWW6.0X240	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	- -	2,32	- -	1,24	- -	-	- -	-	- -	-	- -	-	- -
SWW6.0X260	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	- -	2,32	- -	1,24	- -	-	- -	-	- -	-	- -
SWW6.0X280	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	- -	2,32	- -	1,24	- -	-	- -	-	- -
SWW6.0X300	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	2,23 2,14	3,16	- -	2,32	- -	1,24	- -	-	- -

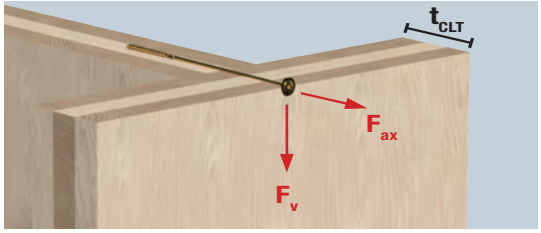
Table continues on next page.

Tension capacity $R_{ax,k}$ ↓

Characteristic capacities	3,16	2,23	With pre-drill
		2,14	Without pre-drill

↑ Shear capacity $R_{v,k}$

For pre-drilling recommendations, see chapter 10.



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CLT to CLT – Wall Connection - SWW Screws at 90° (cont.)

Product Reference	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Panel [kN] – Screws at 90°																					
	Head side CLT panel thickness t_{CLT} [mm]																					
	80		100		120		140		160		180		200		220		240		260		280		300	
SWW8.0X160	5,08	3,51 3,41	4,21	- -	2,92	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWW8.0X180	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -	2,92	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWW8.0X200	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -	2,92	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWW8.0X220	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -	2,92	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWW8.0X240	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -	2,92	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -
SWW8.0X260	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -	2,92	- -	1,56	- -	-	- -	-	- -	-	- -
SWW8.0X280	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -	2,92	- -	1,56	- -	-	- -	-	- -
SWW8.0X300	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -	2,92	- -	1,56	- -	-	- -
SWW8.0X320	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -	2,92	- -	1,56	- -
SWW8.0X340	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -	2,92	- -
SWW8.0X360	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41	4,21	- -
SWW8.0X380	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,51 3,41
SWW8.0X400	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57	5,08	3,74 3,57

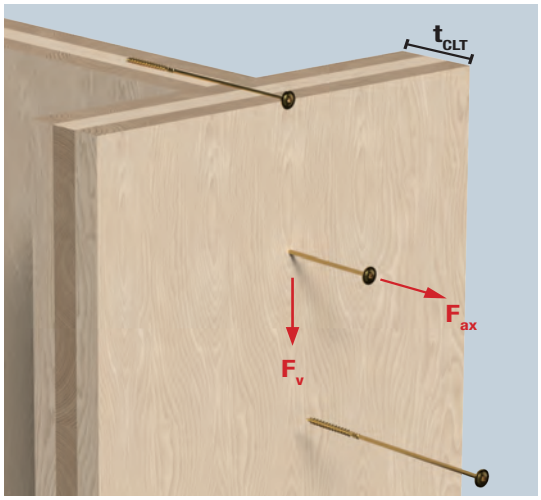
Table continues on next page.

Tension capacity $R_{ax,k}$ ↓

Characteristic capacities	5,08	3,74	With pre-drill
		3,57	Without pre-drill

↑ Shear capacity $R_{v,k}$

For pre-drilling recommendations, see chapter 10.



SW Solid Wood

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CLT to CLT – Wall Connection - SWW Screws at 90° (cont.)

Product Reference	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Panel [kN] – Screws at 90°																							
	Head side CLT panel thickness t_{CLT} [mm]																							
	80		100		120		140		160		180		200		220		240		260		280		300	
SWW10.0X160	-	-	5,03	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				-		-		-		-		-		-		-		-		-		-		-
SWW10.0X180	-	-	6,38	4,34	5,03	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				4,20		-		-		-		-		-		-		-		-		-		-
SWW10.0X200	-	-	6,38	4,73	6,38	4,34	5,03	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-	-	-	-	-
				4,57		4,20		-		-		-		-		-		-		-		-		-
SWW10.0X220	-	-	6,38	5,02	6,38	4,73	6,38	4,34	5,03	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-	-	-
				4,78		4,57		4,20		-		-		-		-		-		-		-		-
SWW10.0X240	-	-	6,38	5,02	6,38	5,02	6,38	4,73	6,38	4,34	5,03	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-
				4,78		4,78		4,57		4,20		-		-		-		-		-		-		-
SWW10.0X260	-	-	6,38	5,02	6,38	5,02	6,38	5,02	6,38	4,73	6,38	4,34	5,03	-	3,49	-	1,87	-	-	-	-	-	-	-
				4,78		4,78		4,78		4,57		4,20		-		-		-		-		-		-
SWW10.0X280	-	-	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	4,73	6,38	4,34	5,03	-	3,49	-	1,87	-	-	-	-	-
				4,78		4,78		4,78		4,78		4,57		4,20		-		-		-		-		-
SWW10.0X300	-	-	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	4,73	6,38	4,34	5,03	-	3,49	-	1,87	-	-	-
				4,78		4,78		4,78		4,78		4,78		4,57		4,20		-		-		-		-
SWW10.0X320	-	-	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	4,73	6,38	4,34	5,03	-	3,49	-	1,87	-
				4,78		4,78		4,78		4,78		4,78		4,78		4,57		4,20		-		-		-
SWW10.0X340	-	-	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	4,73	6,38	4,34	5,03	-	3,49	-
				4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,57		4,20		-		-
SWW10.0X360	-	-	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	4,73	6,38	4,34	5,03	-
				4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,57		4,20		-
SWW10.0X380	-	-	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	4,73	6,38	4,34
				4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,57		4,20
SWW10.0X400	-	-	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	5,02	6,38	4,73
				4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,78		4,57

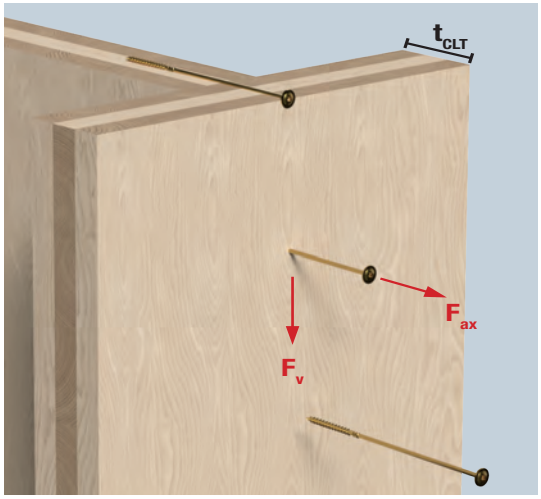
Characteristic parameters of fasteners and more information are included in chapter 10.

Tension capacity $R_{ax,k}$ ↓

Characteristic capacities	6,38	5,02	With pre-drill
		4,78	Without pre-drill

↑ Shear capacity $R_{v,k}$

For pre-drilling recommendations, see chapter 10.



SW Solid Wood

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SWC – Countersunk Screw

SWC is a countersunk structural wood screw designed to take high loads. The countersunk head gives a flush fitting while allowing the CLT panels to close up firmly.

Advantages:

- Countersunk head creates a flush finish
- Milling thread for reduced drive-in torque
- No pre-drilling required

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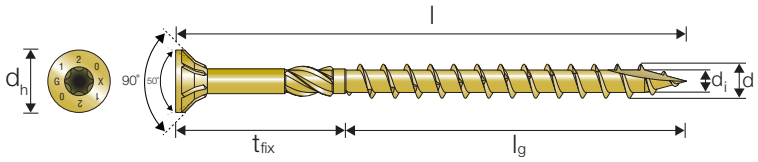

SWC – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
SWC6.0xℓ	6,0	200-300	70	11,8	3,9	130-230
SWC8.0xℓ	8,0	80-400	50-80	14,6	5,2	30-320
SWC10.0xℓ	10,0	100-400	50-80	17,8	6,2	50-320

CLT to CLT – Wall Connection – SWC Screws at 90°

Product Reference	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Panel [kN] – Screws at 90°																							
	Head side CLT panel thickness t_{CLT} [mm]																							
	80		100		120		140		160		180		200		220		240		260		280		300	
SWC6.0X180	1,66	1,86 1,77	1,66	1,86 1,77	1,66	-	1,66	-	1,24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC6.0X200	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	-	1,66	-	1,24	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC6.0X220	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	-	1,66	-	1,24	-	-	-	-	-	-	-	-	-	-	-
SWC6.0X240	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	-	1,66	-	1,24	-	-	-	-	-	-	-	-	-
SWC6.0X260	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	-	1,66	-	1,24	-	-	-	-	-	-	-
SWC6.0X280	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	-	1,66	-	1,24	-	-	-	-	-
SWC6.0X300	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	1,86 1,77	1,66	-	1,66	-	1,24	-	-	-

Table continues on next page.

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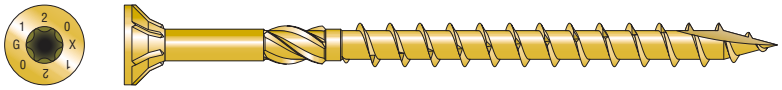


CLT to CLT – Wall Connection – SWC Screws at 90° (cont.)

Product Reference	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Panel [kN] – Screws at 90°																					
	Head side CLT panel thickness t_{CLT} [mm]																					
	80		100		120		140		160		180		200		220		240		260		280		300	
SWC8.0X160	2,66	2,91 2,80	2,66	- -	2,66	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWC8.0X180	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -	2,66	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWC8.0X200	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -	2,66	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWC8.0X220	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -	2,66	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWC8.0X240	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -	2,66	- -	1,56	- -	-	- -	-	- -	-	- -	-	- -
SWC8.0X260	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -	2,66	- -	1,56	- -	-	- -	-	- -	-	- -
SWC8.0X280	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -	2,66	- -	1,56	- -	-	- -	-	- -
SWC8.0X300	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -	2,66	- -	1,56	- -	-	- -
SWC8.0X320	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -	2,66	- -	1,56	- -
SWC8.0X340	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -	2,66	- -
SWC8.0X360	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80	2,66	- -
SWC8.0X380	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	2,91 2,80
SWC8.0X400	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97	2,66	3,14 2,97

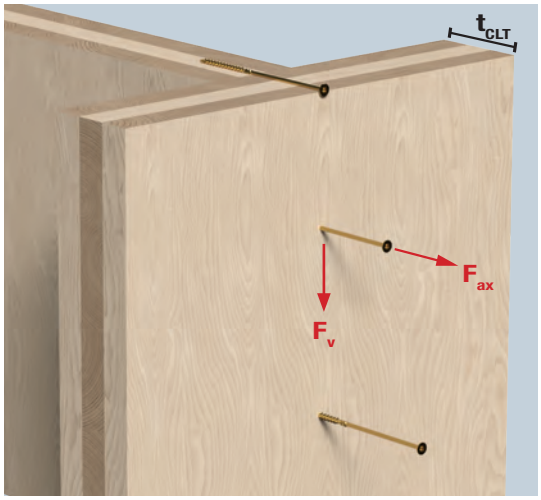
Table continues on next page.

Tension capacity $R_{ax,k}$ ↓

Characteristic capacities	2,66	3,14	With pre-drill
		2,97	Without pre-drill

↑ Shear capacity $R_{v,k}$

For pre-drilling recommendations, see chapter 10.



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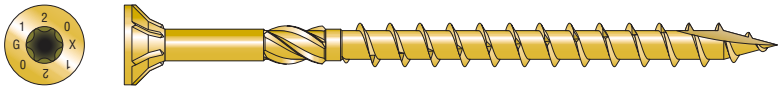
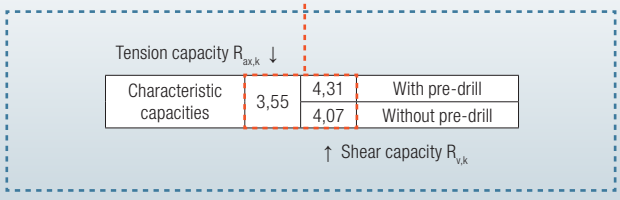


CLT to CLT – Wall Connection – SWC Screws at 90° (cont.)

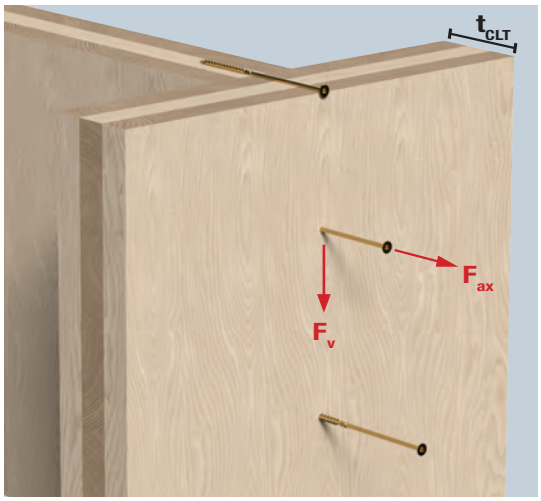
Product Reference	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Panel [kN] – Screws at 90°																							
	Head side CLT panel thickness t_{CLT} [mm]																							
	80		100		120		140		160		180		200		220		240		260		280		300	
SWC10.0X160	-	-	3,55	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				-		-		-		-		-		-		-		-		-		-		-
SWC10.0X180	-	-	3,55	3,63	3,55	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-		3,49		-		-		-		-		-		-		-		-		-		-
SWC10.0X200	-	-	3,55	4,02	3,55	3,63	3,55	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-	-	-	-	-
		-		3,87		3,49		-		-		-		-		-		-		-		-		-
SWC10.0X220	-	-	3,55	4,31	3,55	4,02	3,55	3,63	3,55	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-	-	-
		-		4,07		3,87		3,49		-		-		-		-		-		-		-		-
SWC10.0X240	-	-	3,55	4,31	3,55	4,31	3,55	4,02	3,55	3,63	3,55	-	3,49	-	1,87	-	-	-	-	-	-	-	-	-
		-		4,07		4,07		3,87		3,49		-		-		-		-		-		-		-
SWC10.0X260	-	-	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,02	3,55	3,63	3,55	-	3,49	-	1,87	-	-	-	-	-	-	-
		-		4,07		4,07		4,07		3,87		3,49		-		-		-		-		-		-
SWC10.0X280	-	-	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,02	3,55	3,63	3,55	-	3,49	-	1,87	-	-	-	-	-
		-		4,07		4,07		4,07		4,07		3,87		3,49		-		-		-		-		-
SWC10.0X300	-	-	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,02	3,55	3,63	3,55	-	3,49	-	1,87	-	-	-
		-		4,07		4,07		4,07		4,07		4,07		3,87		3,49		-		-		-		-
SWC10.0X320	-	-	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,02	3,55	3,63	3,55	-	3,49	-	1,87	-
		-		4,07		4,07		4,07		4,07		4,07		4,07		3,87		3,49		-		-		-
SWC10.0X340	-	-	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,02	3,55	3,63	3,55	-	3,49	-
		-		4,07		4,07		4,07		4,07		4,07		4,07		4,07		3,87		3,49		-		-
SWC10.0X360	-	-	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,02	3,55	3,63	3,55	-
		-		4,07		4,07		4,07		4,07		4,07		4,07		4,07		4,07		3,87		3,49		-
SWC10.0X380	-	-	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,02	3,55	3,63
		-		4,07		4,07		4,07		4,07		4,07		4,07		4,07		4,07		4,07		3,87		3,49
SWC10.0X400	-	-	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,31	3,55	4,02
		-		4,07		4,07		4,07		4,07		4,07		4,07		4,07		4,07		4,07		4,07		3,87

Characteristic parameters of fasteners and more information are included in chapter 10.



For pre-drilling recommendations, see chapter 10.

Use Solid Wood to make your calculations.
Go to **solidwood.strongtie.eu**



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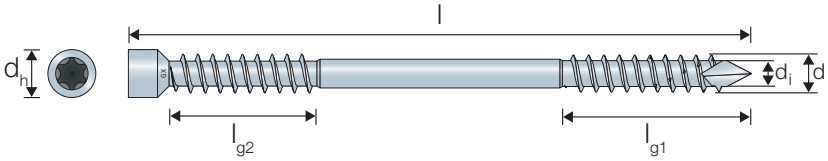
SWD – Double Threaded Screw

SWD screws can be used to create almost hidden connections due to the small cylinder head. The design of the screw makes it suitable for inclined and angled installations.

Advantages:

- High load capacity
- Small cylinder head for hidden assemblies
- Can be installed in cross pair to take loads in two directions

ETA-21/0670



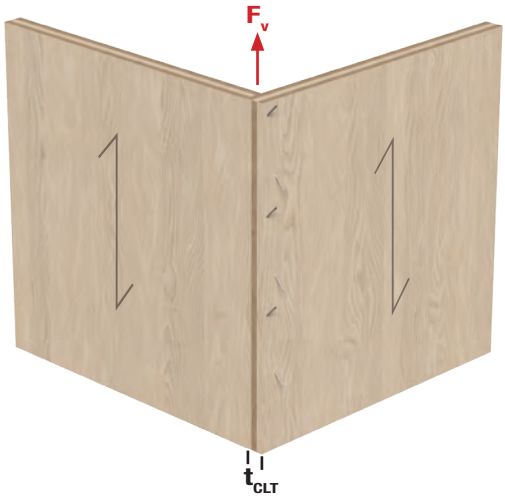
SWD – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_{g1}	l_{g2}	d_h	d_i
SWD6.5xℓ	6,5	65-220	40-95	33,5-88,5	8	4,0
SWD8.0xℓ	8,0	90-330	40-95	31,5-86,5	10	5,4

CLT to CLT – Wall Connection – SWD Screws 45° Cross Pairs

Product Reference	Minimum thickness $t_{CLT,min}$	Shear capacity $R_{v,k} = \min(R_{w,k,pair}; R_{buck,k,pair})$ [kN]	
		$R_{w,k,pair}$ [kN]	$R_{buck,k,pair}$
SWD6.5X90	52	3,9	1,96 + 5,51 /k_{mod}
SWD6.5X130	56	3,9	1,96 + 5,51 /k_{mod}
SWD6.5X160	67	6,9	3,43 + 5,51 /k_{mod}
SWD6.5X190	78	8,6	4,31 + 5,51 /k_{mod}
SWD6.5X220	88	10,1	5,19 + 5,51 /k_{mod}
SWD8.0X90	64	4,4	2,17 + 10,22 /k_{mod}
SWD8.0X130	64	4,4	2,17 + 10,22 /k_{mod}
SWD8.0X160	67	7,8	3,9 + 10,22 /k_{mod}
SWD8.0X190	78	9,9	4,94 + 10,22 /k_{mod}
SWD8.0X220	88	12	5,98 + 10,22 /k_{mod}
SWD8.0X245	97	13,7	6,84 + 10,22 /k_{mod}
SWD8.0X275	108	13,7	6,84 + 10,22 /k_{mod}
SWD8.0X300	117	17,5	8,74 + 10,22 /k_{mod}
SWD8.0X330	127	17,5	8,74 + 10,22 /k_{mod}

Characteristic parameters of fasteners and more information are included in chapter 10.



HELPFUL TIP

The minimum distance between the crossed screws are 1,5xd. Ensure that the screw threads do not touch each other during installation.

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Minimum Distances for Screws 90° Angles Between CLT Panels

SWC

Dimensions	a_1	$a_{3.c}$	$a_{4.c}$
SWC6,0	60	36	18
SWC8,0	80	48	24
SWC10,0	100	60	30

SWW

Dimensions	a_1	$a_{3.c}$	$a_{4.c}$
SWW6,0	60	36	18
SWW8,0	80	48	24
SWW10,0	100	60	30

Recommended max. Pre-Drilling Diameter:

Pre-drilling improve resistance but not space and edge distance in CLT.

SWC

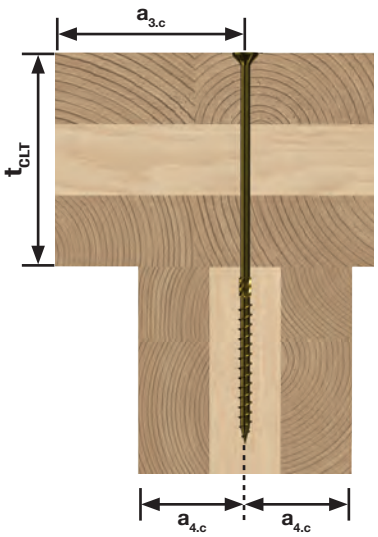
Product Reference	Max. Pre-Drill Hole Diameter
SWC6,0	Ø3,5
SWC8,0	Ø5,0
SWC10,0	Ø6,0

SWW

Product Reference	Max. Pre-Drill Hole Diameter
SWW6,0	Ø3,5
SWW8,0	Ø5,0
SWW10,0	Ø6,0

SWD

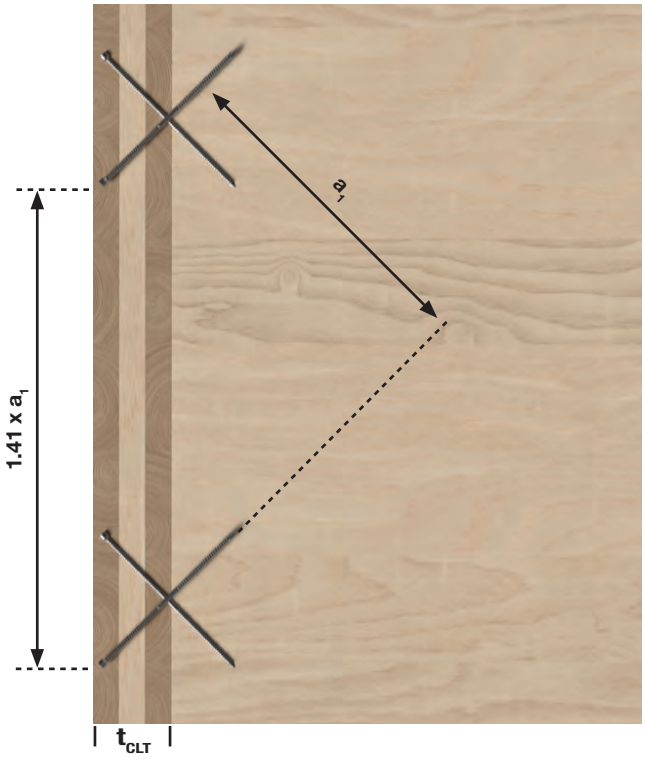
Product Reference	Max. Pre-Drill Hole Diameter
SWD6,5	Ø3,5
SWD8,0	Ø5,0

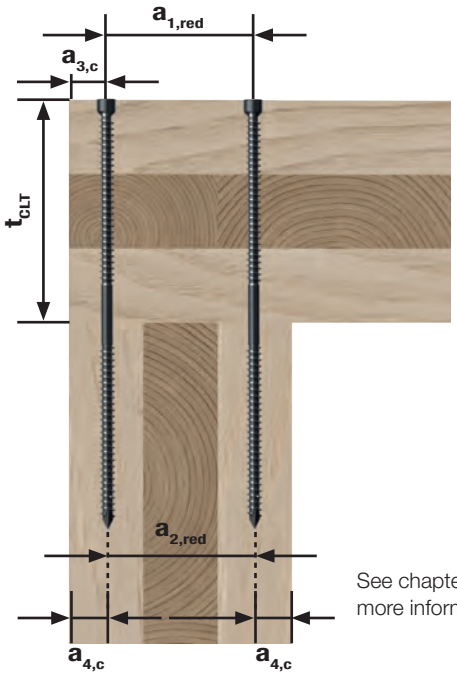


Minimum Distances for Screws 90° Angles Between CLT Panels – 45° Cross Pairs

SWD

Dimensions	a_1	$a_{1,red}$	$a_{2,red}$	$a_{3,c}$	$a_{4,c}$
SWD6,5	65	10	10	39	20
SWD8,0	80	12	12	48	24





See chapter 10 for more information.

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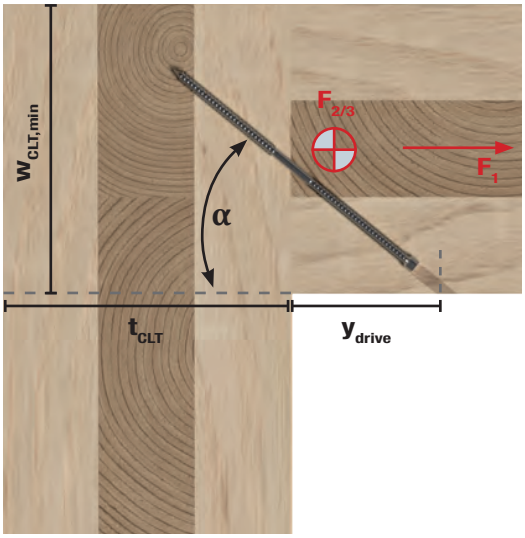
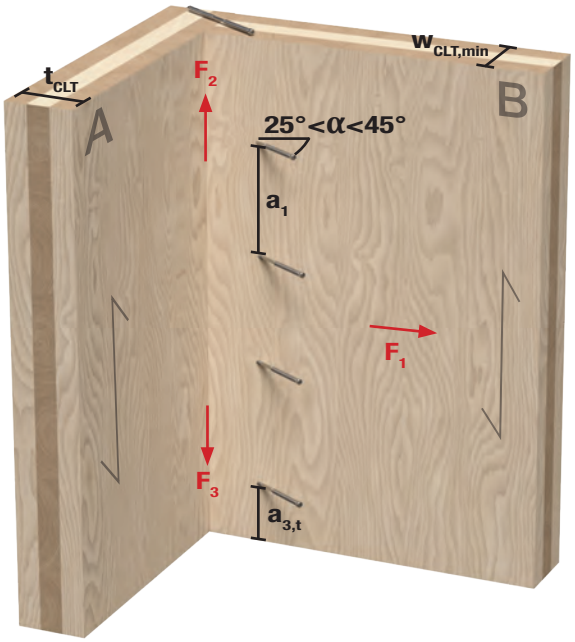
CLT to CLT – Wall Connection - SWD Screws inclined 25°

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		80			90			100			120			140			160			180				
		y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$
			[kN]			[kN]			[kN]			[kN]			[kN]			[kN]			[kN]	
SWD6.5x160	100	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25
SWD6.5x190	110	105	3,82	2,45	95-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45
SWD6.5x220	120	-	-	-	-	-	-	115-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59
SWD8.0x220	125	-	-	-	-	-	-	115-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59
SWD8.0x245	135	-	-	-	-	-	-	-	-	-	120-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77
SWD8.0x275	150	-	-	-	-	-	-	-	-	-	145-160	5,88	3,77	125-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77
SWD8.0x300	150	-	-	-	-	-	-	-	-	-	-	-	-	150-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00
SWD8.0x330	165	-	-	-	-	-	-	-	-	-	-	-	-	175-185	6,75	4,00	155-185	6,75	4,00	135-185	6,75	4,00

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		200			220			240			260			280			300							
		y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$
			[kN]			[kN]			[kN]			[kN]			[kN]			[kN]			[kN]	
SWD6.5x160	100	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25
SWD6.5x190	110	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45
SWD6.5x220	120	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59
SWD8.0x220	125	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59
SWD8.0x245	135	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77
SWD8.0x275	150	110-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77
SWD8.0x300	150	135-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00
SWD8.0x330	165	135-185	6,75	4,00	135-185	6,75	4,00	135-185	6,75	4,00	135-185	6,75	4,00	135-185	6,75	4,00	135-185	6,75	4,00	135-185	6,75	4,00

Table continues on next page.





SWD – Minimum Spacings and Edge and End Distances

Spacing or Distance [mm]	SWD6,5	SWD8,0
a_1	26	32
$a_{3,t}$	39	48

Note: Other min. spacing and edge distances requirements are fulfilled for the installation characteristics given in the load table. If the grain orientation of the CLT panel is different the spacing defintion may change.

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Structural Fasteners

CLT to CLT – Wall Connection - SWD Screws inclined 35°

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		80			90			100			120			140			160			180		
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]
SWD6.5x190	130	90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45
SWD6.5x220	145	-	-	-	100-105	3,72	2,59	90-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59
SWD8.0x220	150	-	-	-	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59
SWD8.0x245	165	-	-	-	-	-	-	115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77
SWD8.0x275	180	-	-	-	-	-	-	140	5,23	3,77	120-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77
SWD8.0x300	190	-	-	-	-	-	-	-	-	-	140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00
SWD8.0x330	205	-	-	-	-	-	-	-	-	-	165	5,84	4,00	145-165	5,84	4,00	125-165	5,84	4,00	120-165	5,84	4,00

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		200			220			240			260			280			300						
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]			
SWD6.5x190	130	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45			
SWD6.5x220	145	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59			
SWD8.0x220	150	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59			
SWD8.0x245	165	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77			
SWD8.0x275	180	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77			
SWD8.0x300	190	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00			
SWD8.0x330	205	120-165	5,84	4,00	120-165	5,84	4,00	120-165	5,84	4,00	120-165	5,84	4,00	120-165	5,84	4,00	120-165	5,84	4,00			

CLT to CLT – Wall Connection - SWD Screws inclined 45°

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		80			90			100			120			140			160			180		
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]
SWD6.5x220	165	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59
SWD8.0x245	190	-	-	-	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77
SWD8.0x275	210	-	-	-	115-120	4,71	3,77	105-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77
SWD8.0x300	225	-	-	-	-	-	-	-	-	-	105-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4,00
SWD8.0x330	245	-	-	-	-	-	-	-	-	-	125-140	5,15	4,00	105-140	5,15	4,00	100-140	5,15	4,00	100-140	5,15	4,00

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		200			220			240			260			280			300						
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]			
SWD6.5x220	165	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59			
SWD8.0x245	190	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77			
SWD8.0x275	210	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77			
SWD8.0x300	225	100-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4	100-120	5,15	4,00			
SWD8.0x330	245	100-140	5,15	4,00	100-140	5,15	4,00	100-140	5,15	4,00	100-140	5,15	4,00	100-140	5,15	4	100-140	5,15	4,00			

Characteristic parameters of fasteners and more information are included in chapter 10.

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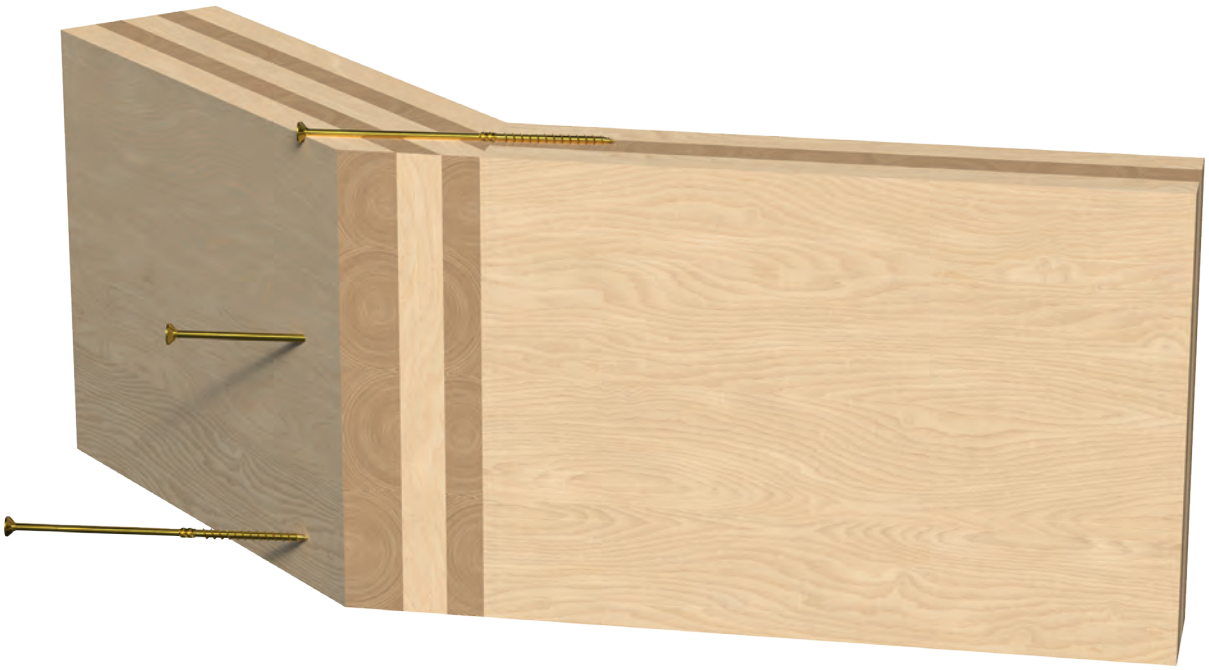
Structural Fasteners

For CLT wall junctions with angles less or greater than 90°, structural screw installation inclines can be adapted to the required plane for a secure and discrete connection.



Items Required

Timber Fasteners
SWW Washer-Head Screw,
SWC Countersunk Screws

SWW SWC

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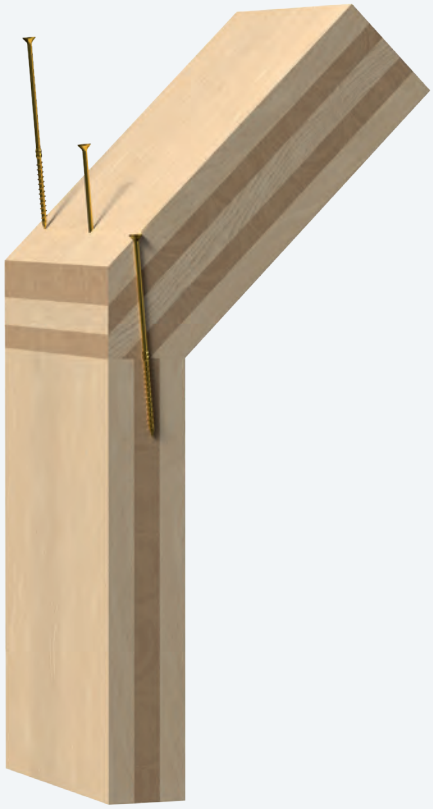
Roof to Wall Connection Using SWC Structural Screws



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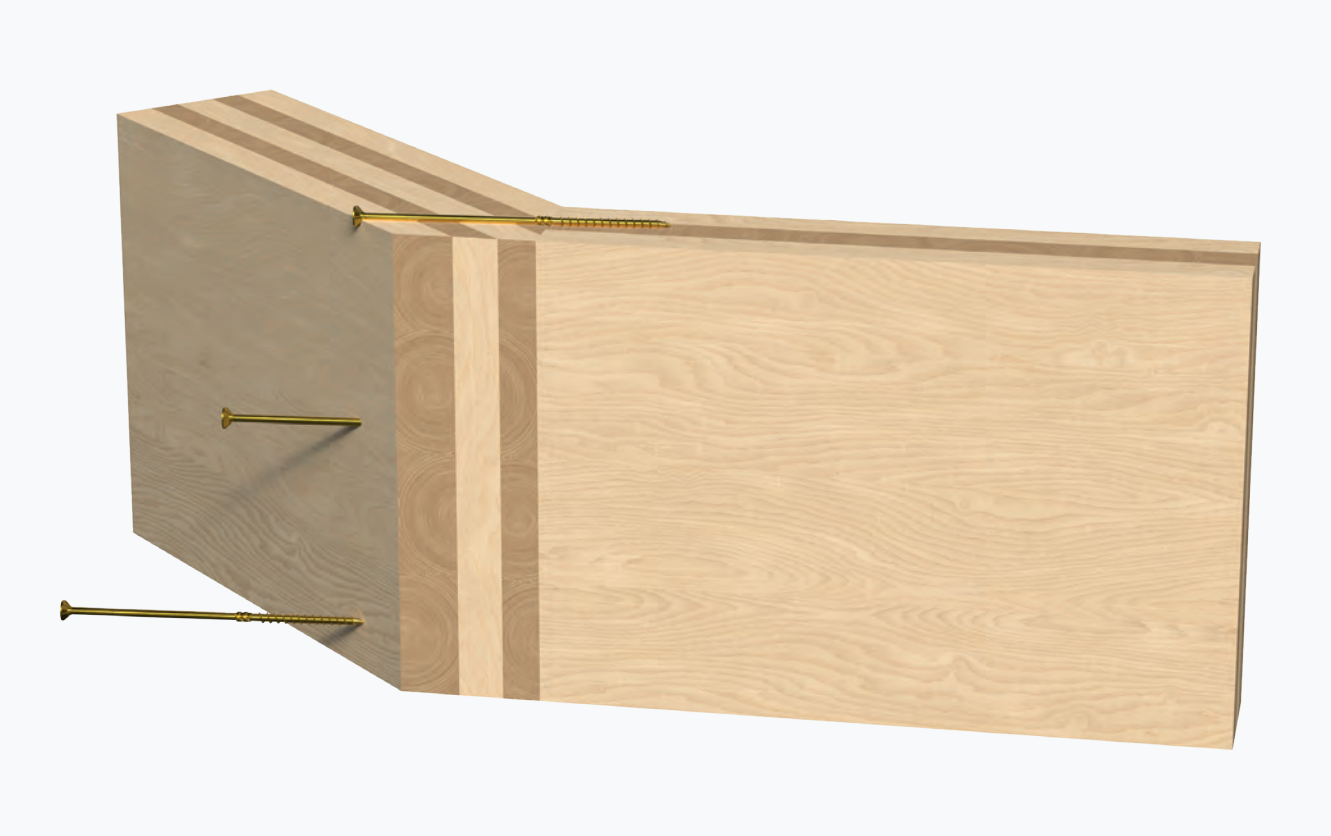
Corner Connection Using SWC Structural Screws



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Solid Wood Fastener Dimensioning Software

In just four simple steps, Solid Wood helps you calculate and select fastening solutions suitable for the specific wood structure at hand, according to Eurocode 5 and our ETA.

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The software generates a PDF-report that can be used as documentation for the project.

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CLT Wall to CLT Floor Connections

Upper storeys in mass timber structures often comprise CLT wall and floor panels.

Junctions for this assembly method need to transfer vertical forces down through the structure while resisting both horizontal shear loads and uplift arising from the rotation of racking walls. Given the grain direction where they connect, dedicated fastener patterns are suggested to prevent the timber from splitting.

This section describes methods suitable for connecting CLT walls to CLT floors or ceilings and includes options for visible or discrete installation settings, as well as those to help prevent acoustic transfer.

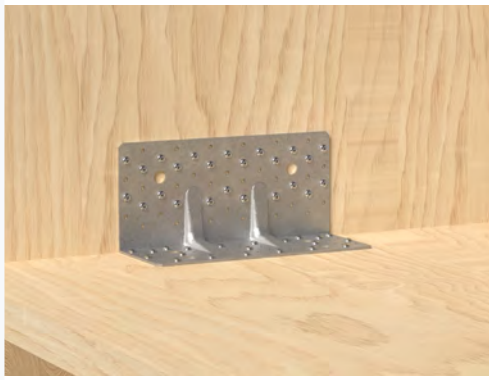
CLT Wall to CLT Floor / Ceiling Connection Solutions

Structural Angle Brackets

Product Options:

ABR255	see page 93
AE116	see page 94
AG922	see page 95
ABR100	see page 96
ABR9020	see page 97

Angle brackets are an optimal solution for resisting shear and uplift loads. With varying options based on load capacity and access requirements, this range is the most flexible.



Enhanced Structural Angle Bracket

Product Options:

AB255SSH	see page 99
AB255HD	see page 100

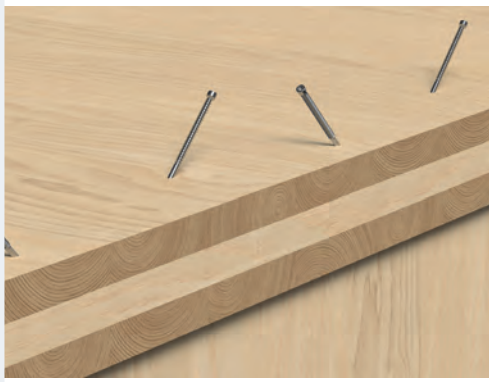
With a low height profile, the AB255 series connector can be concealed within the floor elements such as insulation, concrete and tiling. A better option for extracting the maximum capacity from a discrete connection.

Structural Fasteners

Product Options:

SWD Cross Pair	see page 102
SWD Inclined	see page 103
ESCRFTZ Cross Pair	see page 105

Structural screws are an easy and fast way to connect CLT panels together as they require no pre-drilling. They provide a clean, hidden connection where aesthetic values are paramount.

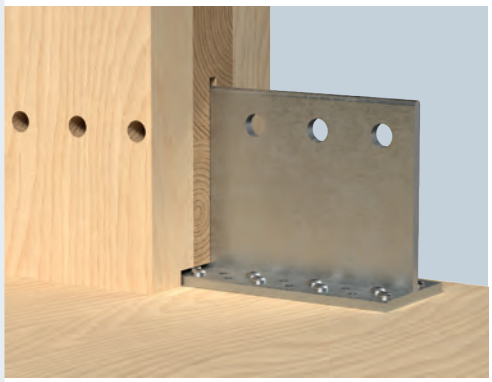


Concealed Connection

Product Options:

BTALU	see page 108

The BTALU concealed connector is installed within pre-cut sections of the vertical CLT panel, resulting in an invisible connection capable of impressive characteristic capacities.

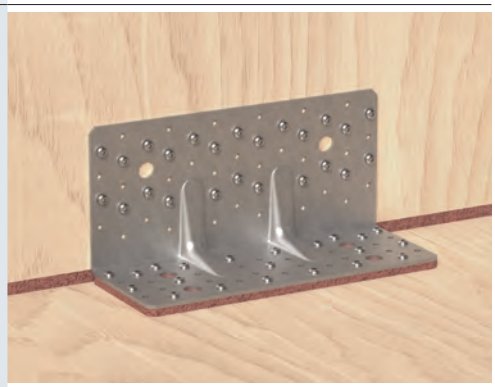


Acoustic Solutions

Product Options:

SIT, SITW, SITW-H	see page 111
SWW + SIT	see page 112
ABAI	see page 114
ABR255 + SIT	see page 116

Angle brackets and fasteners adapted for use with acoustic absorbent material help to provide superior resistance to sound transfer through CLT wall and floor junctions.



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Structural Angle Brackets

Angle brackets are an optimal solution for resisting shear and uplift loads. With varying options based on load capacity and access requirements, this range is the most flexible.

Items Required

Angle Brackets – Uplift and Shear Restraint
ABR255, AE116, AG922, ABR100, ABR9020

ABR255

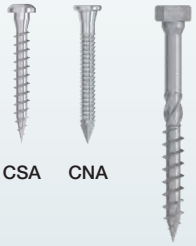
AE116

AG922

ABR100

ABR9020

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail,
SSH Hex-Head Connector Screw



CSA CNA SSH

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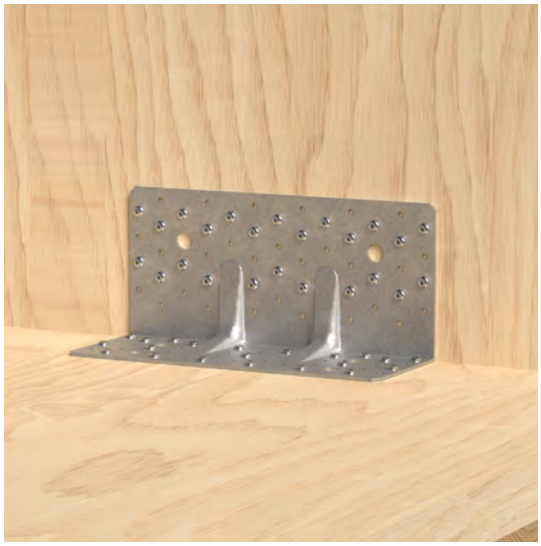
ABR255 – Reinforced Angle Bracket

Developed specifically for CLT construction, this reinforced angle bracket delivers high load capacities in all force directions and can be installed in a variety of fastener patterns to meet the required characteristic and slip modulus performance values in CLT to CLT installations.

Advantages:

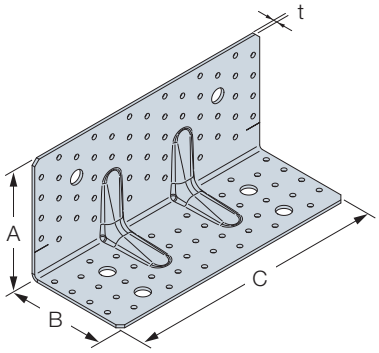
- High load performance in all force directions
- Versatile fixing and fastener pattern choices
- Enables the use of fewer connectors per CLT panel



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
ABR255	120	100	255	3,0	52 Ø5	2 Ø14	41 Ø5	4 Ø14



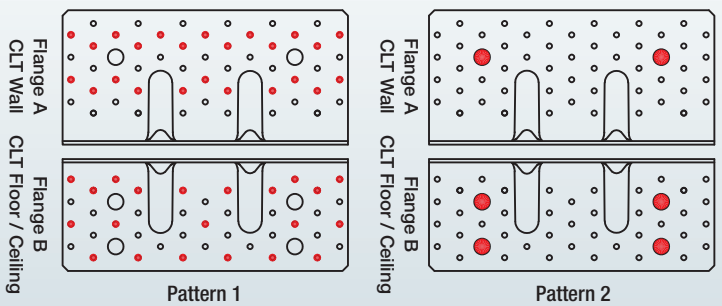
Characteristic Capacity and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

Model No.	Fasteners			Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Fastening Pattern	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k} = k_{ser,R3,k}$
ABR255	24 CNA4.0x50	21 CNA4.0x50	Pattern 1	$15,6/k_{mod}^{0,4}$	28,6	7,7	3,9
	24 CNA4.0x60	21 CNA4.0x60		$18,1/k_{mod}^{0,4}$	31,4	8,9	4,3
	24 CSA5.0x50	21 CSA5.0x50		$18,1/k_{mod}^{0,4}$	31,4	8,9	4,3
	2 SSH12.0x80	4 SSH12.0x80	Pattern 2	13,4	18,4	1,8	2,6

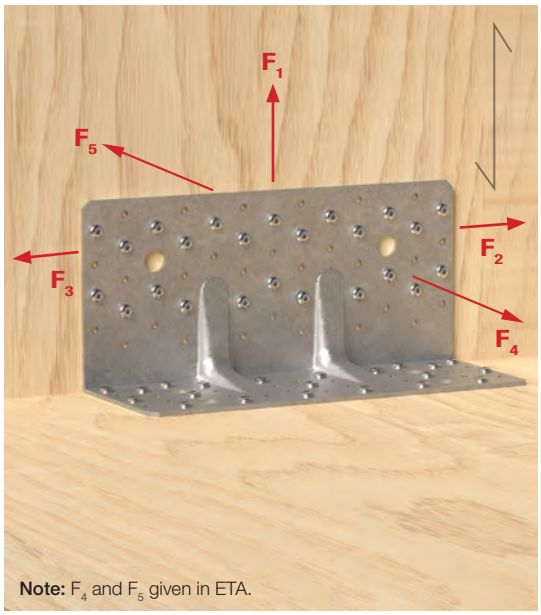
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



Note: F_4 and F_5 given in ETA.

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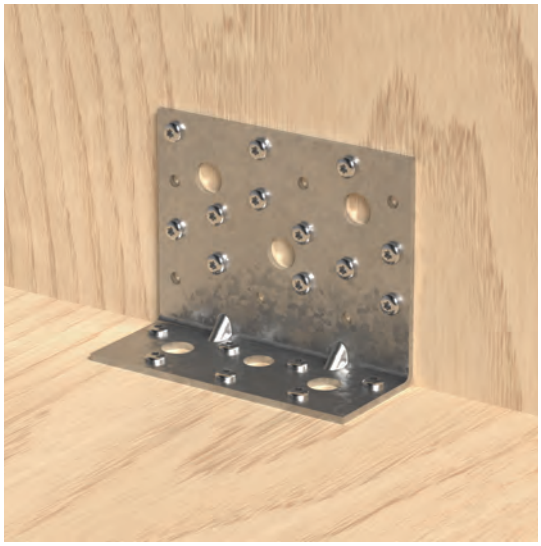
AE116 – Reinforced Angle Bracket

With a more discrete (48mm) return, the AE116 form combines good load capacity with a fast and simple installation process - especially paired with SSH connector screws.

Advantages:

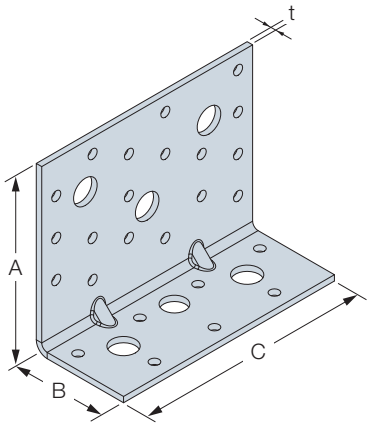
- A good balance between connector size and shear load capacity
- Versatile fixing and fastener pattern choices
- Improved capacity when installed with SSH screws



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
AE116	90	48	116	3,0	18 Ø5	3 Ø13	7 Ø5	3 Ø13



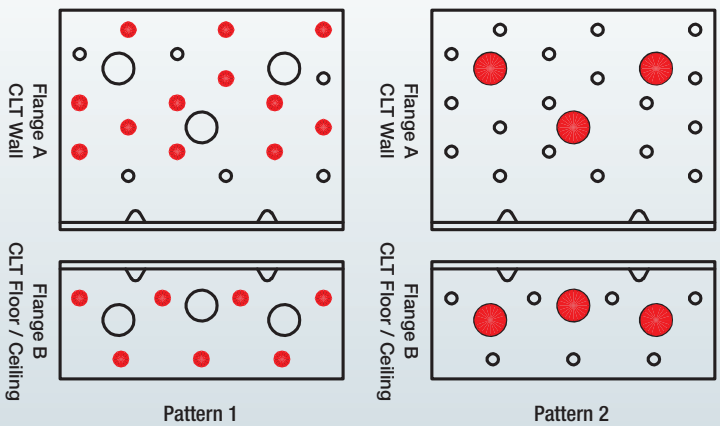
Characteristic Capacity and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

Model No.	Fasteners			Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Fastening Pattern	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k} = k_{ser,R3,k}$
AE116	12 CNA4.0x60	7 CNA4.0x60	Pattern 1	4,9	11,5	1,7	2,2
	12 CSA5.0x50	7 CSA5.0x50		4,9	11,5	1,7	2,2
	3 SSH12.0x80	3 SSH12.0x80	Pattern 2	16,5	14,7	1,8	2,3

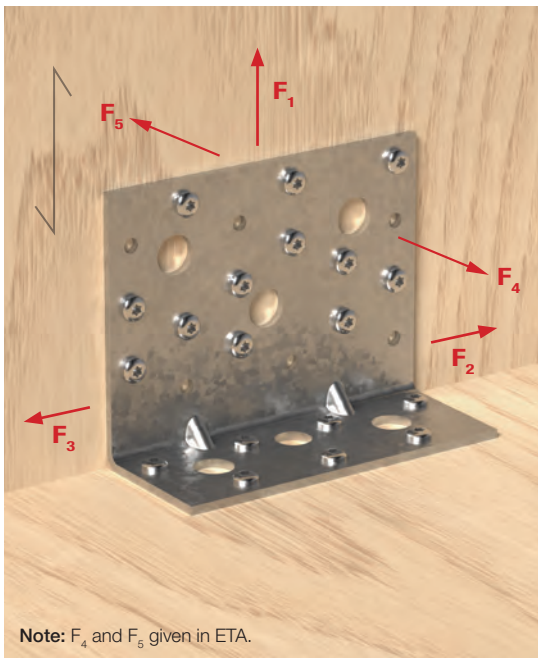
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



Note: F_4 and F_5 given in ETA.

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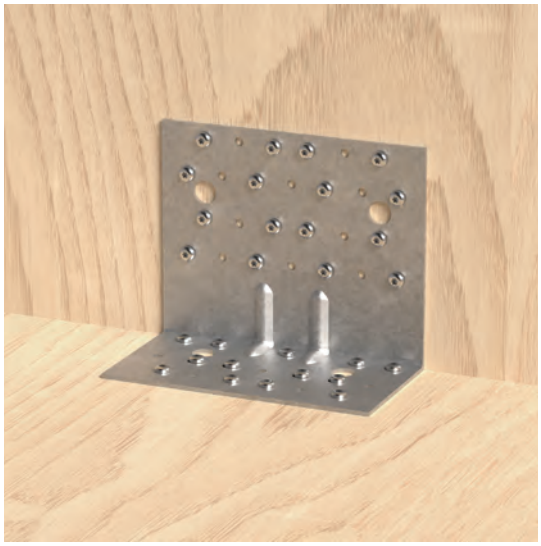
AG922 – Reinforced Angle Bracket

Providing good load capacity and stiffness. When used in conjunction with SSH connector screws, the AG922 can deliver equally high tensile and shear loads.

Advantages:

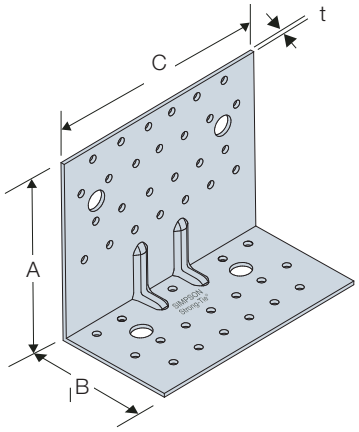
- High capacity and rigidity
- Versatile fixing and fastener pattern choices
- Flexible choice for CLT to CLT connections



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
AG922	121	79	150	2,5	26 Ø5	2 Ø13	18 Ø5	2 Ø13



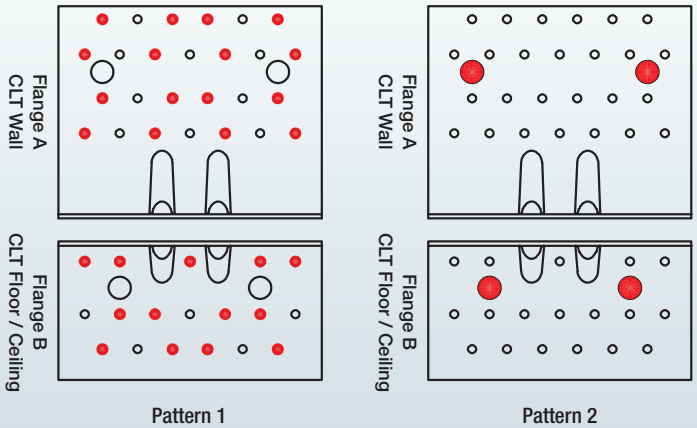
Characteristic Capacity and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

Model No.	Fasteners			Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Fastening Pattern	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k} = k_{ser,R3,k}$
AG922	12 CNA4.0x50	13 CNA4.0x50	Pattern 1	9,7	-	1,5	-
	12 CSA5.0x40	13 CSA5.0x40		9,7	-	1,5	-
	2 SSH12.0x80	2 SSH12.0x80	Pattern 2	11,5	11,5	1,4	1,5

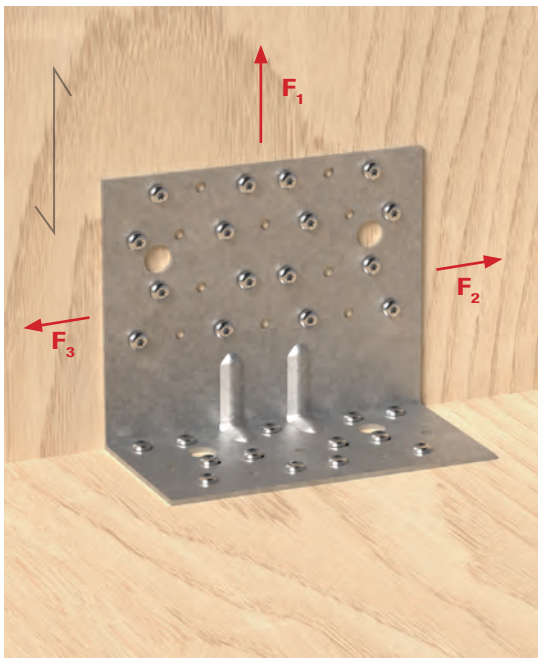
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



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ABR100 – Double Reinforced Angle Bracket

The rolled edge design of the ABR100 gives it impressive strength and stiffness considering its comparatively smaller form. The adapted fastener pattern recommended here is ideally suited to the grain direction of a CLT panel's outer layer.

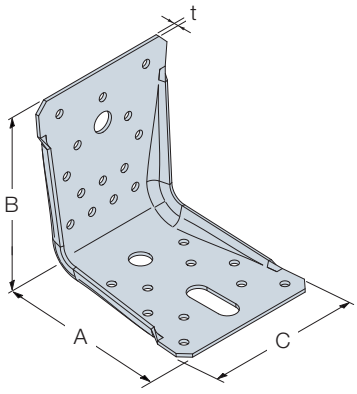
Advantages:

- High stiffness from a smaller form factor
- Optimised for high capacity in shear and uplift
- Fastener patterns adapted to CLT grain direction

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A			Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Obround	Screws or Nails	Bolts
ABR100	103	103	90	2,0	10 Ø5	1 Ø12	1 Ø12x32	14 Ø5	1 Ø12

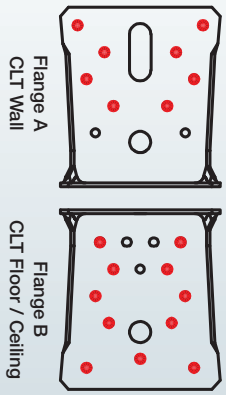


Characteristic Capacity and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

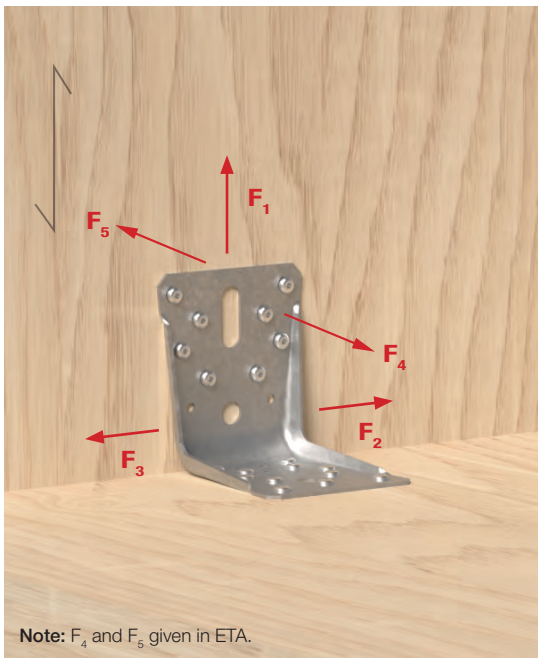
Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k} = k_{ser,R3,k}$
ABR100	8 CNA4.0x50	11 CNA4.0x50	7,9	8,7	2,6	0,9
	8 CSA5.0x40	11 CSA5.0x40	7,9	8,7	2,6	0,9

Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation: $\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$

Fastening Pattern



Red dots indicate holes filled with fasteners.



Note: F_4 and F_5 given in ETA.

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ABR9020 – Reinforced Angle Bracket

The smallest form factor and the fastest to install due to the reduced fastener count required, the ABR9020 features a large reinforcing rib that significantly improves its capacity and stiffness. The adapted fastener pattern recommended here is ideally suited to the grain direction of a CLT panel's outer layer.

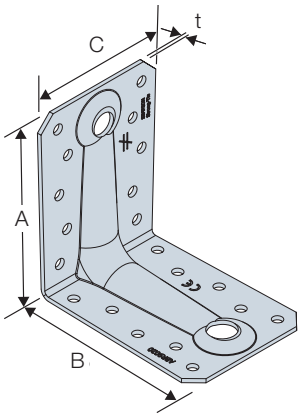
Advantages:

- Small and versatile
- Good load performance from a small form factor
- Fast installation - just 10 fasteners

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
ABR9020	88	88	65	2,0	10 Ø5	1 Ø11	10 Ø5	1 Ø13

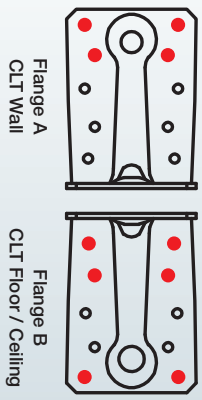


Characteristic Capacity and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

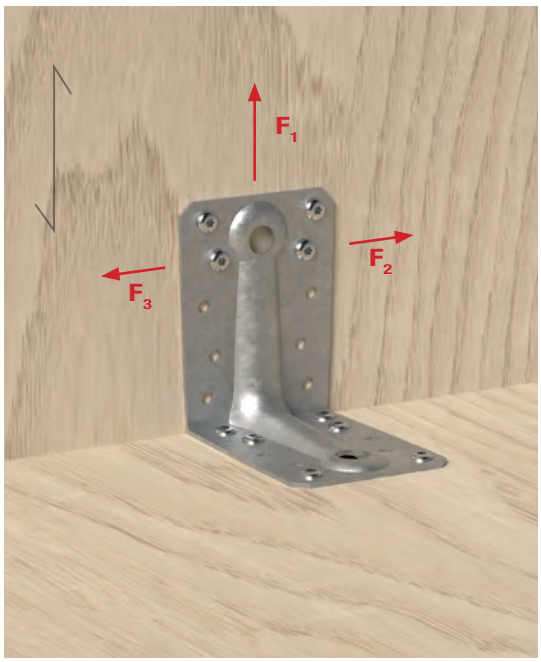
Model No.	Fasteners		Characteristic Values [kN]	
	Flange A CLT	Flange B CLT	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$
ABR9020	4 CNA4.0x60	6 CNA4.0x60	4,9	3,4
	4 CSA5.0x40	6 CSA5.0x40	5,9	3,5

Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation: $\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$

Fastening Pattern



Red dots indicate holes filled with fasteners.



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Enhanced Structural Angle Bracket

With a low height profile, the AB255 series connector can be concealed within the floor elements such as insulation, concrete and tiling. A better option for extracting the maximum capacity from a discrete connection.

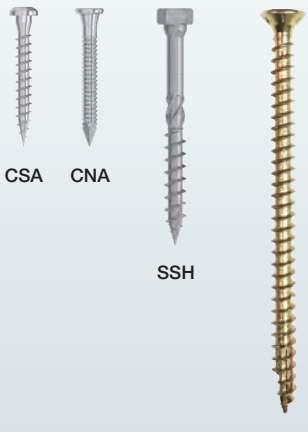
Items Required

Angle Brackets – Uplift and Shear Restraint
AB255SSH, AB255HD

AB255HD

AB255SSH

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail,
SSH Hex-Head Connector Screw,
ESCRFTC Fully Threaded Countersunk Screw



CSA CNA SSH ESCRFTC

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Enhanced Structural Angle Bracket

AB255SSH – Heavy Duty Angle Bracket

Developed specifically for use with SSH connector screws, this CLT-CLT connection delivers extreme tensile and shear load capacities, yet has a profile low enough for flooring elements to be placed over it.

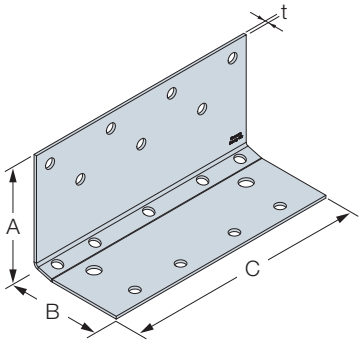
Advantages:

- Faster installation due to comparatively low fastener count
- Can be hidden within the thickness of floor elements such as insulation, concrete or tiling.
- Range of characteristic values based on SSH screw length

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A	Qty Holes Flange B	
	A	B	C	t	Screws	Screws	Bolts
AB255SSH	123	100	255	3,0	7 Ø11	9 Ø11	2 Ø14



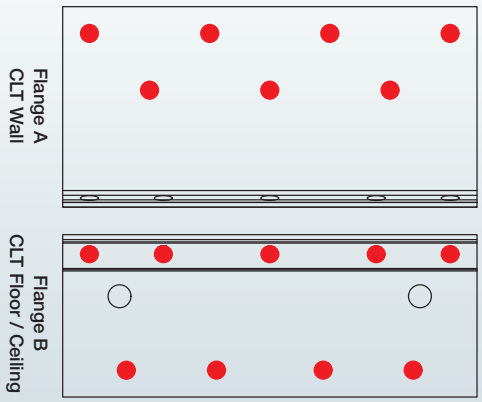
Characteristic Capacity and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

Model No.	Fasteners		Characteristic Values [kN]	
	Flange A CLT	Flange B CLT	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$
AB255SSH	7 SSH10.0x100	9 SSH10.0x100	$26,3/k_{mod}^{0,09}$	35,0
	7 SSH10.0x120	9 SSH10.0x120	42,6	42,6
	7 SSH10.0x160	9 SSH10.0x160	56,2	48,5

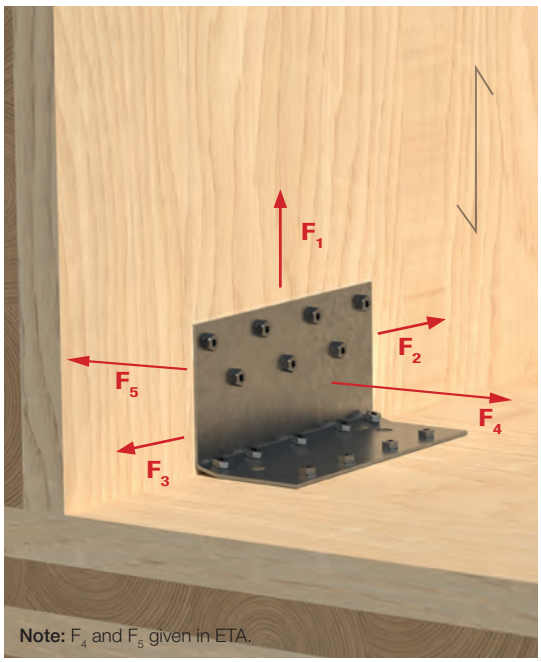
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



Note: F_4 and F_5 given in ETA.

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Enhanced Structural Angle Bracket

AB255HD – Heavy Duty Angle Bracket

This CLT-CLT connection delivers extreme tensile and shear load capacities, yet has a profile low enough for flooring elements to be placed over it. Can be installed in a variety of fastener patterns to meet the required characteristic and slip modulus performance values in CLT to CLT installations.

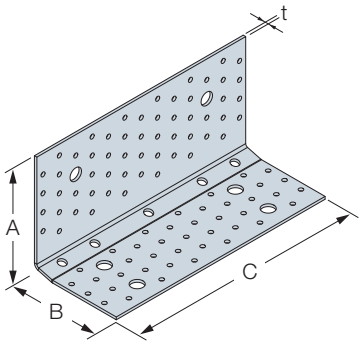
Advantages:

- Extreme load capacities
- Can be hidden within the thickness of floor elements such as insulation, concrete or tiling.
- Versatile fixing and fastener pattern choices

ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts	Screws or Nails	Bolts
AB255HD	123	100	255	3,0	56 Ø5	2 Ø14	41 Ø5 + 5 Ø9	4 Ø14



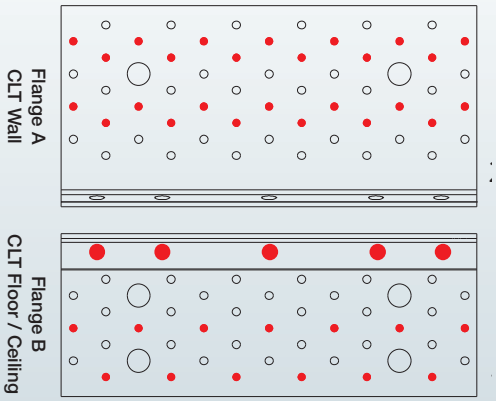
Characteristic Capacity and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k} = k_{ser,R3,k}$
AB255HD	26 CNA4.0x50	13 CNA4.0x50 + 5 ESCRFTC8.0x200	min (57,6 ; 56/k_{mod})	42,9	12,2	16,0
	26 CNA4.0x60	13 CNA4.0x60 + 5 ESCRFTC8.0x200	min (61,4 ; 56/k_{mod})	45,7	12,2	16,0
	26 CSA5.0x50	13 CSA5.0x50 + 5 ESCRFTC8.0x200	min (63,9 ; 56/k_{mod})	46,0	12,2	16,0

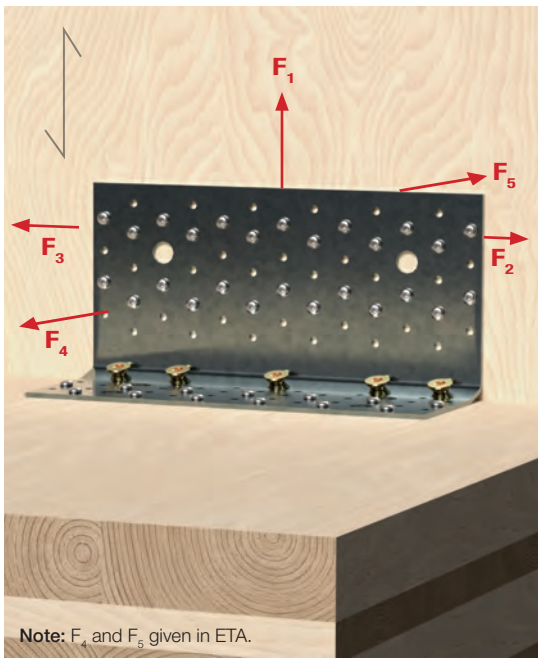
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



Note: F_4 and F_5 given in ETA.

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Structural Fasteners

Structural screws are an easy and fast way to connect CLT panels together as they require no pre-drilling. They provide a clean, hidden connection where aesthetic values are paramount.

Items Required

Timber Fasteners
SWD Double Threaded Screw,
ESCRFTZ Fully Threaded Cylinder-Head Screw

SWD

ESCRFTZ

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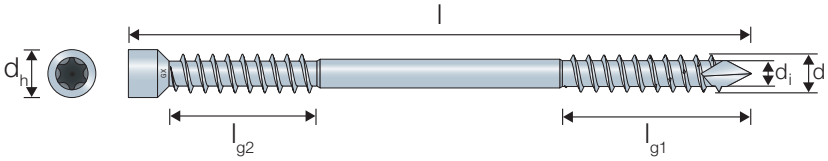
SWD – Double Threaded Screw

SWD is a double threaded structural screw designed to connect CLT and mass timber wood members. The screws are suitable for inclined installations and can be installed as a cross pair to take loads in several directions.

Advantages:

- Double threaded, pulls the two wood members together
- Small cylinder head for allowing hidden assemblies
- Can be installed in cross pair to take loads in two directions
- No pre-drilling required

ETA-21/0670



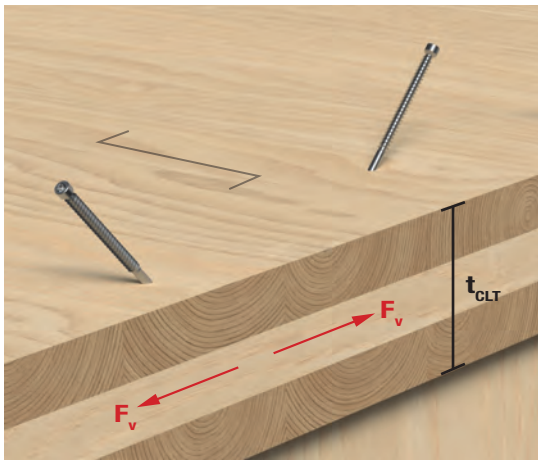
SWD – Range Overview

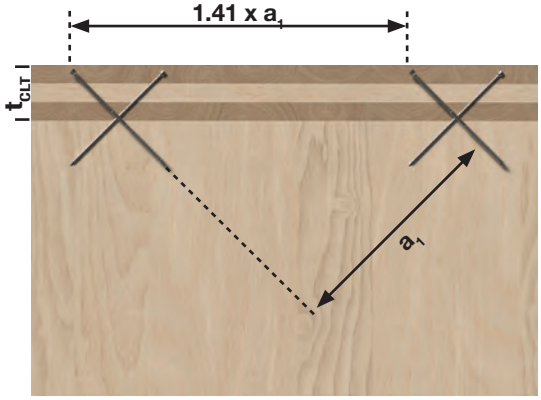
Product Reference	Dimensions [mm]					
	d	l	l_{g1}	l_{g2}	d_h	d_i
SWD6.5xℓ	6,5	65-220	40-95	33,5-88,5	8	4,0
SWD8.0xℓ	8,0	90-330	40-95	31,5-86,5	10	5,4

CLT Wall to CLT Floor / Ceiling Connection – SWD 45° Cross Pairs

Product Reference	Minimum thickness $t_{CLT,min}$	Shear capacity $R_{v,k} = \min(R_{w,k,pair}; R_{buck,k,pair})$ [kN]	
		$R_{w,k,pair}$	$R_{buck,k,pair}$
SWD6.5X90	52	3,9	1,96 + 5,51 /k_{mod}
SWD6.5X130	56	3,9	1,96 + 5,51 /k_{mod}
SWD6.5X160	67	6,9	3,43 + 5,51 /k_{mod}
SWD6.5X190	78	8,6	4,31 + 5,51 /k_{mod}
SWD6.5X220	88	10,4	5,19 + 5,51 /k_{mod}
SWD8.0X90	64	4,4	2,17 + 10,22 /k_{mod}
SWD8.0X130	64	4,4	2,17 + 10,22 /k_{mod}
SWD8.0X160	67	7,8	3,9 + 10,22 /k_{mod}
SWD8.0X190	78	9,9	4,94 + 10,22 /k_{mod}
SWD8.0X220	88	12,0	5,98 + 10,22 /k_{mod}
SWD8.0X245	97	13,7	6,84 + 10,22 /k_{mod}
SWD8.0X275	108	13,7	6,84 + 10,22 /k_{mod}
SWD8.0X300	117	17,5	8,74 + 10,22 /k_{mod}
SWD8.0X330	127	17,5	8,74 + 10,22 /k_{mod}

Characteristic parameters of fasteners and more information are included in chapter 10.





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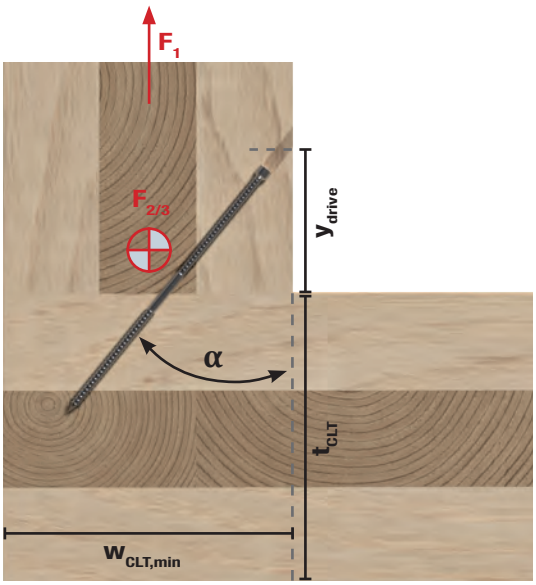
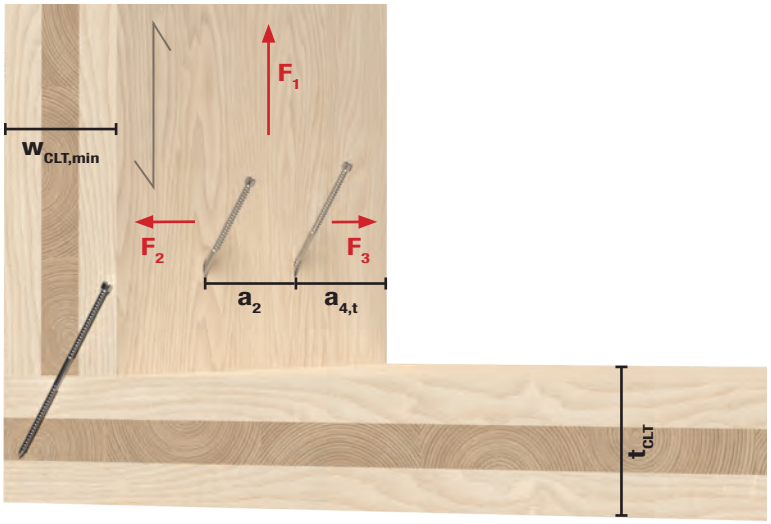
CLT Wall to CLT Floor / Ceiling Connection – SWD 25° Inclined Installation

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		80			90			100			120			140			160			180		
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]
SWD6.5x160	100	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25
SWD6.5x190	110	105	3,82	2,45	95-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45
SWD6.5x220	120	-	-	-	-	-	-	115-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59
SWD8.0x220	125	-	-	-	-	-	-	115-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59
SWD8.0x245	135	-	-	-	-	-	-	-	-	-	120-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77
SWD8.0x275	150	-	-	-	-	-	-	-	-	-	145-160	5,88	3,77	125-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77
SWD8.0x300	150	-	-	-	-	-	-	-	-	-	-	-	-	150-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00
SWD8.0x330	165	-	-	-	-	-	-	-	-	-	-	-	-	175-185	6,75	4,00	155-185	6,75	4,00	135-185	6,75	4,00

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		200			220			240			260			280			300						
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]			
SWD6.5x160	100	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25	90	3,31	2,25			
SWD6.5x190	110	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45	90-105	3,82	2,45			
SWD6.5x220	120	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59	95-120	4,26	2,59			
SWD8.0x220	125	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59	110-120	5,41	3,59			
SWD8.0x245	135	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77	110-130	5,88	3,77			
SWD8.0x275	150	110-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77	110-160	5,88	3,77			
SWD8.0x300	150	135-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00	135-155	6,75	4,00			
SWD8.0x330	165	135-185	6,75	4,00	135-185	6,75	4,00	135-185	6,75	4,00	135-185	6,75	4,00	135-185	6,75	4,00	135-185	6,75	4,00			

Table continues on next page.





SWD

	Ø6,5	Ø8,0
a_2	17	20
$a_{4,t}$	39	48

Note: Other min. spacing and edge distances requirements are fulfilled for the installation characteristics given in the load table. If the grain orientation of the CLT panel is different the spacing defintion may change.

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CLT Wall to CLT Floor / Ceiling Connection – SWD 35° Inclined Installation

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		80			90			100			120			140			160			180		
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]
SWD6.5x190	130	90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45
SWD6.5x220	145	-	-	-	100-105	3,72	2,59	90-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59
SWD8.0x220	150	-	-	-	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59
SWD8.0x245	165	-	-	-	-	-	-	115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77
SWD8.0x275	180	-	-	-	-	-	-	140	5,23	3,77	120-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77
SWD8.0x300	190	-	-	-	-	-	-	-	-	-	140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00
SWD8.0x330	205	-	-	-	-	-	-	-	-	-	165	5,84	4,00	145-165	5,84	4,00	125-165	5,84	4,00	120-165	5,84	4,00

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		200			220			240			260			280			300						
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]			
SWD6.5x190	130	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45	85-90	3,4	2,45			
SWD6.5x220	145	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59	85-105	3,72	2,59			
SWD8.0x220	150	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59	105	4,87	3,59			
SWD8.0x245	165	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77	105-115	5,23	3,77			
SWD8.0x275	180	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77	105-140	5,23	3,77			
SWD8.0x300	190	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00	120-140	5,84	4,00			
SWD8.0x330	205	120-165	5,84	4,00	120-165	5,84	4,00	120-165	5,84	4,00	120-165	5,84	4,00	120-165	5,84	4,00	120-165	5,84	4,00			

CLT Wall to CLT Floor / Ceiling Connection – SWD 45° Inclined Installation

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		80			90			100			120			140			160			180		
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]
SWD6.5x220	165	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59
SWD8.0x245	190	-	-	-	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77
SWD8.0x275	210	-	-	-	115-120	4,71	3,77	105-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77
SWD8.0x300	225	-	-	-	-	-	-	-	-	-	105-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4,00
SWD8.0x330	245	-	-	-	-	-	-	-	-	-	125-140	5,15	4,00	105-140	5,15	4,00	100-140	5,15	4,00	100-140	5,15	4,00

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		200			220			240			260			280			300						
		y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	y_{drive}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]			
SWD6.5x220	165	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59	85-90	3,3	2,59			
SWD8.0x245	190	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77	100	4,71	3,77			
SWD8.0x275	210	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77	100-120	4,71	3,77			
SWD8.0x300	225	100-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4,00	100-120	5,15	4	100-120	5,15	4,00			
SWD8.0x330	245	100-140	5,15	4,00	100-140	5,15	4,00	100-140	5,15	4,00	100-140	5,15	4,00	100-140	5,15	4	100-140	5,15	4,00			

Characteristic parameters of fasteners and more information are included in chapter 10.

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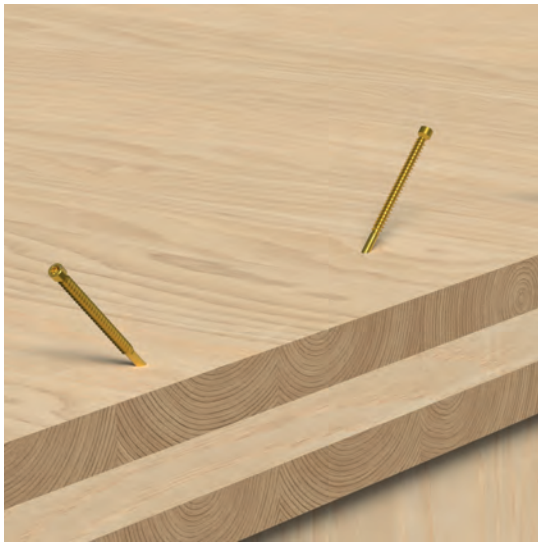
ESCRFTZ – Fully Threaded Cylinder-Head Screw

The fully threaded ESCRFTZ screws are designed for CLT and glulam constructions. The screw is approved to be used for beam reinforcement applications and is suitable for inclined installations. By installing a cross pair the connection can take loads in several directions.

Advantages:
- Fully threaded
- Small cylinder head for hidden assemblies
- No pre-drilling required



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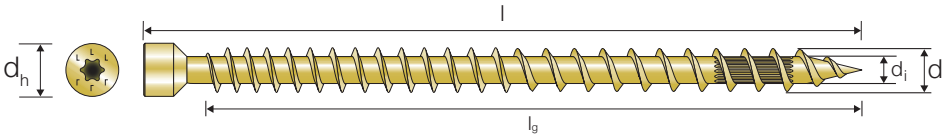


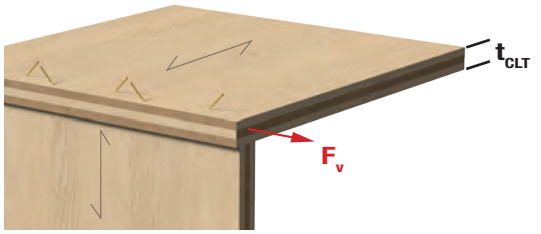
ESCRFTZ – Range Overview

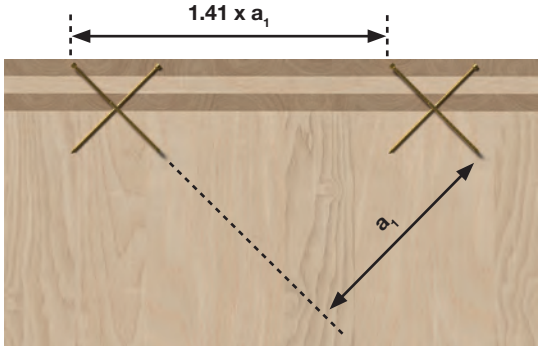
Product Reference	Dimensions [mm]				
	d	l	l_g	d_h	d_i
ESCRFTZ8.0xℓ	8,0	120 - 400	110 - 390	10,2	5,2

CLT Wall to CLT Floor / Ceiling Connection – ESCRFTZ 45° Cross Pairs

Product Reference	Minimum thickness $t_{CLT,min}$	Shear capacity $R_{v,k} = \min(R_{w,k,pair}; R_{buck,k,pair})$ [kN]	
		$R_{w,k,pair}$	$R_{buck,k,pair}$
ESCRFTZ8.0X120	64	6,2	3,11 + 9,23 /k_{mod}
ESCRFTZ8.0X140	64	7,6	3,8 + 9,23 /k_{mod}
ESCRFTZ8.0X160	67	9,0	4,49 + 9,23 /k_{mod}
ESCRFTZ8.0X180	74	10,4	5,18 + 9,23 /k_{mod}
ESCRFTZ8.0X200	81	11,8	5,87 + 9,23 /k_{mod}
ESCRFTZ8.0X220	88	13,1	6,56 + 9,23 /k_{mod}
ESCRFTZ8.0X240	95	14,5	7,25 + 9,23 /k_{mod}
ESCRFTZ8.0X260	102	15,9	7,95 + 9,23 /k_{mod}
ESCRFTZ8.0X280	109	17,3	8,64 + 9,23 /k_{mod}
ESCRFTZ8.0X300	117	18,7	9,33 + 9,23 /k_{mod}
ESCRFTZ8.0X350	134	22,1	11,06 + 9,23 /k_{mod}
ESCRFTZ8.0X400	152	25,6	12,79 + 9,23 /k_{mod}

Characteristic parameters of fasteners and more information are included in chapter 10.





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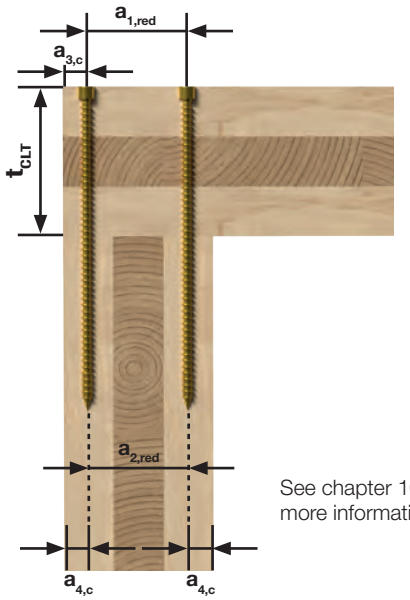
Minimum Distances
CLT Wall to CLT Floor / Ceiling Connection – Screws 45° Cross Pairs

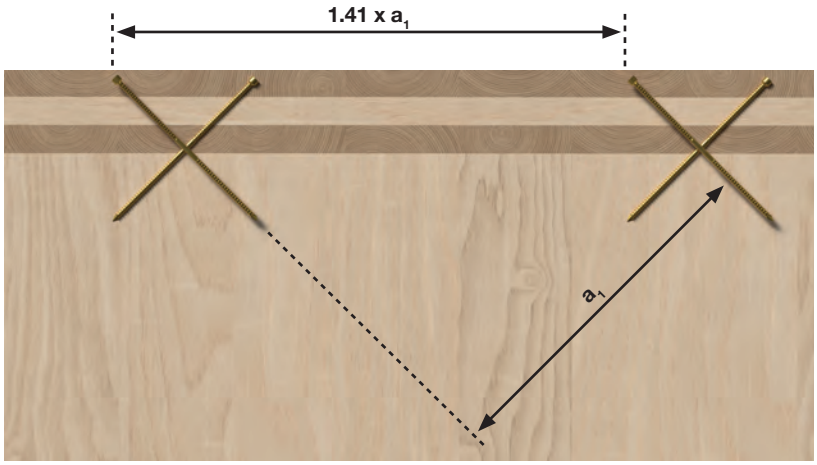
Dimensions	a_1	$a_{1,red}$	$a_{2,red}$	$a_{3,c}$	$a_{4,c}$
SWD6.5	65	10	10	39	20
SWD8.0	80	12	12	48	24
ESCRFTZ6.5	80	12	12	48	24



See chapter 10 for more information.

Recommended max. Pre-Drilling Diameter:

Product Reference	Max. Pre-Drill Hole Diameter [mm]
SWD6,5	Ø3,5
SWD8,0	Ø5,0
ESCRFTZ8,0	Ø5,0



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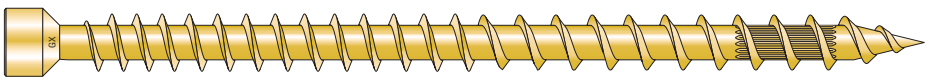
HELPFUL TIP

When to choose fully threaded screws or double threaded screws?



ESCRFTZ

Fully threaded screws can take higher loads, if well placed. They can be used for reinforcement of beams.

OR

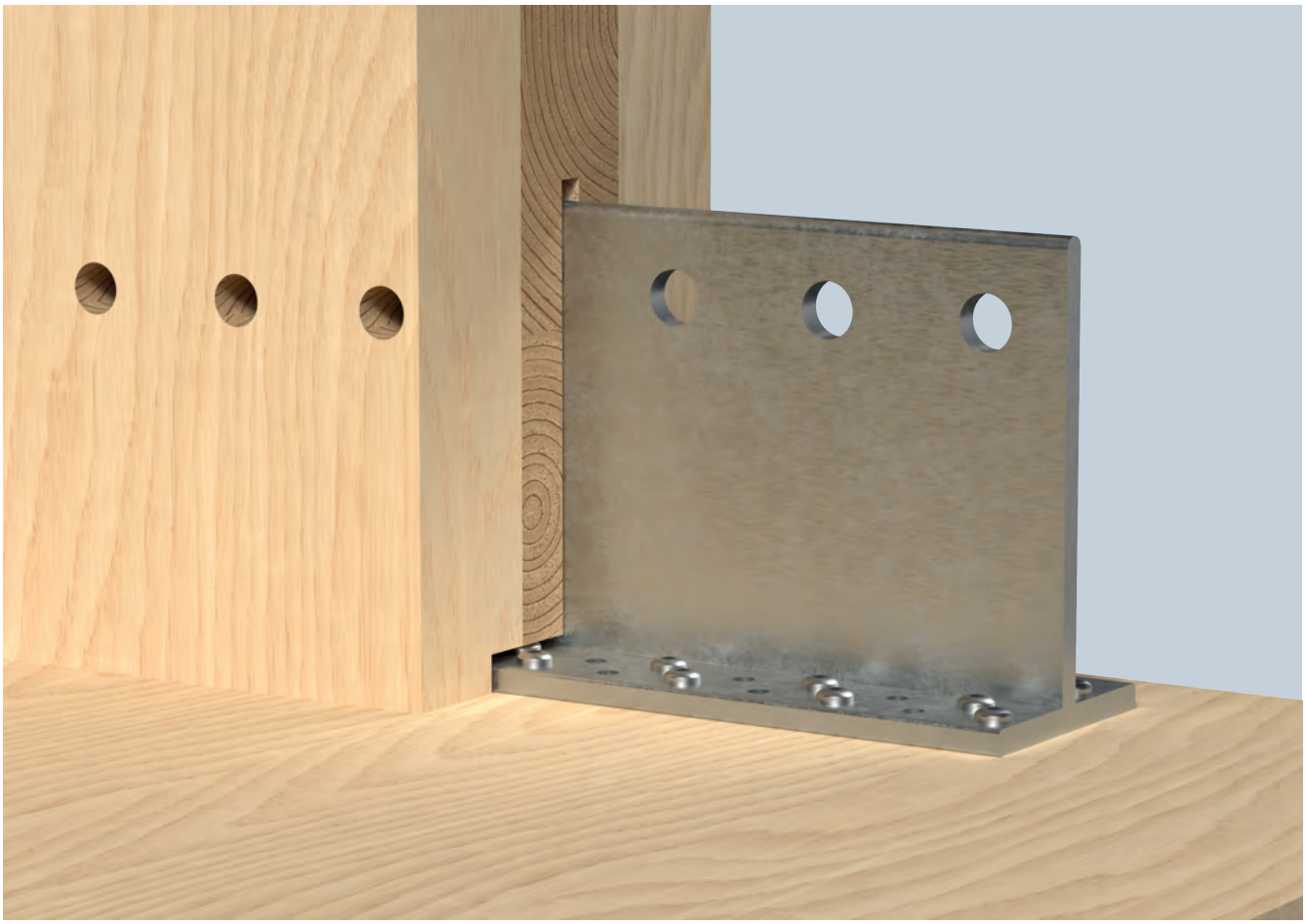
SWD

Double threaded screws have the advantage of partial threaded screws and fully threaded screws:

- Take higher loads than partially threaded screws
- Can pull two wood members together creating a clamp effect

Concealed Connection

The BTALU concealed connector is installed within pre-cut sections of the vertical CLT panel, resulting in an invisible connection capable of impressive characteristic capacities.



Items Required

Concealed Connector – Uplift and Shear Restraint
BTALU

BTALU

Timber Fasteners
CSA Connector Screw,
CNA Connector Nails,
STD Dowels for Concealed Connectors

CSA CNA

STD

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Concealed Connection

BTALU – Concealed Connector

A wall-to-floor connection solution when both faces of the CLT panel are to be visisble is the BTALU connector – as it is completely concealed once installed. Dowels can be chosen to fit into the CLT panel, with plugs that can be added to achieve a perfect cosmetic result. This method also helps to achieve good fire performance.

Advantages:

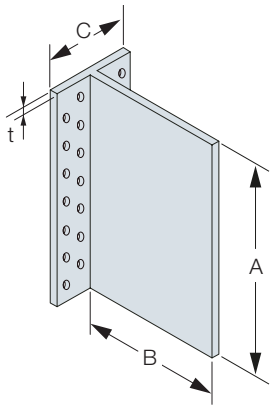
- Concealed connection
- Adjustable length to fit all configuration
- Good fire performance

ETA-07/0245

Note: BTALU holes to be drilled by the user

Dimensions

Model No.	Dimensions [mm]				Qty Holes
	A	B	C	t	Screws or Nails
BTALU90	90	103	62	6,0	16 Ø5
BTALU120	120	103	62	6,0	22 Ø5
BTALU160	160	103	62	6,0	30 Ø5
BTALU200	200	103	62	6,0	38 Ø5
BTALU240	240	103	62	6,0	46 Ø5
BTALU1200	1200	103	62	6,0	240 Ø5
BTALU3000	3000	103	62	6,0	600 Ø5



Characteristic Capacity – CLT Wall to CLT Floor / Ceiling Connection – 1 Concealed Connector

Model No.	Fasteners		Characteristic Values [kN]					
	Flange A CLT Floor / Ceiling	Flange B CLT Wall	Shear ($R_{1,k} = R_{2,k}$) Length of the dowels [mm]					Tension ($R_{4,k}$) All lengths
			80	100	120	140	160	
BTALU120	20 CNA4.0x50	3 STD12	18,2	19,4	20,7	22,3	23,9	9,8
BTALU160	28 CNA4.0x50	4 STD12	29,5	31,2	33,3	35,7	38,2	13,7
BTALU200	36 CNA4.0x50	5 STD12	41,9	44,3	47,2	50,4	53,9	17,6
BTALU240	44 CNA4.0x50	6 STD12	54,9	57,9	61,7	65,9	70,3	21,5
BTALU280	52 CNA4.0x50	7 STD12	68,0	71,7	76,4	81,7	87,2	25,5
BTALU320	60 CNA4.0x50	8 STD12	81,0	85,5	91,2	97,5	104,1	29,4
BTALU360	68 CNA4.0x50	9 STD12	93,8	99,0	105,8	113,3	121,1	33,3
BTALU400	76 CNA4.0x50	10 STD12	106,1	112,3	120,2	129,0	137,9	37,2
BTALU440	84 CNA4.0x50	11 STD12	118,0	125,2	134,4	144,4	154,7	41,2
BTALU480	92 CNA4.0x50	12 STD12	129,3	137,7	148,2	159,7	171,3	45,1
BTALU520	100 CNA4.0x50	12 STD12	129,3	138,4	150,5	163,1	175,8	49,0
BTALU560	108 CNA4.0x50	12 STD12	129,3	138,4	150,7	164,9	179,1	52,9
BTALU600	116 CNA4.0x50	12 STD12	129,3	138,4	150,7	164,9	180,4	56,8

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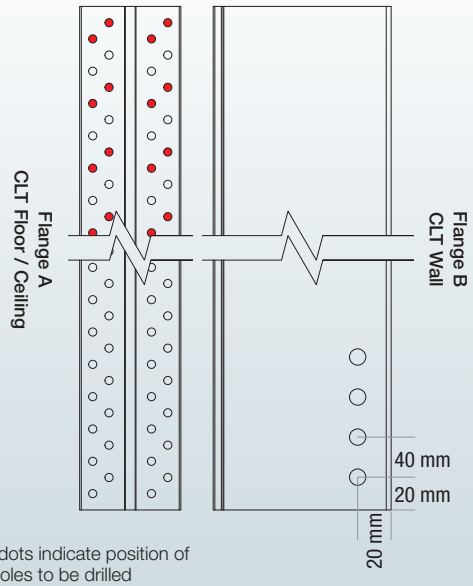
Concealed Connection

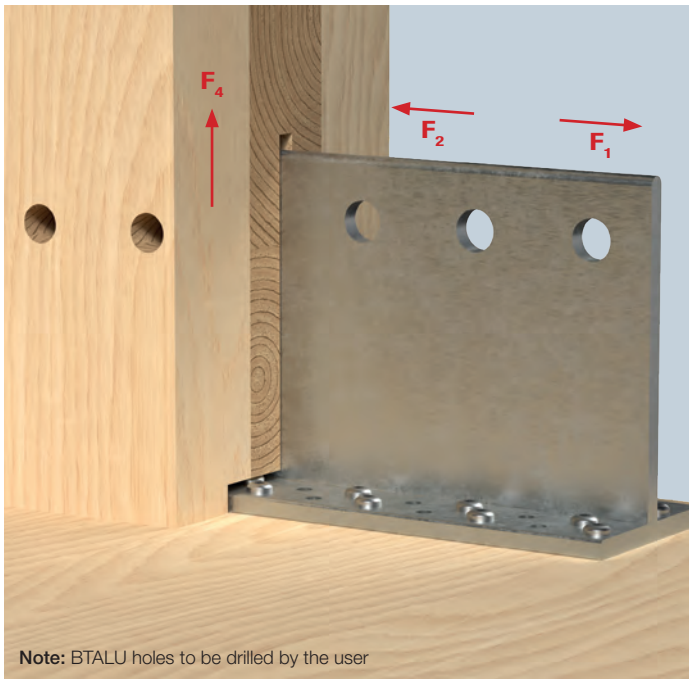
Characteristic Capacity – CLT Wall to CLT Floor / Ceiling Connection – 1 Concealed Connector

Model No.	Fasteners		Characteristic Values [kN]					
	Flange A CLT Floor / Ceiling	Flange B CLT Wall	Shear ($R_{1,k} = R_{2,k}$) Length of the dowels [mm]					Tension ($R_{4,k}$) All lengths
			80	100	120	140	160	
BTALU120	20 CSA5.0x50	3 STD12	32,2	34,6	37,6	41,1	45,1	18,4
BTALU160	24 CSA5.0x50	4 STD12	43,0	46,1	50,1	54,9	60,0	24,5
BTALU200	28 CSA5.0x50	5 STD12	53,8	57,6	62,7	68,6	75,1	30,6
BTALU240	32 CSA5.0x50	6 STD12	64,6	69,2	75,3	82,4	90,1	36,7
BTALU280	36 CSA5.0x50	7 STD12	75,4	80,7	87,9	96,1	105,2	42,8
BTALU320	40 CSA5.0x50	8 STD12	86,2	92,2	100,4	109,9	120,3	49,0
BTALU360	44 CSA5.0x50	9 STD12	97,0	103,8	113,0	123,6	135,3	55,1
BTALU400	48 CSA5.0x50	10 STD12	107,8	115,3	125,5	137,4	145,0	61,2
BTALU440	52 CSA5.0x50	11 STD12	118,5	126,9	138,1	145,4	147,7	67,3
BTALU480	56 CSA5.0x50	12 STD12	129,3	138,4	145,5	148,0	149,5	73,4
BTALU520	56 CSA5.0x50	12 STD12	129,3	138,4	145,5	148,0	149,5	79,6
BTALU560	56 CSA5.0x50	12 STD12	129,3	138,4	145,5	148,0	149,5	85,7
BTALU600	56 CSA5.0x50	12 STD12	129,3	138,4	145,5	148,0	149,5	91,8

Fastening Pattern



Red dots indicate position of the holes to be drilled



Note: BTALU holes to be drilled by the user

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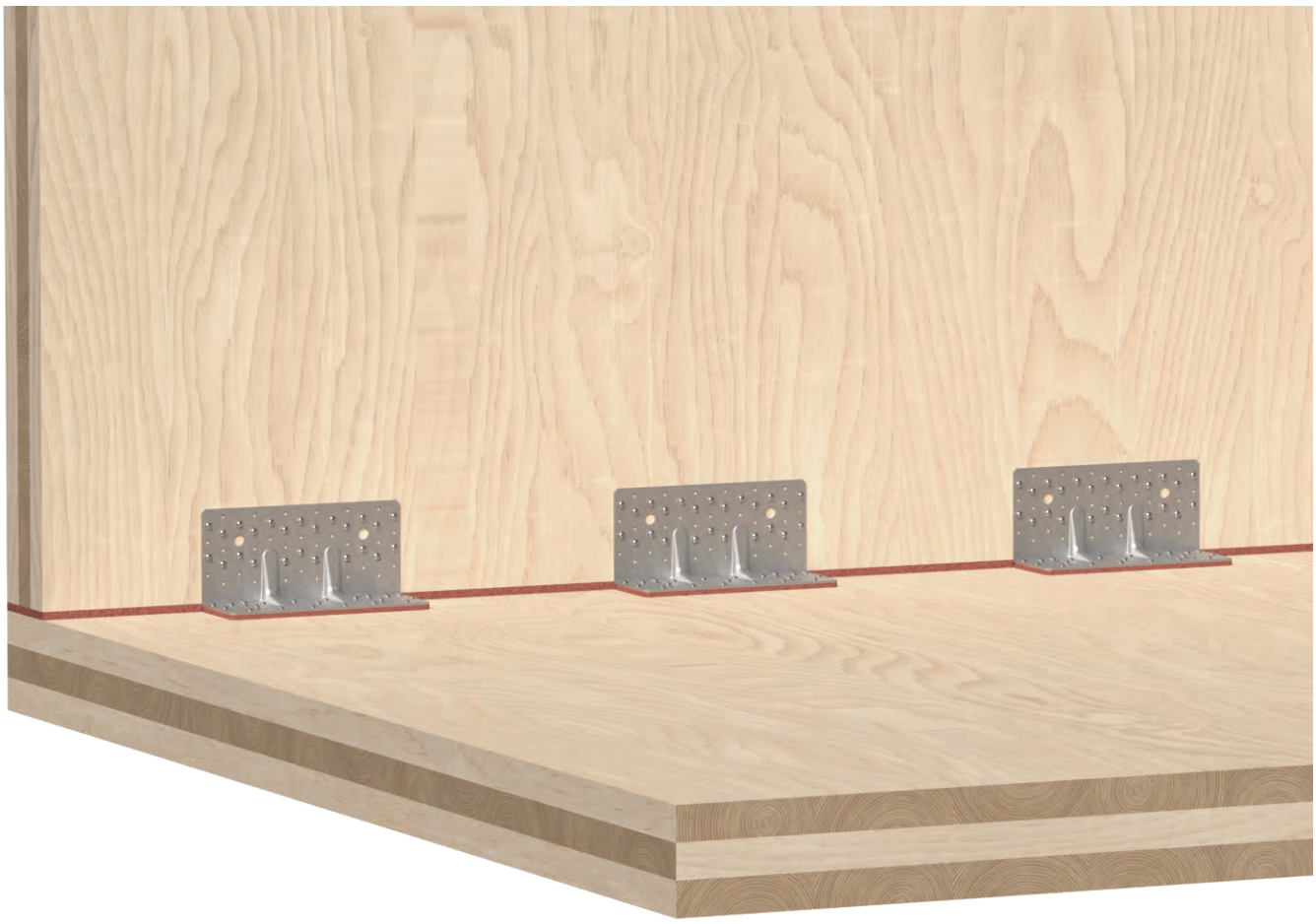
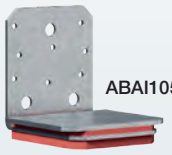
Acoustic Solutions

Angle brackets and fasteners adapted for use with acoustic absorbent material help to provide superior resistance to sound transfer through CLT wall and floor junctions.



Items Required

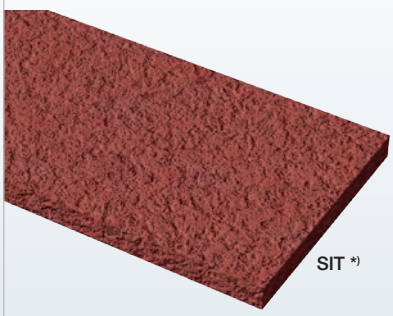
Acoustic Isolating Angle Brackets – Uplift and shear restraint
ABAI105, ABR255



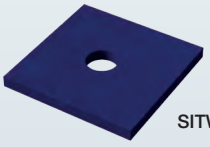
ABAI105

ABR255

Acoustic Isolating Washers
SIT + SITW + SITW-M



SIT *)

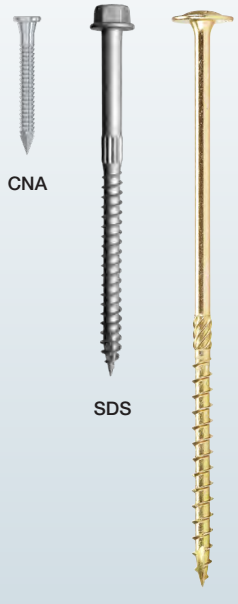


SITW

SITW-M

*) Colour may change depending on product

Timber Fasteners
CNA Connector Nails,
SDS ABAI Connector Screw,
SWW Washer-Head Screw



CNA

SDS

SWW

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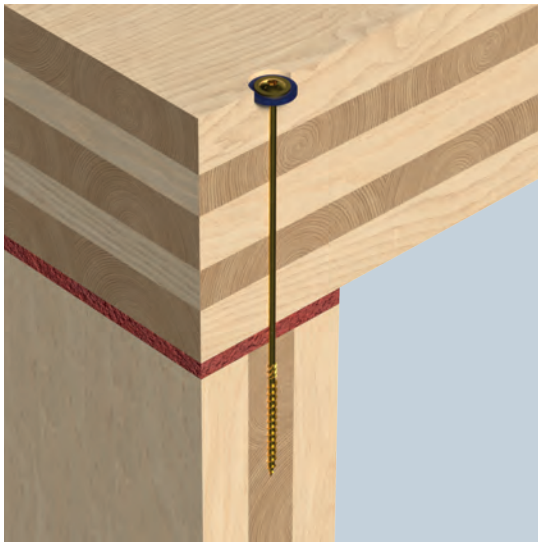
SIT SITW SITW-H – Acoustic Isolating Washers

SITW washers are combined with SIT isolating strips to create a high-performance system in CLT buildings that are required to deliver superior acoustic performance. The isolating washer is fitted between a metal washer and the CLT when assembling with screws, which prevents vibration being transmitted through the connection.

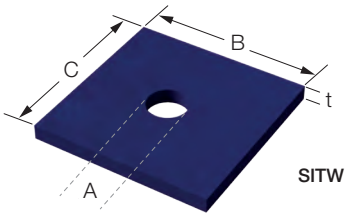
Advantages:

- Reduced sound transfer between structural components
- Improved draught sealing



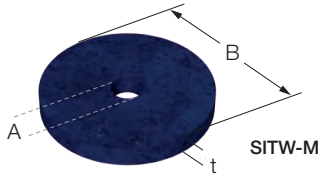
Dimensions

Model No.	Dimensions [mm]			Static load [N/mm²]	
	Width	Length	Thickness	Min.	Max.
SIT75	On demand	On demand	6 or 12,5	0,05	0,075
SIT150				0,10	0,15
SIT350				0,23	0,35
SIT750				0,50	0,75
SIT1500				1,00	1,50



SITW

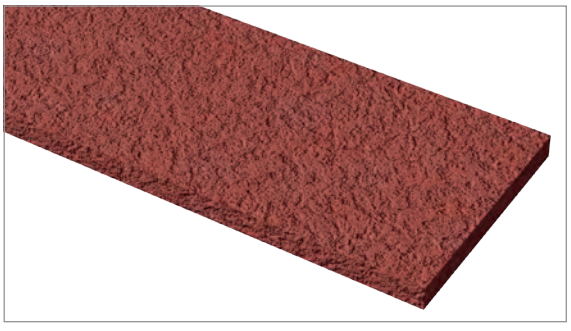
Model No.	Compatible connectors	Dimensions [mm]			
		A	B	C	t
SITW70/70	HTT	Ø~12	70	70	6,0
SITW100/265	ABR255	-	100	265	6,0



SITW-M

The SIT material is chosen depending of the load applied on the panel, the width of the panel and the expected performances.
Contact us for more information.

Model No.	Compatible fasteners	Dimensions [mm]		
		A	B	t
SITW-M0608	Ø6 or 8	Ø8,5	Ø34	6
SITW-M1012	Ø10 or 12	Ø12,5	Ø49	6



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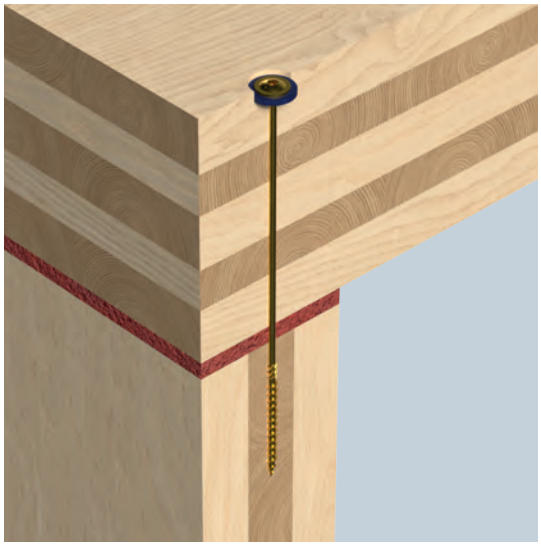
SWW + SIT – Washer-Head Screw with Acoustic Isolating Washers

In wall-to-wall connections the SWW washer-head screw is recommended due to the high head pull-through resistance it provides. The washer head also pulls the wall elements together, creating a firm assembly. By adding an acoustic washer the transfer of sound is decreased.

Advantages:

- High head pull-through resistance
- Pull the wood members together
- No pre-drilling required



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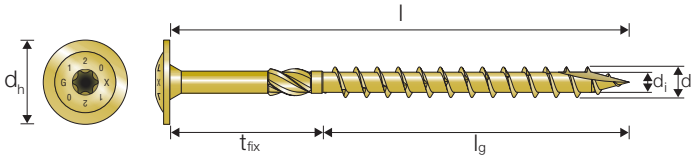

SWW – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
SWW6.0xℓ	6,0	60 - 300	42 - 70	14	3,9	18 - 230
SWW8.0xℓ	8,0	80 - 400	50 - 80	22	5,2	30 - 320
SWW10.0xℓ	10,0	100 - 400	50 - 80	25	6,2	50 - 320

CLT Wall to CLT Floor / Ceiling Connection – SWW + SIT 90° Installation

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																			
		80		100		120		140		160		180		200		220		240		260	
		$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$
		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]	
SWW6x160 + SIT	60	3,16	0,75	2,91	0,75	1,87	0,6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWW6x180 + SIT	60	3,16	0,75	3,16	0,75	2,91	0,75	1,87	0,6	-	-	-	-	-	-	-	-	-	-	-	-
SWW6x200 + SIT	60	3,16	0,75	3,16	0,75	3,16	0,75	2,91	0,75	1,87	0,6	-	-	-	-	-	-	-	-	-	-
SWW6x220 + SIT	60	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	2,91	0,75	1,87	0,6	-	-	-	-	-	-	-	-
SWW6x240 + SIT	60	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	2,91	0,75	1,87	0,6	-	-	-	-	-	-
SWW6x260 + SIT	60	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	2,91	0,75	1,87	0,6	-	-	-	-
SWW6x280 + SIT	60	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	2,91	0,75	1,87	0,6	-	-
SWW6x300 + SIT	60	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	3,16	0,75	2,91	0,75	1,87	0,6

Table continues on next page.

HELPFUL TIP

Head side element must be predrilled to avoid sound transmission between the smooth shank part of the screw and the timber.

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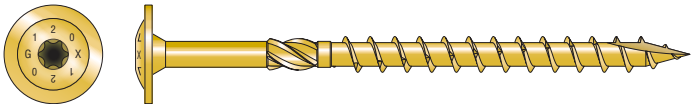
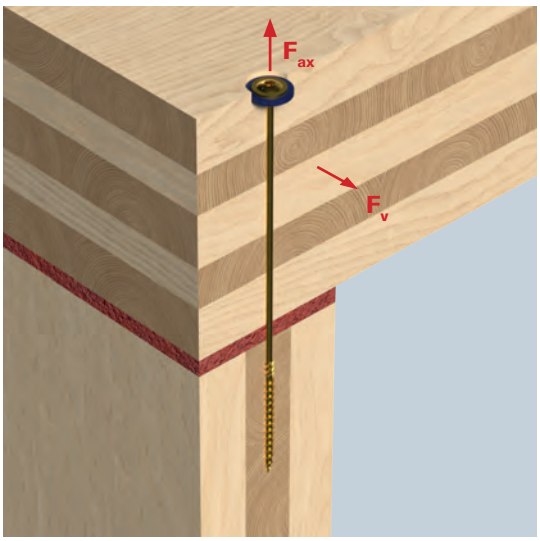
Acoustic Solutions

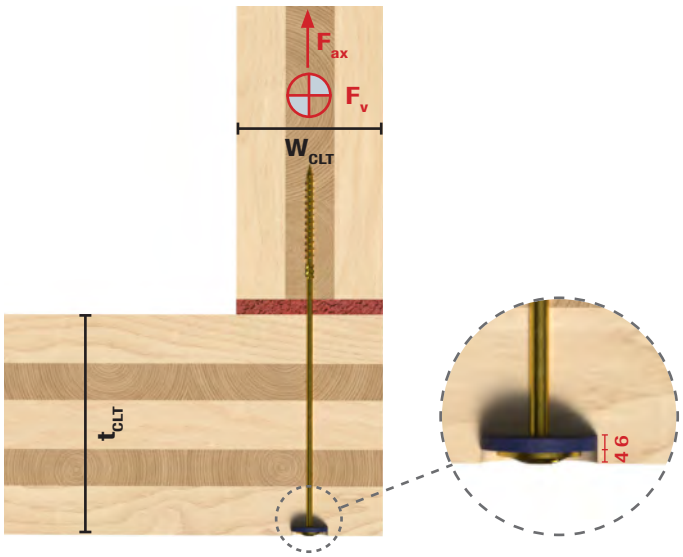


CLT Wall to CLT Floor / Ceiling Connection – SWW + SIT 90° Installation (cont.)

Product Reference	$w_{CLT,min}$ [mm]	t_{CLT} [mm]																					
		100		120		140		160		180		200		220		240		260		280		300	
		$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$
		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]	
SWW8x160 + SIT	80	3,67	1,18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWW8x180 + SIT	80	4,92	1,39	3,67	1,18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWW8x200 + SIT	80	5,08	1,39	4,92	1,39	3,67	1,18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWW8x220 + SIT	80	5,08	1,39	5,08	1,39	4,92	1,39	3,67	1,18	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWW8x240 + SIT	80	5,08	1,39	5,08	1,39	5,08	1,39	4,92	1,39	3,67	1,18	-	-	-	-	-	-	-	-	-	-	-	-
SWW8x260 + SIT	80	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	4,92	1,39	3,67	1,18	-	-	-	-	-	-	-	-	-	-
SWW8x280 + SIT	80	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	4,92	1,39	3,67	1,18	-	-	-	-	-	-	-	-
SWW8x300 + SIT	80	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	4,92	1,39	3,67	1,18	-	-	-	-	-	-
SWW8x320 + SIT	80	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	4,92	1,39	3,67	1,18	-	-	-	-
SWW8x340 + SIT	80	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	4,92	1,39	3,67	1,18	-	-
SWW8x360 + SIT	80	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	4,92	1,39	3,67	1,18
SWW8x380 + SIT	80	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	4,92	1,39
SWW8x400 + SIT	80	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39	5,08	1,39
SWW10x180 + SIT	100	-	-	4,38	1,52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWW10x200 + SIT	100	-	-	5,89	1,79	4,38	1,52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWW10x220 + SIT	100	-	-	6,38	1,99	5,89	1,79	4,38	1,52	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWW10x240 + SIT	100	-	-	6,38	1,99	6,38	1,99	5,89	1,79	4,38	1,52	-	-	-	-	-	-	-	-	-	-	-	-
SWW10x260 + SIT	100	-	-	6,38	1,99	6,38	1,99	6,38	1,99	5,89	1,79	4,38	1,52	-	-	-	-	-	-	-	-	-	-
SWW10x280 + SIT	100	-	-	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	5,89	1,79	4,38	1,52	-	-	-	-	-	-	-	-
SWW10x300 + SIT	100	-	-	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	5,89	1,79	4,38	1,52	-	-	-	-	-	-
SWW10x320 + SIT	100	-	-	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	5,89	1,79	4,38	1,52	-	-	-	-
SWW10x340 + SIT	100	-	-	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	5,89	1,79	4,38	1,52	-	-
SWW10x360 + SIT	100	-	-	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	5,89	1,79	4,38	1,52
SWW10x380 + SIT	100	-	-	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	5,89	1,79
SWW10x400 + SIT	100	-	-	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99	6,38	1,99

Characteristic parameters of fasteners and more information are included in chapter 10.





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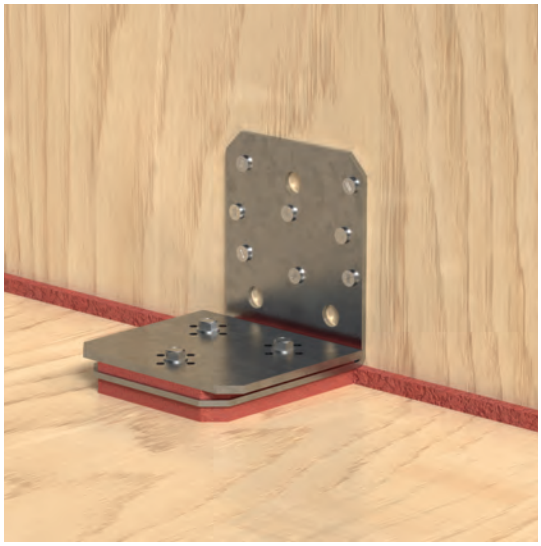
ABAI – Acoustic Isolating Angle Bracket

Developed specifically to provide exceptional acoustic performance, ABAI features two intermediate layers of sound isolation material to be fully integrated into the CLT wall-to-floor connection, preventing the transmission of vibration through the angle bracket and fasteners.

Advantages:

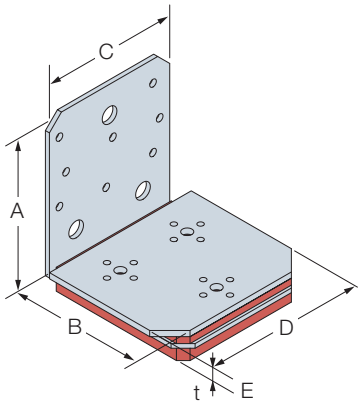
- Good balance between mechanical and acoustic performances
- Reduced build time and cost as addition sound insulation is not required
- Dedicated CLT-CLT fastener pattern



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]						Qty Holes Flange A		Qty Holes Flange B
	A	B	C	D	E	t	Screws or Nails	Bolts/ Anchors	Screws
ABAI105	113	103	90	106	18	3,0	8 Ø5	3 Ø11	3 Ø7



Characteristic Capacity and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k} = k_{ser,R3,k}$
ABAI105	8 CNA4.0x60	3 SDS25600	$2,0/k_{mod}$	$2,0/k_{mod}$	0,8	0,6
	8 CSA5.0x50	3 SDS25600	$2,0/k_{mod}$	$2,0/k_{mod}$	0,8	0,6

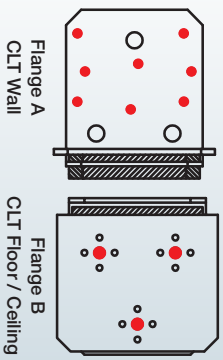
Ultimate Limit State Capacity (Limit Deformation) and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Tensile $R_{1,u}$	Shear $R_{2,u} = R_{3,u}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k} = k_{ser,R3,k}$
ABAI105	8 CNA4.0x60	3 SDS25600	$7,9/k_{mod}$	$5,9/k_{mod}$	0,8	0,6
	8 CSA5.0x50	3 SDS25600	$7,9/k_{mod}$	$5,9/k_{mod}$	0,8	0,6

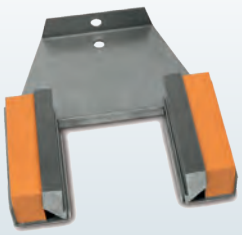
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

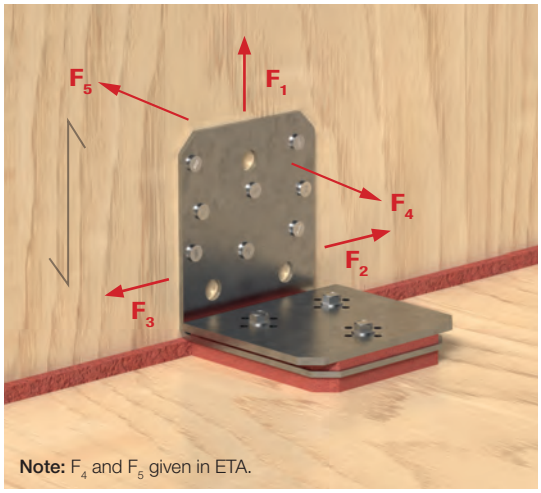
Fastening Pattern



Red dots indicate holes filled with fasteners.



Note: For proper acoustic performance ABAI105 needs to be installed using MOABAI mounting template.



Note: F_4 and F_5 given in ETA.

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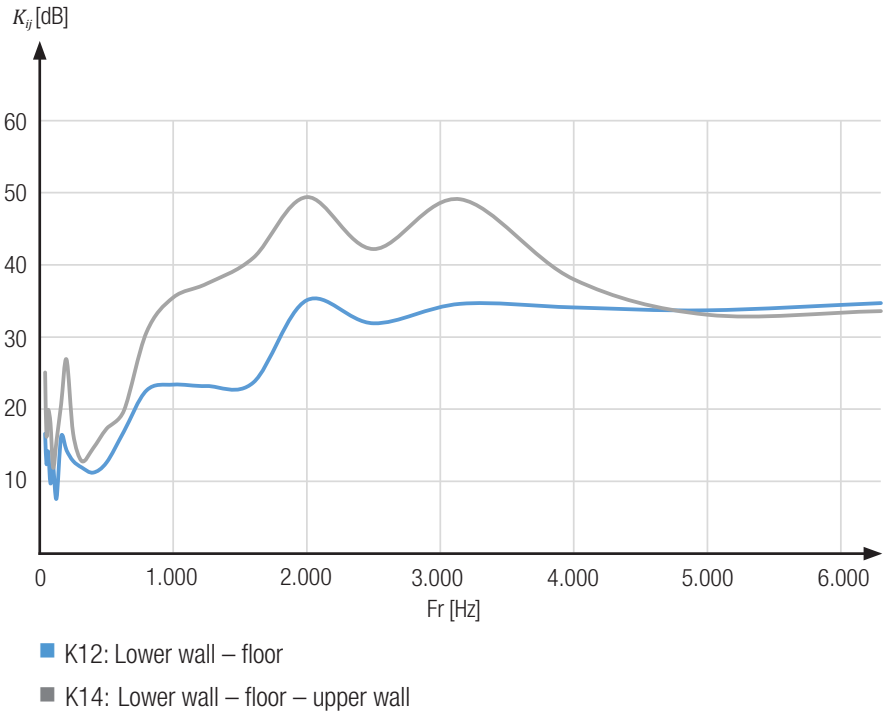
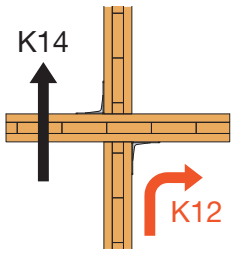
Acoustic Performance of ABAI105 with Sound Insulation Tile (SIT) at CLT Wall to CLT Floor Connection

Vibration Reduction Indices





Calculated Gains Compared to a Typical Angle Bracket without an Isolating Strip

	K12 [dB]	Gain12 [dB]	K14 [dB]	Gain14 [dB]
BF	12,7	0,9	18,3	4,7
MF	15,8	1,3	21,8	2,1
HF	31,4	9,4	40,5	1,6

In terms of sound transmission between the wall and floor, very high gains are achieved in the high frequency band. When it comes to transmission between levels, there is a significant increase in hearing perception for the low-frequency band compared to an typical angle bracket without an isolating strip.

Bass Frequencies

Fr [Hz]	K12 [dB]	K14 [dB]
40	16,6	25,1
50	12,4	16,3
63	14,1	19,9
80	9,7	18,1
100	12,0	11,9
125	7,6	15,6
160	16,2	20,7

Midrange Frequencies

Fr [Hz]	K12 [dB]	K14 [dB]
200	14,3	26,9
250	12,8	16,6
315	11,9	12,8
400	11,2	14,6
500	12,6	17,3
630	16,9	19,8
800	22,6	30,7
1000	23,4	35,5

High Frequencies

Fr [Hz]	K12 [dB]	K14 [dB]
1.250	23,2	37,4
1.600	23,7	41,0
2.000	35,1	49,4
2.500	31,9	42,2
3.150	34,6	49,1
4.000	34,1	38,0
5.000	33,7	33,1
6.300	34,7	33,6

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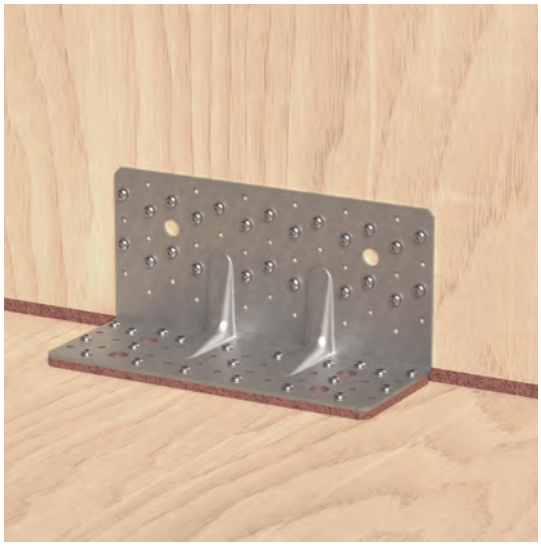
Acoustic Solutions

ABR255 + SIT – Reinforced Angle Bracket with Acoustic Isolation

Combined with SIT, the ABR255 provides high performances with improved acoustic performances.

Advantages:

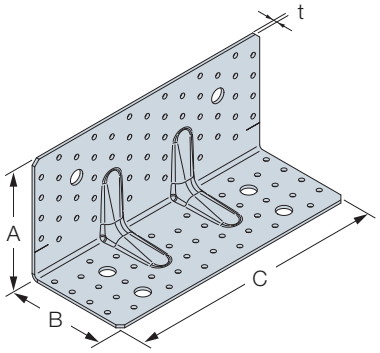
- High performance adapted to CLT buildings
- Very versatile thanks to its various nail pattern and fixing possibilities
- Load capacities in all directions



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B	
	A	B	C	t	Screws or Nails	Bolts/ Anchors	Screws or Nails	Bolts
ABR255	120	100	255	3,0	52 Ø5	2 Ø14	41 Ø5	4 Ø14
SITW100/265	100	265	-	6,0	-	-	-	-



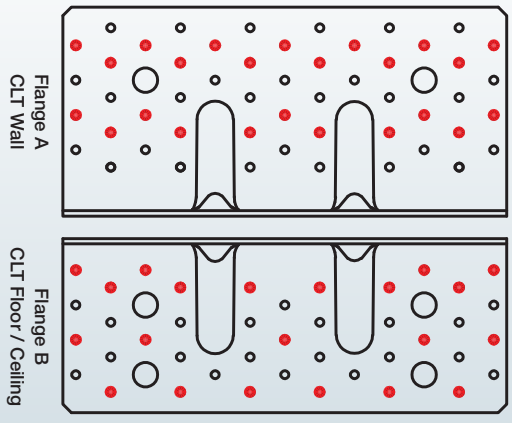
Characteristic Capacity and Slip Modulus – CLT Wall to CLT Floor / Ceiling Connection – 1 Angle Bracket

Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Flange A CLT	Flange B CLT	Tensile $R_{1,k}$	Shear $R_{2,k} = R_{3,k}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k} = k_{ser,R3,k}$
ABR255	24 CNA4.0x50	21 CNA4.0x50	$15,6/k_{mod}^{0,4}$	28,6	7,7	3,9
	24 CNA4.0x60	21 CNA4.0x60	$18,1/k_{mod}^{0,4}$	31,4	8,9	4,3
	24 CSA5.0x50	21 CSA5.0x50	$18,1/k_{mod}^{0,4}$	31,4	8,9	4,3

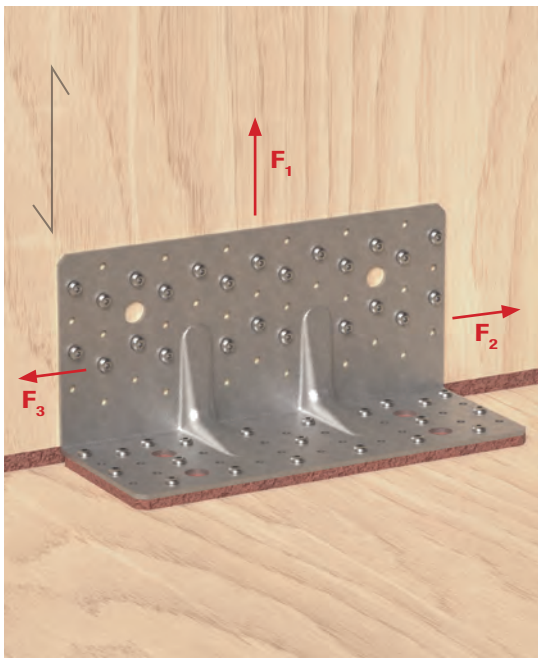
Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$$

Fastening Pattern



Red dots indicate holes filled with fasteners.



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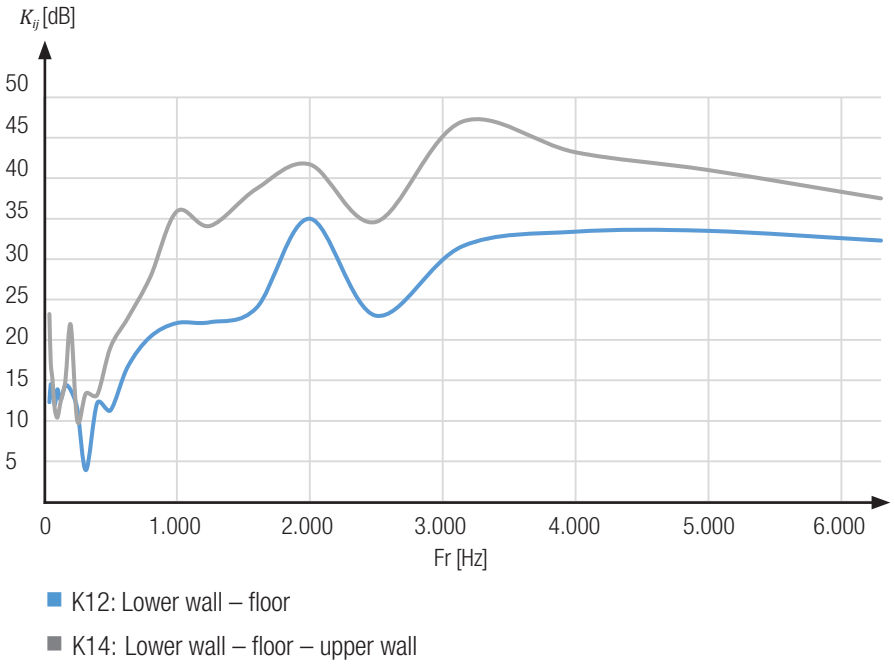
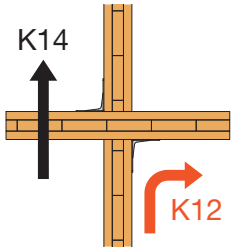
Acoustic Solutions

Acoustic Performance of ABAI105 with Sound Insulation Tile (SIT) at CLT Wall to CLT Floor / Ceiling Connection

Vibration Reduction Indices





Bass Frequencies

Fr [Hz]	K12 [dB]	K14 [dB]
40	12,3	23,2
50	14,5	17,2
63	14,4	15,1
80	12,0	11,5
100	13,9	10,4
125	12,6	12,4
160	14,4	14,9

Midrange Frequencies

Fr [Hz]	K12 [dB]	K14 [dB]
200	13,8	21,9
250	11,5	10,0
315	3,9	13,4
400	12,2	13,2
500	11,3	19,1
630	16,7	22,7
800	20,4	27,8
1000	22,1	35,9

High Frequencies

Fr [Hz]	K12 [dB]	K14 [dB]
1.250	22,2	34,1
1.600	24,0	38,7
2.000	35,0	41,7
2.500	23,0	34,6
3.150	31,6	47,0
4.000	33,4	43,2
5.000	33,5	41,0
6.300	32,3	37,5

Calculated Gains Compared to a Typical Angle Bracket without an Isolating Strip

	K12 [dB]	Gain12 [dB]	K14 [dB]	Gain14 [dB]
BF	13,5	1,7	15,0	1,4
MF	14,0	-0,5	20,5	0,8
HF	29,4	7,4	39,8	0,9

In terms of sound transmission between the wall and floor, very high gains are achieved in the high frequency band. When it comes to transmission between levels, there is a significant increase in hearing perception for the low-frequency band compared to an typical angle bracket without an isolating strip.

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CLT Floor to CLT Floor In-Plane Horizontal Connections

For larger buildings with upper floor spans greater than 15 metres it is necessary to link floor panels together.

A vital component in maintaining the stability of the structure and to resist racking forces, junctions between floor panels transmit shear forces between the panels.

The following section describes methods for linking floor panels using timber or steel splines, half-lap joints and butt-joints.

CLT Floor to CLT Floor Solutions

Timber Spline Connection

Product Options:

TTUFS see page 121
WSV see page 123

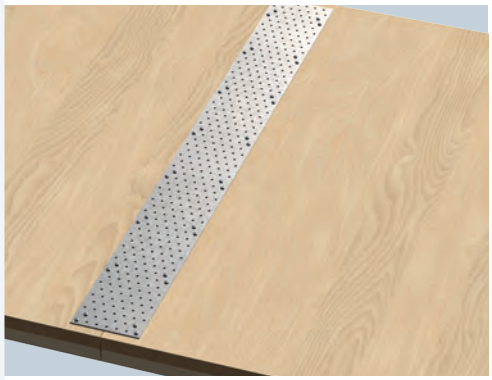
A common method for linking CLT floor panels, timber splines can be installed via routing a groove and fastening the spline across the gap.

Steel Spline Connection

Product Options:

NP see page 125
CSA see page 126

Similar to using a timber spline, with the benefits of a higher performance and a more cost-efficient solution as no routing of the panel is required.

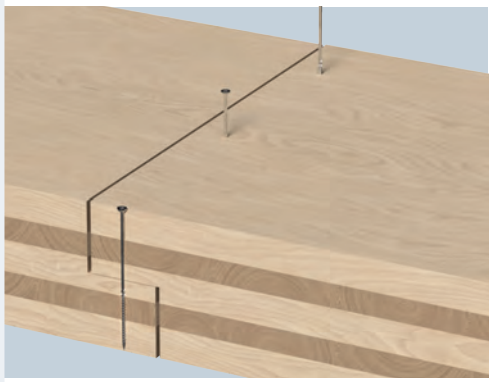


Half-Lap Joint

Product Options:

SWD see page 129
ESCRFTZ see page 130
TTUFS see page 131
SWC see page 132
SWW see page 134

Overlapping panels like this allows one panel to support the other during installation. Load capacity can be increased through the use of fully threaded screws where the timber splits.

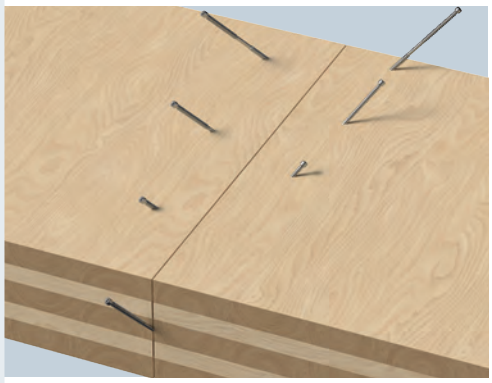


Butt-Joint

Product Options:

SWD see page 138
ESCRFTZ see page 140

Butt-joints are often employed as this form of CLT panel requires a simpler manufacturing process. The panels are pulled together using fully or double threaded structural screws which can also be installed in cross pairs for even greater load capacities.



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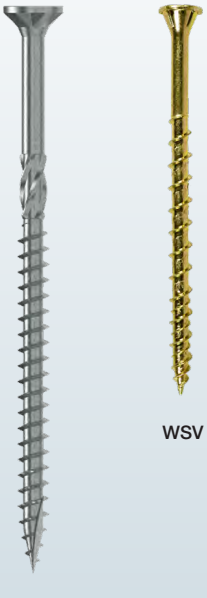
Timber Spline Connection

A common method for linking CLT floor panels, timber splines can be installed via routing a groove and fastening the spline across the gap.

Items Required

Timber Fasteners
TTUFS Countersunk Screw,
WSV Quik Drive® Collated Screw

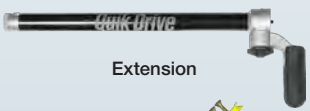


TTUFS

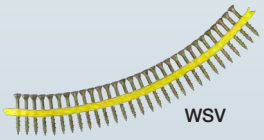
WSV

WSV is installed with our Quik Drive® QDPRO76SKE system

Attachment
QDPRO76



Extension



WSV

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Timber Spline Connection

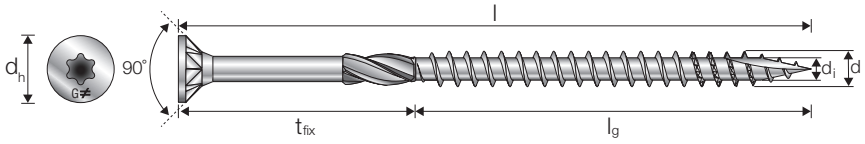
TTUFS – Countersunk Screw

The Solid-Drive TTUFS countersunk screws are available in a variety of dimensions, the deep 6-lobe recess provides a good control during installation and the countersunk head allows a flush finish after installation suitable for spline applications.

Advantages:

- Countersunk head sinks into the wood allowing a flush finish
- Milling thread to reduce the drive-in torque
- ETA approved

ETA-21/0670



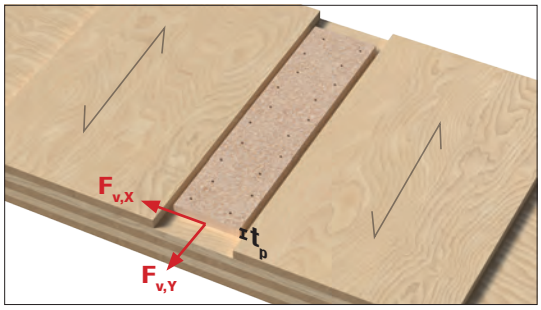
TTUFS – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
TTUFS4.5xℓ	4,5	25 - 80	20 - 50	8,4	2,8	5 - 5
TTUFS5.0xℓ	5,0	30 - 120	25 - 60	9,5	3,1	5 - 60
TTUFS6.0xℓ	6,0	40 - 180	34 - 70	11,6	3,7	6 - 110

TTUFS – CLT Spline Connection
Plywood Board ρ_k = 490 kg/m³ to CLT ρ_k = 350 kg/m³

Product Reference	Chracteristic Shear ($R_{v,X,k}$ or $R_{v,Y,k}$) Capacity for Plywood ($\rho_k \geq$ 490 kg/m³) to CLT ($\rho_k \geq$ 350kg/m³) Connection Depending of the Thickness of the Panel t_p				
	15	18	22	25	30
	$R_{v,90,k,15}$	$R_{v,90,k,18}$	$R_{v,90,k,22}$	$R_{v,90,k,25}$	$R_{v,90,k,30}$
TTUFS4.5X40	0,97	–	–	–	–
TTUFS4.5X45	1,01	1,07	–	–	–
TTUFS4.5X50	1,01	1,08	1,41	1,37	–
TTUFS4.5X60	1,01	1,08	1,44	1,44	1,44
TTUFS4.5X70	1,01	1,08	1,44	1,46	1,46
TTUFS4.5X80	1,01	1,08	1,44	1,51	1,51
TTUFS5.0X40	1,08	–	–	–	–
TTUFS5.0X50	1,20	1,28	1,59	1,56	–
TTUFS5.0X60	1,20	1,28	1,69	1,78	1,74
TTUFS5.0X70	1,20	1,28	1,69	1,78	1,93
TTUFS5.0X80	1,20	1,28	1,69	1,78	1,93
TTUFS5.0X90	1,20	1,28	1,69	1,78	1,95
TTUFS5.0X100	1,20	1,28	1,69	1,78	1,95
TTUFS5.0X120	1,20	1,28	1,69	1,78	1,95

Table continues on next page.



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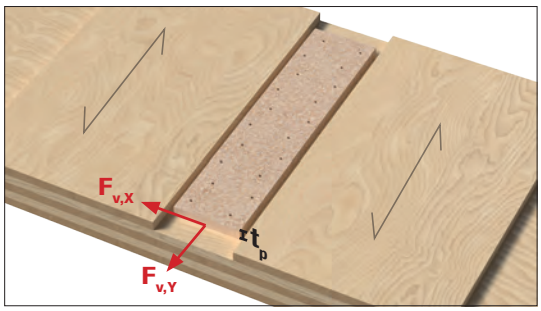
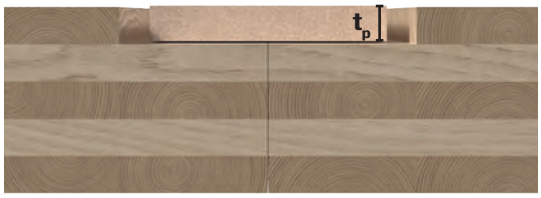
Timber Spline Connection

TTUFS – CLT Spline Connection
Plywood Board ρ_k = 490 kg/m³ to CLT ρ_k = 350 kg/m³ (cont)

Product Reference	Chracteristic Shear ($R_{v,X,k}$ or $R_{v,Y,k}$) Capacity for Plywood ($\rho_k \geq 490$ kg/m³) to CLT ($\rho_k \geq 350$kg/m³) Connection Depending of the Thickness of the Panel t_p				
	15	18	22	25	30
	$R_{v,90,k,15}$	$R_{v,90,k,18}$	$R_{v,90,k,22}$	$R_{v,90,k,25}$	$R_{v,90,k,30}$
TTUFS6.0X40	1,31	-	-	-	-
TTUFS6.0X50	1,53	1,56	1,74	1,71	-
TTUFS6.0X60	1,53	1,61	2,05	2,11	2,01
TTUFS6.0X70	1,53	1,61	2,15	2,25	2,43
TTUFS6.0X80	1,53	1,61	2,15	2,25	2,43
TTUFS6.0X90	1,53	1,61	2,17	2,27	2,45
TTUFS6.0X100	1,53	1,61	2,17	2,27	2,45
TTUFS6.0X120	1,53	1,61	2,17	2,27	2,45
TTUFS6.0X140	1,53	1,61	2,17	2,27	2,45
TTUFS6.0X160	1,53	1,61	2,17	2,27	2,45
TTUFS6.0X180	1,53	1,61	2,17	2,27	2,45

Characteristic parameters of fasteners and more information are included in chapter 10.

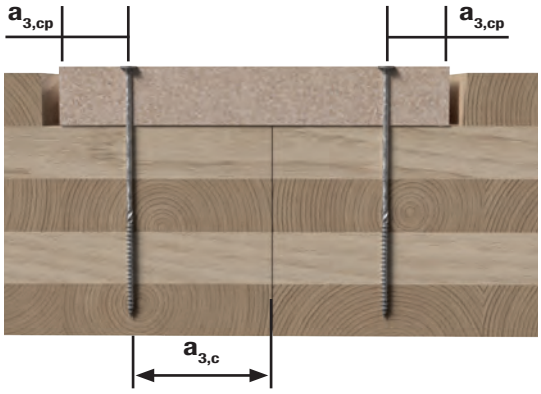


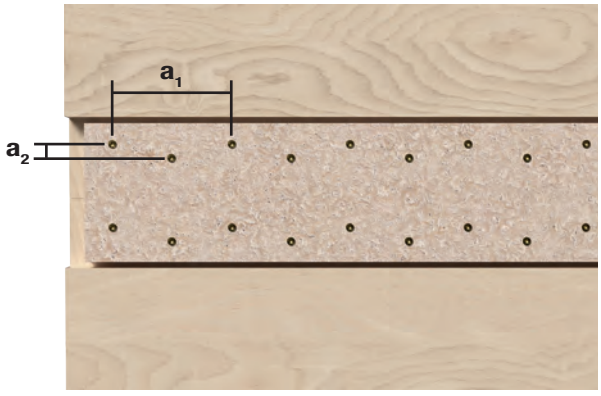


Minimum Distances for Screws
CLT Spline Connection

TTUFS

Dimension	Angle Between the Load and the Grain 0°			
	a_1	a_2	$a_{3,c}$	$a_{3,cp}$
4.5xℓ	18	18	28	14
5.0xℓ	20	20	30	15
6.0xℓ	24	24	36	18





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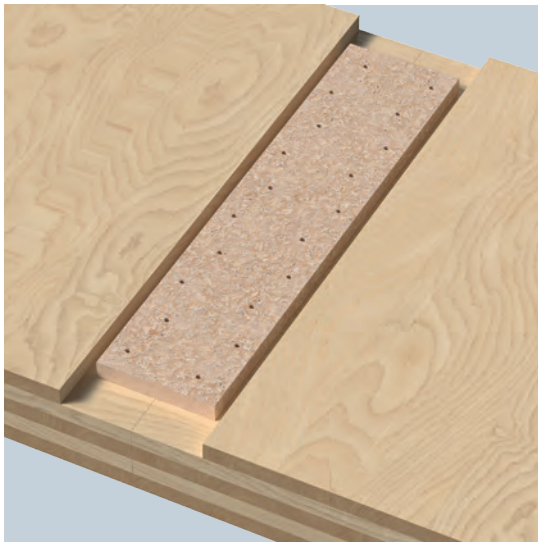
Timber Spline Connection

WSV – Quik Drive® Collated Screw

The collated WSV wood screws are installed by uisng the Quik Drive auto-feed screw driving system. By adding the extension on the tool you can install the screws in a standing position with a high speed and good ergonomics.

Advantages:

- Available in Quik Drive (Collated screw)
- Ribbed head design countersinks easily and creates a flush end result
- Deep 6-lobe recess



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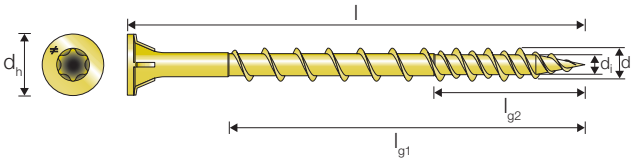


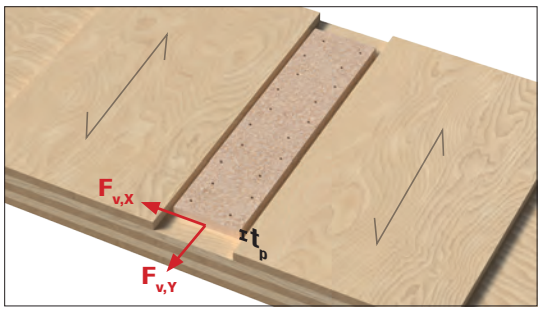
WSV – Range Overview

Product Reference	Dimensions [mm]				
	d	l	l_g	d_h	d_i
WSV4.6xℓ	4,6	44 - 76	31 - 55	8,5	3,1

WSV – CLT Spline Connection
Plywood Board ρ_k = 490 kg/m³ to CLT ρ_k = 350 kg/m³

Product Reference	Chracteristic Shear ($R_{v,X,k}$ or $R_{v,Y,k}$) Capacity for Plywood ($\rho_k \geq$ 490 kg/m³) to CLT ($\rho_k \geq$ 350 kg/m³) Connection Depending of the Thickness of the Panel t_p				
	15	18	22	25	30
	$R_{v,90,k,15}$	$R_{v,90,k,18}$	$R_{v,90,k,22}$	$R_{v,90,k,25}$	$R_{v,90,k,30}$
WSV44E (4.6x44)	0,78	0,82	0,75	0,69	-
WSV51E (4.6x51)	0,78	0,87	0,89	0,83	0,73
WSV64E (4.6x64)	1,20	1,20	1,00	1,10	1,00
WSV76E (4.6x76)	1,23	1,23	1,23	1,23	1,23

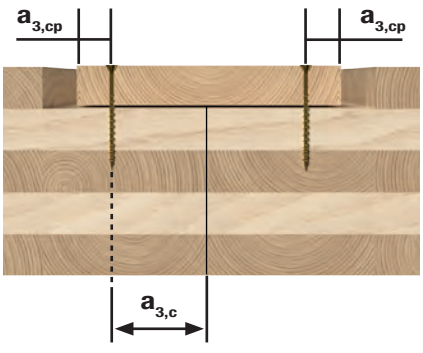
Characteristic parameters of fasteners and more information are included in chapter 10.

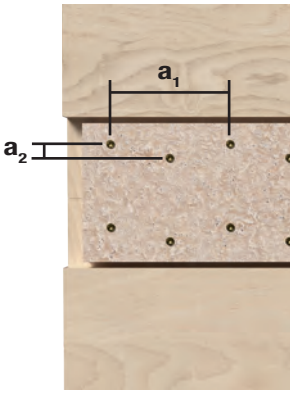


Minimum Distances for Screws
CLT Spline Connection

WSV

Dimension	Angle Between the Load and the Grain 0°			
	a_1	a_2	$a_{3,c}$	$a_{3,cp}$
4.6xℓ	18	18	28	14





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Steel Spline Connection

Similar to using a timber spline, with the benefits of a higher performance and a more cost-efficient solution as no routing of the panel is required.

Items Required

Nail Plate
NP

NP

Timber Fasteners
CSA Connector Screw,
CSA-T Connector Screw Quik Drive®

CSA

CSA-T

Quik Drive® **QDBPC50E** system is designed specifically for installing CSA-T connector screws.

Attachment
QDBPC50E

CSA-T

Extension
QDEXTE

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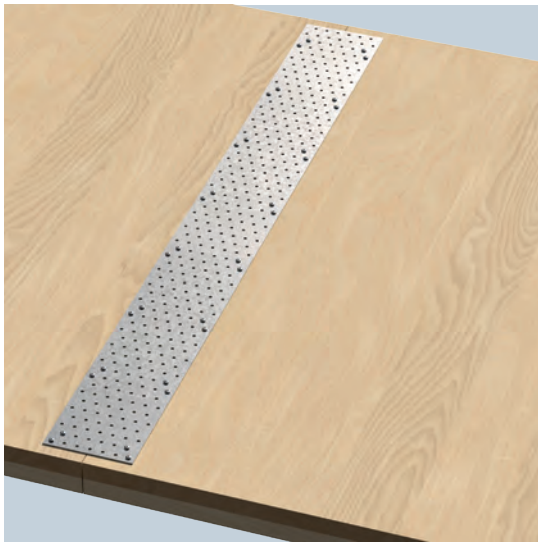
Steel Spline Connection

NP – Nail Plate

NP nail plates for CLT floor panel connections are a cost-efficient and stronger alternative to using timber splines. They don't require any routing or timber preparation – simply place over the panel joints and fasten according to the pattern described below.

Advantages:

- Fast and simple – no timber routing required
- Better performance characteristics than using timber splines
- Available in three configurations based on 2 m lengths

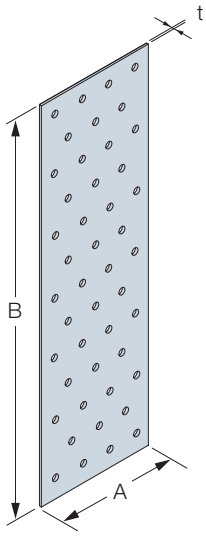


CE UKCA

Dimensions

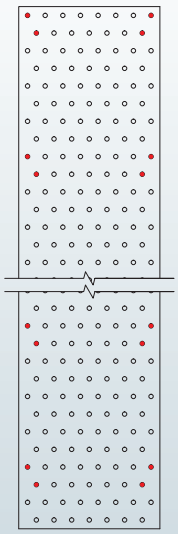
Model No.	Dimensions [mm]			Qty Holes
	A	B	t	Screws or Nails
NP20/140/1200	140	1200	2,0	390 Ø5
NP20/160/1200	160	1200	2,0	450 Ø5
NP20/200/1200	200	1200	2,0	510 Ø5

For other dimensions or load capacities, please contact Simpson Strong-Tie.

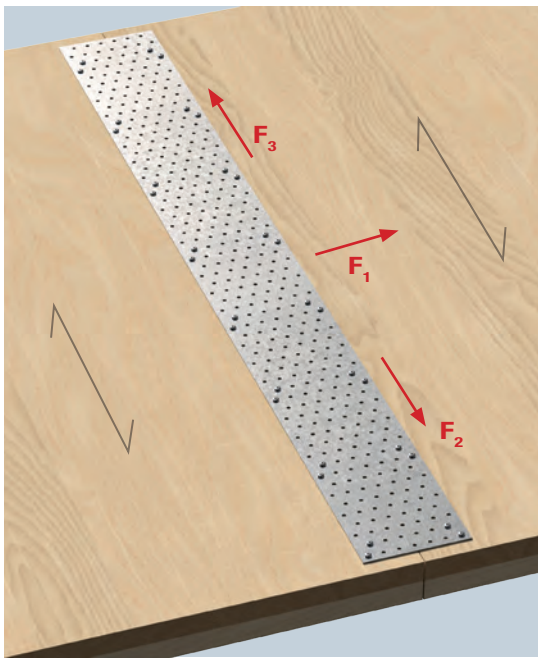


Fastening Pattern

Example of a Nail Plate fastening pattern.



Red dots indicate holes filled with fasteners.



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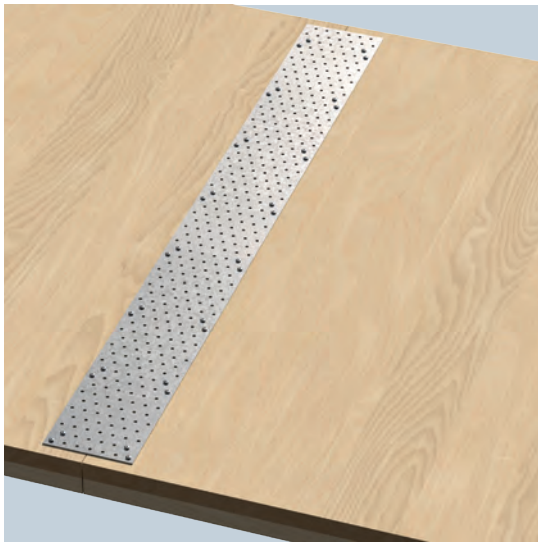
Steel Spline Connection

CSA – Connector Screw

CSA screws are developed for a maximum fit in the steel connector. CSA screws can be installed with the Quik Drive system for a fast and easy installation, the automated system is preffered when you need many screws such as steel spline applications.

Advantages:

- Conical shape under the head for maximum fit in the connector holes
- ETA approved
- Available in Quik Drive



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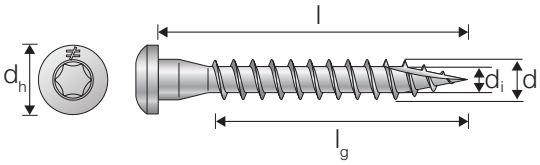
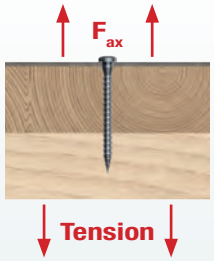


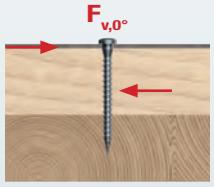
CSA – Range Overview

Product Reference	Dimensions [mm]				
	d	l	l_g	d_h	d_i
CSA5.0xℓ	4,85	25 - 80	19 - 74	8,3	3,15

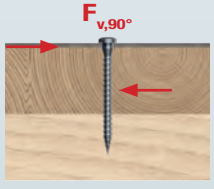
CSA Electroplated – Characteristic Capacity
1,0-4,0 mm Steel to Timber C24, CLT ρ_k = 350 kg/m^3

Product Reference	Tension Capacity – C24 – $R_{ax,k}$ [kN]	Shear Capacity Parallel and Perpendiular to the Grain – C24 – $R_{v,k} = R_{v,0,k} = R_{v,90,k}$ [kN]
CSA5.0X35	2,11	1,99
CSA5.0X40	2,47	2,25
CSA5.0X50	3,20	2,63
CSA5.0X80	5,38	3,50





Shear Parallel (0°) to the Grain



Shear Perpendicular (90°) to the Grain

For CSA screws: $R_{v,0°,k} = R_{v,90°,k} = R_{v,k}$

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Steel Spline Connection

CSA – Minimum Distances for Screws in Shear or Combined Loads[1)] Steel to CLT C24

Outer Thread Diameter d [mm]	Pre-drill	Angle Between Load Direction and Screw = 0°		
		a_1	a_2	$a_{3,c}$
5.0	With pre-drill	18	11	35
	Without pre-drill	42	18	50

[1)] Minimum distances comply with EN 1995-1-1 (Eurocode 5) and ETA-04/0013
[2)] Values given in the table is based on the $\rho_k \leq 350$ kg/m^3
[3)] Minimum distances from the unloaded edge perpendicular to the grain may be reduced to $a_{4,c} = 3 \times d$ if the spacing parallel to the grain (a_1) and the end distance ($a_{3,t}$) is at least $25 \times d$.

CSA – Minimum Distances in the Steel Plate

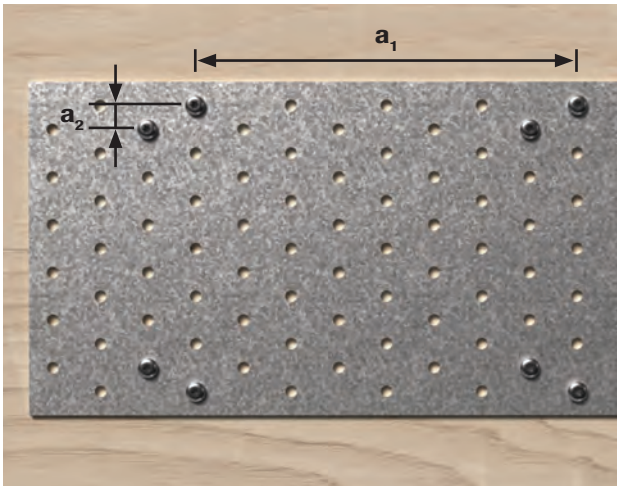
Outer Thread Diameter d [mm]	a_1*	a_2*	e_1*	e_2*
5.0	11	12	6	6

*According to EN 1993-1-8 §3.5

Once you have the spacing and edge distance in steel and timber, you pick the maximum for each dimension between steel and timber.

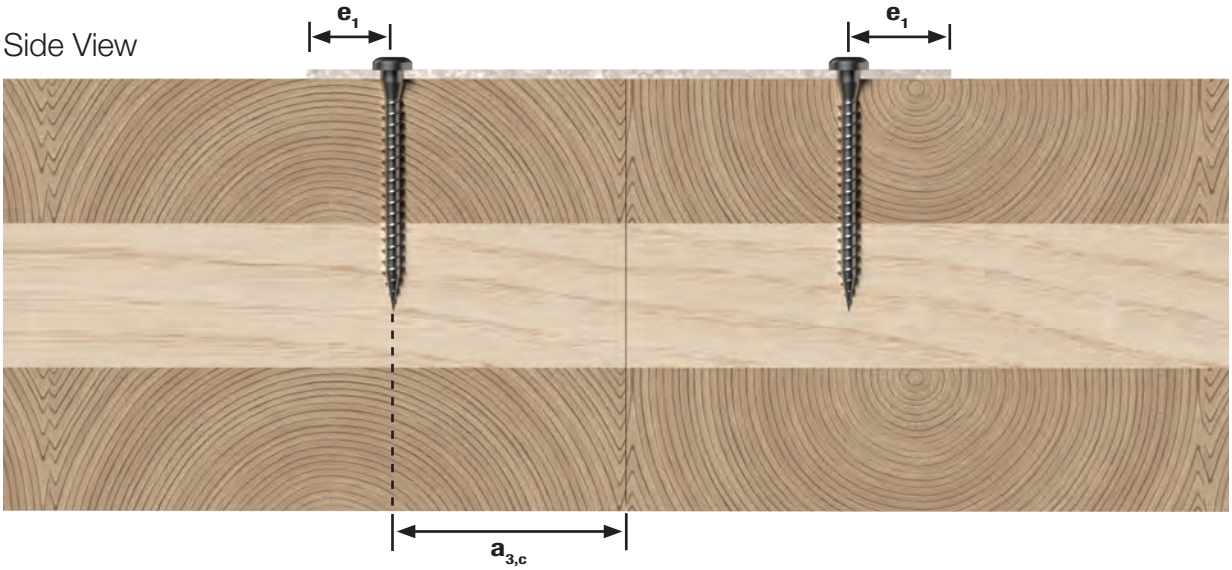
See explanation of α in chapter 10.

Top View



a_1 = min screw spacing parallell to the grain
a_2 = min screw spacing perpendicular to the grain

Side View



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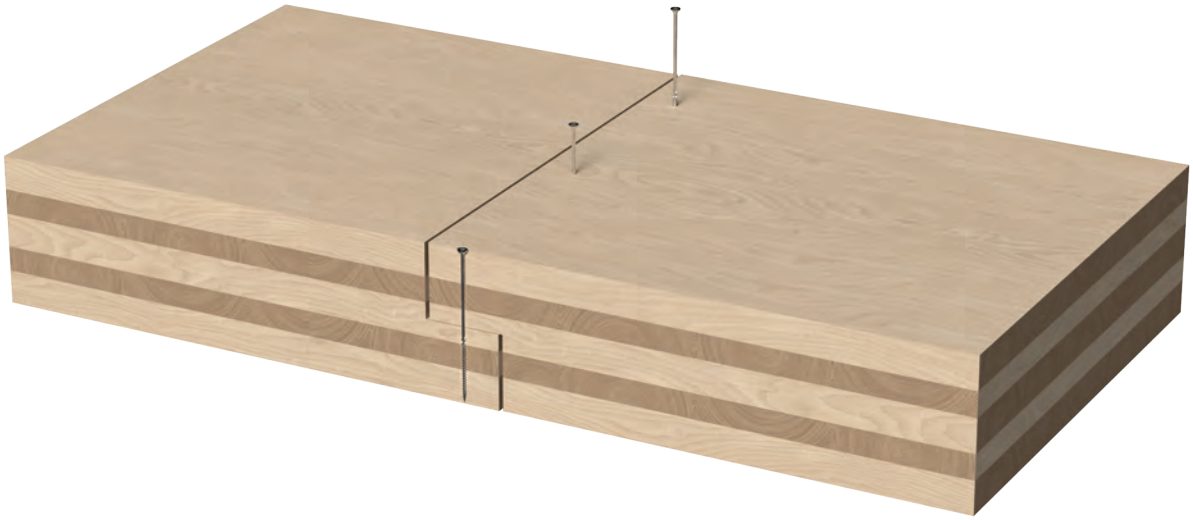
Half-Lap Joint

Overlapping panels like this allows one panel to support the other during installation. Load capacity can be increased through the use of fully threaded screws where the timber splits.



Items Required

Timber Fasteners
ESCRFTZ Fully Threaded Cylinder-Head Screw,
TTUFS Countersunk Screw,
SWD Double Threaded Screw,
SWC Countersunk Screw,
SWW Washer-Head Screw

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Half-Lap Joint

SWD – Double Threaded Screw

The double threaded SWD screw has a small cylinder head that almost creates an hidden assembly after installation. By installing the screw in cross pairs the load capacity can be increased and at the same time take loads in several directions.

Advantages:

- Pulls the two wood members together
- Small cylinder head for almost hidden assemblies
- No pre-drilling required

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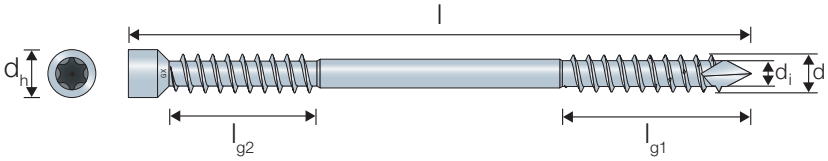


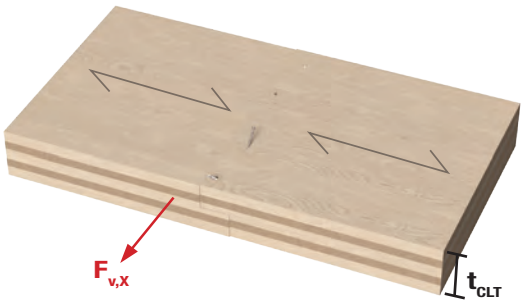
SWD – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_{g1}	l_{g2}	d_h	d_i
SWD6.5xℓ	6,5	65-220	40-95	33,5-88,5	8	4,0
SWD8.0xℓ	8,0	90-330	40-95	31,5-86,5	10	5,4

SWD – Half-Lap Connection – Per Pair $R_{v,X,k}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k,pair}$) – 45° Cross Pairs CLT to CLT ρ_k = 350 kg/m³

Product Reference	Minimum Thickness of the Panel $t_{CLT,min}$	Shear (X) Characteristic Capacity per Pair $R_{v,X,k}$ [kN] – Cross Pairs of Screws	
		$R_{w,k,pair}$	$R_{buck,k,pair}$
SWD6.5X65	51	3,5	14,59 + 13,99 /k_{mod}
SWD6.5X90	69	5,0	14,59 + 13,99 /k_{mod}
SWD6.5X130	97	5,0	14,59 + 13,99 /k_{mod}
SWD6.5X160	118	8,2	14,59 + 13,99 /k_{mod}
SWD6.5X190	139	10,1	14,59 + 13,99 /k_{mod}
SWD6.5X220	161	12,0	14,59 + 13,99 /k_{mod}
SWD8.0X90	69	5,9	14,59 + 13,99 /k_{mod}
SWD8.0X130	97	5,9	14,59 + 13,99 /k_{mod}
SWD8.0X160	118	9,6	14,59 + 13,99 /k_{mod}
SWD8.0X190	139	11,9	14,59 + 13,99 /k_{mod}
SWD8.0X220	161	14,1	14,59 + 13,99 /k_{mod}
SWD8.0X245	178	15,9	14,59 + 13,99 /k_{mod}
SWD8.0X275	199	15,9	14,59 + 13,99 /k_{mod}
SWD8.0X300	217	20,0	14,59 + 13,99 /k_{mod}
SWD8.0X330	238	20,0	14,59 + 13,99 /k_{mod}

Characteristic parameters of fasteners and more information are included in chapter 10.



HELPFUL TIP

The structural guide **GSCREW4560** can be used to ensure the correct angle during installation

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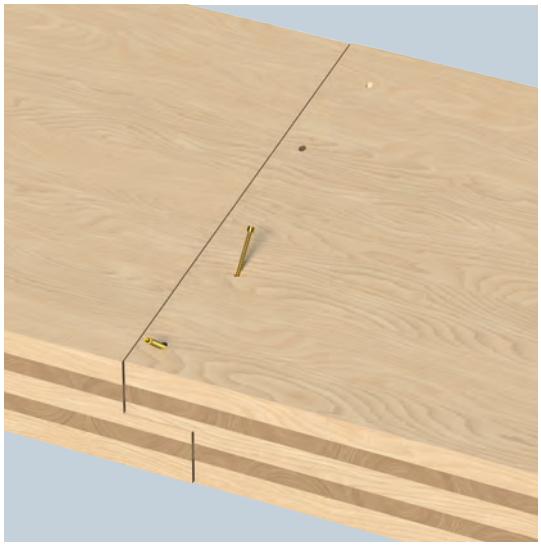
Half-Lap Joint

ESCRFTZ – Fully Threaded Cylinder-Head Screw

The fully threaded ESRFTZ screw has a small cylinder head that almost creates a hidden assembly after installation. By installing the screw in cross pairs the load capacity can be increased and at the same time take loads in several directions.

Advantages:

- Fully threaded
- Small cylinder head for hidden assemblies
- No pre-drilling required



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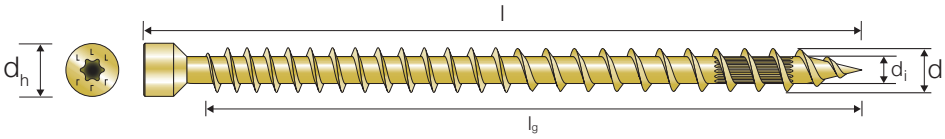


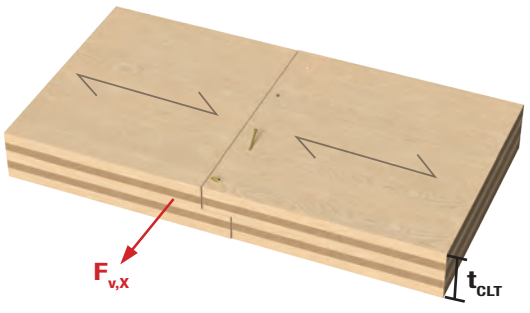
ESCRFTZ – Range Overview

Product Reference	Dimensions [mm]				
	d	l	l_g	d_h	d_i
ESCRFTZ8.0xℓ	8,0	120 - 400	110 - 390	10,2	5,2

ESCRFTZ – Half-Lap Connection – Per Pair $R_{v,X,k}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k,pair}$) – 45° Cross Pairs CLT to CLT ρ_k = 350 kg/m³

Product Reference	Minimum Thickness of the Panel $t_{CLT,min}$	Shear (X) Characteristic Capacity per Pair $R_{v,X,k}$ [kN] – Cross Pairs of Screws	
		$R_{w,k,pair}$	$R_{buck,k,pair}$
ESCRFTZ8.0X120	90	7,4	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X140	104	8,9	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X160	118	10,4	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X180	132	11,9	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X200	146	13,3	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X220	161	14,8	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X240	175	16,3	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X260	189	17,8	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X280	203	19,3	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X300	217	20,7	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X350	252	24,5	14,59 + 13,99 /k_{mod}
ESCRFTZ8.0X400	288	28,2	14,59 + 13,99 /k_{mod}

Characteristic parameters of fasteners and more information are included in chapter 10.



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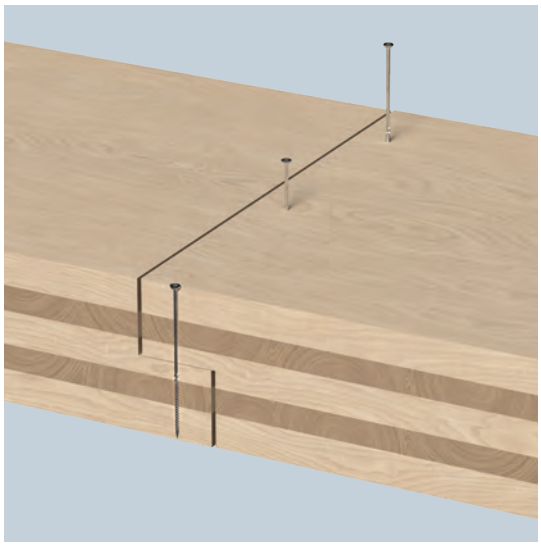
Half-Lap Joint

TTUFS – Countersunk Screw

TTUFS is a countersunk structural wood screw with a partial thread. The screw can be installed without any pre-drilling. If higher load capacity or longer screws are needed, see the SWC product family.

Advantages:

- Countersunk head creates a flush finish
- Milling thread for reduced drive-in torque
- No pre-drilling required



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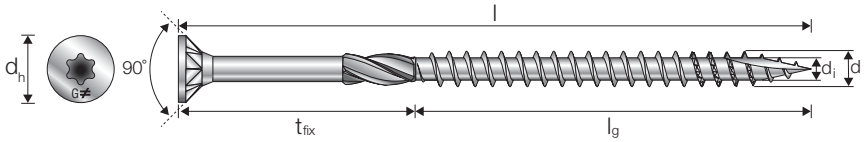


TTUFS – Range Overview

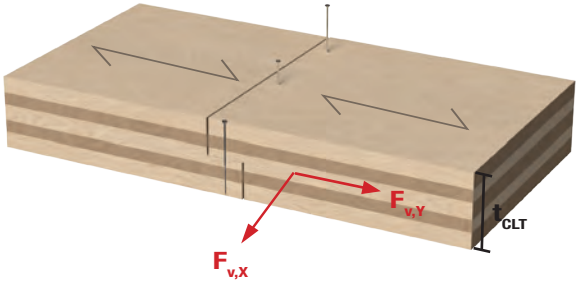
Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
TTUFS 6.0xℓ	6,0	40-180	34-70	11,6	3,7	6-110

TTUFS – Half-Lap Connection – Screws at 90° CLT to CLT ρ_k = 350 kg/m³

Product Reference	Predrilling	Minimum Thickness of the Panel $t_{CLT,min}$	Shear Capacity $R_{v,k} = R_{v,X,k} = R_{v,Y,k}$ [kN] – Screws at 90°
TTUFS4.5X70	With predrill	80	1,5
	Without predrill	80	1,3
TTUFS4.5X80	With predrill	100	1,5
	Without predrill	100	1,3
TTUFS5.0X70	With predrill	80	1,9
	Without predrill	80	1,6
TTUFS5.0X80	With predrill	90	1,9
	Without predrill	90	1,6
TTUFS5.0X90	With predrill	100	1,9
	Without predrill	100	1,6
TTUFS5.0X100	With predrill	120	1,9
	Without predrill	120	1,6
TTUFS5.0X120	With predrill	130	1,9
	Without predrill	130	1,6

Product Reference	Predrilling	Minimum Thickness of the Panel $t_{CLT,min}$	Shear Capacity $R_{v,k} = R_{v,X,k} = R_{v,Y,k}$ [kN] – Screws at 90°
TTUFS6.0X70	With predrill	80	2,6
	Without predrill	80	2,0
TTUFS6.0X80	With predrill	90	2,6
	Without predrill	90	2,1
TTUFS6.0X90	With predrill	100	2,6
	Without predrill	100	2,1
TTUFS6.0X100	With predrill	120	2,6
	Without predrill	120	2,1
TTUFS6.0X120	With predrill	140	2,6
	Without predrill	140	2,1
TTUFS6.0X140	With predrill	150	2,6
	Without predrill	150	2,1
TTUFS6.0X160	With predrill	170	2,6
	Without predrill	170	2,1
TTUFS6.0X180	With predrill	190	2,6
	Without predrill	190	2,1

Characteristic parameters of fasteners and more information are included in chapter 10.



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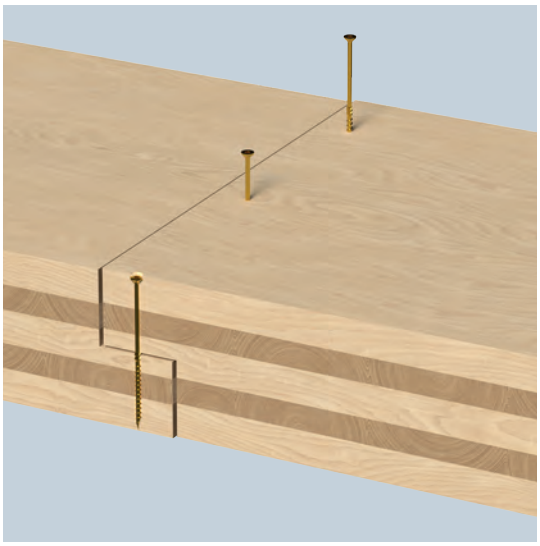
Half-Lap Joint

SWC – Countersunk Screw

SWC is a countersunk structural wood screw designed to take high loads. The countersunk head gives a flush fitting while allowing the CLT panels to close up firmly.

Advantages:

- Countersunk head creates a flush finish
- Milling thread for reduced drive-in torque
- No pre-drilling required



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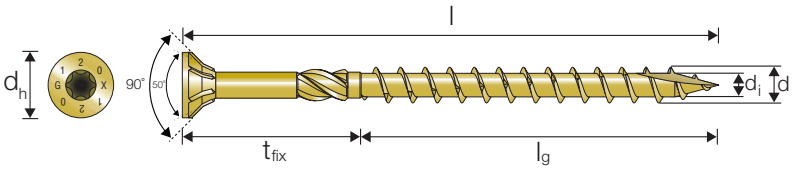

SWC – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
SWC6.0xℓ	6,0	200 - 300	70	11,8	3,9	130 - 230
SWC8.0xℓ	8,0	80 - 400	50 - 80	14,6	5,2	30 - 320
SWC10.0xℓ	10,0	100 - 400	50 - 80	17,8	6,2	50 - 320

SWC – Half-Lap Connection – Screws at 90° CLT to CLT ρ_k = 350 kg/m^3

Product Reference	Predrilling	Minimum Thickness of the Panel $t_{CLT,min}$	Shear Capacity $R_{v,k} = R_{v,X,k} = R_{v,Y,k}$ [kN] – Screws at 90°
SWC6.0X200	With predrill	210	2,5
	Without predrill	210	2,1
SWC6.0X220	With predrill	230	2,5
	Without predrill	230	2,1
SWC6.0X240	With predrill	250	2,5
	Without predrill	250	2,1
SWC6.0X260	With predrill	270	2,5
	Without predrill	270	2,1
SWC6.0X280	With predrill	290	2,5
	Without predrill	290	2,1
SWC6.0X300	With predrill	310	2,5
	Without predrill	310	2,1

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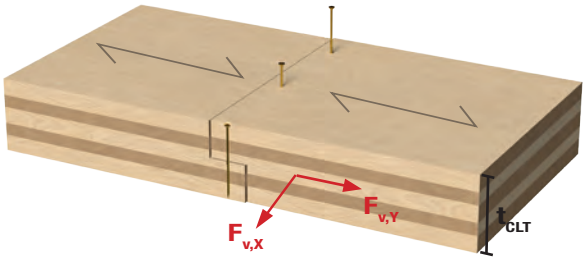

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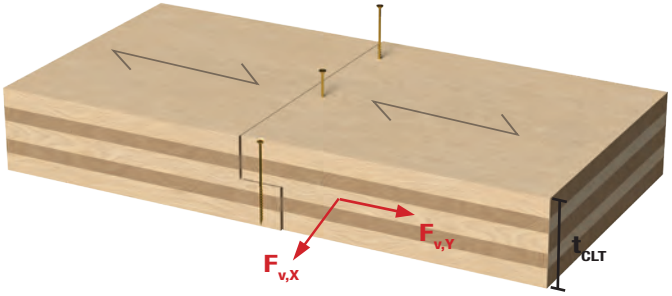
Half-Lap Joint

SWC – Half-Lap Connection – Screws at 90° CLT to CLT ρ_k = 350 kg/m³ (cont.)

Product Reference	Predrilling	Minimum Thickness of the Panel $t_{CLT,min}$	Shear Capacity $R_{v,k} = R_{v,X,k} = R_{v,Y,k}$ [kN] – Screws at 90°
SWC8.0X80	With predrill	100	4,0
	Without predrill	100	2,7
SWC8.0X90	With predrill	100	4,5
	Without predrill	100	3,0
SWC8.0X100	With predrill	110	4,5
	Without predrill	110	3,2
SWC8.0X120	With predrill	160	4,5
	Without predrill	160	3,2
SWC8.0X140	With predrill	160	4,5
	Without predrill	160	3,6
SWC8.0X160	With predrill	170	4,5
	Without predrill	170	3,6
SWC8.0X180	With predrill	190	4,5
	Without predrill	190	3,6
SWC8.0X200	With predrill	210	4,5
	Without predrill	210	3,6
SWC8.0X220	With predrill	230	4,5
	Without predrill	230	3,6
SWC8.0X240	With predrill	250	4,5
	Without predrill	250	3,6
SWC8.0X260	With predrill	270	4,5
	Without predrill	270	3,6
SWC8.0X280	With predrill	290	4,5
	Without predrill	290	3,6
SWC8.0X320	With predrill	330	4,5
	Without predrill	330	3,6
SWC8.0X340	With predrill	350	4,5
	Without predrill	350	3,6
SWC8.0X360	With predrill	370	4,5
	Without predrill	370	3,6
SWC8.0X380	With predrill	390	4,5
	Without predrill	390	3,6
SWC8.0X400	With predrill	410	4,5
	Without predrill	410	3,6

Product Reference	Predrilling	Minimum Thickness of the Panel $t_{CLT,min}$	Shear Capacity $R_{v,k} = R_{v,X,k} = R_{v,Y,k}$ [kN] – Screws at 90°
SWC10.0X100	With predrill	110	6,2
	Without predrill	110	3,9
SWC10.0X120	With predrill	130	6,4
	Without predrill	130	4,5
SWC10.0X140	With predrill	160	6,4
	Without predrill	160	4,7
SWC10.0X160	With predrill	170	6,4
	Without predrill	170	5,0
SWC10.0X180	With predrill	190	6,4
	Without predrill	190	5,0
SWC10.0X200	With predrill	210	6,4
	Without predrill	210	5,0
SWC10.0X220	With predrill	230	6,4
	Without predrill	230	5,0
SWC10.0X240	With predrill	250	6,4
	Without predrill	250	5,0
SWC10.0X260	With predrill	270	6,4
	Without predrill	270	5,0
SWC10.0X280	With predrill	290	6,4
	Without predrill	290	5,0
SWC10.0X300	With predrill	310	6,4
	Without predrill	310	5,0
SWC10.0X320	With predrill	330	6,4
	Without predrill	330	5,0
SWC10.0X340	With predrill	350	6,4
	Without predrill	350	5,0
SWC10.0X360	With predrill	370	6,4
	Without predrill	370	5,0
SWC10.0X380	With predrill	390	6,4
	Without predrill	390	5,0
SWC10.0X400	With predrill	410	6,4
	Without predrill	410	5,0

Characteristic parameters of fasteners and more information are included in chapter 10.



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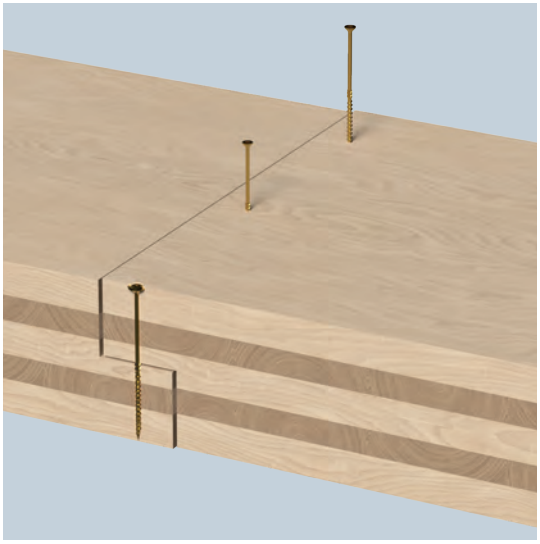
Half-Lap Joint

SWW – Washer-Head Screw

The SWW washer head screw can be used when high head-pull thorugh resistance is needed. The washer head pulls the wood members together and creates a firm assembly.

Advantages:

- High head-pull through resistance
- Pulls the wood members together
- No pre-drilling required



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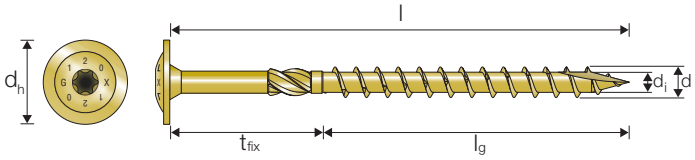

SWW – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
SWW6.0xℓ	6,0	60 - 300	42 - 70	14	3,9	18 - 230
SWW8.0xℓ	8,0	80 - 400	50 - 80	22	5,2	30 - 320
SWW10.0xℓ	10,0	100 - 400	50 - 80	25	6,2	50 - 320

SWW – Half-Lap Connection – Screws at 90° CLT to CLT ρ_k = 350 kg/m³

Product Reference	Predrilling	Minimum Thickness of the Panel $t_{CLT,min}$	Shear Capacity $R_{v,k} = R_{v,X,k} = R_{v,Y,k}$ [kN] – Screws at 90°
SWW6.0X80	With predrill	100	2,9
	Without predrill	100	2,3
SWW6.0X90	With predrill	100	2,9
	Without predrill	100	2,5
SWW6.0X100	With predrill	110	2,9
	Without predrill	110	2,5
SWW6.0X120	With predrill	130	2,9
	Without predrill	130	2,5
SWW6.0X140	With predrill	150	2,9
	Without predrill	150	2,5
SWW6.0X160	With predrill	170	2,9
	Without predrill	170	2,5

Product Reference	Predrilling	Minimum Thickness of the Panel $t_{CLT,min}$	Shear Capacity $R_{v,k} = R_{v,X,k} = R_{v,Y,k}$ [kN] – Screws at 90°
SWW6.0X180	With predrill	190	2,9
	Without predrill	190	2,5
SWW6.0X200	With predrill	210	2,9
	Without predrill	210	2,5
SWW6.0X220	With predrill	230	2,9
	Without predrill	230	2,5
SWW6.0X240	With predrill	250	2,9
	Without predrill	250	2,5
SWW6.0X260	With predrill	270	2,9
	Without predrill	270	2,5
SWW6.0X280	With predrill	290	2,9
	Without predrill	290	2,5
SWW6.0X300	With predrill	310	2,9
	Without predrill	310	2,5

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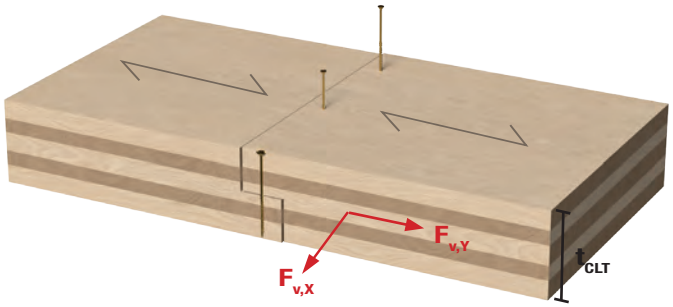
Half-Lap Joint

SWW – Half-Lap Connection – Screws at 90° CLT to CLT ρ_k = 350 kg/m³ (cont.)

Product Reference	Predrilling	Minimum Thickness of the Panel $t_{CLT,min}$	Shear Capacity $R_{v,k} = R_{v,X,k} = R_{v,Y,k}$ [kN] – Screws at 90°
SWW8.0X80	With predrill	100	4,6
	Without predrill	100	3,3
SWW8.0X90	With predrill	100	5,1
	Without predrill	100	3,6
SWW8.0X100	With predrill	110	5,1
	Without predrill	110	3,8
SWW8.0X120	With predrill	160	5,1
	Without predrill	160	3,8
SWW8.0X140	With predrill	160	5,1
	Without predrill	160	4,2
SWW8.0X160	With predrill	170	5,1
	Without predrill	170	4,2
SWW8.0X180	With predrill	190	5,1
	Without predrill	190	4,2
SWW8.0X200	With predrill	210	5,1
	Without predrill	210	4,2
SWW8.0X220	With predrill	230	5,1
	Without predrill	230	4,2
SWW8.0X240	With predrill	250	5,1
	Without predrill	250	4,2
SWW8.0X260	With predrill	270	5,1
	Without predrill	270	4,2
SWW8.0X280	With predrill	290	5,1
	Without predrill	290	4,2
SWW8.0X300	With predrill	310	5,1
	Without predrill	310	4,2
SWW8.0X320	With predrill	330	5,1
	Without predrill	330	4,2
SWW8.0X340	With predrill	350	5,1
	Without predrill	350	4,2
SWW8.0X360	With predrill	370	5,1
	Without predrill	370	4,2
SWW8.0X380	With predrill	390	5,1
	Without predrill	390	4,2
SWW8.0X400	With predrill	410	5,1
	Without predrill	410	4,2

Product Reference	Predrilling	Minimum Thickness of the Panel $t_{CLT,min}$	Shear Capacity $R_{v,k} = R_{v,X,k} = R_{v,Y,k}$ [kN] – Screws at 90°
SWW10.0X100	With predrill	110	6,9
	Without predrill	110	4,6
SWW10.0X120	With predrill	130	7,0
	Without predrill	130	5,1
SWW10.0X140	With predrill	160	7,1
	Without predrill	160	5,5
SWW10.0X160	With predrill	170	7,1
	Without predrill	170	5,7
SWW10.0X180	With predrill	190	7,1
	Without predrill	190	5,7
SWW10.0X200	With predrill	210	7,1
	Without predrill	210	5,7
SWW10.0X220	With predrill	230	7,1
	Without predrill	230	5,7
SWW10.0X240	With predrill	250	7,1
	Without predrill	250	5,7
SWW10.0X260	With predrill	270	7,1
	Without predrill	270	5,7
SWW10.0X280	With predrill	290	7,1
	Without predrill	290	5,7
SWW10.0X300	With predrill	310	7,1
	Without predrill	310	5,7
SWW10.0X320	With predrill	330	7,1
	Without predrill	330	5,7
SWW10.0X340	With predrill	350	7,1
	Without predrill	350	5,7
SWW10.0X360	With predrill	370	7,1
	Without predrill	370	5,7
SWW10.0X380	With predrill	390	7,1
	Without predrill	390	5,7
SWW10.0X400	With predrill	410	7,1
	Without predrill	410	5,7

Characteristic parameters of fasteners and more information are included in chapter 10.



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Half-Lap Joint

Minimum Distances for Screws
CLT Half-Lap Connection

TTUFS

Dimensions	$a_{3,c}$
4.5xℓ	27
5.0xℓ	30
6.0xℓ	36

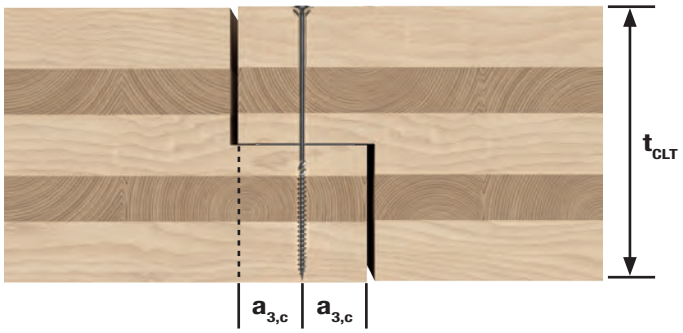
Valid for both pre-drilled and non pre-drilled

SWW

Dimensions	$a_{3,c}$
6.0xℓ	36
8.0xℓ	48
10.0xℓ	60

SWC

Dimensions	$a_{3,c}$
6.0xℓ	36
8.0xℓ	48
10.0xℓ	60



Recommended max. Pre-Drill Hole Diameter Wood

Fastener	Fastener diameter d						
	Ø4,5	Ø5,0	Ø6,0	Ø6,5	Ø8,0	Ø10,0	Ø12,0
TTUFS	Ø2,5	Ø3,0	Ø3,5	-	-	-	-
SWW	-	-	Ø3,5	-	Ø5,0	Ø6,0	-
SWC	-	-	Ø3,5	-	Ø5,0	Ø6,0	-
SWD	-	-	-	Ø3,5	Ø5,0	-	-
ESCRFTZ	-	-	Ø3,5	-	Ø5,0	Ø6,0	Ø6,5

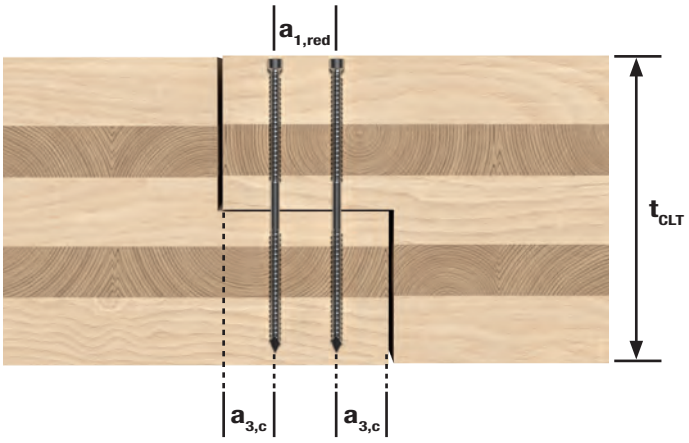
Minimum Distances for Screws
Half-Lap Connection – 45° Cross Pairs

SWD

Product Reference	$a_{1,red}$	$a_{3,c}$
6.5xℓ	10	39
8.0xℓ	12	48

ESCRFTZ

Product Reference	$a_{1,red}$	$a_{3,c}$
8.0xℓ	12	48
10.0xℓ	15	60



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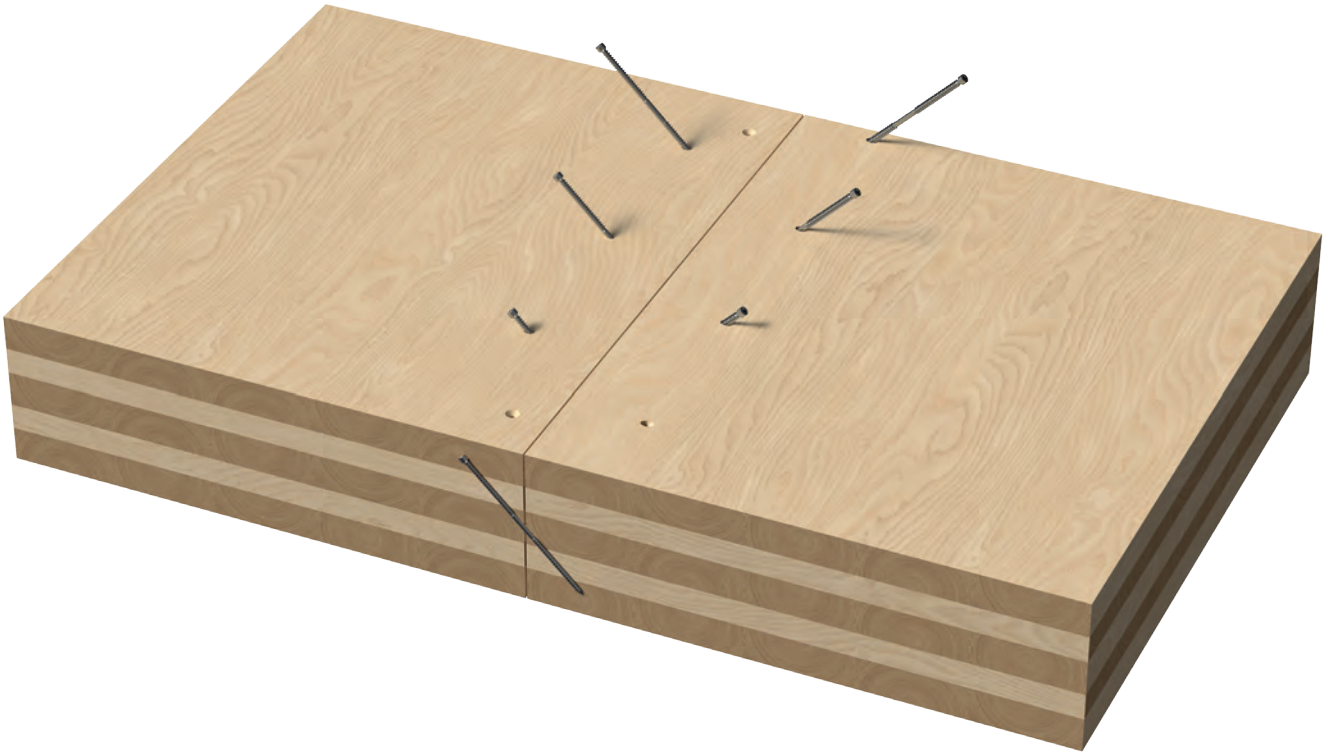
Butt-Joint

Butt-joints are often employed as this form of CLT panel requires a simpler manufacturing process. The panels are pulled together using fully or double threaded structural screws which can also be installed in cross pairs for even greater load capacities.



Items Required

Timber Fasteners
SWD Double Threaded Screw,
ESCRFTZ Fully Threaded Cylinder-Head Screw

SWD ESCRFTZ

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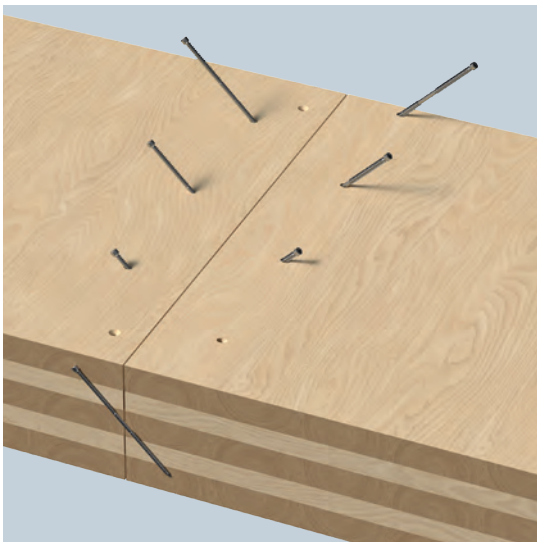
Butt-Joint

SWD – Double Threaded Screw

SWD is a double threaded structural screw designed to connect CLT and mass timber wood members. The screws are suitable for inclined installations and can be installed as a cross pair to take loads in two directions.

Advantages:

- Double threaded, pulls the two wood members together
- Small cylinder head for allowing hidden assemblies
- Can be installed in cross pair to take loads in two directions
- No pre-drilling required



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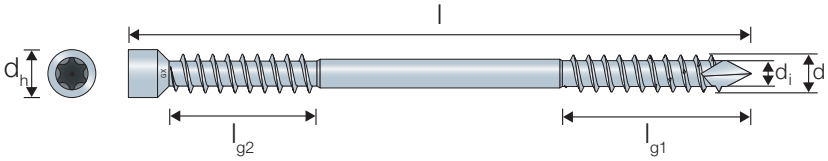


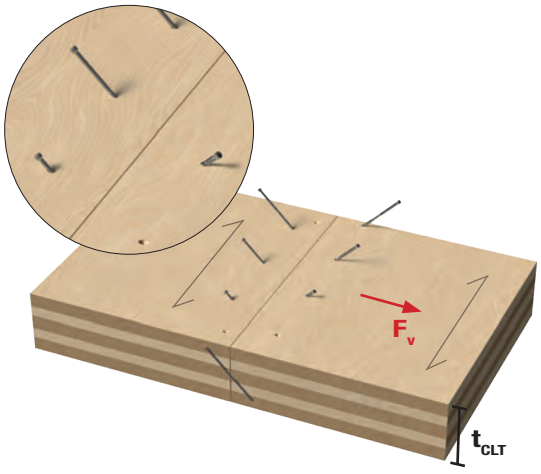
SWD – Range Overview

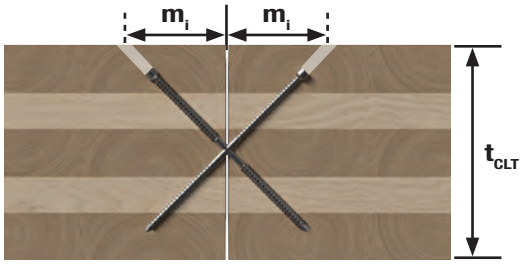
Product Reference	Dimensions [mm]					
	d	l	l_{g1}	l_{g2}	d_h	d_i
SWD6.5xℓ	6,5	65-220	40-95	33,5-88,5	8	4,0
SWD8.0xℓ	8,0	90-330	40-95	31,5-86,5	10	5,4

SWD – Butt-Joint Connection – Per Pair $R_{v,X,k}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k,pair}$) – 45° Cross Pair CLT to CLT ρ_k = 350 kg/m³

Product Reference	Minimum Thickness of the Panel $t_{CLT,min}$	Insertion distance m_i	Shear Characteristic Capacity per Pair $R_{v,k}$ [kN] – Cross Pairs of Screws $R_{v,k,pair}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k}$)	
			$R_{w,k,pair}$ (Tension)	$R_{buck,k,pair}$ (Compression)
SWD6.5X90	69	32	2,8	1,39 + 5,51 /k_{mod}
SWD6.5X130	97	46	2,8	1,39 + 5,51 /k_{mod}
SWD6.5X160	118	57	4,9	2,43 + 5,51 /k_{mod}
SWD6.5X190	139	67	6,1	3,05 + 5,51 /k_{mod}
SWD6.5X220	161	78	7,4	3,67 + 5,51 /k_{mod}
SWD8.0X90	69	32	3,1	1,54 + 10,22 /k_{mod}
SWD8.0X130	97	46	3,1	1,54 + 10,22 /k_{mod}
SWD8.0X160	118	57	5,5	2,76 + 10,22 /k_{mod}
SWD8.0X190	139	67	7,0	3,49 + 10,22 /k_{mod}
SWD8.0X220	161	78	8,5	4,22 + 10,22 /k_{mod}
SWD8.0X245	178	87	9,7	4,84 + 10,22 /k_{mod}
SWD8.0X275	199	97	9,7	4,84 + 10,22 /k_{mod}
SWD8.0X300	217	106	12,4	6,18 + 10,22 /k_{mod}
SWD8.0X330	238	117	12,4	6,18 + 10,22 /k_{mod}

Characteristic parameters of fasteners and more information are included in chapter 10.





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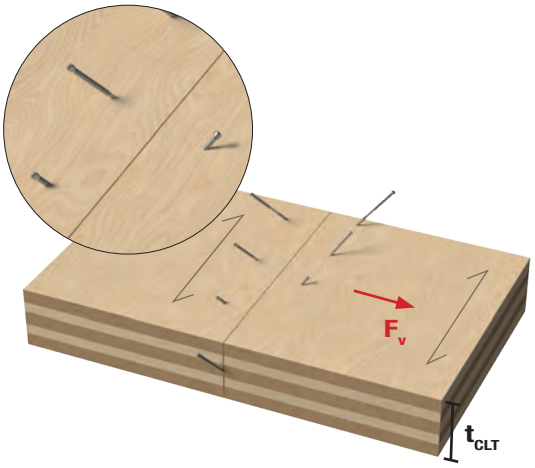
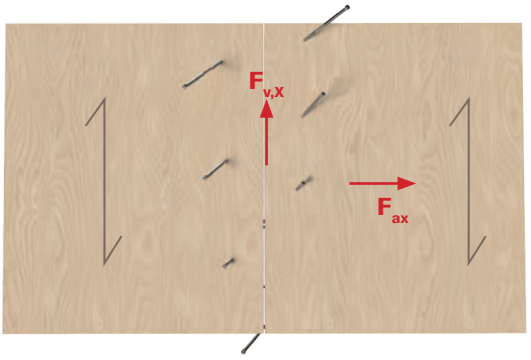
Butt-Joint

SWD – Butt-Joint Connection with Angled 2x45° Cross Pairs – Per Pair $R_{v,X,k}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k,pair}$) CLT to CLT ρ_k = 350 kg/m³

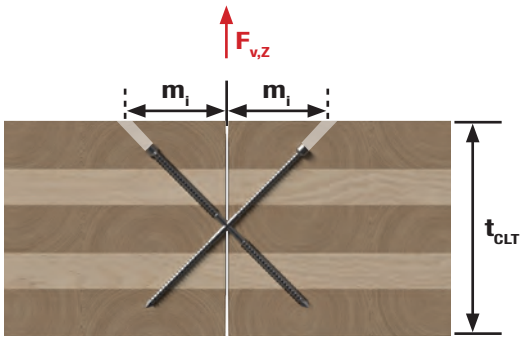
Product Reference	Minimum Thickness of the Panel $t_{CLT,min}$	Insertion distance m_i	Characteristic Capacity ($R_{v,X,k} = R_{v,Z,k} = R_{ax,k}$) – CLT $R_{v,k,pair}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k}$)	
			$R_{w,k,pair}$ (Tension)	$R_{buck,k,pair}$ (Compression)
SWD6.5x90	104	32	3,94	1,96 + 5,51 /k_{mod}
SWD6.5x130	104	46	3,94	1,96 + 5,51 /k_{mod}
SWD6.5x160	126	57	6,87	3,43 + 5,51 /k_{mod}
SWD6.5x190	147	67	8,64	4,31 + 5,51 /k_{mod}
SWD6.5x220	168	78	10,40	5,19 + 5,51 /k_{mod}
SWD8x90	128	32	4,36	2,17 + 10,22 /k_{mod}
SWD8x130	128	46	4,36	2,17 + 10,22 /k_{mod}
SWD8x160	128	57	7,81	3,9 + 10,22 /k_{mod}
SWD8x190	147	67	9,89	4,94 + 10,22 /k_{mod}
SWD8x220	168	78	11,96	5,98 + 10,22 /k_{mod}
SWD8x245	186	87	13,69	6,84 + 10,22 /k_{mod}
SWD8x275	207	97	13,69	6,84 + 10,22 /k_{mod}
SWD8x300	225	106	17,49	8,74 + 10,22 /k_{mod}
SWD8x330	246	117	17,49	8,74 + 10,22 /k_{mod}

Characteristic parameters of fasteners and more information are included in chapter 10.





The structural guide **GSCREW4560** can be used to ensure the correct angle during installation



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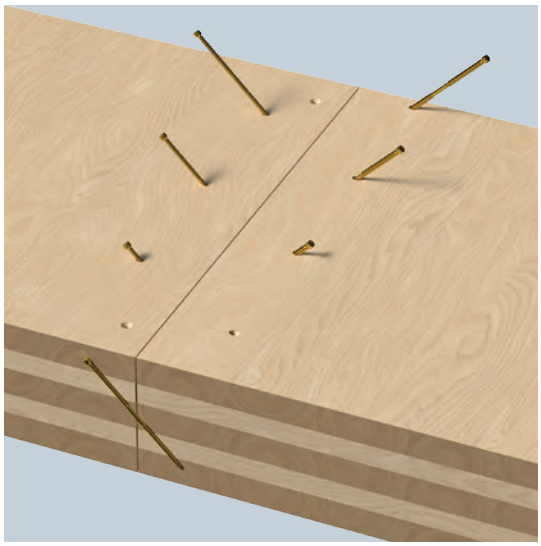
Butt-Joint

ESCRFTZ – Fully Threaded Cylinder-Head Screw

The fully threaded ESCRFTZ screws are designed for CLT and glulam constructions, the screw is approved to be used for reinforcement applications and are suitable for inclined installations. By installing a cross pair the connection can take loads in several directions.

Advantages:
- Fully threaded
- Small cylinder head for hidden assemblies
- No pre-drilling required



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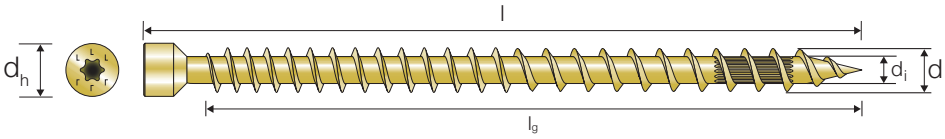


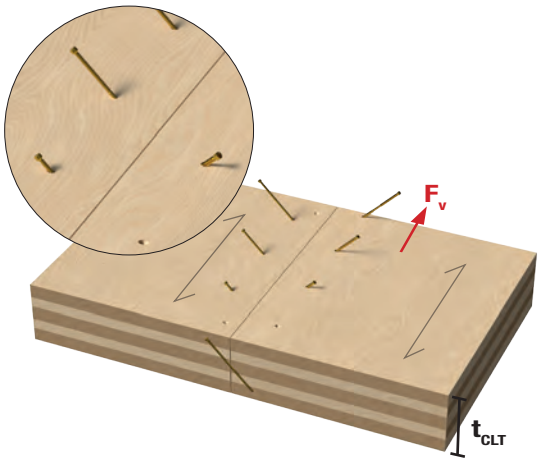
ESCRFTZ – Range Overview

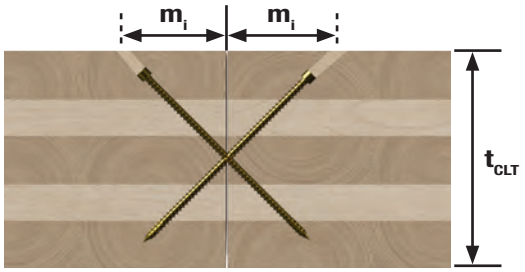
Product Reference	Dimensions [mm]				
	d	l	l_g	d_h	d_i
ESCRFTZ8.0xℓ	8,0	120 - 400	110 - 390	10,2	5,2

ESCRFTZ – Butt-Joint Connection – Per Pair $R_{v,X,k}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k,pair}$) – 45° Cross Pair CLT to CLT ρ_k = 350 kg/m³

Product Reference	Minimum Thickness of the Panel $t_{CLT,min}$	Insertion distance m_i	Shear Characteristic Capacity per Pair $R_{v,k}$ [kN] – Cross Pairs of Screws $R_{v,k,pair}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k}$)	
			$R_{w,k,pair}$ (Tension)	$R_{buck,k,pair}$ (Compression)
ESCRFTZ8.0X120	90	42	4,4	2,2 + 9,23 /k_{mod}
ESCRFTZ8.0X140	104	49	5,4	2,68 + 9,23 /k_{mod}
ESCRFTZ8.0X160	118	57	6,4	3,17 + 9,23 /k_{mod}
ESCRFTZ8.0X180	132	64	7,3	3,66 + 9,23 /k_{mod}
ESCRFTZ8.0X200	146	71	8,3	4,15 + 9,23 /k_{mod}
ESCRFTZ8.0X220	161	78	9,3	4,64 + 9,23 /k_{mod}
ESCRFTZ8.0X240	175	85	10,3	5,13 + 9,23 /k_{mod}
ESCRFTZ8.0X260	189	92	11,2	5,62 + 9,23 /k_{mod}
ESCRFTZ8.0X280	203	99	12,2	6,11 + 9,23 /k_{mod}
ESCRFTZ8.0X300	217	106	13,2	6,6 + 9,23 /k_{mod}
ESCRFTZ8.0X350	252	124	15,6	7,82 + 9,23 /k_{mod}
ESCRFTZ8.0X400	288	141	18,1	9,04 + 9,23 /k_{mod}

Characteristic parameters of fasteners and more information are included in chapter 10.





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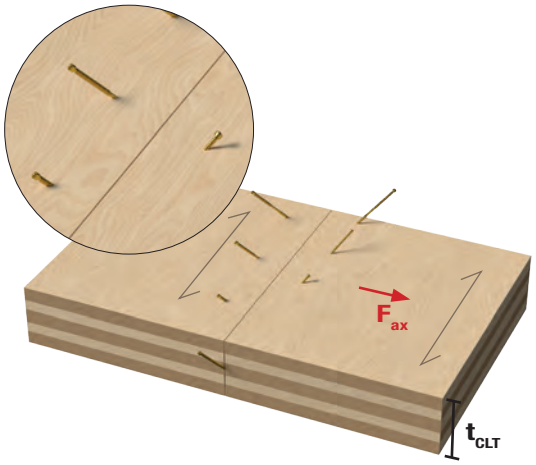
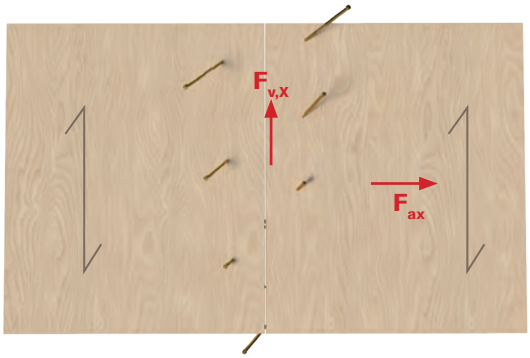
Butt-Joint

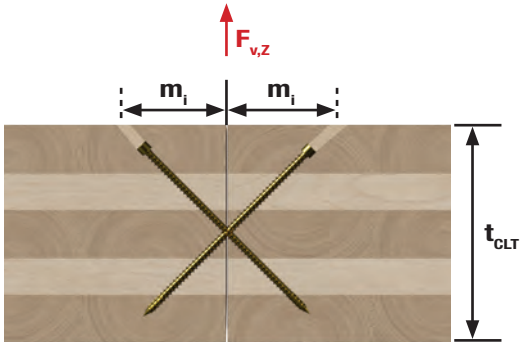
ESCRFTZ – Butt-Joint Connection with Angled 2x45° Cross Pairs – Per Pair $R_{v,X,k}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k,pair}$) CLT to CLT ρ_k = 350 kg/m³

Product Reference	Minimum Thickness of the Panel $t_{CLT,min}$	Insertion distance m_i	Characteristic Capacity ($R_{v,X,k} = R_{v,Z,k} = R_{ax,k}$) – CLT $R_{v,k,pair}$ [kN] = min ($R_{w,k,pair}$; $R_{buck,k}$)	
			$R_{w,k,pair}$ (Tension)	$R_{buck,k,pair}$ (Compression)
ESCRFTZ8.0X120	128	30	6,22	3,11 + 9,23 /k_{mod}
ESCRFTZ8.0X140	128	35	7,61	3,8 + 9,23 /k_{mod}
ESCRFTZ8.0X160	128	40	8,99	4,49 + 9,23 /k_{mod}
ESCRFTZ8.0X180	140	45	10,37	5,18 + 9,23 /k_{mod}
ESCRFTZ8.0X200	154	50	11,75	5,87 + 9,23 /k_{mod}
ESCRFTZ8.0X220	168	55	13,14	6,56 + 9,23 /k_{mod}
ESCRFTZ8.0X240	182	60	14,52	7,25 + 9,23 /k_{mod}
ESCRFTZ8.0X260	196	65	15,90	7,95 + 9,23 /k_{mod}
ESCRFTZ8.0X280	210	70	17,29	8,64 + 9,23 /k_{mod}
ESCRFTZ8.0X300	225	75	18,67	9,33 + 9,23 /k_{mod}
ESCRFTZ8.0X350	260	88	22,13	11,06 + 9,23 /k_{mod}
ESCRFTZ8.0X400	295	100	25,58	12,79 + 9,23 /k_{mod}

Characteristic parameters of fasteners and more information are included in chapter 10.







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CLT Wall to CLT Wall (in plane connection)

Multi-storey mass timber structures feature CLT walls stacked above each other in a vertical plane, the junctions of which can either be directly joined, or include a floor panel between them.

In these cases, the wall panel connections are required to absorb the loads between the panels.

This section describes methods suitable for in-plane vertical connections across the panel joints and intermediate CLT layers, as well as connections across an intermediate floor level.

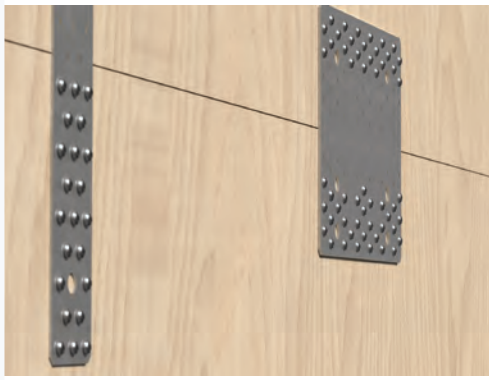
CLT Wall to CLT Wall (in plane connection) Solutions

Tension Plates and Anchor Plates
(direct wall panel contact)

Product Options:

NPB60400 see page 145
NPB100540 see page 145
NPB140540 see page 145
NPB255 see page 146

Where a CLT panel is connected to the edge of another vertically adjoining panel, this combination sees the tension plate providing uplift resistance, while the anchor plates handle shear forces.

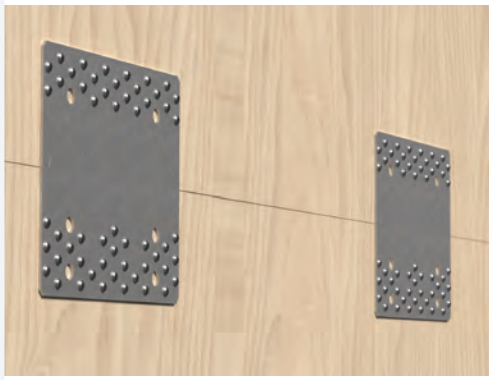


Anchor Plates
(direct wall panel contact)

Product Options:

NPB255 see page 148

Here the tension plates are replaced with more anchor plates to accommodate uplift and shear forces placed on vertically adjoining CLT panels.

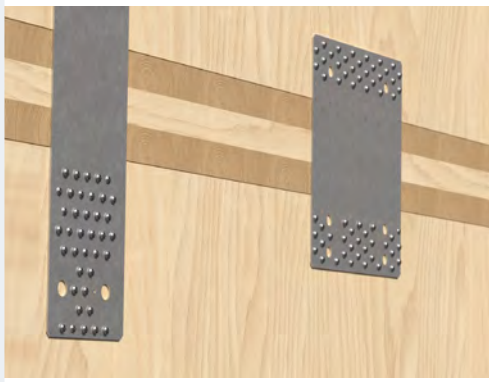


Tension Plates and Anchor Plates
(with intermediate horizontal layer)

Product Options:

NPB255SO see page 150
NPB100540 see page 151
NPB140540 see page 151

Where two vertical CLT panels are connected via an intermediate CLT floor panels' flush edge, this combination sees the tension plate providing uplift resistance, while the anchor plates handle shear forces.

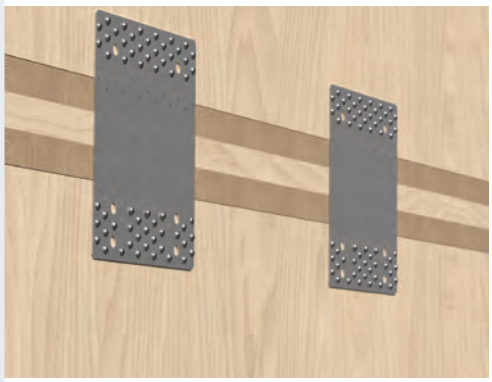


Anchor Plates
(with intermediate horizontal layer)

Product Options:

NPB255SO see page 153

Where two vertical CLT panels are connected via an intermediate CLT floor panels' flush edge, the tension plates are replaced with more anchor plates to accommodate uplift and shear forces.

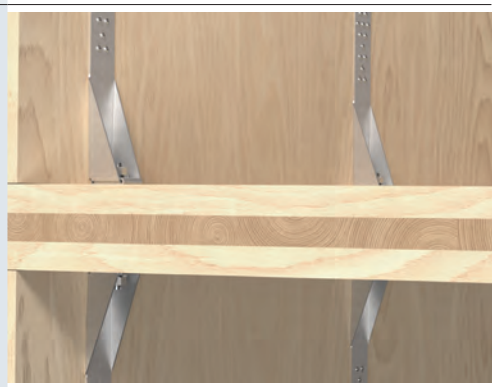


Hold Downs
(with intermediate horizontal layer)

Product Options:

HTT see page 155

Where two vertical CLT panels are intersected by a horizontal floor layer, the use of hold downs installed in pairs with a single rod connecting through the floor panel provides excellent performance characteristics.



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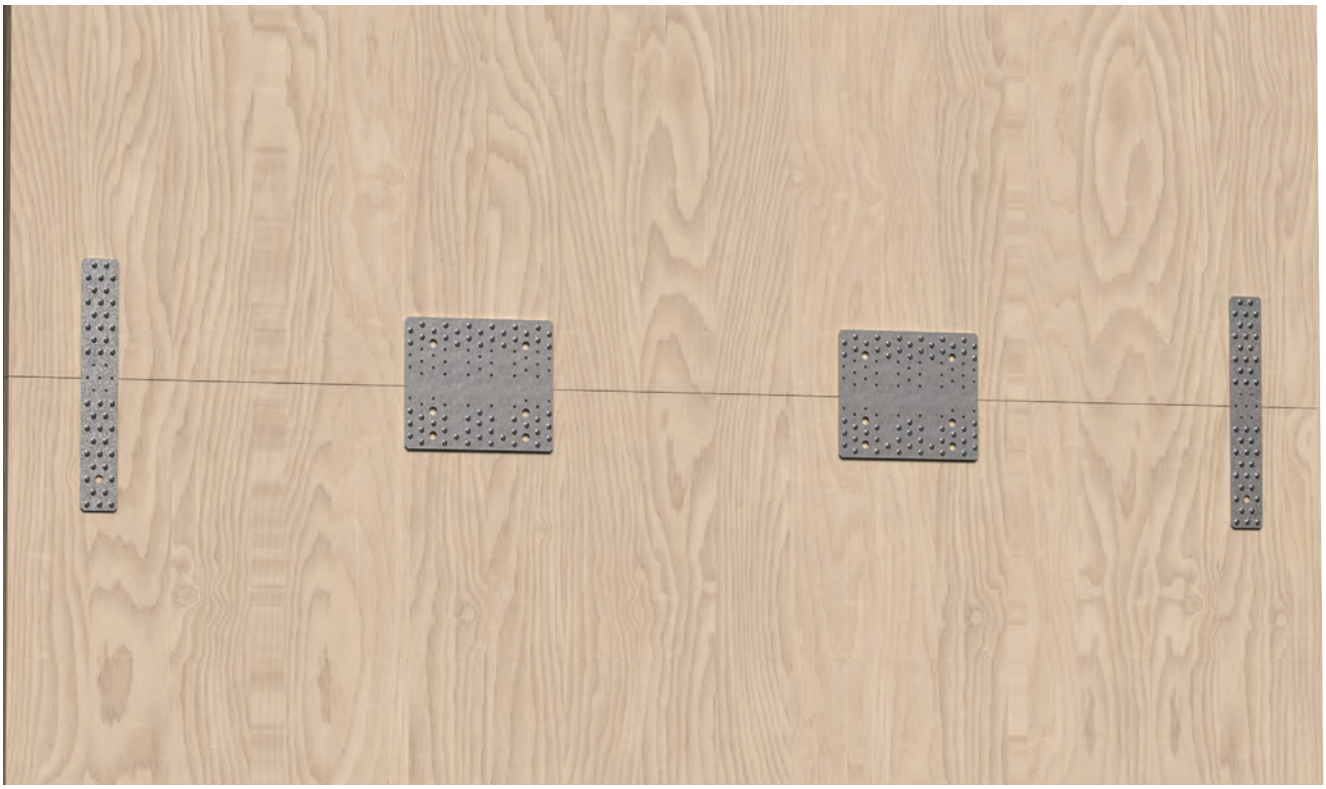
Tension Plates and Anchor Plates

Where a CLT panel is connected to the edge of another vertically adjoining panel, this combination sees the tension plate providing uplift resistance, while the anchor plates handle shear forces.

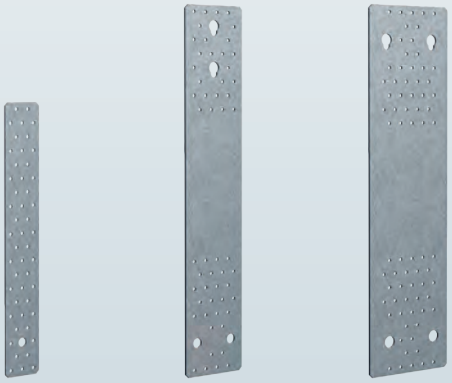


Items Required

Anchor Plate – Shear Restraint
NPB

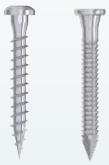
NPB255

Tension Plate – Uplift Restraint
NPB



NPB60400 NPB100540 NPB140540

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Quik Drive® **QDBPC50E** system is designed specifically for installing CSA-T connector screws.

Attachment
QDBPC50E

CSA-T

Extension
QDEXTE

C-CLT-EU-2023 ©2023 SIMPSON STRONG-TIE COMPANY INC.

Tension Plates and Anchor Plates

NPB – Tension Plate

A 3 mm thick plate with various fastener pattern options, the NPB is an excellent method for connecting CLT walls to CLT walls that meet along the same plane, including across intermediate timber layers. This variant of the NPB is able to resist very high uplift forces.

Advantages:

- Very high uplift capacity
- Fast and simple connection between CLT and concrete along the same plane
- Variety of fixing and fastening options to suit the required balance of installation time and load capacity

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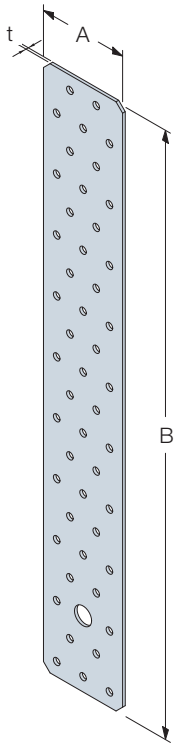
Dimensions

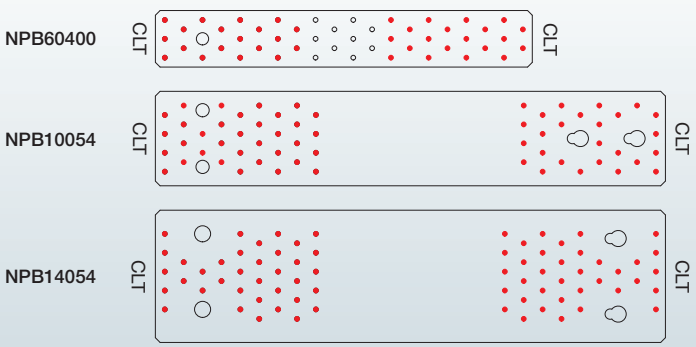
Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB60400	60	400	2,0	49 Ø5	1 Ø13
NPB100540	100	540	3,0	54 Ø5	2 Ø14 + 2 Ø17
NPB140540	140	540	3,0	72 Ø5	4 Ø17



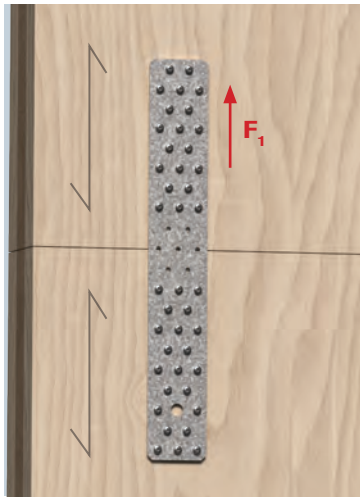
Characteristic Capacity and Slip Modulus – CLT to CLT – 1 Tension Plate

Model No.	Fasteners		Characteristic Values [kN] Tensile $R_{1,k}$	Slip Modulus [kN/mm] Tensile $k_{ser,R1,k}$
	Upper Part	Bottom Part		
NPB60400	20 CNA4.0x50	19 CNA4.0x50	min (44,0 ; 26,7/k_{mod})	3,5
	20 CNA4.0x60	19 CNA4.0x60	min (48,0 ; 26,7/k_{mod})	3,5
	20 CSA5.0x50	19 CSA5.0x50	min (52,6 ; 26,7/k_{mod})	7,6
NPB100540	26 CNA4.0x50	28 CNA4.0x50	min (57,2 ; 71,3/k_{mod})	6,0
	26 CNA4.0x60	28 CNA4.0x60	min (62,4 ; 71,3/k_{mod})	6,4
	26 CSA5.0x50	28 CSA5.0x50	min (68,3 ; 71,3/k_{mod})	15,6
NPB140540	37 CNA4.0x50	36 CNA4.0x50	min (81,4 ; 102,5/k_{mod})	8,3
	37 CNA4.0x60	36 CNA4.0x60	min (88,8 ; 102,5/k_{mod})	8,9
	37 CSA5.0x50	367 CSA5.0x50	min (97,3 ; 102,5/k_{mod})	9,9

Fastening Pattern



Red dots indicate holes filled with fasteners.



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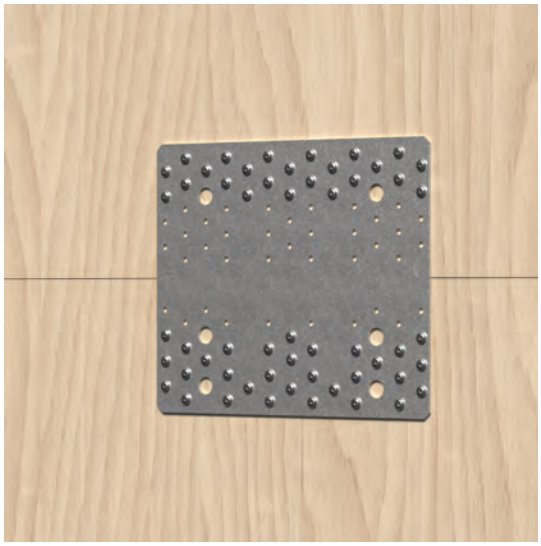
Tension Plates and Anchor Plates

NPB – Anchor Plate

A 3 mm thick plate with various fastener pattern options, the NPB255 is an excellent method for connecting CLT walls to CLT walls that meet along the same plane, as it can provide high load capacities in terms of shear and uplift forces.

Advantages:

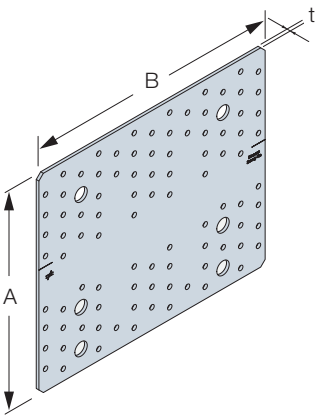
- High shear and uplift capacity
- Fast and simple connection between CLT and concrete along the same plane



ETA-06/0106

Dimensions

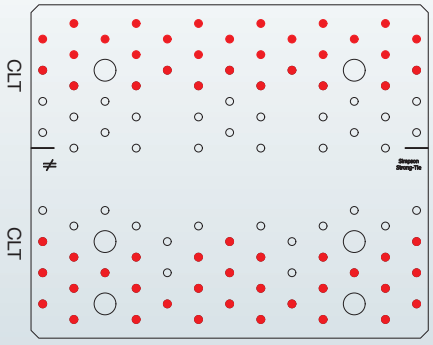
Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB255	214	255	3,0	93 Ø5	6 Ø14



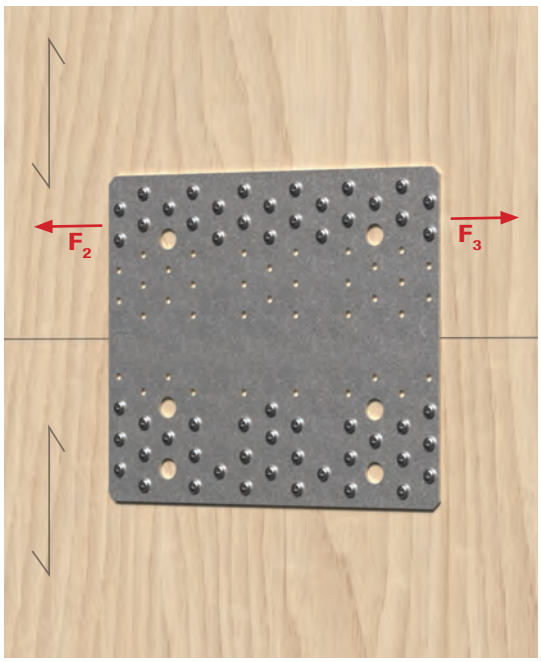
Characteristic Capacity and Slip Modulus – CLT to CLT – 1 Anchor Plate

Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Upper Part	Bottom Part	Shear $R_{2,k}$	Shear $k_{ser,R2,k}$
NPB255	30 CNA4.0x50	31 CNA4.0x50	33,9	2,4
	30 CNA4.0x60	31 CNA4.0x60	36,1	2,6
	30 CSA5.0x50	31 CSA5.0x50	40,2	2,9

Fastening Pattern



Red dots indicate holes filled with fasteners.



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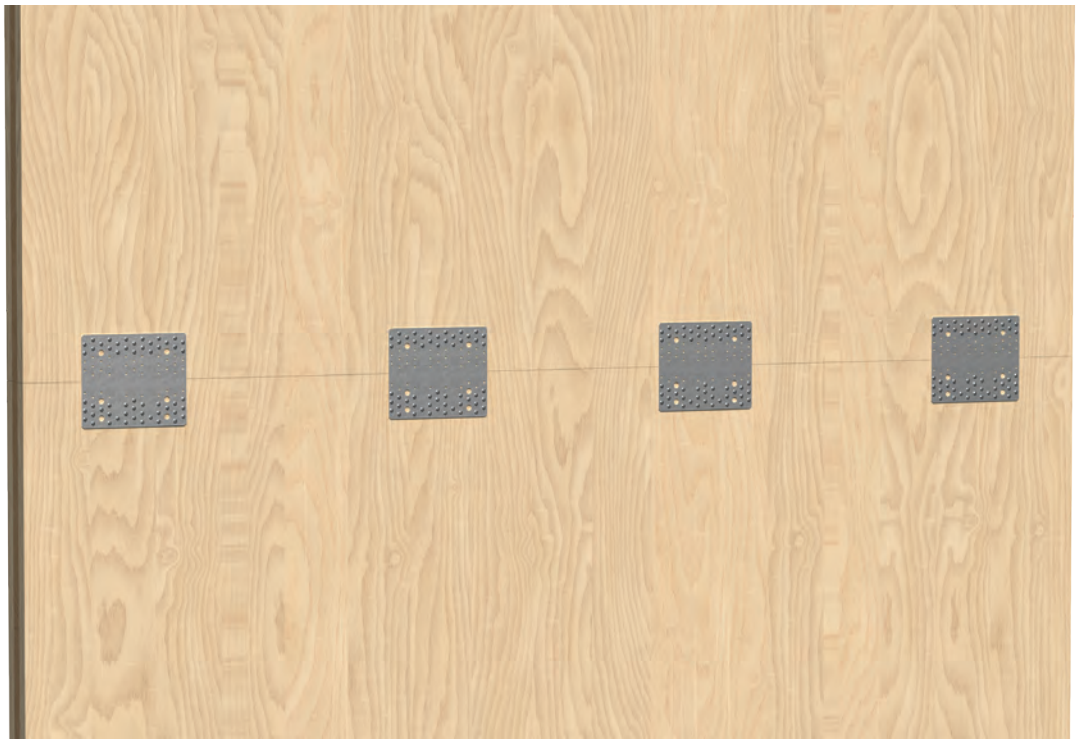
Anchor Plates

Here the tension plates are replaced with more anchor plates to accommodate uplift and shear forces placed on vertically adjoining CLT panels.

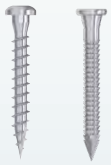


Items Required

Anchor Plate – Shear and Uplift Restraint
NPB

NPB255

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Quik Drive® **QDBPC50E** system is designed specifically for installing CSA-T connector screws.

Attachment
QDBPC50E

CSA-T

Extension
QDEXTE

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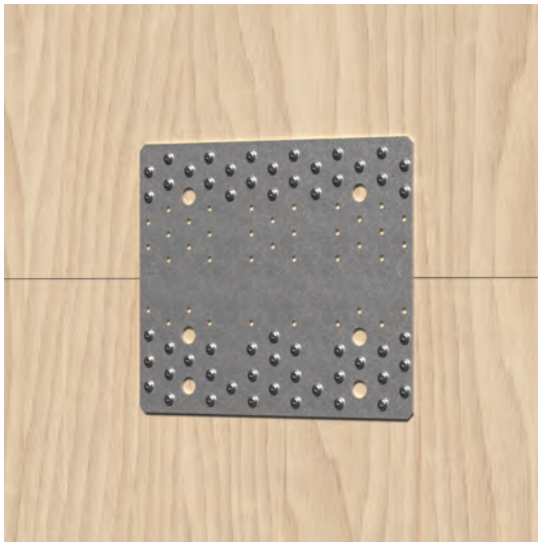
Anchor Plates

NPB – Anchor Plate

A 3 mm thick plate with various fastener pattern options, the NPB255 is an excellent method for connecting CLT walls to CLT walls that meet along the same plane, as it can provide high load capacities in terms of shear and uplift forces.

Advantages:

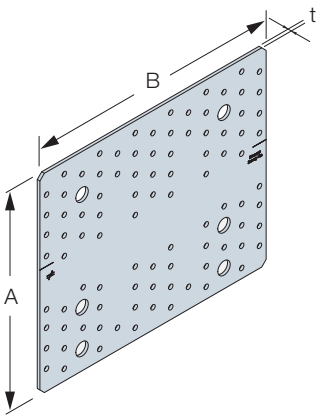
- High shear and uplift capacity
- Fast and simple connection between CLT and concrete along the same plane



ETA-06/0106

Dimensions

Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB255	214	255	3,0	93 Ø5	6 Ø14

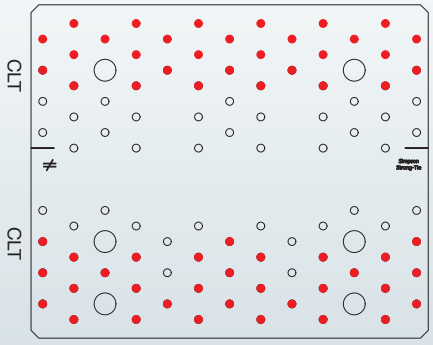


Characteristic Capacity and Slip Modulus – CLT to CLT – 1 Anchor Plate

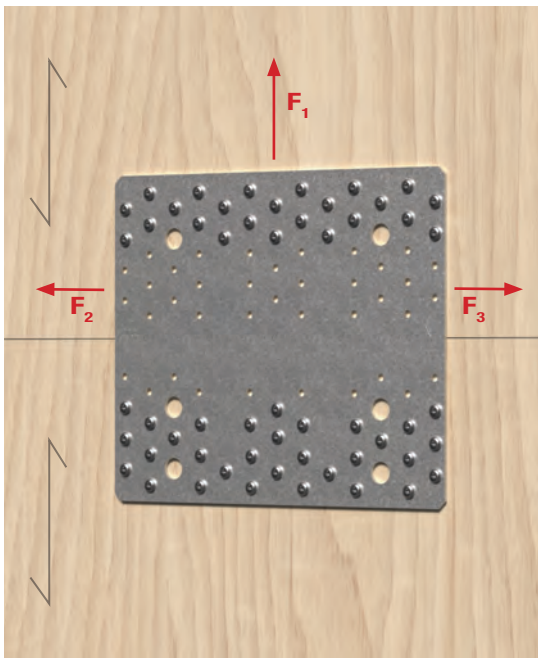
Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Upper Part	Bottom Part	Tensile $R_{1,k}$	Shear $R_{2,k}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k}$
NPB255	30 CNA4.0x50	31 CNA4.0x50	66,6	33,9	7,0	2,4
	30 CNA4.0x60	31 CNA4.0x60	70,8	36,1	7,4	2,6
	30 CSA5.0x50	31 CSA5.0x50	78,9	40,2	8,2	2,9

Angle brackets take uplift and shear loads at the same time. It means that interaction between both load direction should be considered using this equation: $\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1$

Fastening Pattern



Red dots indicate holes filled with fasteners.



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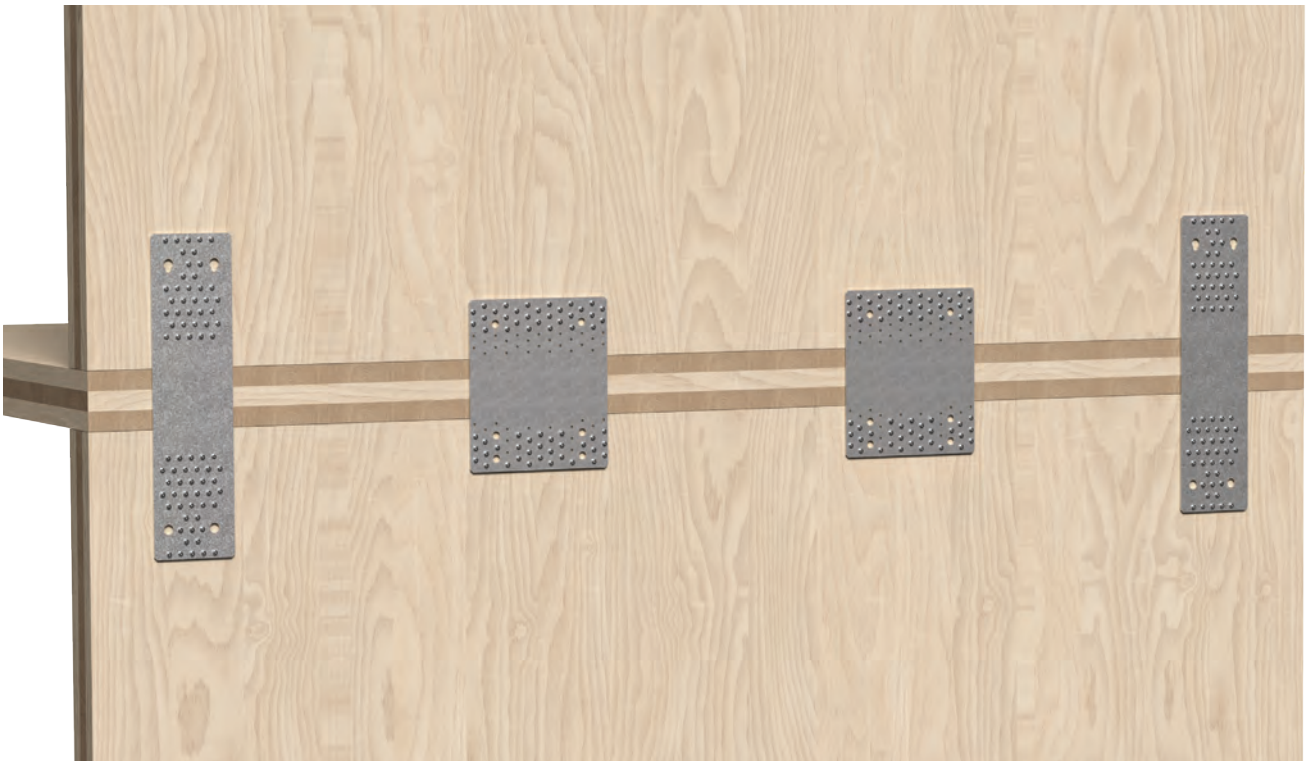
Tension Plates and Anchor Plates

Where two vertical CLT panels are connected via an intermediate CLT floor panels' flush edge, this combination sees the tension plate providing uplift resistance, while the anchor plates handle shear forces.

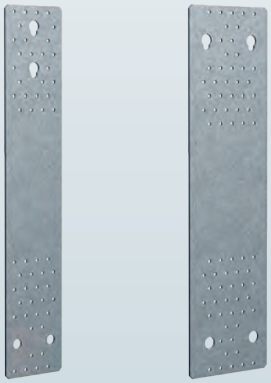


Items Required

Anchor Plate – Shear Restraint
NPB

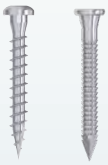
NPB255SO

Tension Plates – Uplift Restraint
NPB



NPB100540 NPB140540

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA CNA

Quik Drive® **QDBPC50E** system is designed specifically for installing CSA-T connector screws.

Attachment
QDBPC50E

CSA-T

Extension
QDEXTE

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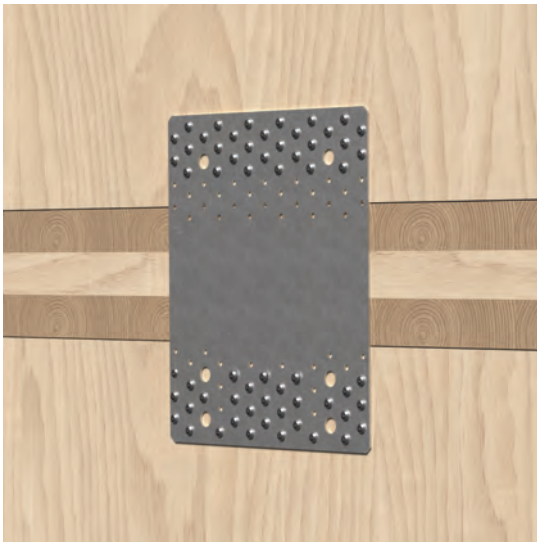
NPB – Anchor Plate

A 3 mm thick plate with various fastener pattern options, the NPB255SO is an excellent method for connecting CLT walls to CLR walls that meet along the same plane via an 80 mm thick intermediate timber layer, as it can provide high load capacities in terms of shear and uplift forces. The face of the NPB255SO is marked with a guide to ensure fasteners are always installed with a minimum edge distance maintained.

Advantages:

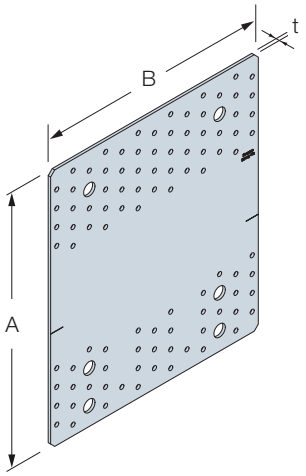
- High shear and uplift capacity
- Fast and simple connection between CLT and concrete along the same plane



ETA-06/0106

Dimensions

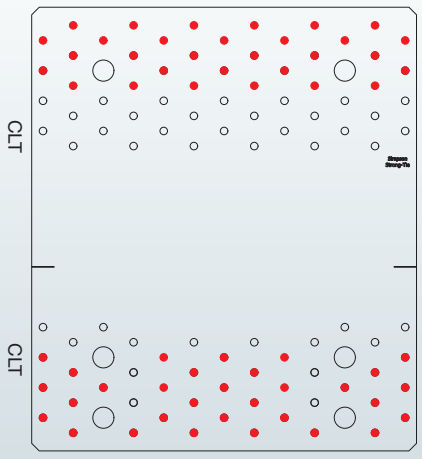
Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB255SO	294	255	3,0	97 Ø5	6 Ø14



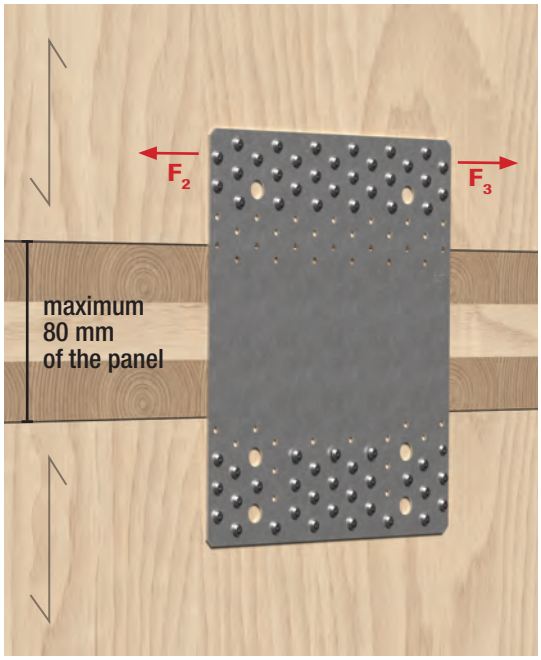
Characteristic Capacity and Slip Modulus – CLT to CLT – 1 Anchor Plate

Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Upper Part	Bottom Part	Shear $R_{2,k}$	Shear $k_{ser,R2,k}$
NPB255SO	30 CNA4.0x50	31 CNA4.0x50	25,0	2,3
	30 CNA4.0x60	31 CNA4.0x60	26,6	2,4
	30 CSA5.0x50	31 CSA5.0x50	29,7	5,9

Fastening Pattern



Red dots indicate holes filled with fasteners.



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NPB – Tension Plate

A 3 mm thick plate with various fastener pattern options, the NPB is an excellent method for connecting CLT walls to CLT walls that meet along the same plane, including across intermediate timber layers. This variant of the NPB is able to resist very high uplift forces.

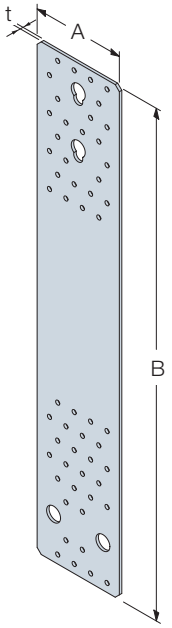
Advantages:

- Very high uplift capacity
- Fast and simple connection between CLT and concrete along the same plane
- Variety of fixing and fastening options to suit the required balance of installation time and load capacity

ETA-06/0106

Dimensions

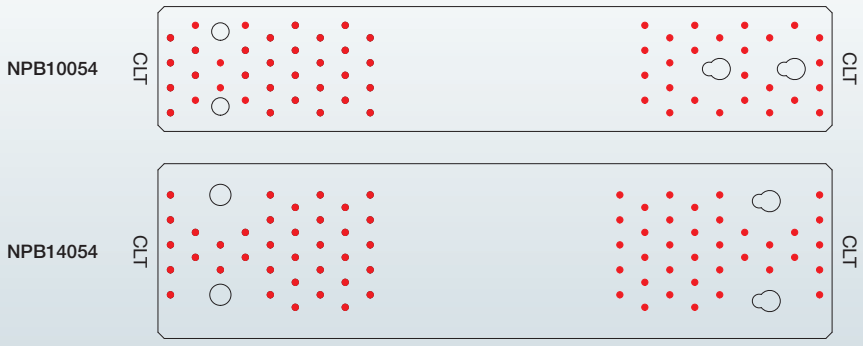
Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB100540	100	540	3,0	54 Ø5	2 Ø14 + 2 Ø17
NPB140540	140	540	3,0	72 Ø5	4 Ø17



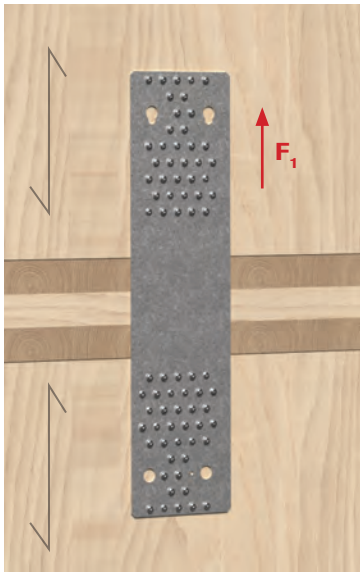
Characteristic Capacity and Slip Modulus – CLT to CLT – 1 Tension Plate

Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Upper Part	Bottom Part	Tensile $R_{1,k}$ *)	Tensile $k_{ser,R1,k}$
NPB100540	26 CNA4.0x50	28 CNA4.0x50	min (57,2 ; 71,3/k_{mod})	6,0
	26 CNA4.0x60	28 CNA4.0x60	min (62,4 ; 71,3/k_{mod})	6,4
	26 CSA5.0x50	28 CSA5.0x50	min (68,3 ; 71,3/k_{mod})	15,6
NPB140540	37 CNA4.0x50	36 CNA4.0x50	min (81,4 ; 102,5/k_{mod})	8,3
	37 CNA4.0x60	36 CNA4.0x60	min (88,8 ; 102,5/k_{mod})	8,9
	37 CSA5.0x50	367 CSA5.0x50	min (97,3 ; 102,5/k_{mod})	9,9

Fastening Pattern



Red dots indicate holes filled with fasteners.



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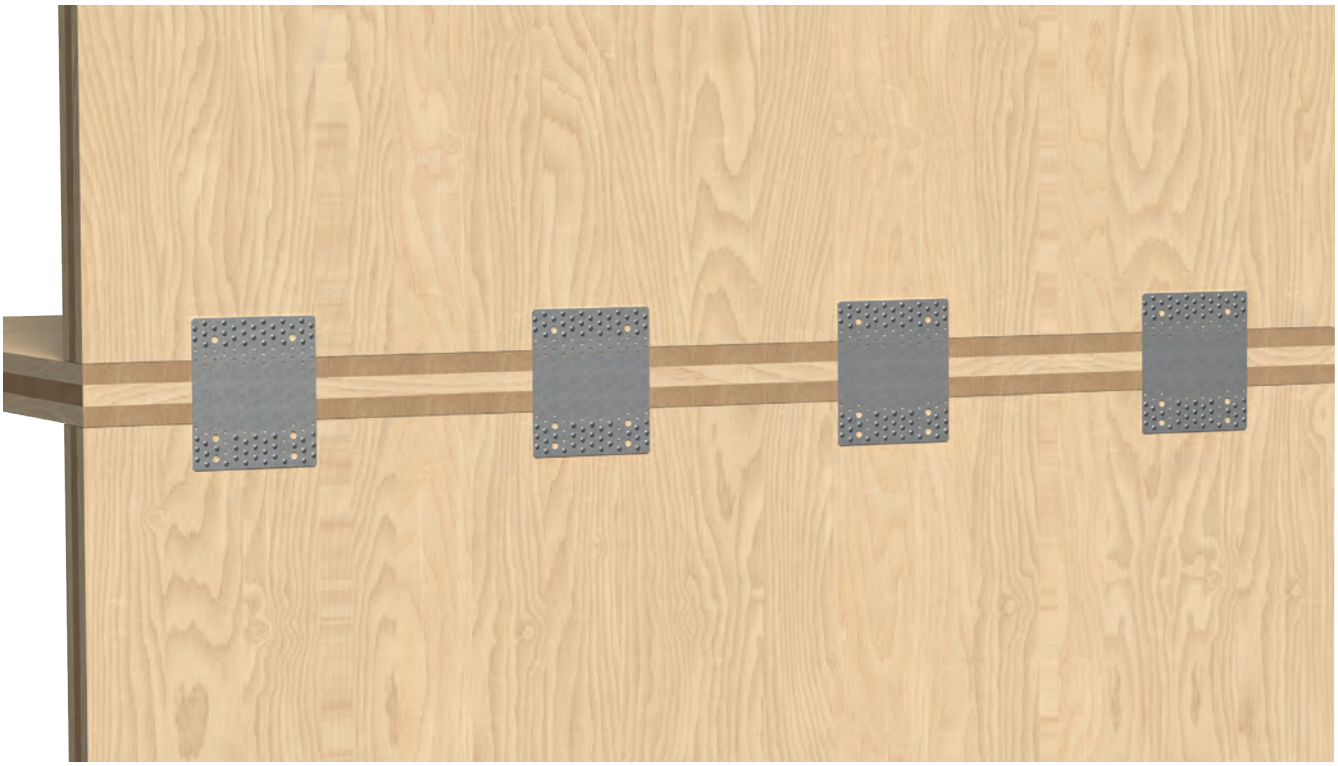
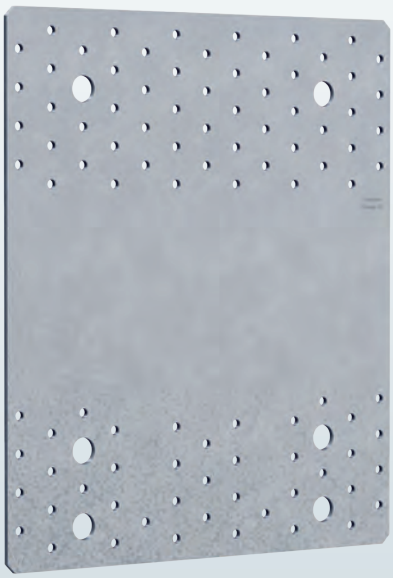
Anchor Plates

Where two vertical CLT panels are connected via an intermediate CLT floor panels' flush edge, the tension plates are replaced with more anchor plates to accommodate uplift and shear forces.



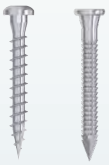
Items Required

Anchor Plate – Shear and Uplift Restraint
NPB



NPB255SO

Timber Fasteners
CSA Connector Screw,
CNA Connector Nail



CSA **CNA**

Quik Drive® **QDBPC50E** system is designed specifically for installing CSA-T connector screws.

Attachment QDBPC50E

CSA-T

Extension QDEXTE

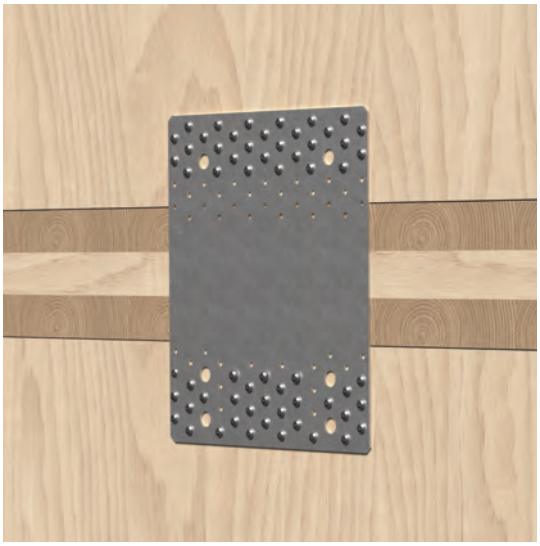
C-CLT-EU-2023 ©2023 SIMPSON STRONG-TIE COMPANY INC.

Anchor Plates

NPB – Anchor Plate

A 3 mm thick plate with various fastener pattern options, the NPB255SO is an excellent method for connecting CLT walls to CLR walls that meet along the same plane via an 80 mm thick intermediate timber layer, as it can provide high load capacities in terms of shear and uplift forces. The face of the NPB255SO is marked with a guide to ensure fasteners are always installed with a minimum edge distance maintained.

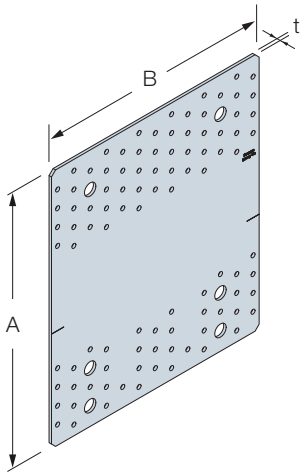
Advantages:
- High shear and uplift capacity
- Fast and simple connection between CLT and concrete along the same plane



ETA-06/0106

Dimensions

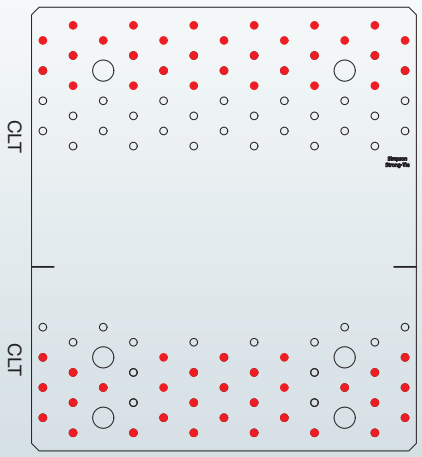
Model No.	Dimensions [mm]			Qty Holes	
	A	B	t	Screws or Nails	Bolts/Anchors
NPB255SO	294	255	3,0	97 Ø5	6 Ø14



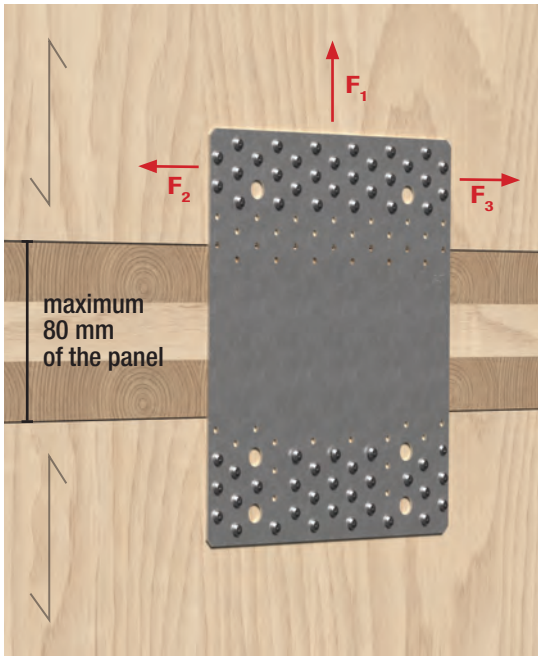
Characteristic Capacity and Slip Modulus – CLT to CLT – 1 Anchor Plate

Model No.	Fasteners		Characteristic Values [kN]		Slip Modulus [kN/mm]	
	Upper Part	Bottom Part	Tensile $R_{1,k}$	Shear $R_{2,k}$	Tensile $k_{ser,R1,k}$	Shear $k_{ser,R2,k}$
NPB255SO	30 CNA4.0x50	31 CNA4.0x50	66,6	25,0	7,0	2,3
	30 CNA4.0x60	31 CNA4.0x60	70,8	26,6	7,4	2,4
	30 CSA5.0x50	31 CSA5.0x50	78,9	29,7	18,0	5,9

Fastening Pattern



Red dots indicate holes filled with fasteners.



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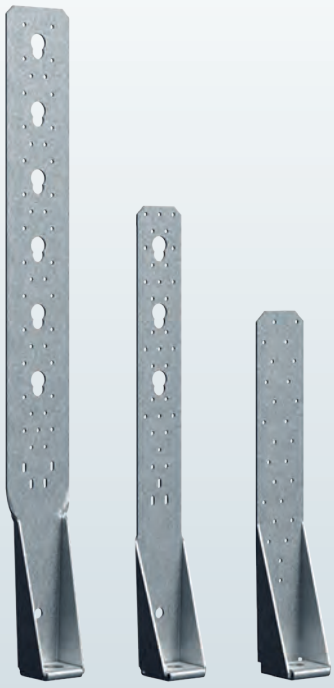
Hold Downs

Where two vertical CLT panels are intersected by a horizontal floor layer, the use of hold downs installed in pairs with a single rod connecting through the floor panel provides excellent performance characteristics.

Items Required

Hold Downs – Uplift Restraint
HTT



HTT31 HTT22E HTT5

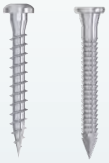
Fasteners
Threaded Rod of 1 Meter + Nut + Washer

Threaded Rod

Nut

Washer

Timber Fasteners
CSA Connector Screw, CNA Connector Nail



CSA CNA

Quik Drive® **QDBPC50E** system is designed specifically for installing CSA-T connector screws.

Attachment QDBPC50E

CSA-T

Extension QDEXTE

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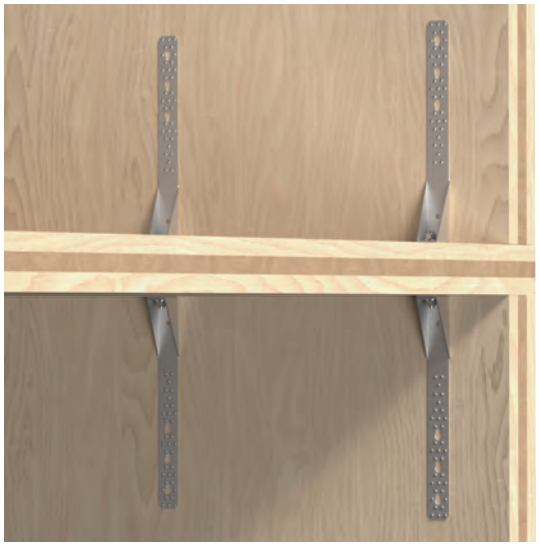
Hold Downs

HTT – Heavy Duty Hold Down

In situations where upper and lower storey walls require a connection that can cross a vertical floor panel, the HTT hold down can be used in opposing pairs, with a threaded rod connecting them via the floor. This configuration can support extremely high uplift loads.

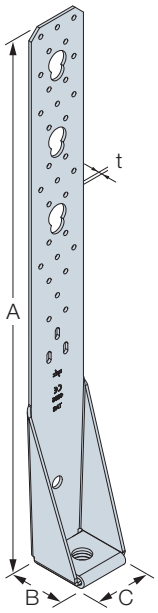
Advantages:
- Very high uplift capacity
- Can be installed via a CLT floor
- Choice of three HTT configurations to achieve the optimal balance of installation time and load capacity



ETA-07/0285

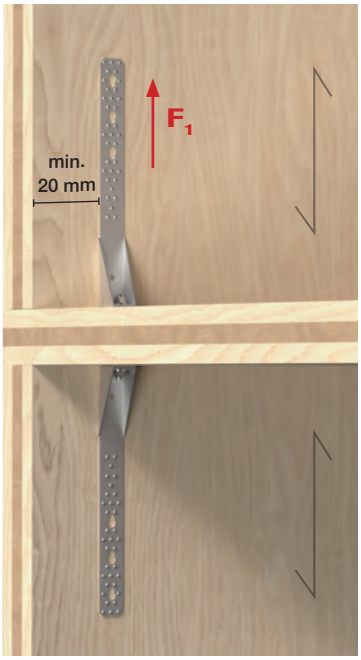
Dimensions

Model No.	Dimensions [mm]				Qty Holes Flange A		Qty Holes Flange B
	A	B	C	t	Screws or Nails	Bolts/Anchors	Bolts
HTT5	404	62	90	2,8	26 Ø4.7	-	1 Ø17.5
HTT22E	558	60	63	3,0	31 Ø5	3 Ø21	1 Ø18
HTT31	785	60	90	3,0	41 Ø5	6 Ø21	1 Ø26



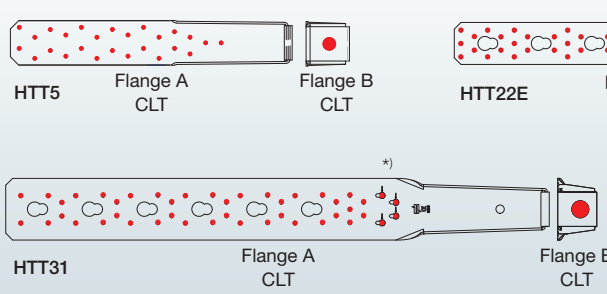
Characteristic Capacity and Slip Modulus – CLT to CLT – 1 Hold Down

Model No.	Fasteners		Characteristic Values [kN]	Slip Modulus [kN/mm]
	Flange A CLT	Flange B CLT	Tensile $R_{1,k}$	Tensile $k_{ser,1,k}$
HTT5	26 CNA4.0x50	1 Ø16	24,7	2,2
	26 CNA4.0x60	1 Ø16	31,0	2,6
HTT22E	29 CNA4.0x50 + 5 CSA5.0x50	1 Ø16	min (67,1 ; 57,5/k_{mod})	6,1
	29 CNA4.0x60 + 5 CSA5.0x50	1 Ø16	min (73,2 ; 57,5/k_{mod})	6,8
	34 CSA5.0x50	1 Ø16	min (80,2 ; 57,5/k_{mod})	8,3
	34 CSA5.0x80	1 Ø16	min (106,7 ; 57,5/k_{mod})	8,4
HTT31	41 CNA4.0x50 + 4 CSA5.0x50	1 Ø24	min (85,7 ; 85,1/k_{mod})	-
	41 CNA4.0x60 + 4 CSA5.0x50	1 Ø24	min (85,7 ; 85,1/k_{mod})	-
	45 CSA5.0x50	1 Ø24	min (85,7 ; 85,1/k_{mod})	24,3
	45 CSA5.0x50	1 Ø24	min (85,7 ; 85,1/k_{mod})	24,3



Fastening Pattern

*) **HTT22E:** CSA5.0x50 or longer screws must be placed in the 5 bottom holes (including 3 oblong holes).



*) **HTT31:** CSA5.0x50 or longer screws must be placed at the bottom of the 4 obling holes.

Red dots indicate holes filled with fasteners.

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CLT Floor to CLT Wall

Balloon frame timber structures where vertical supports run the full height of the building, can help overcome the compression that would otherwise distort floor panels.

In this case, the floors ensure that the structure transmits the vertical (and some shear) loads into the wall.

This section describes methods to connect CLT floor to CLT walls either directly or via timber or steel wall profiles.

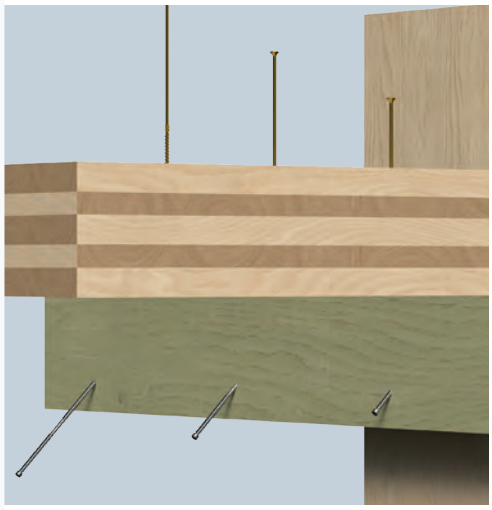
CLT Floor to CLT Wall Solutions

Structural Screws – Timber Wall Plate

Product Options:

TTUFS	see page 159
SWW	see page 161
SWC	see page 164
SWD	see page 167
ESCRFTZ	see page 168

By fastening a timber wall plate to the vertical panel, the floor can be suspended temporarily, allowing work to continue. This solution also provides good fire resistance properties.



Structural Screws – Steel Wall Profile

Product Options:

SSH	see page 171
SWC	see page 175

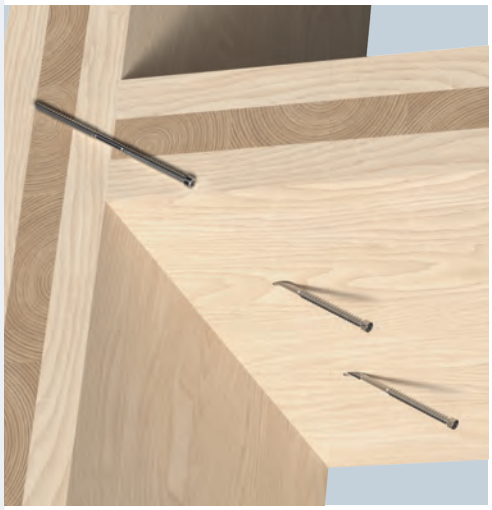
Similar to a timber wall plate, steel wall profiles also allow the floor to be suspended while work continues, with the additional benefit of a higher load capacity once fully installed.

Structural Screws – Direct Panel Connection

Product Options:

SWD	see page 180

For areas such as ceilings and corners where additional timber plates are not desired, structural screws can be used to fasten the wall panel directly into the suspended floor.



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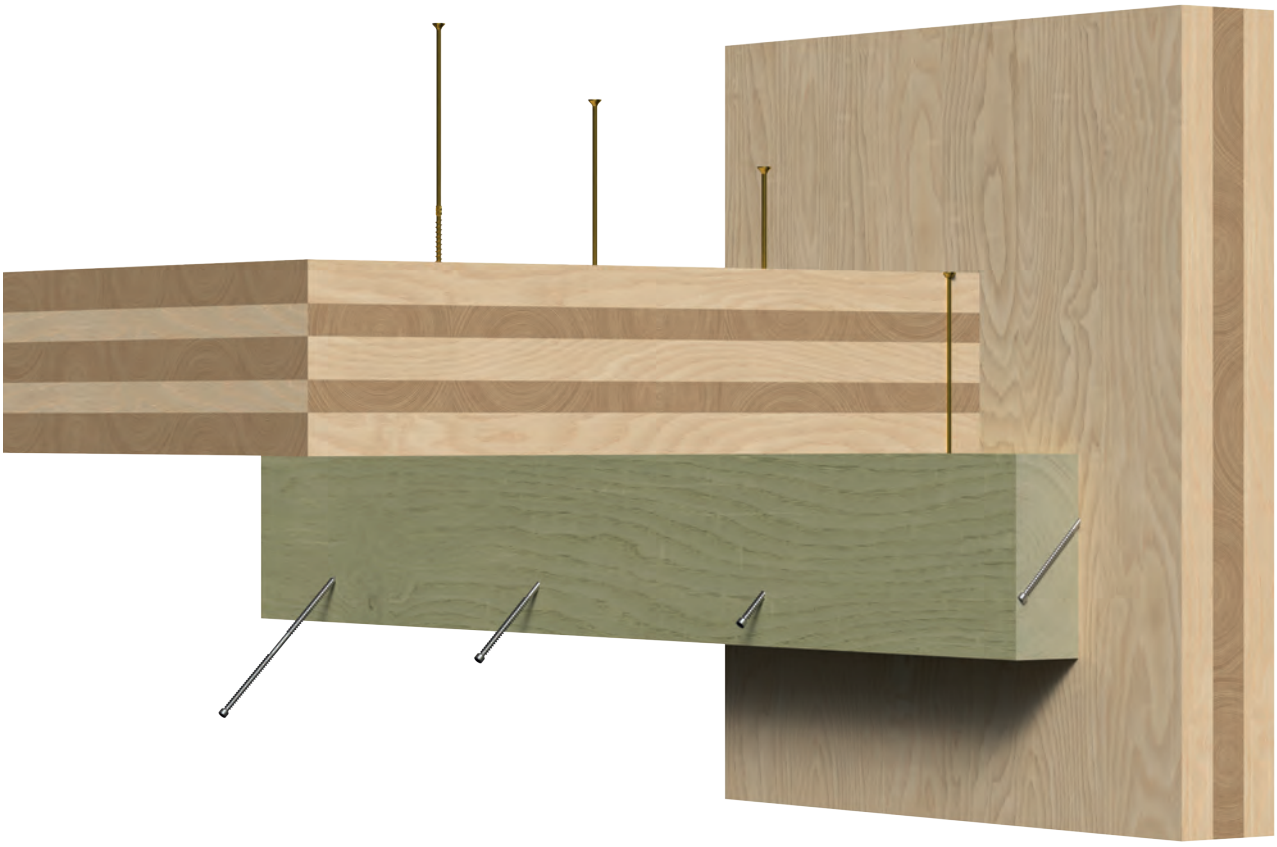
Structural Screws – Timber Wall Plate

By fastening a timber wall plate to the vertical panel, the floor can be suspended temporarily, allowing work to continue. This solution also provides good fire resistance properties.



Items Required

Timber Fasteners
TTUFS Countersunk Screw,
SWW Washer-Head Screw,
SWC Countersunk Screw,
SWD Double Threaded Screw,
ESCRFTZ Fully Threaded Cylinder-Head Screw

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Structural Screws – Timber Wall Plate

TTUFS – Countersunk Screw

TTUFS is a countersunk wood screw available in a variety of dimensions, the deep 6-lobe recess provides a good control during installation. The countersunk head allows a flush finish after installation and are suitable for thinner timber wall plates.

Advantages:

- Countersunk head allowing a flush finish
- Milling thread to reduce the drive-in torque
- No pre-drilling required

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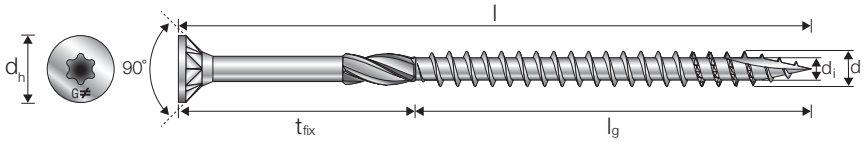


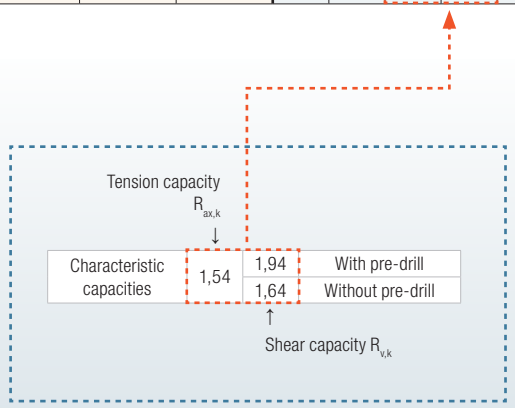
TTUFS – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
TTUFS 6.0xℓ	6,0	40-180	34-70	11,6	3,7	6-110

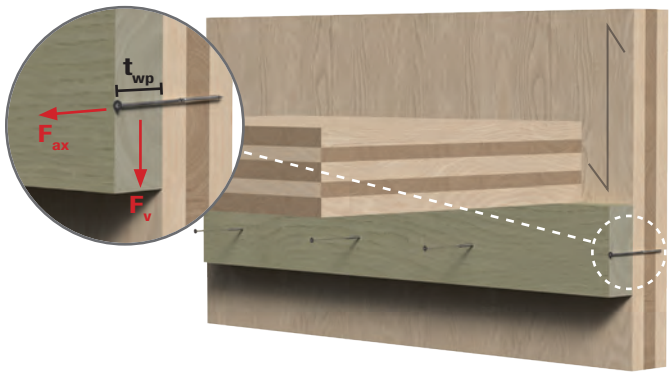
Solid-Timber (C24) Wall-Plate to CLT Panel – TTUFS Screws at 90°

Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_{wp} [mm]	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Wall-Plate [kN] – Screws at 90°															
			Wall-Plate Thickness t_{wp} [mm]															
			36		45		50		60		63		70		75		80		100	
TTUFS5.0X80	40	40	1,54	1,94	1,54	1,94	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				1,64		1,64		-		-		-		-		-		-		-
TTUFS5.0X90	45	45	1,54	1,94	1,54	1,94	1,54	1,94	-	-	-	-	-	-	-	-	-	-	-	-
				1,64		1,64		1,64		-		-		-		-		-		-
TTUFS5.0X100	60	40	1,54	1,94	1,54	1,94	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				1,64		1,64		-		-		-		-		-		-		-
TTUFS5.0X120	60	60	1,54	1,94	1,54	1,94	1,54	1,94	1,54	1,94	1,54	1,94	-	-	-	-	-	-	-	-
				1,64		1,64		1,64		1,64		1,64		-		-		-		-

Table continues on next page.



For pre-drilling recommendations, see chapter 10.



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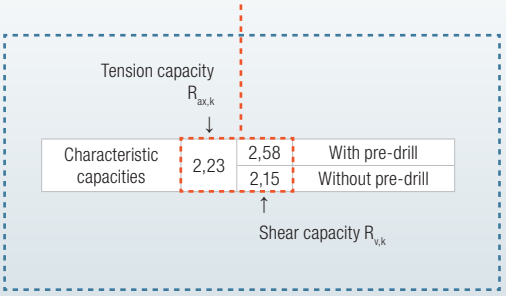
Structural Screws – Timber Wall Plate

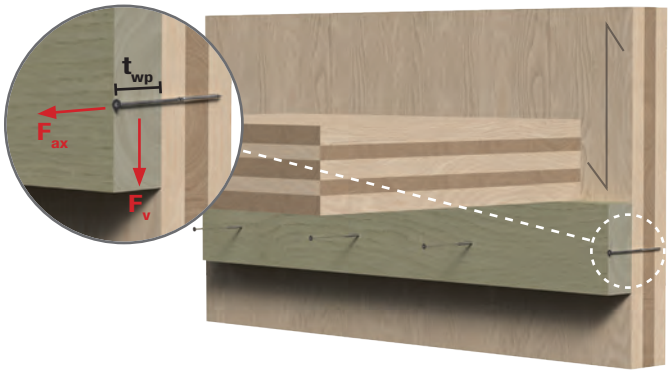
Solid-Timber (C24) Wall-Plate to CLT Panel – TTUFS Screws at 90° (cont.)

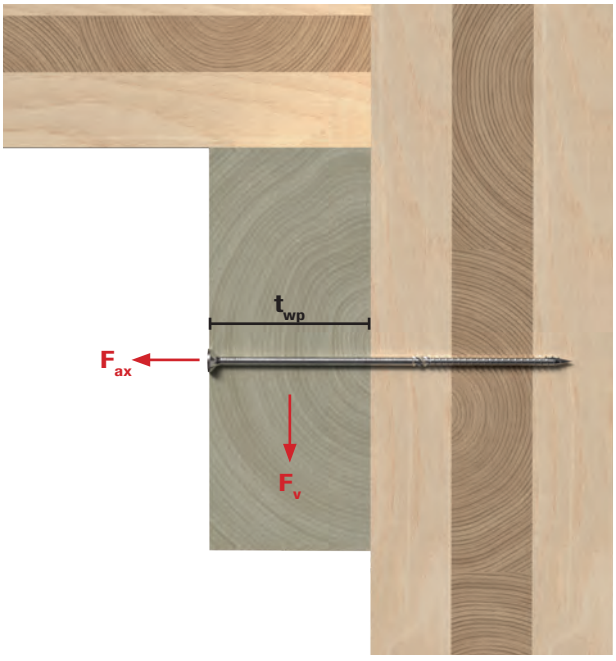
Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_{wp} [mm]	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Wall-Plate [kN] – Screws at 90°															
			Wall-Plate Thickness t_{wp} [mm]															
			36		45		50		60		63		70		75		80		100	
TTUFS6.0X80	40	40	2,23	2,58 2,09	2,23	2,58 2,06	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X90	45	45	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X100	60	40	2,23	2,58 2,09	2,23	2,58 2,15	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X120	70	50	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X140	70	70	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	-	- -	-	- -
TTUFS6.0X160	70	90	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	-	- -
TTUFS6.0X180	70	110	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15

Characteristic parameters of fasteners and more information are included in chapter 10.



For pre-drilling recommendations, see chapter 10.





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Structural Screws – Timber Wall Plate

SWW – Washer-Head Screw

For connecting timber wall plate to a CLT wall the SWW screw can be used, the washer head increase the head-pull through resistance and pulls the two wood members together and creates a firm assembly.

Advantages:

- High head-pull through resistance
- Pulls the wood members together
- No pre-drilling required

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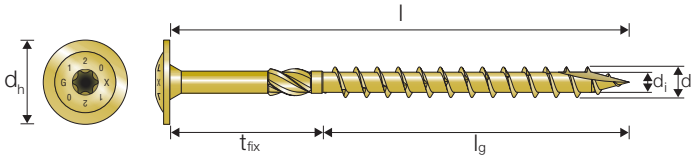

SWW – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
SWW6.0xℓ	6,0	60 - 300	42 - 70	14	3,9	18 - 230
SWW8.0xℓ	8,0	80 - 400	50 - 80	22	5,2	30 - 320
SWW10.0xℓ	10,0	100 - 400	50 - 80	25	6,2	50 - 320

Solid-Timber (C24) Wall-Plate to CLT Panel – SWW Screws at 90°

Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_{wp} [mm]	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Wall-Plate [kN] – Screws at 90°																	
			Wall-Plate Thickness t_{wp} [mm]																	
			36		45		50		60		63		70		75		80		100	
SWW6.0X100	50	50	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
SWW6.0X120	50	70	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	-	- -	-	- -
SWW6.0X140	70	70	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	-	- -	-	- -
SWW6.0X160	70	90	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	-	- -
SWW6.0X180	70	110	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46
SWW6.0X200	70	130	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46
SWW6.0X220	70	150	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46
SWW6.0X240	70	170	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46
SWW6.0X260	70	190	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46
SWW6.0X280	70	210	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46
SWW6.0X300	70	230	3,16	2,91 2,35	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46	3,16	2,91 2,46

Table continues on next page.

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Structural Screws – Timber Wall Plate

Solid-Timber (C24) Wall-Plate to CLT Panel – SWW Screws at 90° (cont.)

Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_{wp} [mm]	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Wall-Plate [kN] – Screws at 90°															
			Wall-Plate Thickness t_{wp} [mm]															
			36		45		50		60		63		70		75		80		100	
SWW8.0X100	50	50	5,04	4,63 3,49	5,04	5,06 3,76	5,04	5,06 3,81	-	-	-	-	-	-	-	-	-	-	-	-
SWW8.0X120	80	40	5,08	4,64 3,50	5,08	5,07 3,77	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWW8.0X140	80	60	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	-	-	-	-	-	-	-	-
SWW8.0X160	80	80	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	-	-
SWW8.0X180	80	100	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X200	80	120	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X220	80	140	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X240	80	160	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X260	80	180	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X280	80	200	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X300	80	220	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X320	80	240	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X340	80	260	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X360	80	280	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X380	80	300	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17
SWW8.0X400	80	320	5,08	4,64 3,50	5,08	5,07 3,77	5,08	5,07 3,94	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17	5,08	5,07 4,17

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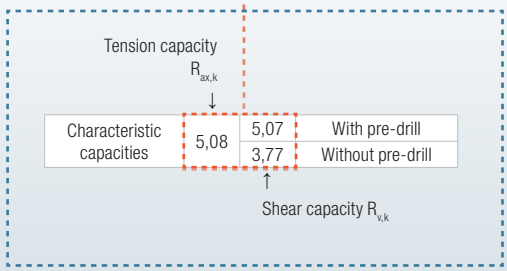
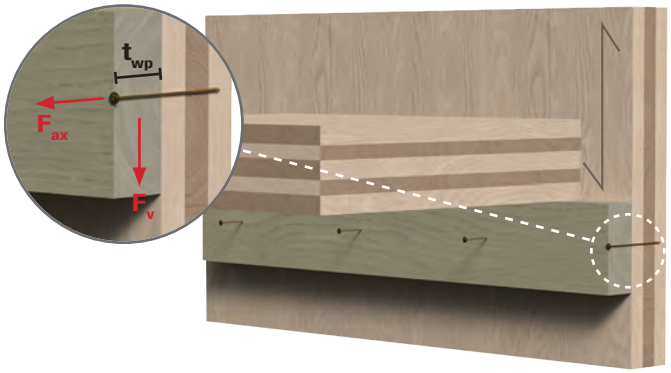


For pre-drilling recommendations, see chapter 10.



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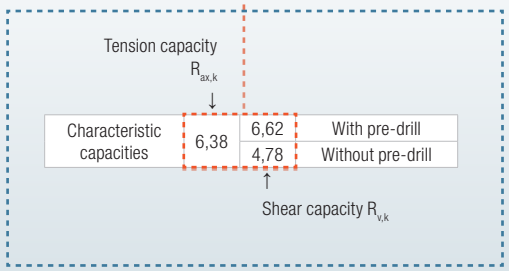
Structural Screws – Timber Wall Plate

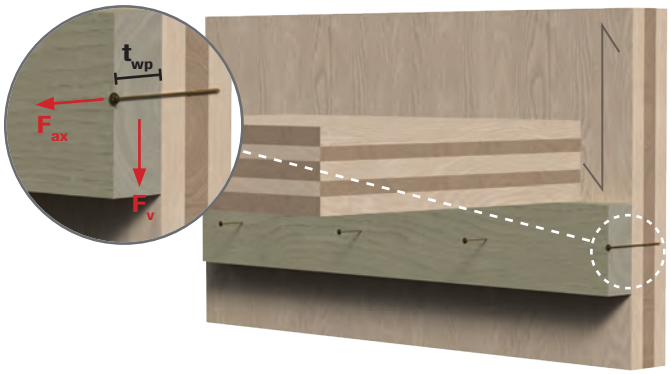
Solid-Timber (C24) Wall-Plate to CLT Panel – SWW Screws at 90° (cont.)

Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_{wp} [mm]	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Wall-Plate [kN] – Screws at 90°															
			Wall-Plate Thickness t_{wp} [mm]															
			36		45		50		60		63		70		75		80		100	
SWW10.0X100	50	50	-	-	6,10	6,56 4,53	6,10	6,87 4,50	-	-	-	-	-	-	-	-	-	-	-	-
SWW10.0X120	50	70	-	-	6,10	6,56 4,72	6,10	6,92 4,89	6,10	6,99 5,10	6,10	6,99 5,11	6,10	6,92 4,89	5,49	6,56 4,72	-	-	-	-
SWW10.0X140	80	60	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	-	-	-	-	-	-	-	-
SWW10.0X160	80	80	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	-	-
SWW10.0X180	80	100	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X200	80	120	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X220	80	140	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X240	80	160	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X260	80	180	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X280	80	200	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X300	80	220	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X320	80	240	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X340	80	260	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X360	80	280	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X380	80	300	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67
SWW10.0X400	80	320	-	-	6,38	6,62 4,78	6,38	6,99 4,96	6,38	7,06 5,34	6,38	7,06 5,46	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67	6,38	7,06 5,67

Characteristic parameters of fasteners and more information are included in chapter 10.



For pre-drilling recommendations, see chapter 10.



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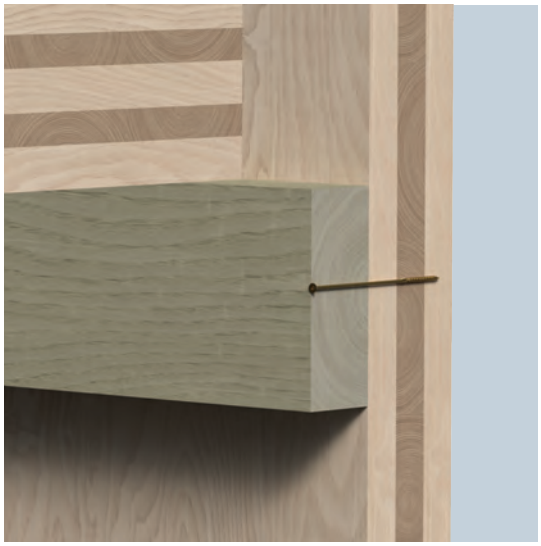
Structural Screws – Timber Wall Plate

SWC – Countersunk Screw

SWC is a countersunk structural wood screw designed to take high loads. The countersink head gives a flush fitting while allowing the wall plate and the CLT panel to close up firmly.

Advantages:

- Countersunk head creates a flush finish
- Milling thread for reduced drive-in torque
- No pre-drilling required



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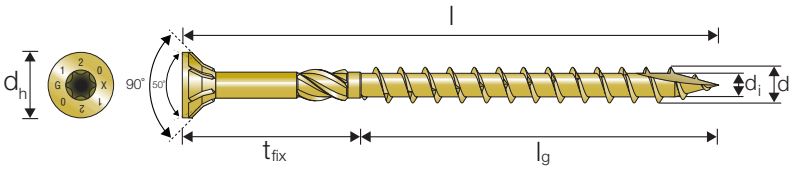

SWC – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
SWC6.0xℓ	6,0	200 - 300	70	11,8	3,9	130 - 230
SWC8.0xℓ	8,0	80 - 400	50 - 80	14,6	5,2	30 - 320
SWC10.0xℓ	10,0	100 - 400	50 - 80	17,8	6,2	50 - 320

Solid-Timber (C24) Wall-Plate to CLT Panel – SWC Screws at 90°

Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_{wp} [mm]	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Wall-Plate [kN] – Screws at 90°																	
			Wall-Plate Thickness t_{wp} [mm]																	
			36		45		50		60		63		70		75		80		100	
SWC6.0X200	70	130	1,66	2,53 1,97	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09
SWC6.0X220	70	150	1,66	2,53 1,97	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09
SWC6.0X240	70	170	1,66	2,53 1,97	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09
SWC6.0X260	70	190	1,66	2,53 1,97	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09
SWC6.0X280	70	210	1,66	2,53 1,97	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09
SWC6.0X300	70	230	1,66	2,53 1,97	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09	1,66	2,53 2,09

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Structural Screws – Timber Wall Plate

Solid-Timber (C24) Wall-Plate to CLT Panel – SWC Screws at 90°

Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_{wp} [mm]	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Wall-Plate [kN] – Screws at 90°															
			Wall-Plate Thickness t_{wp} [mm]															
			36		45		50		60		63		70		75		80		100	
SWC8.0X100	50	50	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,21	-	-	-	-	-	-	-	-	-	-	-	-
SWC8.0X120	80	40	2,66	4,04 2,90	2,66	4,47 3,17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC8.0X140	80	60	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	-	-	-	-	-	-	-	-
SWC8.0X160	80	80	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	-	-
SWC8.0X180	80	100	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X200	80	120	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X220	80	140	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X240	80	160	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X260	80	180	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X280	80	200	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X300	80	220	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X320	80	240	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X340	80	260	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X360	80	280	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X380	80	300	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57
SWC8.0X400	80	320	2,66	4,04 2,90	2,66	4,47 3,17	2,66	4,47 3,33	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57	2,66	4,47 3,57

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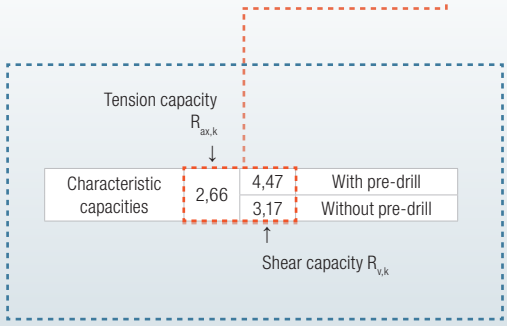
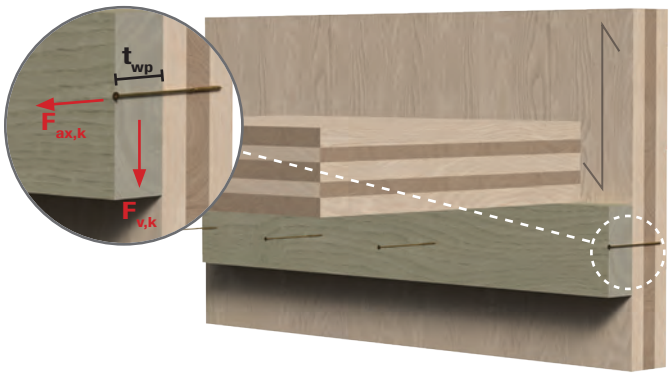


For pre-drilling recommendations, see chapter 10.



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Structural Screws – Timber Wall Plate

Solid-Timber (C24) Wall-Plate to CLT Panel – SWC Screws at 90°

Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_{wp} [mm]	Tension Capacity $R_{ax,k}$ Shear Capacity $R_{v,k}$ Depending on the Thickness of the Wall-Plate [kN] – Screws at 90°															
			Wall-Plate Thickness t_{wp} [mm]															
			36		45		50		60		63		70		75		80		100	
SWC10.0X100	50	50	-	-	3,55	5,92	3,55	6,24	-	-	-	-	-	-	-	-	-	-	-	-
				-		3,89		3,87		-		-		-		-		-		-
SWC10.0X120	50	70	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,28	3,55	5,92	-	-	-	-
				-		4,08		4,25		4,46		4,47		4,25		4,08		-		-
SWC10.0X140	80	60	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	-	-	-	-	-	-	-	-
				-		4,08		4,25		4,63		4,75		-		-		-		-
SWC10.0X160	80	80	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	-	-
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		-
SWC10.0X180	80	100	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X200	80	120	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X220	80	140	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X240	80	160	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X260	80	180	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X280	80	200	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X300	80	220	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X320	80	240	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X340	80	260	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X360	80	280	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X380	80	300	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96
SWC10.0X400	80	320	-	-	3,55	5,92	3,55	6,28	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35	3,55	6,35
				-		4,08		4,25		4,63		4,75		4,96		4,96		4,96		4,96

Characteristic parameters of fasteners and more information are included in chapter 10.

Minimum Edge Distances for Screws Wall-Plate to CLT Panel

SWW

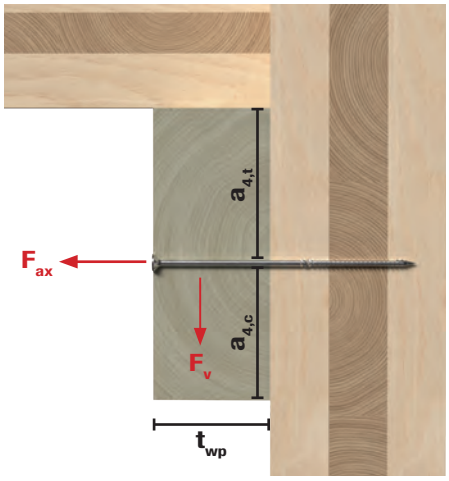
Dimensions	Pre-drill*	$a_{4,c}$	$a_{4,t}$
6.0xℓ	With pre-drill	18	42
	Without pre-drill	30	42
8.0xℓ	With pre-drill	24	56
	Without pre-drill	40	56
10.0xℓ	With pre-drill	30	70
	Without pre-drill	50	70

* Pre-drill refers to wall-plate only

SWC

Dimensions	Pre-drill*	$a_{4,c}$	$a_{4,t}$
6.0xℓ	With pre-drill	18	42
	Without pre-drill	30	42
8.0xℓ	With pre-drill	24	56
	Without pre-drill	40	56
10.0xℓ	With pre-drill	30	70
	Without pre-drill	50	70

* Pre-drill refers to wall-plate only



TTUFS

Dimensions	Pre-drill*	$a_{4,c}$	$a_{4,t}$
5.0xℓ	With pre-drill	15	35
	Without pre-drill	25	35
6.0xℓ	With pre-drill	18	42
	Without pre-drill	30	42

* Pre-drill refers to wall-plate only

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Structural Screws – Timber Wall Plate

SWD – Double Threaded Screw

SWD screws can be used to create almost hidden connections due to the small cylinder head. The design of the screw makes it suitable for inclined and angled installations that increase the load capacity.

Advantages:

- High load capacity
- Small cylinder head for hidden assemblies
- No pre-drilling required

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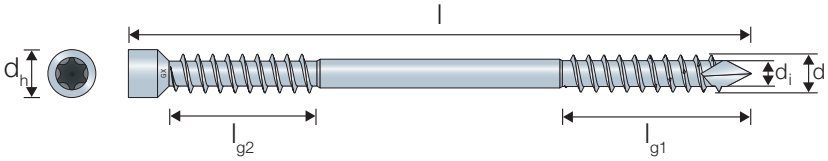


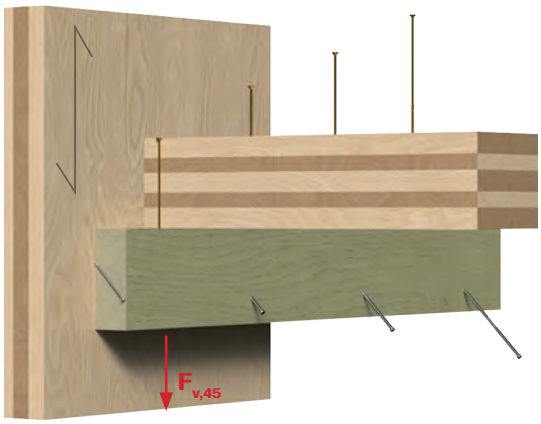
SWD – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_{g1}	l_{g2}	d_h	d_i
SWD6.5xℓ	6,5	65-220	40-95	33,5-88,5	8	4,0
SWD8.0xℓ	8,0	90-330	40-95	31,5-86,5	10	5,4

Solid-Timber (C24) Wall-Plate to CLT Panel – SWD Inclined Screws at 45°

Product Reference	Minimum Wall-Plate Thickness t_{wp} [mm]	Shear Capacity $R_{v,45,k}$ [kN] – Screws at 45°
SWD6.5X65	23	1,8
SWD6.5X90	32	2,5
SWD6.5X130	46	2,5
SWD6.5X160	57	4,1
SWD6.5X190	68	5,0
SWD6.5X220	78	6,0
SWD8.0X90	32	3,0
SWD8.0X130	46	3,0
SWD8.0X160	57	4,8
SWD8.0X190	68	5,9
SWD8.0X220	78	7,0
SWD8.0X245	87	7,9
SWD8.0X275	98	7,9
SWD8.0X300	107	10,0
SWD8.0X330	117	10,0

Characteristic parameters of fasteners and more information are included in chapter 10.



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Structural Screws – Timber Wall Plate

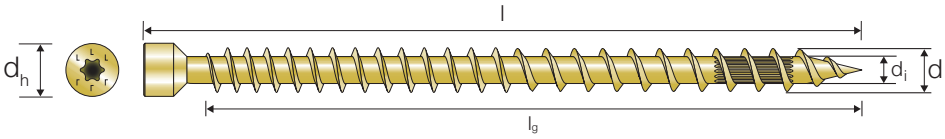
ESCRFTZ –
Fully Threaded Cylinder-Head Screw

ESCRFTZ is a fully threaded screw that can be used to create almost hidden connections due to the small cylinder head. The design of the screw makes it suitable for inclined and angled installations that increase the load capacity.

Advantages:

- High load capacity
- Small cylinder head for hidden assemblies
- No pre-drilling required

ETA-13/0796



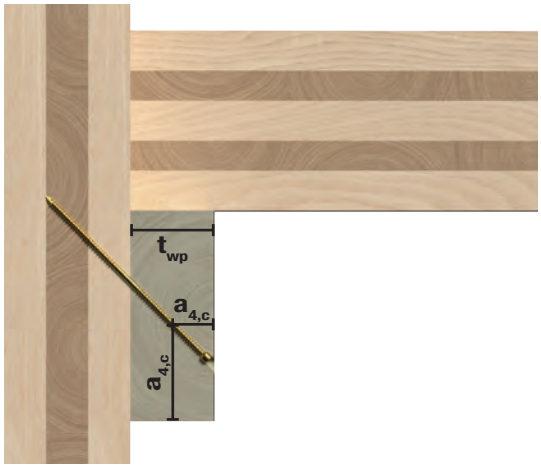
ESCRFTZ – Range Overview

Product Reference	Dimensions [mm]				
	d	l	l_g	d_h	d_i
ESCRFTZ8.0xℓ	8,0	120 - 400	110 - 390	10,2	5,2

Solid-Timber (C24) Wall-Plate to CLT Panel – ESCRFTZ Inclined Screws at 45°

Product Reference	Minimum Wall-Plate Thickness t_{wp} [mm]	Shear Capacity $R_{v,45,k}$ [kN] – Screws at 45°
ESCRFTZ8.0X120	43	3,7
ESCRFTZ8.0X140	50	4,4
ESCRFTZ8.0X160	57	5,2
ESCRFTZ8.0X180	64	5,9
ESCRFTZ8.0X200	71	6,7
ESCRFTZ8.0X220	78	7,4
ESCRFTZ8.0X240	85	8,2
ESCRFTZ8.0X260	92	8,9
ESCRFTZ8.0X280	99	9,6
ESCRFTZ8.0X300	107	10,4
ESCRFTZ8.0X350	124	12,2
ESCRFTZ8.0X400	142	14,1

Characteristic parameters of fasteners and more information are included in chapter 10.



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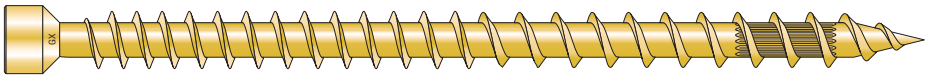
Structural Screws – Timber Wall Plate

Minimum Edge Distances for Screws
Solid-Timber Wall-Plate to CLT Connection - Screws at 45°

Dimensions	$a_{4,c}$
SWD6.5	26
SWD8.0xℓ	32
ESCRFTZ8.0	32
ESCRFTZ10.0	40

HELPFUL TIP

When to choose fully threaded screws or double threaded screws?



Fully threaded screws can take higher loads, if well placed. They can be used for reinforcement of beams.

OR

Double threaded screws have the advantage of partial threaded screws and fully threaded screws:
- Take higher loads than partially threaded screws
- Can pull two wood members together creating a clamp effect

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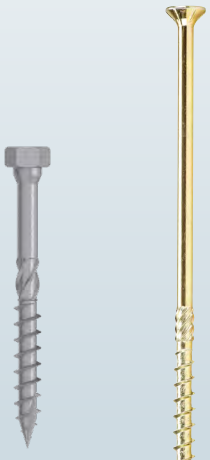
Structural Screws – Steel Wall Profile

Similar to a timber wall plate, steel wall profiles also allow the floor to be suspended while work continues, with the additional benefit of a higher load capacity once fully installed.

Items Required

Timber Fasteners
SSH Hex-Head Connector Screw,
SWC Countersunk Screw



SSH

SWC

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Structural Screws – Steel Wall Profile

SSH – Hex-Head Connector Screw

The SSH hex-head screw is a heavy-duty connector screw designed for steel to wood applications. The design of the screw provides an excellent connection to the steel and can transfer high loads. The head combining hex and 6-lobe drive allows to install the screw with either a hex-driver or a 6-lobe driver bit.

Advantages:

- Can be installed with hex-driver bit or 6-lobe driver bit
- No pre-drilling required.
- Impreg+ coating

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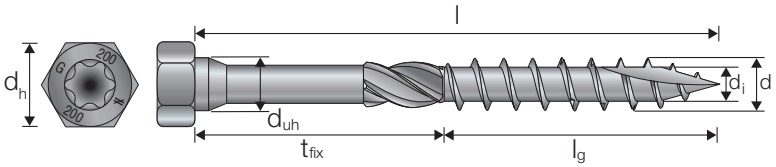

SSH – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_h	t_{fix}
SSH6.0xℓ	6,0	40 - 120	24 - 75	14,5	3,65	16 - 45
SSH8.0xℓ	8,0	40 - 300	32 - 110	13	5,1	8 - 190
SSH10.0xℓ	10,0	50 - 280	42 - 125	15	6,15	8 - 155
SSH12.0xℓ	12,0	60 - 200	48 - 110	17	6,7	12 - 90

Steel Wall Profile to CLT Panel – SSH Screws at 90°

Product Reference	Tension Capacity – Steel to CLT – $R_{ax,k}$ [kN][1]	Shear Capacity – Steel to CLT – [kN]					
		Thin Steel[2]			Thick Steel[3]		
		Maximum Thickness [mm]	Pre-Drill	$R_{v,k}$	Minimum Thickness [mm]	Pre-Drill	$R_{v,k}$
SSH6.0x40[4]	1,8	3,0	With pre-drill	2,40	6,0	With pre-drill	3,16
			Without pre-drill	1,49		Without pre-drill	2,29
SSH6.0x50[4]	2,6	3,0	With pre-drill	2,77	6,0	With pre-drill	3,64
			Without pre-drill	1,89		Without pre-drill	2,82
SSH6.0x60[4]	3,4	3,0	With pre-drill	2,95	6,0	With pre-drill	3,82
			Without pre-drill	2,29		Without pre-drill	3,19
SSH6.0x75[4]	3,4	3,0	With pre-drill	2,95	6,0	With pre-drill	3,82
			Without pre-drill	2,50		Without pre-drill	3,19
SSH6.0x90[4]	3,4	3,0	With pre-drill	2,95	6,0	With pre-drill	3,82
			Without pre-drill	2,50		Without pre-drill	3,19
SSH6.0x120[4]	6,0	3,0	With pre-drill	3,61	6,0	With pre-drill	4,48
			Without pre-drill	3,16		Without pre-drill	3,85

Table continues on next page.

[1] For steel thickness ≤ d
[2] Thin plate: thickness ≤ 0.5xd
[3] Thick plate: thickness ≥ d
[4] 6.0 mm screws have a different head design – see chapter 10.
For intermediate steel thicknesses, the capacity can be obtained by interpolation.
For recommended hole diameter in steel, see chapter 10.

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Structural Screws – Steel Wall Profile

Steel Wall Profile to CLT Panel – SSH Screws at 90° (cont.)

Product Reference	Tension Capacity – Steel to CLT – $R_{ax,k}$ [kN][1]	Shear Capacity – Steel to CLT – [kN]					
		Thin Steel[2]			Thick Steel[3]		
		Maximum Thickness [mm]	Pre-Drill	$R_{v,k}$	Minimum Thickness [mm]	Pre-Drill	$R_{v,k}$
SSH8.0X40	3,6	4,0	With pre-drill	3,04	8,0	With pre-drill	4,75
			Without pre-drill	1,77		Without pre-drill	3,54
SSH8.0X50	4,7	4,0	With pre-drill	3,89	8,0	With pre-drill	5,67
			Without pre-drill	2,26		Without pre-drill	4,12
SSH8.0x60	4,7	4,0	With pre-drill	4,73	8,0	With pre-drill	6,39
			Without pre-drill	2,76		Without pre-drill	4,48
SSH8.0x70	4,7	4,0	With pre-drill	4,93	8,0	With pre-drill	6,48
			Without pre-drill	3,25		Without pre-drill	4,89
SSH8.0X80	4,7	4,0	With pre-drill	4,93	8,0	With pre-drill	6,48
			Without pre-drill	3,74		Without pre-drill	5,23
SSH8.0X90	4,7	4,0	With pre-drill	4,93	8,0	With pre-drill	6,48
			Without pre-drill	4,04		Without pre-drill	5,23
SSH8.0X100	6,1	4,0	With pre-drill	5,29	8,0	With pre-drill	6,85
			Without pre-drill	4,40		Without pre-drill	5,59
SSH8.0X120	9,5	4,0	With pre-drill	6,12	8,0	With pre-drill	7,68
			Without pre-drill	5,23		Without pre-drill	6,42
SSH8.0X140	9,5	4,0	With pre-drill	6,12	8,0	With pre-drill	7,68
			Without pre-drill	5,23		Without pre-drill	6,42
SSH8.0X160	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X180	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X200	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X240	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X260	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X280	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X300	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH10.0X50	3,9	5,0	With pre-drill	3,62	10,0	With pre-drill	5,87
			Without pre-drill	2,59		Without pre-drill	4,92
SSH10.0X60	5,1	5,0	With pre-drill	5,68	10,0	With pre-drill	7,68
			Without pre-drill	3,16		Without pre-drill	5,29
SSH10.0X80	5,1	5,0	With pre-drill	6,41	10,0	With pre-drill	8,54
			Without pre-drill	4,32		Without pre-drill	6,20
SSH10.0X90	5,1	5,0	With pre-drill	6,41	10,0	With pre-drill	8,54
			Without pre-drill	4,89		Without pre-drill	6,70
SSH10.0X100	6,7	5,0	With pre-drill	6,81	10,0	With pre-drill	8,94
			Without pre-drill	5,47		Without pre-drill	7,09
SSH10.0X120	10,3	5,0	With pre-drill	7,71	10,0	With pre-drill	9,84
			Without pre-drill	6,41		Without pre-drill	8,00
SSH10.0X140	10,3	5,0	With pre-drill	7,71	10,0	With pre-drill	9,84
			Without pre-drill	6,41		Without pre-drill	8,00
SSH10.0X160	13,3	5,0	With pre-drill	8,47	10,0	With pre-drill	10,60
			Without pre-drill	7,16		Without pre-drill	8,75
SSH10.0X180	13,3	5,0	With pre-drill	8,47	10,0	With pre-drill	10,60
			Without pre-drill	7,16		Without pre-drill	8,75
SSH10.0X200	13,3	5,0	With pre-drill	8,47	10,0	With pre-drill	10,60
			Without pre-drill	7,16		Without pre-drill	8,75
SSH10.0X240	15,1	5,0	With pre-drill	8,92	10,0	With pre-drill	11,05
			Without pre-drill	7,62		Without pre-drill	9,21
SSH10.0X280	15,1	5,0	With pre-drill	8,92	10,0	With pre-drill	11,05
			Without pre-drill	7,62		Without pre-drill	9,21

[1] For steel thickness ≤ d
[2] Thin plate: thickness ≤ 0.5xd
[3] Thick plate: thickness ≥ d
For intermediate steel thicknesses, the capacity can be obtained by interpolation.
For recommended hole diameter in steel, see chapter 10.

Table continues on next page.

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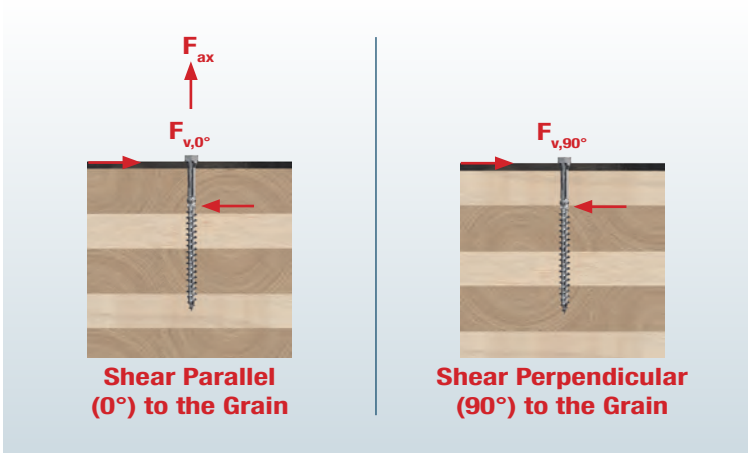
Structural Screws – Steel Wall Profile

Steel Wall Profile to CLT Panel – SSH Screws at 90° (cont.)

Product Reference	Tension Capacity – Steel to CLT – $R_{ax,k}$ [kN][1]	Shear Capacity – Steel to CLT – [kN]					
		Thin Steel[2]			Thick Steel[3]		
		Maximum Thickness [mm]	Pre-Drill	$R_{v,k}$	Minimum Thickness [mm]	Pre-Drill	$R_{v,k}$
SSH12.0X60	7,0	6,0	With pre-drill	6,55	12,0	With pre-drill	9,27
			Without pre-drill	3,53		Without pre-drill	6,45
SSH12.0X80	7,0	6,0	With pre-drill	8,23	12,0	With pre-drill	10,91
			Without pre-drill	4,84		Without pre-drill	7,41
SSH12.0X90	7,0	6,0	With pre-drill	8,23	12,0	With pre-drill	10,91
			Without pre-drill	5,49		Without pre-drill	7,96
SSH12.0X100	8,1	6,0	With pre-drill	8,49	12,0	With pre-drill	11,17
			Without pre-drill	6,14		Without pre-drill	8,74
SSH12.0X120	12,4	6,0	With pre-drill	9,59	12,0	With pre-drill	12,27
			Without pre-drill	7,45		Without pre-drill	9,84
SSH12.0X140	12,4	6,0	With pre-drill	9,59	12,0	With pre-drill	12,27
			Without pre-drill	7,87		Without pre-drill	9,84
SSH12.0X160	16,1	6,0	With pre-drill	10,50	12,0	With pre-drill	13,18
			Without pre-drill	8,78		Without pre-drill	10,75
SSH12.0X180	16,1	6,0	With pre-drill	10,50	12,0	With pre-drill	13,18
			Without pre-drill	8,78		Without pre-drill	10,75
SSH12.0X200	16,1	6,0	With pre-drill	10,50	12,0	With pre-drill	13,18
			Without pre-drill	8,78		Without pre-drill	10,75

[1] For steel thickness ≤ d
[2] Thin plate: thickness ≤ 0.5xd
[3] Thick plate: thickness ≥ d
For intermediate steel thicknesses, the capacity can be obtained by interpolation.
For recommended hole diameter in steel, see chapter 10.

Characteristic parameters of fasteners and more information are included in chapter 10.



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Structural Screws – Steel Wall Profile

SSH – Recommended Maximum Steel Hole Diameter

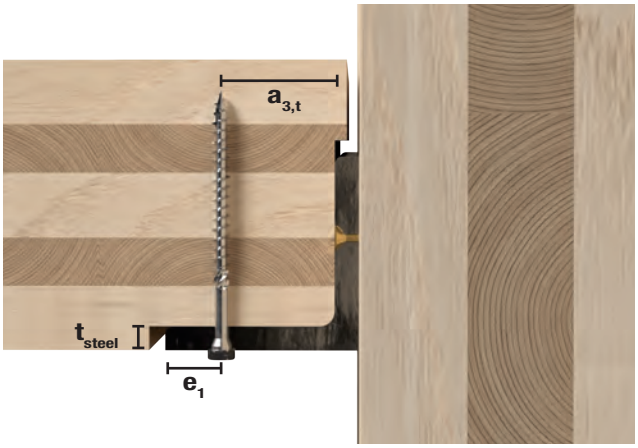
SSH6,0	SSH8,0	SSH10,0	SSH12,0
Ø7 mm	Ø9 mm	Ø11 mm	Ø13 mm

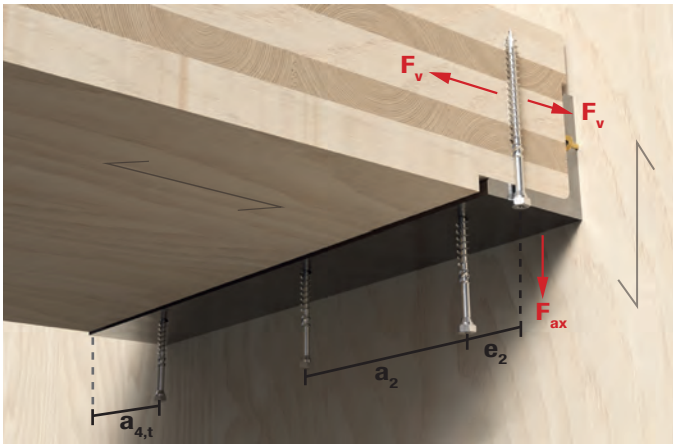
Note: The cone under the head have the same diameter as the outer thread.

SSH – Minimum Spacings and Edge and End Distances

Spacing or distance [mm]		SSH6,0	SSH8,0	SSH10,0	SSH12,0
CLT	a_2	15	20	25	30
	$a_{3,t}$	36	48	60	72
	$a_{4,t}$	36	48	60	72
Steel	e_1	8	10	12	15
	e_2	8	10	12	15
	a_2	15	20	24	29

Note: Both CLT and Steel edge distances need to be fulfilled.
* According to EN 1993-1-8 §3.5





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Structural Screws – Steel Wall Profile

SWC – Countersunk Screw

SWC is a countersunk structural screw designed to take high loads. To create a flush finish between the screw and the steel plate, the hole profile needs to be adapted to the SWC geometry.

Advantages:

- Countersunk head creates a flush finish
- Milling thread for reduced drive-in torque
- No pre-drilling required

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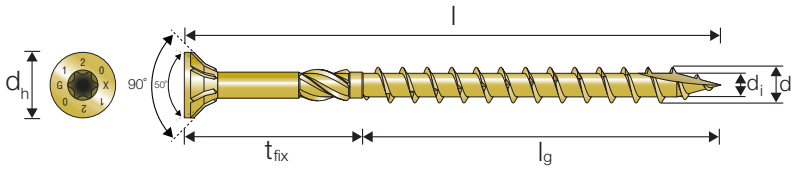

SWC – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
SWC6.0xℓ	6,0	200 - 300	70	11,8	3,9	130 - 230
SWC8.0xℓ	8,0	80 - 400	50 - 80	14,6	5,2	30 - 320
SWC10.0xℓ	10,0	100 - 400	50 - 80	17,8	6,2	50 - 320

Steel Wall Profile to CLT Panel – SWC Screws at 90°

Product Reference	Tension Capacity – Steel to CLT – $R_{ax,k}$ [kN][1]	Shear Capacity – Steel to CLT – [kN]					
		Thin Steel[2]			Thick Steel[3]		
		Maximum Thickness [mm]	Pre-Drill	$R_{v,k}$	Minimum Thickness [mm]	Pre-Drill	$R_{v,k}$
SWC6.0X200	5,5	3	With pre-drill	3,49	6	With pre-drill	4,36
			Without pre-drill	3,04		Without pre-drill	3,73
SWC6.0X220	5,5	3	With pre-drill	3,49	6	With pre-drill	4,36
			Without pre-drill	3,04		Without pre-drill	3,73
SWC6.0X240	5,5	3	With pre-drill	3,49	6	With pre-drill	4,36
			Without pre-drill	3,04		Without pre-drill	3,73
SWC6.0X260	5,5	3	With pre-drill	3,49	6	With pre-drill	4,36
			Without pre-drill	3,04		Without pre-drill	3,73
SWC6.0X280	5,5	3	With pre-drill	3,49	6	With pre-drill	4,36
			Without pre-drill	3,04		Without pre-drill	3,73
SWC6.0X300	5,5	3	With pre-drill	3,49	6	With pre-drill	4,36
			Without pre-drill	3,04		Without pre-drill	3,73

Table continues on next page.

[1] For steel thickness ≤ d
[2] Thin plate thickness ≤ 0.5xd
[3] Thick plate thickness ≥ d
For intermediate steel thicknesses, the capacity can be obtained by interpolation.
For recommended hole diameter in steel, see chapter 10.

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Structural Screws – Steel Wall Profile

Steel Wall Profile to CLT Panel – SWC Screws at 90° (cont.)

Product Reference	Tension Capacity – Steel to CLT – $R_{ax,k}$ [kN][1]	Shear Capacity – Steel to CLT – [kN]					
		Thin Steel[2]			Thick Steel[3]		
		Maximum Thickness [mm]	Pre-Drill	$R_{v,k}$	Minimum Thickness [mm]	Pre-Drill	$R_{v,k}$
SWC8.0X80	5,0	4	With pre-drill	5,06	8	With pre-drill	6,64
			Without pre-drill	3,74		Without pre-drill	5,37
SWC8.0X100	5,0	4	With pre-drill	5,06	8	With pre-drill	6,64
			Without pre-drill	4,16		Without pre-drill	5,37
SWC8.0X120	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X140	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X160	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X180	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X200	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X220	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X240	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X260	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X280	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X300	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X320	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X340	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X360	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X380	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12
SWC8.0X400	8,1	4	With pre-drill	5,82	8	With pre-drill	7,40
			Without pre-drill	4,92		Without pre-drill	6,12

Table continues on next page.

[1] For steel thickness ≤ d
[2] Thin plate thickness ≤ 0.5xd
[3] Thick plate thickness ≥ d
For intermediate steel thicknesses, the capacity can be obtained by interpolation.
For recommended hole diameter in steel, see chapter 10.

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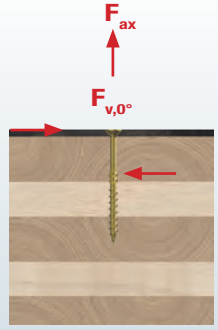
Structural Screws – Steel Wall Profile

Steel Wall Profile to CLT Panel – SWC Screws at 90° (cont.)

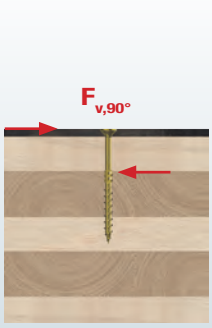
Product Reference	Tension Capacity – Steel to CLT – $R_{ax,k}$ [kN][1]	Shear Capacity – Steel to CLT – [kN]					
		Thin Steel[2]			Thick Steel[3]		
		Maximum Thickness [mm]	Pre-Drill	$R_{v,k}$	Minimum Thickness [mm]	Pre-Drill	$R_{v,k}$
SWC10.0X100	6,1	5	With pre-drill	6,99	10	With pre-drill	9,25
			Without pre-drill	5,47		Without pre-drill	7,29
SWC10.0X120	6,1	5	With pre-drill	6,99	10	With pre-drill	9,25
			Without pre-drill	5,60		Without pre-drill	7,29
SWC10.0X140	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X160	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X180	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X200	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X220	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X240	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X260	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X280	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X300	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X320	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X340	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X360	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X380	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21
SWC10.0X400	9,8	5	With pre-drill	7,90	10	With pre-drill	10,17
			Without pre-drill	6,52		Without pre-drill	8,21

[1] For steel thickness ≤ d
[2] Thin plate thickness ≤ 0.5xd
[3] Thick plate thickness ≥ d
For intermediate steel thicknesses, the capacity can be obtained by interpolation.
For recommended hole diameter in steel, see chapter 10.

Characteristic parameters of fasteners and more information are included in chapter 10.



Shear Parallel (0°) to the Grain



Shear Perpendicular (90°) to the Grain

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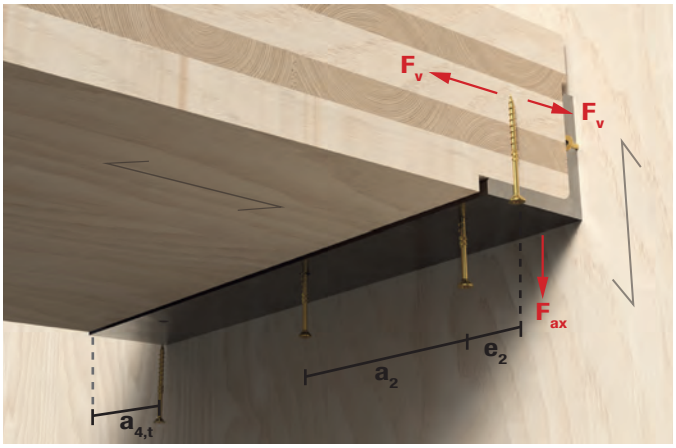
Structural Screws – Steel Wall Profile

SWC – Minimum Spacings and Edge and End Distances

Spacing or distance [mm]		SWC6,0	SWC8,0	SWC10,0
CLT	a_2	15	20	25
	$a_{3,t}$	36	48	60
	$a_{4,t}$	36	48	60
Steel	e_1	8	10	12
	e_2	8	10	12
	a_2	15	20	24

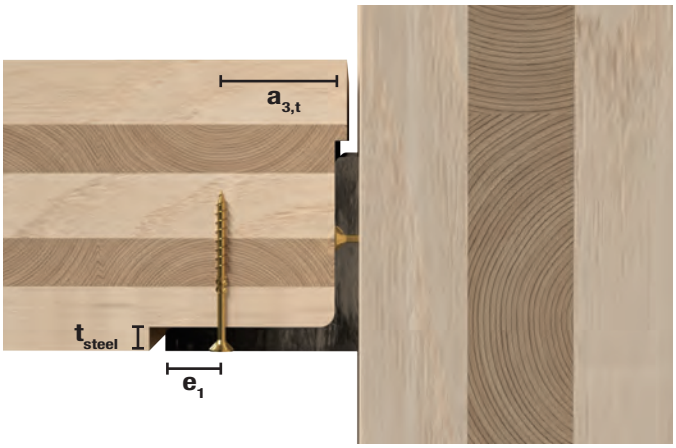
Note: Both CLT and Steel edge distances need to be fulfilled.
* According to EN 1993-1-8 §3.5

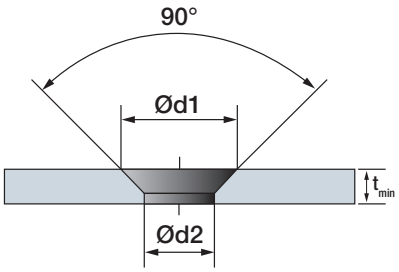


SWC – Recommended Hole Design in Steel Countersunk Screws

Diameter	Ød1$_{min}$	Ød2$_{min}$	Øt$_{min}$
SWC6,0	15,5	6,5	3,5
SWC8,0	19,0	9,0	6,0
SWC10,0	22,5	11,0	7,0

Note: Calculation with steel to wood do not take the strength of the steel in consideration, but only the wood and the fastener, see Eurocode 3 for steel plate design.
If the grain orientation of the CLT panel is different the spacing defintion may change.





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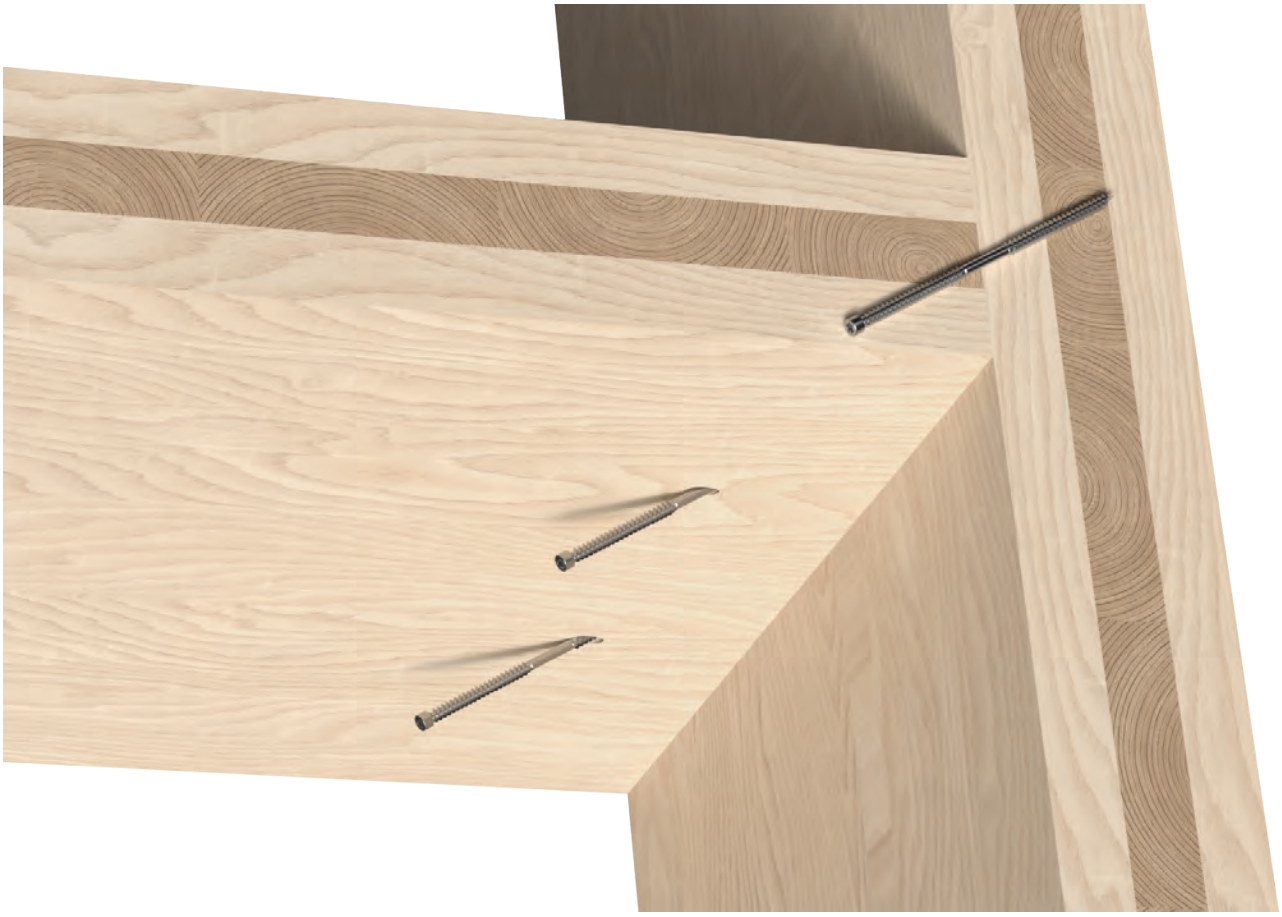
Structural Screws – Direct Panel Connection

For areas such as ceilings and corners where additional timber plates are not desired, structural screws can be used to fasten the wall panel directly into the suspended floor.



Items Required

Timber Fasteners
SWD Double Threaded Screw

SWD

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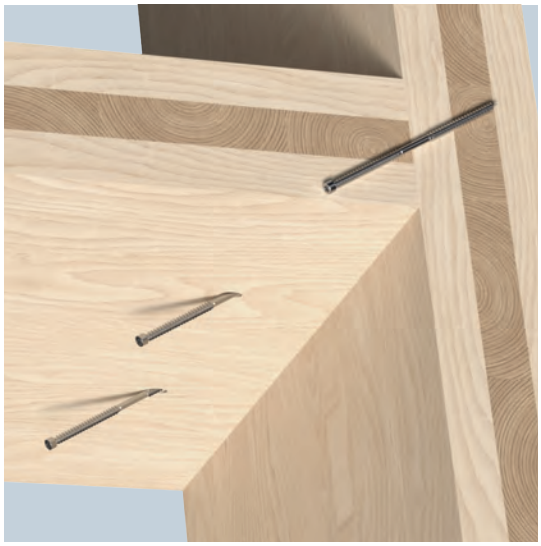
Structural Screws – Direct Panel Connection

SWD – Double Threaded Screw

SWD screws can be used to create almost hidden connections due to the small cylinder head. The design of the screw makes it suitable for inclined and angled installations that increase the load capacity.

Advantages:

- High load capacity
- Small cylinder head for hidden assemblies
- No pre-drilling required



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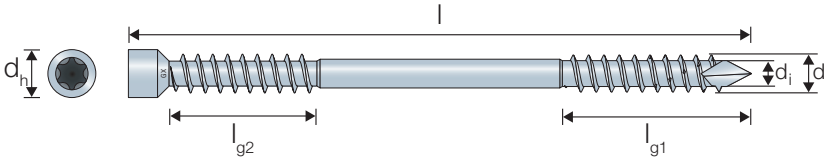


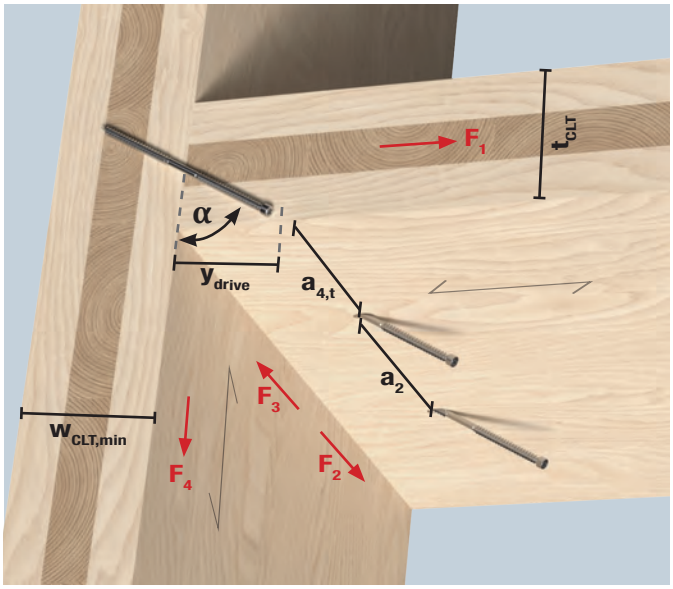
SWD – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_{g1}	l_{g2}	d_h	d_i
SWD6.5xℓ	6,5	65-220	40-95	33,5-88,5	8	4,0
SWD8.0xℓ	8,0	90-330	40-95	31,5-86,5	10	5,4

SWD – Minimum Spacings and Edge and End Distances

Spacing or distance [mm]	SWD6,5	SWD8,0
a_2	17	20
$a_{4,t}$	39	48

Note: Other min. spacing and edge distances requirements are fulfilled for the installation characteristics given in the load table. If the grain orientation of the CLT panel is different the spacing defintion may change.



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Structural Screws – Direct Panel Connection

CLT Floor to CLT Panel – SWD inclined Screws at 25°

Product Reference	$t_{CLT,min}$ [mm]	t_{CLT} [mm]																			
		80				90				100				120				140			
		y_{drive}	$R_{1,k}$	$R_{2/3}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$
			[kN]				[kN]				[kN]				[kN]				[kN]		
SWD6.5x160	65	90	3,31	2,25	2,36	90	3,31	2,25	2,36	90	3,31	2,25	2,36	90	3,31	2,25	2,36	90	3,31	2,25	2,36
SWD6.5x190	65	105	3,82	2,45	2,62	95-105	3,82	2,45	2,62	90-105	3,82	2,45	2,62	90-105	3,82	2,45	2,62	90-105	3,82	2,45	2,62
SWD6.5x220	65	-	-	-	-	-	-	-	-	115-120	4,26	2,59	2,78	95-120	4,26	2,59	2,78	95-120	4,26	2,59	2,78
SWD8.0x220	80	-	-	-	-	-	-	-	-	115-120	5,41	3,59	3,83	110-120	5,41	3,59	3,83	110-120	5,41	3,59	3,83
SWD8.0x245	80	-	-	-	-	-	-	-	-	-	-	-	-	120-130	5,88	3,77	4,04	110-130	5,88	3,77	4,04
SWD8.0x275	85	-	-	-	-	-	-	-	-	-	-	-	-	145-160	5,88	3,77	4,04	125-160	5,88	3,77	4,04
SWD8.0x300	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150-155	6,75	4	4,32
SWD8.0x330	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	175-185	6,75	4	4,32

Product Reference	$t_{CLT,min}$ [mm]	t_{CLT} [mm]																			
		160				180				200				220				240			
		y_{drive}	$R_{1,k}$	$R_{2/3}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$
			[kN]				[kN]				[kN]				[kN]				[kN]		
SWD6.5x160	65	90	3,31	2,25	2,36	90	3,31	2,25	2,36	90	3,31	2,25	2,36	90	3,31	2,25	2,36	90	3,31	2,25	2,36
SWD6.5x190	65	90-105	3,82	2,45	2,62	90-105	3,82	2,45	2,62	90-105	3,82	2,45	2,62	90-105	3,82	2,45	2,62	90-105	3,82	2,45	2,62
SWD6.5x220	65	95-120	4,26	2,59	2,78	95-120	4,26	2,59	2,78	95-120	4,26	2,59	2,78	95-120	4,26	2,59	2,78	95-120	4,26	2,59	2,78
SWD8.0x220	80	110-120	5,41	3,59	3,83	110-120	5,41	3,59	3,83	110-120	5,41	3,59	3,83	110-120	5,41	3,59	3,83	110-120	5,41	3,59	3,83
SWD8.0x245	80	110-130	5,88	3,77	4,04	110-130	5,88	3,77	4,04	110-130	5,88	3,77	4,04	110-130	5,88	3,77	4,04	110-130	5,88	3,77	4,04
SWD8.0x275	85	110-160	5,88	3,77	4,04	110-160	5,88	3,77	4,04	110-160	5,88	3,77	4,04	110-160	5,88	3,77	4,04	110-160	5,88	3,77	4,04
SWD8.0x300	85	135-155	6,75	4,0	4,32	135-155	6,75	4,0	4,32	135-155	6,75	4,0	4,32	135-155	6,75	4,0	4,32	135-155	6,75	4,0	4,32
SWD8.0x330	100	155-185	6,75	4,0	4,32	135-185	6,75	4,0	4,32	135-185	6,75	4,0	4,32	135-185	6,75	4,0	4,32	135-185	6,75	4,0	4,32

Product Reference	$t_{CLT,min}$ [mm]	t_{CLT} [mm]											
		260				280				300			
		y_{drive}	$R_{1,k}$	$R_{2/3}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$
			[kN]				[kN]				[kN]		
SWD6.5x160	65	90	3,31	2,25	2,36	90	3,31	2,25	2,36	90	3,31	2,25	2,36
SWD6.5x190	65	90-105	3,82	2,45	2,62	90-105	3,82	2,45	2,62	90-105	3,82	2,45	2,62
SWD6.5x220	65	95-120	4,26	2,59	2,78	95-120	4,26	2,59	2,78	95-120	4,26	2,59	2,78
SWD8.0x220	80	110-120	5,41	3,59	3,83	110-120	5,41	3,59	3,83	110-120	5,41	3,59	3,83
SWD8.0x245	80	110-130	5,88	3,77	4,04	110-130	5,88	3,77	4,04	110-130	5,88	3,77	4,04
SWD8.0x275	85	110-160	5,88	3,77	4,04	110-160	5,88	3,77	4,04	110-160	5,88	3,77	4,04
SWD8.0x300	85	135-155	6,75	4,0	4,32	135-155	6,75	4,0	4,32	135-155	6,75	4,0	4,32
SWD8.0x330	100	135-185	6,75	4,0	4,32	135-185	6,75	4,0	4,32	135-185	6,75	4,0	4,32

Characteristic parameters of fasteners and more information are included in chapter 10.

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Structural Screws – Direct Panel Connection

CLT Floor to CLT Panel – SWD inclined Screws at 35°

Product Reference	$t_{CLT,min}$ [mm]	t_{CLT} [mm]																			
		80				90				100				120				140			
		y_{drive}	$R_{1,k}$	$R_{2/3}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$
			[kN]				[kN]				[kN]				[kN]				[kN]		
SWD6.5x190	75	90	3,4	2,45	2,8	85-90	3,4	2,45	2,8	85-90	3,4	2,45	2,8	85-90	3,4	2,45	2,8	85-90	3,4	2,45	2,8
SWD6.5x220	85	-	-	-	-	100-105	3,72	2,59	2,99	90-105	3,72	2,59	2,99	85-105	3,72	2,59	2,99	85-105	3,72	2,59	2,99
SWD8.0x220	85	-	-	-	-	105	4,87	3,59	3,92	105	4,87	3,59	3,92	105	4,87	3,59	3,92	105	4,87	3,59	3,92
SWD8.0x245	95	-	-	-	-	-	-	-	-	115	5,23	3,77	4,31	105-115	5,23	3,77	4,31	105-115	5,23	3,77	4,31
SWD8.0x275	110	-	-	-	-	-	-	-	-	140	5,23	3,77	4,31	120-140	5,23	3,77	4,31	105-140	5,23	3,77	4,31
SWD8.0x300	110	-	-	-	-	-	-	-	-	-	-	-	-	140	5,84	4,0	4,65	120-140	5,84	4,0	4,65
SWD8.0x330	130	-	-	-	-	-	-	-	-	-	-	-	-	165	5,84	4,0	4,65	145-165	5,84	4,0	4,65

Product Reference	$t_{CLT,min}$ [mm]	t_{CLT} [mm]																			
		160				180				200				220				240			
		y_{drive}	$R_{1,k}$	$R_{2/3}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$
			[kN]				[kN]				[kN]				[kN]				[kN]		
SWD6.5x190	75	85-90	3,4	2,45	2,8	85-90	3,4	2,45	2,8	85-90	3,4	2,45	2,8	85-90	3,4	2,45	2,8	85-90	3,4	2,45	2,8
SWD6.5x220	85	85-105	3,72	2,59	2,99	85-105	3,72	2,59	2,99	85-105	3,72	2,59	2,99	85-105	3,72	2,59	2,99	85-105	3,72	2,59	2,99
SWD8.0x220	85	105	4,87	3,59	3,92	105	4,87	3,59	3,92	105	4,87	3,59	3,92	105	4,87	3,59	3,92	105	4,87	3,59	3,92
SWD8.0x245	95	105-115	5,23	3,77	4,31	105-115	5,23	3,77	4,31	105-115	5,23	3,77	4,31	105-115	5,23	3,77	4,31	105-115	5,23	3,77	4,31
SWD8.0x275	110	105-140	5,23	3,77	4,31	105-140	5,23	3,77	4,31	105-140	5,23	3,77	4,31	105-140	5,23	3,77	4,31	105-140	5,23	3,77	4,31
SWD8.0x300	110	120-140	5,84	4,0	4,65	120-140	5,84	4,0	4,65	120-140	5,84	4,0	4,65	120-140	5,84	4,0	4,65	120-140	5,84	4,0	4,65
SWD8.0x330	130	125-165	5,84	4,0	4,65	120-165	5,84	4,0	4,65	120-165	5,84	4,0	4,65	120-165	5,84	4,0	4,65	120-165	5,84	4,0	4,65

Product Reference	$t_{CLT,min}$ [mm]	t_{CLT} [mm]											
		260				280				300			
		y_{drive}	$R_{1,k}$	$R_{2/3}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$
			[kN]				[kN]				[kN]		
SWD6.5x190	75	85-90	3,4	2,45	2,8	85-90	3,4	2,45	2,8	85-90	3,4	2,45	2,8
SWD6.5x220	85	85-105	3,72	2,59	2,99	85-105	3,72	2,59	2,99	85-105	3,72	2,59	2,99
SWD8.0x220	85	105	4,87	3,59	3,92	105	4,87	3,59	3,92	105	4,87	3,59	3,92
SWD8.0x245	95	105-115	5,23	3,77	4,31	105-115	5,23	3,77	4,31	105-115	5,23	3,77	4,31
SWD8.0x275	110	105-140	5,23	3,77	4,31	105-140	5,23	3,77	4,31	105-140	5,23	3,77	4,31
SWD8.0x300	110	120-140	5,84	4,0	4,65	120-140	5,84	4,0	4,65	120-140	5,84	4,0	4,65
SWD8.0x330	130	120-165	5,84	4,0	4,65	120-165	5,84	4,0	4,65	120-165	5,84	4,0	4,65

Characteristic parameters of fasteners and more information are included in chapter 10.

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Structural Screws – Direct Panel Connection

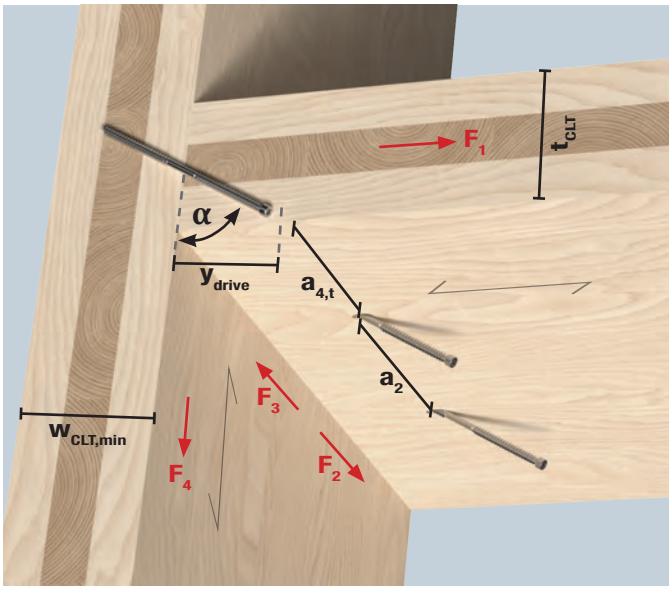
CLT Floor to CLT Panel – SWD inclined Screws at 45°

Product Reference	$t_{CLT,min}$ [mm]	t_{CLT} [mm]																		
		80				90				100				120				140			
		y_{drive}	$R_{1,k}$	$R_{2/3}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$
			[kN]				[kN]				[kN]				[kN]				[kN]		
SWD6.5x220	105	85-90	3,3	2,59		85-90	3,3	2,59	3,3	85-90	3,3	2,59	3,3	85-90	3,3	2,59	3,3	85-90	3,3	2,59	3,3
SWD8.0x245	110	-	-	-	-	100	4,71	3,77	4,49	100	4,71	3,77	4,49	100	4,71	3,77	4,49	100	4,71	3,77	4,49
SWD8.0x275	130	-	-	-	-	115-120	4,71	3,77	4,58	105-120	4,71	3,77	4,71	100-120	4,71	3,77	4,71	100-120	4,71	3,77	4,71
SWD8.0x300	130	-	-	-	-	-	-	-	-	-	-	-	-	105-120	5,15	4,0	5,15	100-120	5,15	4,0	5,15
SWD8.0x330	150	-	-	-	-	-	-	-	-	-	-	-	-	125-140	5,15	4,0	5,15	105-140	5,15	4,0	5,15

Product Reference	$t_{CLT,min}$ [mm]	t_{CLT} [mm]																		
		160				180				200				220				240			
		y_{drive}	$R_{1,k}$	$R_{2/3}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$
			[kN]				[kN]				[kN]				[kN]				[kN]		
SWD6.5x220	105	85-90	3,3	2,59	3,3	85-90	3,3	2,59	3,3	85-90	3,3	2,59	3,3	85-90	3,3	2,59	3,3	85-90	3,3	2,59	3,3
SWD8.0x245	110	100	4,71	3,77	4,49	100	4,71	3,77	4,49	100	4,71	3,77	4,49	100	4,71	3,77	4,49	100	4,71	3,77	4,49
SWD8.0x275	130	100-120	4,71	3,77	4,71	100-120	4,71	3,77	4,71	100-120	4,71	3,77	4,71	100-120	4,71	3,77	4,71	100-120	4,71	3,77	4,71
SWD8.0x300	130	100-120	5,15	4,0	5,15	100-120	5,15	4,0	5,15	100-120	5,15	4,0	5,15	100-120	5,15	4,0	5,15	100-120	5,15	4,0	5,15
SWD8.0x330	150	100-140	5,15	4,0	5,15	100-140	5,15	4,0	5,15	100-140	5,15	4,0	5,15	100-140	5,15	4,0	5,15	100-140	5,15	4,0	5,15

Product Reference	$t_{CLT,min}$ [mm]	t_{CLT} [mm]											
		260				280				300			
		y_{drive}	$R_{1,k}$	$R_{2/3}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	y_{drive}	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$
			[kN]				[kN]				[kN]		
SWD6.5x220	105	85-90	3,3	2,59	3,3	85-90	3,3	2,59	3,3	85-90	3,3	2,59	3,3
SWD8.0x245	110	100	4,71	3,77	4,49	100	4,71	3,77	4,49	100	4,71	3,77	4,49
SWD8.0x275	130	100-120	4,71	3,77	4,71	100-120	4,71	3,77	4,71	100-120	4,71	3,77	4,71
SWD8.0x300	130	100-120	5,15	4,0	5,15	100-120	5,15	4,0	5,15	100-120	5,15	4,0	5,15
SWD8.0x330	150	100-140	5,15	4,0	5,15	100-140	5,15	4,0	5,15	100-140	5,15	4,0	5,15

Characteristic parameters of fasteners and more information are included in chapter 10.



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CLT Floor to Glulam Joist

In large scale mass timber buildings, expansive floor spans can be achieved by using glulam joists to support the CLT floor, resulting in a strong, rigid structure.

This section describes fastener solutions for ensuring a discrete and seamless connection between the floor panels and the joists, which provide excellent tension and shear characteristic capacities.

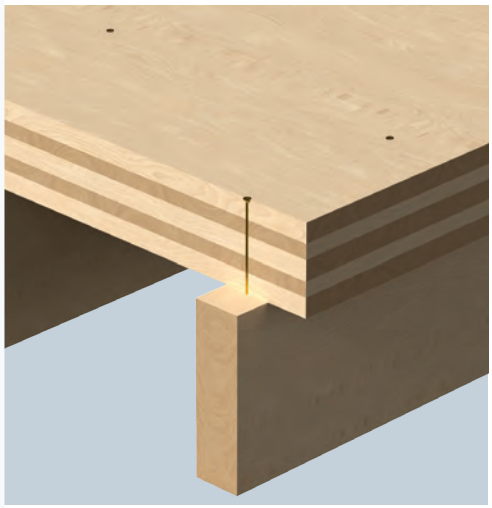
CLT Floor to Glulam Beam Solutions

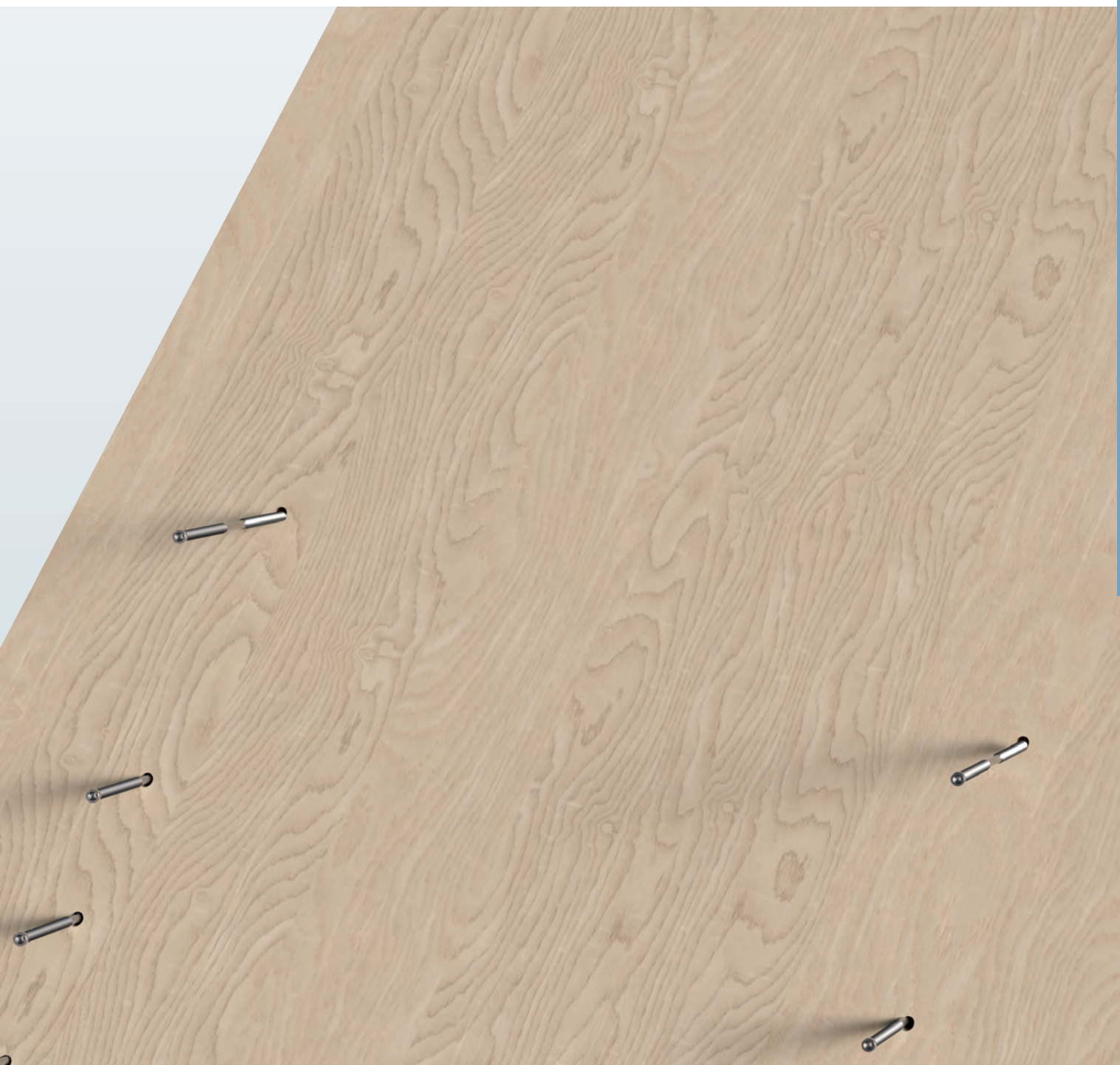
Structural Screws

Product Options:

SWC see page 187
SWD see page 190

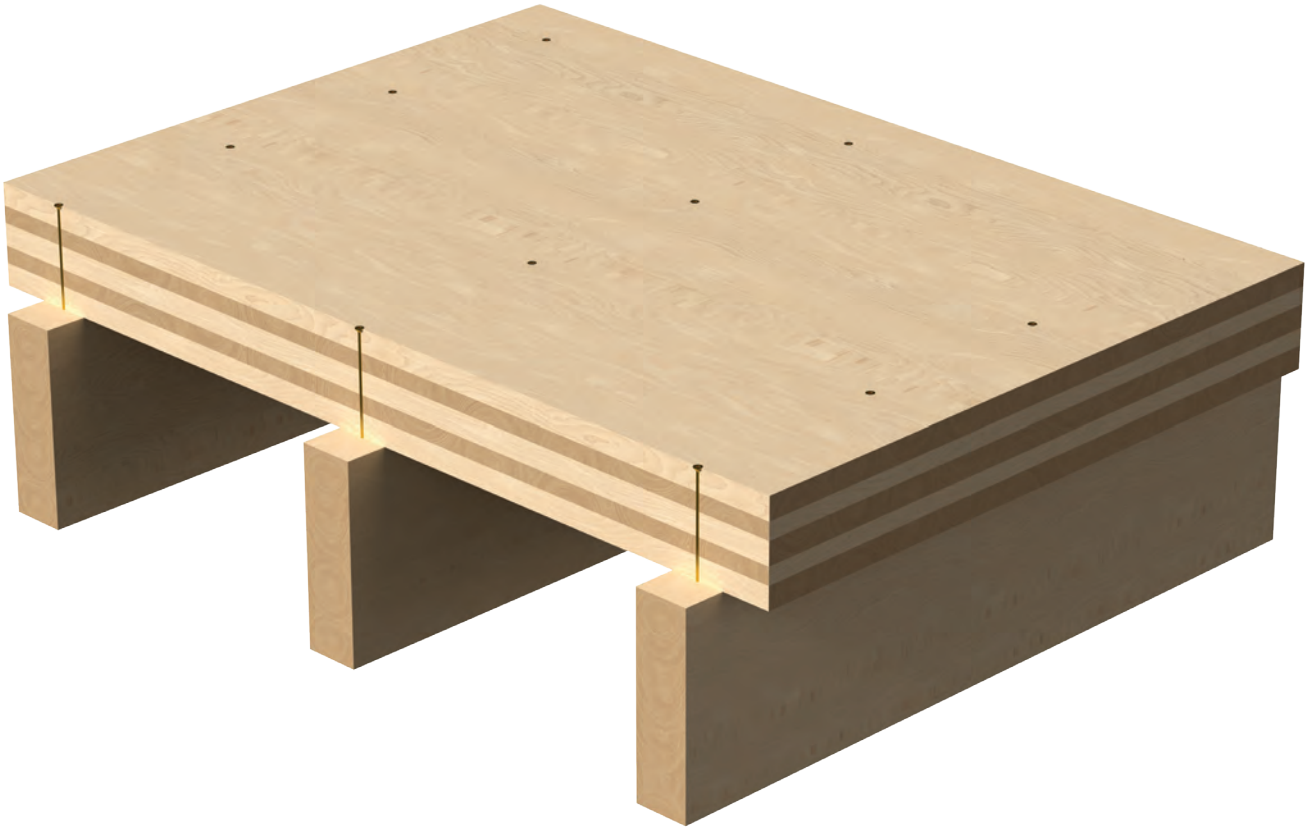
Double and fully-threaded structural screws which provide excellent tension and shear characteristic capacities.





Structural Screws

Double and fully-threaded structural screws which provide excellent tension and shear characteristic capacities.



Items Required

Timber Fasteners
SWC Countersunk Screw,
SWD Double-Threaded Screw

SWC SWD

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Structural Screws

SWC – Countersunk Screw

SWC is a countersunk structural wood screw designed to take high loads. The countersunk head gives a flush fitting while allowing the CLT panels to close up firmly.

Advantages:

- Countersunk head creates a flush finish
- Milling thread for reduced drive-in torque
- No pre-drilling required

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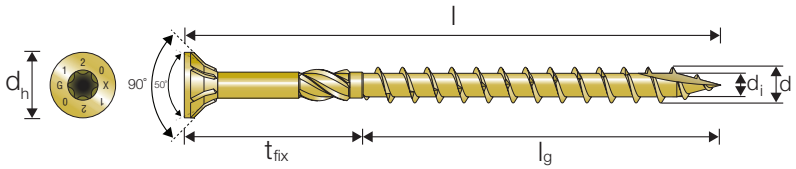

SWC – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
SWC6.0xℓ	6,0	200 - 300	70	11,8	3,9	130 - 230
SWC8.0xℓ	8,0	80 - 400	50 - 80	14,6	5,2	30 - 320
SWC10.0xℓ	10,0	100 - 400	50 - 80	17,8	6,2	50 - 320

CLT to Glulam (GL24h) beam – SWC Screws at 90°

Product Reference	Wood Thickness t_1 [mm]																							
	80		100		120		140		160		180		200		220		240		260		280		300	
	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$
	[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]	
SWC6.0x200	1,66	1,88	1,66	1,88	1,66	1,88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		1,79		1,79		1,79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC6.0x220	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		1,79		1,79		1,79		1,79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC6.0x240	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		1,79		1,79		1,79		1,79		1,79	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC6.0x260	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	-	-	-	-	-	-	-	-	-	-	-	-
		1,79		1,79		1,79		1,79		1,79		1,79	-	-	-	-	-	-	-	-	-	-	-	-
SWC6.0x280	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	-	-	-	-	-	-	-	-	-	-
		1,79		1,79		1,79		1,79		1,79		1,79		1,79	-	-	-	-	-	-	-	-	-	-
SWC6.0x300	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	1,66	1,88	-	-	-	-	-	-	-	-
		1,79		1,79		1,79		1,79		1,79		1,79		1,79		1,79	-	-	-	-	-	-	-	-

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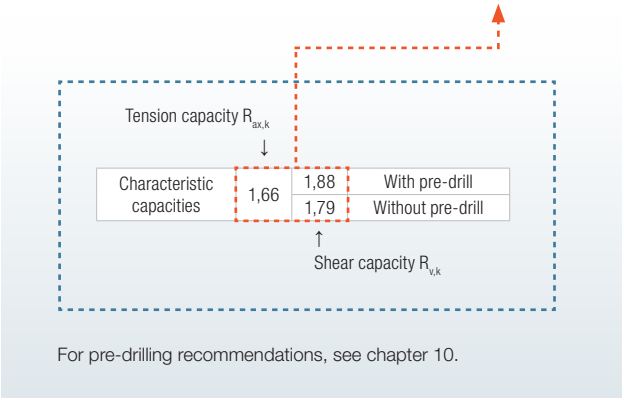

For pre-drilling recommendations, see chapter 10.

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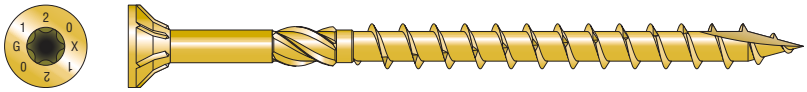
Structural Screws



CLT to Glulam (GL24h) beam – SWC Screws at 90°

Product Reference	Wood Thickness t_1 [mm]																							
	80		100		120		140		160		180		200		220		240		260		280		300	
	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$	$R_{ax,k}$	$R_{v,k}$
	[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]		[kN]	
SWC8.0x160	2,66	2,82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2,72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC8.0x180	2,66	3,16	2,66	2,82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3,00		2,72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC8.0x200	2,66	3,16	2,66	3,16	2,66	2,82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3,00		3,00		2,72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC8.0x220	2,66	3,16	2,66	3,16	2,66	3,16	2,66	2,82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3,00		3,00		3,00		2,72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC8.0x240	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	2,82	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3,00		3,00		3,00		3,00		2,72	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWC8.0x260	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	2,82	-	-	-	-	-	-	-	-	-	-	-	-
		3,00		3,00		3,00		3,00		3,00		2,72	-	-	-	-	-	-	-	-	-	-	-	-
SWC8.0x280	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	2,82	-	-	-	-	-	-	-	-	-	-
		3,00		3,00		3,00		3,00		3,00		3,00		2,72	-	-	-	-	-	-	-	-	-	-
SWC8.0x300	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	2,82	-	-	-	-	-	-	-	-
		3,00		3,00		3,00		3,00		3,00		3,00		3,00		2,72	-	-	-	-	-	-	-	-
SWC8.0x320	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	2,82	-	-	-	-	-	-
		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		2,72	-	-	-	-	-	-
SWC8.0x340	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	2,82	-	-	-	-
		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		2,72	-	-	-	-
SWC8.0x360	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	2,82	-	-
		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		2,72	-	-
SWC8.0x380	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	2,82
		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		2,72
SWC8.0x400	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16	2,66	3,16
		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00		3,00

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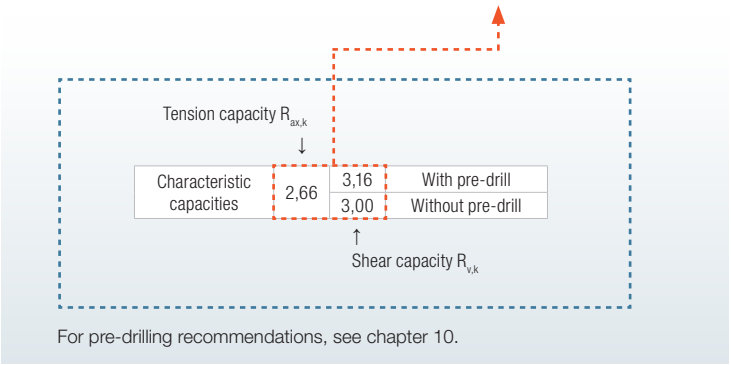
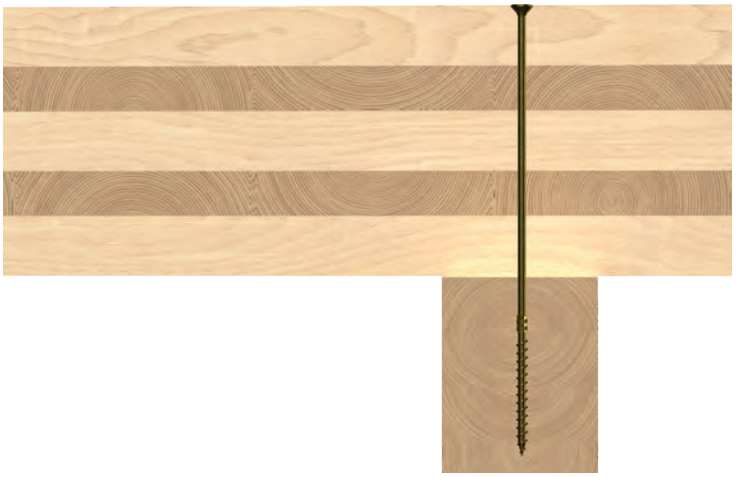
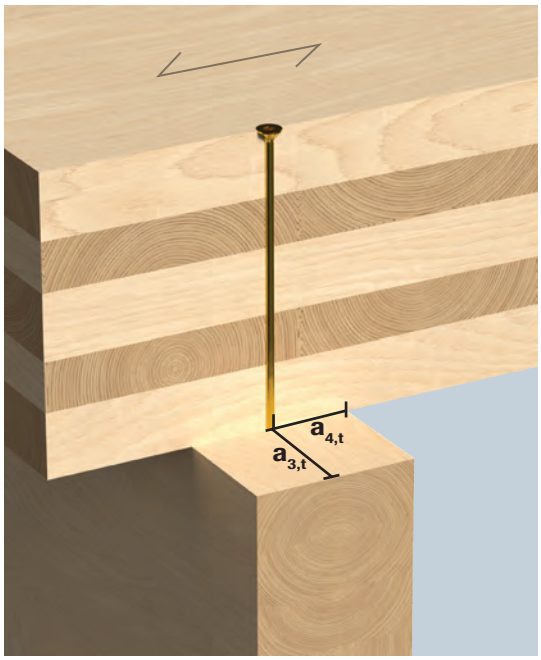


For pre-drilling recommendations, see chapter 10.





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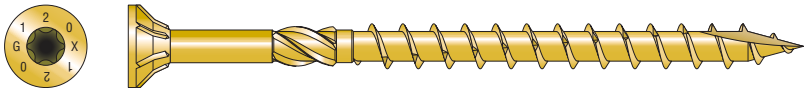
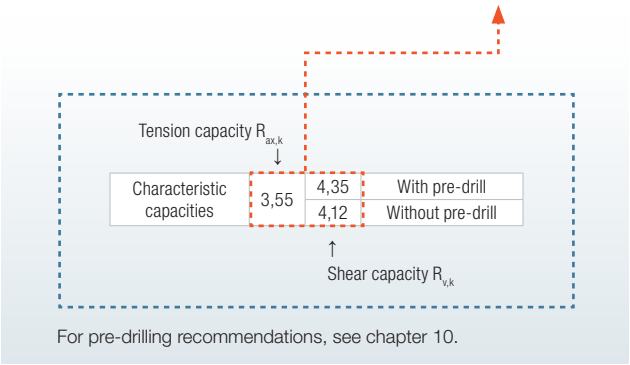
Structural Screws



CLT to Glulam (GL24h) beam – SWC Screws at 90°

Product Reference	Wood Thickness t_1 [mm]																							
	80		100		120		140		160		180		200		220		240		260		280		300	
	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{v,k}$ [kN]
SWC10.0x180	-	-	3,55	3,52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-		3,39		-		-		-		-		-		-		-		-		-		-
SWC10.0x200	-	-	3,55	3,89	3,55	3,52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-		3,75		3,39		-		-		-		-		-		-		-		-		-
SWC10.0x220	-	-	3,55	4,3	3,55	3,89	3,55	3,52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-		4,12		3,75		3,39		-		-		-		-		-		-		-		-
SWC10.0x240	-	-	3,55	4,35	3,55	4,3	3,55	3,89	3,55	3,52	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-		4,12		4,12		3,75		3,39		-		-		-		-		-		-		-
SWC10.0x260	-	-	3,55	4,35	3,55	4,35	3,55	4,3	3,55	3,89	3,55	3,52	-	-	-	-	-	-	-	-	-	-	-	-
		-		4,12		4,12		4,12		3,75		3,39		-		-		-		-		-		-
SWC10.0x280	-	-	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,3	3,55	3,89	3,55	3,52	-	-	-	-	-	-	-	-	-	-
		-		4,12		4,12		4,12		4,12		3,75		3,39		-		-		-		-		-
SWC10.0x300	-	-	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,3	3,55	3,89	3,55	3,52	-	-	-	-	-	-	-	-
		-		4,12		4,12		4,12		4,12		4,12		3,75		3,39		-		-		-		-
SWC10.0x320	-	-	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,3	3,55	3,89	3,55	3,52	-	-	-	-	-	-
		-		4,12		4,12		4,12		4,12		4,12		4,12		3,75		3,39		-		-		-
SWC10.0x340	-	-	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,3	3,55	3,89	3,55	3,52	-	-	-	-
		-		4,12		4,12		4,12		4,12		4,12		4,12		4,12		3,75		3,39		-		-
SWC10.0x360	-	-	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,3	3,55	3,89	3,55	3,52	-	-
		-		4,12		4,12		4,12		4,12		4,12		4,12		4,12		4,12		3,75		3,39		-
SWC10.0x380	-	-	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,3	3,55	3,89	3,55	3,52
		-		4,12		4,12		4,12		4,12		4,12		4,12		4,12		4,12		4,12		3,75		3,39
SWC10.0x400	-	-	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,35	3,55	4,3	3,55	3,89
		-		4,12		4,12		4,12		4,12		4,12		4,12		4,12		4,12		4,12		4,12		3,75

Characteristic parameters of fasteners and more information are included in chapter 10.

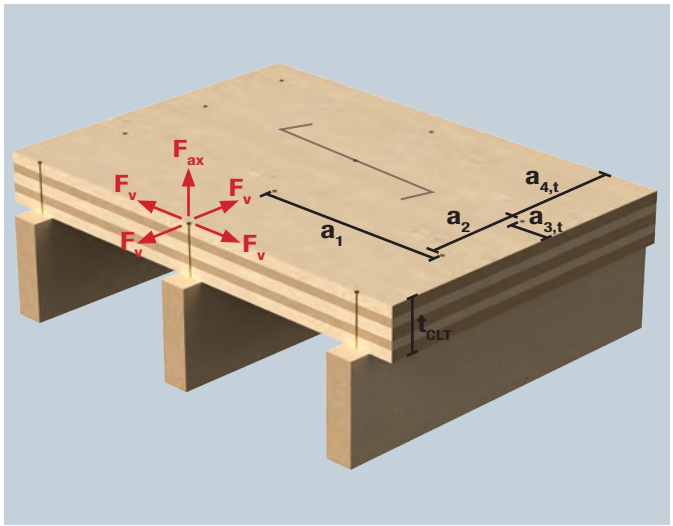


For pre-drilling recommendations, see chapter 10.

SWC – Minimum Spacings and Edge and End Distances

Spacing or distance [mm]		SWC6,0	SWC8,0	SWC10,0
CLT	$a_{1,CLT}$	24	32	40
	$a_{2,CLT}$	15	20	25
	$a_{3,t,CLT}$	36	48	60
	$a_{4,t,CLT}$	36	48	60
Glulam	$a_{1,Glulam}$	72	96	120
	$a_{2,Glulam}$	30	40	50
	$a_{3,t,Glulam}$	90	120	150
	$a_{4,t,Glulam}$	60	80	100

Note: Both CLT and Glulam edge distances needs to be fulfilled. If the grain orientation of the CLT panel is different the spacing defintion may change.



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Structural Screws

SWD – Double Threaded Screw

SWD screws can be used to create almost hidden connections due to the small cylinder head. The design of the screw makes it suitable for inclined and angled installations that increase the load capacity.

Advantages:

- High load capacity
- Small cylinder head for hidden assemblies
- No pre-drilling required

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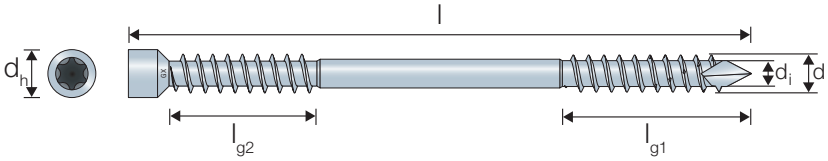

SWD – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_{g1}	l_{g2}	d_h	d_i
SWD6.5xℓ	6,5	65-220	40-95	33,5-88,5	8	4,0
SWD8.0xℓ	8,0	90-330	40-95	31,5-86,5	10	5,4

CLT to Glulam (GL24h) beam – SWD Screws at 90°

Product Reference	$w_{GL,min}$	$h_{GL,min}$	CLT thickness t_{CLT} [mm]																	
			80			100			120			140			160			180		
	[mm]		l_{recess}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	l_{recess}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	l_{recess}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	l_{recess}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	l_{recess}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]	l_{recess}	$R_{1,k}$ [kN]	$R_{2/3,k}$ [kN]
SWD6.5x65	65	65	50	1,41	1,39	70	1,41	1,39	90	1,41	1,39	110	1,41	1,39	130	1,41	1,39	145	1,41	1,34
SWD6.5x90	65	65	35	2,11	1,68	55	2,11	1,68	75	2,11	1,68	95	2,11	1,68	115	2,11	1,68	135	2,11	1,68
SWD6.5x130	65	70	15	2,11	1,97	35	2,11	1,97	55	2,11	1,97	75	2,11	1,97	95	2,11	1,97	115	2,11	1,97
SWD6.5x160	65	85	0	3,48	2,4	20	3,48	2,4	40	3,48	2,4	60	3,48	2,4	80	3,48	2,4	100	3,48	2,4
SWD6.5x190	65	100	-	-	-	5	4,28	2,6	25	4,28	2,6	45	4,28	2,6	65	4,28	2,6	85	4,28	2,6
SWD6.5x220	65	115	-	-	-	-	-	-	10	5,05	2,79	30	5,05	2,79	50	5,05	2,79	70	5,05	2,79
SWD8.0x90	80	80	35	2,35	2,16	55	2,35	2,16	75	2,35	2,16	95	2,35	2,16	115	2,35	2,16	135	2,35	2,16
SWD8.0x130	80	80	15	2,35	2,42	35	2,35	2,42	55	2,35	2,42	75	2,35	2,42	95	2,35	2,42	115	2,35	2,42
SWD8.0x160	80	85	0	3,98	3,06	20	3,98	3,06	40	3,98	3,06	60	3,98	3,06	80	3,98	3,06	100	3,98	3,06
SWD8.0x190	80	100	-	-	-	5	4,92	3,56	25	4,92	3,56	45	4,92	3,56	65	4,92	3,56	85	4,92	3,56
SWD8.0x220	80	115	-	-	-	-	-	-	10	5,85	3,84	30	5,85	3,84	50	5,85	3,84	70	5,85	3,84
SWD8.0x245	80	125	-	-	-	-	-	-	-	-	-	20	6,6	4,03	40	6,6	4,03	55	6,6	4,03
SWD8.0x275	80	140	-	-	-	-	-	-	-	-	-	5	6,6	4,03	20	6,6	4,03	40	6,6	4,03
SWD8.0x300	80	155	-	-	-	-	-	-	-	-	-	-	-	-	10	8,23	4,44	30	8,23	4,44
SWD8.0x330	80	170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	8,23	4,44

Table continues on next page.

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Structural Screws

CLT to Glulam (GL24h) beam – SWD Screws at 90°

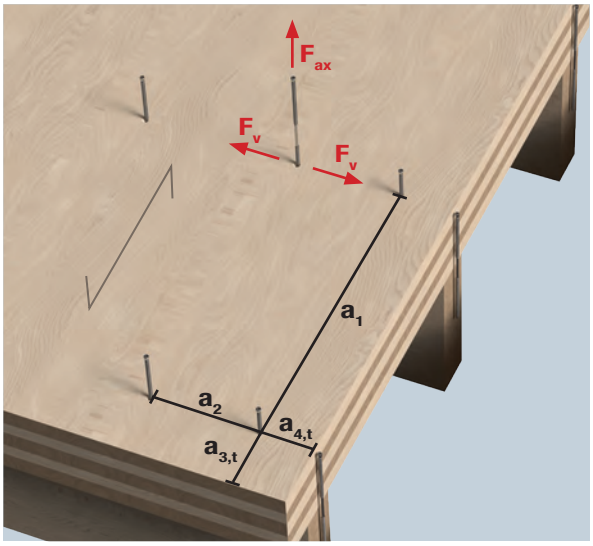
Product Reference	$w_{GL,min}$	$h_{GL,min}$	CLT thickness t_{CLT} [mm]																	
			200			220			230			260			280			300		
	[mm]		L_{recess}	$R_{1,k}$	$R_{2/3,k}$	L_{recess}	$R_{1,k}$	$R_{2/3,k}$	L_{recess}	$R_{1,k}$	$R_{2/3,k}$	L_{recess}	$R_{1,k}$	$R_{2/3,k}$	L_{recess}	$R_{1,k}$	$R_{2/3,k}$	L_{recess}	$R_{1,k}$	$R_{2/3,k}$
				[kN]			[kN]			[kN]			[kN]			[kN]			[kN]	
SWD6.5x65	65	65	170	1,41	1,39	190	1,41	1,39	210	1,41	1,39	230	1,41	1,39	250	1,41	1,39	265	1,41	1,34
SWD6.5x90	65	65	155	2,11	1,68	175	2,11	1,68	195	2,11	1,68	215	2,11	1,68	235	2,11	1,68	255	2,11	1,68
SWD6.5x130	65	70	135	2,11	1,97	155	2,11	1,97	175	2,11	1,97	195	2,11	1,97	215	2,11	1,97	235	2,11	1,97
SWD6.5x160	65	85	120	3,48	2,4	140	3,48	2,4	160	3,48	2,4	180	3,48	2,4	200	3,48	2,4	220	3,48	2,4
SWD6.5x190	65	100	105	4,28	2,6	125	4,28	2,6	145	4,28	2,6	165	4,28	2,6	185	4,28	2,6	205	4,28	2,6
SWD6.5x220	65	115	90	5,05	2,79	110	5,05	2,79	130	5,05	2,79	150	5,05	2,79	170	5,05	2,79	190	5,05	2,79
SWD8.0x90	80	80	155	2,35	2,16	175	2,35	2,16	195	2,35	2,16	215	2,35	2,16	235	2,35	2,16	255	2,35	2,16
SWD8.0x130	80	80	135	2,35	2,42	155	2,35	2,42	175	2,35	2,42	195	2,35	2,42	215	2,35	2,42	235	2,35	2,42
SWD8.0x160	80	85	120	3,98	3,06	140	3,98	3,06	160	3,98	3,06	180	3,98	3,06	200	3,98	3,06	220	3,98	3,06
SWD8.0x190	80	100	105	4,92	3,56	125	4,92	3,56	145	4,92	3,56	165	4,92	3,56	185	4,92	3,56	205	4,92	3,56
SWD8.0x220	80	115	90	5,85	3,84	110	5,85	3,84	130	5,85	3,84	150	5,85	3,84	170	5,85	3,84	190	5,85	3,84
SWD8.0x245	80	125	80	6,6	4,03	100	6,6	4,03	115	6,6	4,03	140	6,6	4,03	160	6,6	4,03	180	6,6	4,03
SWD8.0x275	80	140	65	6,6	4,03	80	6,6	4,03	100	6,6	4,03	125	6,6	4,03	145	6,6	4,03	160	6,6	4,03
SWD8.0x300	80	155	50	8,23	4,44	70	8,23	4,44	90	8,23	4,44	110	8,23	4,44	130	8,23	4,44	150	8,23	4,44
SWD8.0x330	80	170	35	8,23	4,44	55	8,23	4,44	75	8,23	4,44	95	8,23	4,44	115	8,23	4,44	135	8,23	4,44

Table continues on next page.

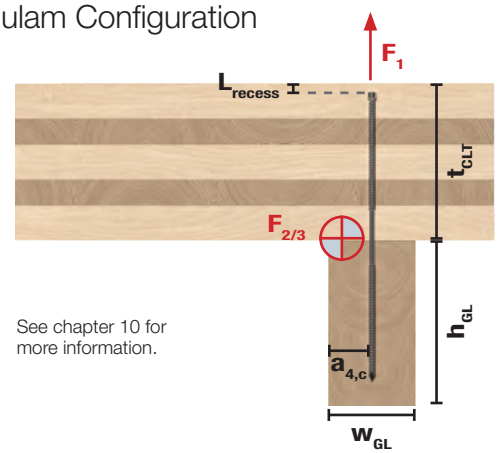
SWD – Minimum Spacings and Edge and End Distances (90°)

Spacing or distance [mm]		SWD6,5	SWD8,0
CLT	$a_{1,CLT}$	26	32
	$a_{2,CLT}$	17	20
	$a_{3,t,CLT}$	39	48
	$a_{4,t,CLT}$	39	48
Glulam	$a_{1,Glulam}$	78	96
	$a_{2,Glulam}$	32,5	40
	$a_{3,t,Glulam}$	98	120
	$a_{4,t,Glulam}$	33	40

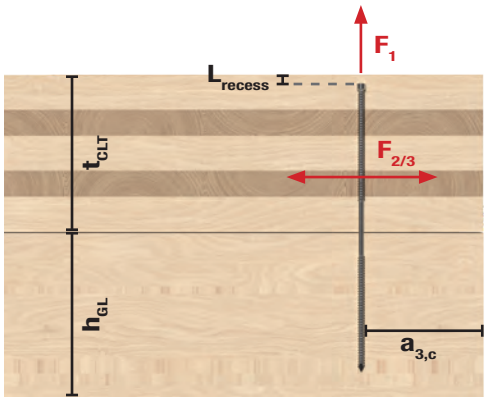
Note: Both CLT and Glulam edge distances needs to be fulfilled. If the grain orientation of the CLT panel is different the spacing defintion may change.



90° CLT to Glulam Configuration



See chapter 10 for more information.



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Structural Screws

CLT to Glulam (GL24h) beam – SWD Inclined Screws at 45°

Product Reference	$w_{GL,min}$	$h_{GL,min}$	CLT thickness t_{CLT} [mm]																	
			80			100			120			140			160			180		
	[mm]		l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$
				[kN]			[kN]			[kN]			[kN]			[kN]			[kN]	
SWD6.5x65	65	65	80	1,08	1,09	110	1,09	1,08	135	1,08	1,09	165	1,08	1,09	195	1,09	1,08	220	1,08	1,09
SWD6.5x90	65	65	70	1,57	1,56	95	1,56	1,57	125	1,57	1,57	155	1,57	1,56	180	1,56	1,57	210	1,57	1,56
SWD6.5x130	65	65	50	1,8	1,82	75	1,82	1,8	105	1,81	1,81	135	1,8	1,82	160	1,82	1,8	190	1,81	1,81
SWD6.5x160	65	65	35	2,52	2,56	60	2,55	2,53	90	2,54	2,54	120	2,52	2,56	145	2,55	2,53	175	2,53	2,54
SWD6.5x190	65	70	20	2,99	3	45	3	2,99	75	3	3	105	2,99	3	130	3	2,99	160	3	3
SWD6.5x220	65	80	5	3,31	3,31	30	3,31	3,31	60	3,31	3,31	90	3,31	3,31	115	3,31	3,31	145	3,31	3,31
SWD8.0x90	80	80	70	1,77	1,75	95	1,76	1,77	125	1,76	1,76	155	1,77	1,75	180	1,76	1,77	210	1,76	1,76
SWD8.0x130	80	80	50	2,07	2,06	75	2,06	2,07	105	2,06	2,06	135	2,07	2,06	160	2,06	2,07	190	2,07	2,06
SWD8.0x160	80	80	35	3,05	3,04	60	3,04	3,05	90	3,05	3,04	120	3,05	3,04	145	3,04	3,05	175	3,05	3,04
SWD8.0x190	80	80	20	3,57	3,61	45	3,6	3,58	75	3,59	3,59	105	3,57	3,61	130	3,6	3,58	160	3,58	3,59
SWD8.0x220	80	80	5	4,09	4,13	30	4,13	4,1	60	4,11	4,11	90	4,09	4,13	115	4,12	4,1	145	4,11	4,12
SWD8.0x245	80	90	-	-	-	20	4,54	4,56	45	4,57	4,52	75	4,55	4,54	105	4,53	4,56	130	4,57	4,52
SWD8.0x275	80	100	-	-	-	5	4,66	4,66	30	4,66	4,66	60	4,66	4,66	90	4,66	4,66	115	4,66	4,66
SWD8.0x300	80	110		-	-	-	-	-	20	5,3	5,3	50	5,3	5,3	75	5,3	5,3	105	5,3	5,3
SWD8.0x330	80	120	-	-	-	-	-	-	5	5,3	5,3	35	5,3	5,3	60	5,3	5,3	90	5,3	5,3

Product Reference	$w_{GL,min}$	$h_{GL,min}$	CLT thickness t_{CLT} [mm]																	
			200			220			230			260			280			300		
	[mm]		l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$	l_{recess}	$R_{1,k}$	$R_{2/3,k}$
				[kN]			[kN]			[kN]			[kN]			[kN]			[kN]	
SWD6.5x65	65	65	250	1,08	1,09	280	1,09	1,08	305	1,08	1,09	335	1,08	1,09	365	1,09	1,08	390	1,08	1,09
SWD6.5x90	65	65	240	1,58	1,56	265	1,56	1,57	295	1,57	1,56	325	1,58	1,56	350	1,56	1,57	380	1,57	1,56
SWD6.5x130	65	65	220	1,79	1,82	245	1,82	1,8	275	1,8	1,81	305	1,79	1,82	330	1,81	1,8	360	1,8	1,81
SWD6.5x160	65	65	205	2,52	2,56	230	2,55	2,53	260	2,53	2,54	290	2,52	2,56	315	2,55	2,53	345	2,53	2,55
SWD6.5x190	65	70	190	2,98	3	215	3	2,99	245	3	3	275	2,98	3	300	3	3	330	3	3
SWD6.5x220	65	80	175	3,31	3,31	200	3,31	3,31	230	3,31	3,31	260	3,31	3,31	285	3,31	3,31	315	3,31	3,31
SWD8.0x90	80	80	240	1,77	1,75	265	1,76	1,77	295	1,76	1,76	325	1,77	1,75	350	1,76	1,77	380	1,77	1,76
SWD8.0x130	80	80	220	2,07	2,06	245	2,06	2,07	275	2,07	2,06	305	2,07	2,06	330	2,06	2,07	360	2,07	2,06
SWD8.0x160	80	80	205	3,05	3,04	230	3,04	3,05	260	3,05	3,04	290	3,04	3,04	315	3,04	3,05	345	3,05	3,04
SWD8.0x190	80	80	190	3,57	3,61	215	3,6	3,58	245	3,58	3,59	275	3,57	3,61	300	3,6	3,58	330	3,58	3,59
SWD8.0x220	80	80	175	4,09	4,13	200	4,12	4,1	230	4,11	4,12	260	4,09	4,14	285	4,12	4,1	315	4,1	4,12
SWD8.0x245	80	90	160	4,55	4,54	190	4,53	4,56	215	4,57	4,53	245	4,55	4,54	275	4,53	4,56	300	4,57	4,53
SWD8.0x275	80	100	145	4,66	4,66	175	4,66	4,66	200	4,66	4,66	230	4,66	4,66	260	4,66	4,66	285	4,66	4,66
SWD8.0x300	80	110	135	5,3	5,3	160	5,3	5,3	190	5,3	5,3	220	5,3	5,3	245	5,3	5,3	275	5,3	5,3
SWD8.0x330	80	120	120	5,3	5,3	145	5,3	5,3	175	5,3	5,3	205	5,3	5,3	230	5,3	5,3	260	5,3	5,3

Characteristic parameters of fasteners and more information are included in chapter 10.

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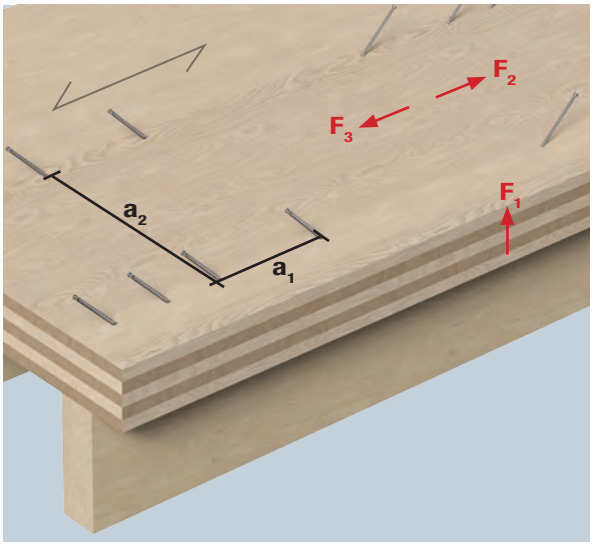
Structural Screws

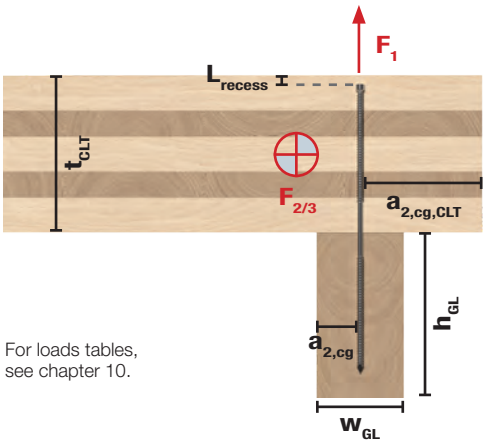
SWD – Minimum Spacings and Edge and End Distances (45°)

Spacing or distance [mm]		SWD6,5	SWD8,0
CLT	$a_{1,CLT}$	26	32
	$a_{2,CLT}$	17	20
	$a_{3,t,CLT}$	39	48
	$a_{4,t,CLT}$	39	48
Glulam	$a_{1,Glulam}$	65	80
	$a_{2,Glulam}$	20	24
	$a_{3,t,Glulam}$	52	64
	$a_{4,t,Glulam}$	20	24

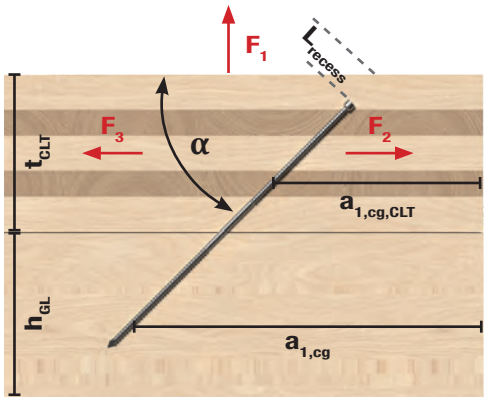
Note: Both CLT and Glulam edge distances needs to be fulfilled. If the grain orientation of the CLT panel is different the spacing defintion may change.



Inclined Screws CLT to Glulam Configuration



For loads tables, see chapter 10.



Note: $a_{1,cg,CLT}$ is a CLT edge distance to centre of gravity of the screw thread

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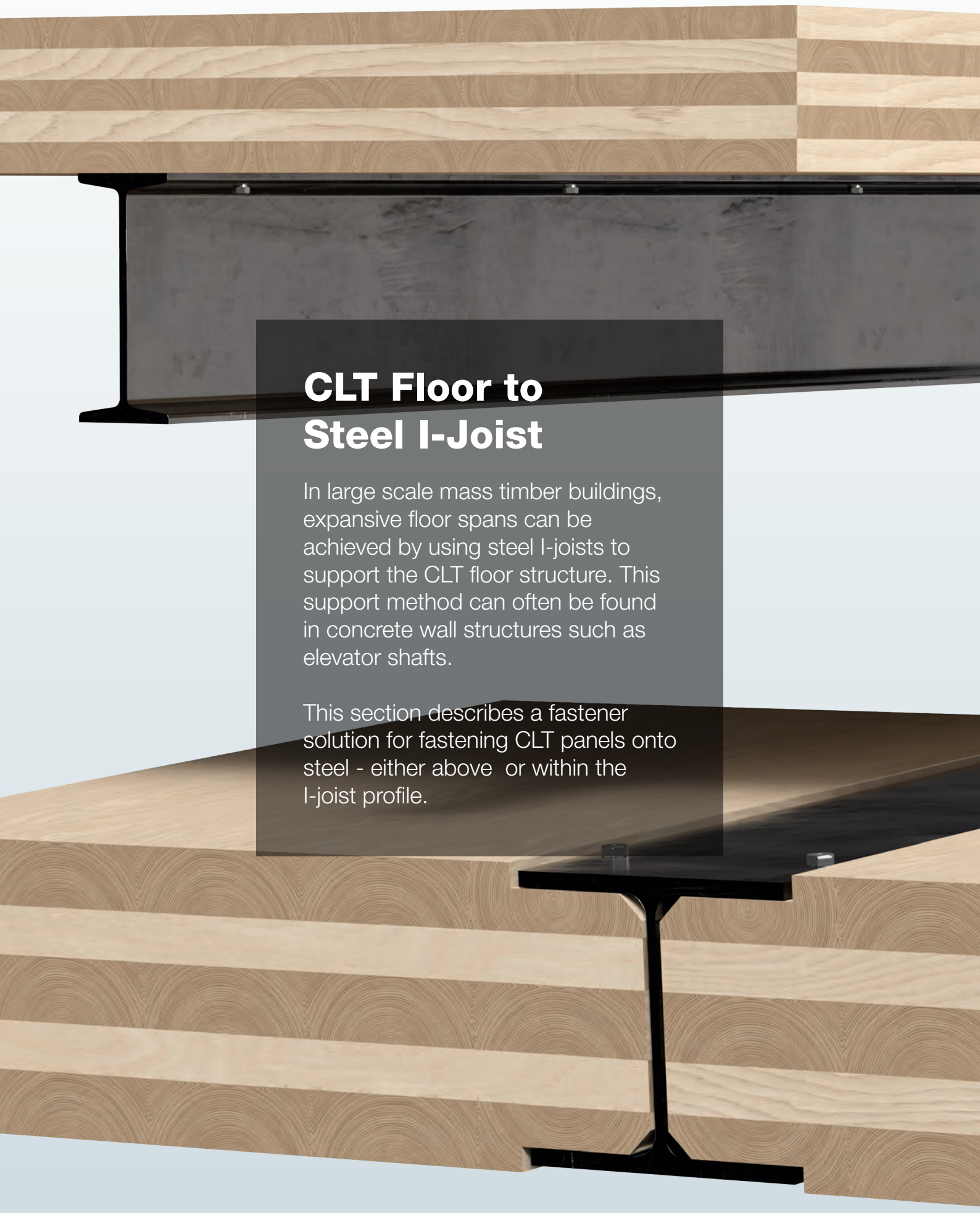

CLT Floor to Steel I-Joist

In large scale mass timber buildings, expansive floor spans can be achieved by using steel I-joists to support the CLT floor structure. This support method can often be found in concrete wall structures such as elevator shafts.

This section describes a fastener solution for fastening CLT panels onto steel - either above or within the I-joist profile.

CLT to Steel Profile Solutions

Structural Hex-Head Screw

Product Options:

SSH see page 197

Secure CLT floor panels to steel.

Structural Hex-Head Screw

Secure CLT floor panels to steel.

Items Required

Timber Fasteners
SSH Hex-Head Connector Screw

SSH

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Structural Hex-Head Screw

SSH – Hex-Head Connector Screw

The SSH hex-head screw is a heavy duty connector screw designed for steel to wood applications such as cross laminated timber and glulam. The design of the screw provide an excellent connection to the steel and can transfer high loads. The head combining hex and torx allows to install the screw with either a hex-driver or a 6-lobe driver bit.

Advantages:

- Can be installed with hex-driver bit or 6-lobe driver bit
- No pre-drilling required
- Impreg+ coating

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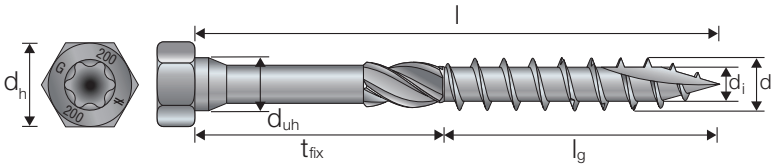

SSH – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_h	t_{fix}
SSH6.0xℓ	6,0	40 - 120	24 - 75	14,5	3,65	16 - 45
SSH8.0xℓ	8,0	40 - 300	32 - 110	13	5,1	8 - 190
SSH10.0xℓ	10,0	50 - 280	42 - 125	15	6,15	8 - 155
SSH12.0xℓ	12,0	60 - 200	48 - 110	17	6,7	12 - 90

Steel Profile to CLT Panel – SSH Screws at 90°

Product Reference	Tension Capacity – Steel to CLT – $R_{ax,k}$ [kN][1]	Shear Capacity – Steel to CLT – [kN]					
		Thin Steel[2]			Thick Steel[3]		
		Maximum Thickness [mm]	Pre-Drill	$R_{v,k}$	Minimum Thickness [mm]	Pre-Drill	$R_{v,k}$
SSH6.0x40[4]	1,8	3,0	With pre-drill	2,40	6,0	With pre-drill	3,16
			Without pre-drill	1,49		Without pre-drill	2,29
SSH6.0x50[4]	2,6	3,0	With pre-drill	2,77	6,0	With pre-drill	3,64
			Without pre-drill	1,89		Without pre-drill	2,82
SSH6.0x60[4]	3,4	3,0	With pre-drill	2,95	6,0	With pre-drill	3,82
			Without pre-drill	2,29		Without pre-drill	3,19
SSH6.0x75[4]	3,4	3,0	With pre-drill	2,95	6,0	With pre-drill	3,82
			Without pre-drill	2,50		Without pre-drill	3,19
SSH6.0x90[4]	3,4	3,0	With pre-drill	2,95	6,0	With pre-drill	3,82
			Without pre-drill	2,50		Without pre-drill	3,19
SSH6.0x120[4]	6,0	3,0	With pre-drill	3,61	6,0	With pre-drill	4,48
			Without pre-drill	3,16		Without pre-drill	3,85

Table continues on next page.

[1] For steel thickness ≤ d
[2] Thin plate: thickness ≤ 0.5xd
[3] Thick plate: thickness ≥ d
[4] 6.0 mm screws have a different head design – see chapter 10.
For intermediate steel thicknesses, the capacity can be obtained by interpolation.
For recommended hole diameter in steel, see chapter 10.

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Structural Hex-Head Screw

Steel Profile to CLT Panel – SSH Screws at 90° (cont.)

Product Reference	Tension Capacity – Steel to CLT – $R_{ax,k}$ [kN][1]	Shear Capacity – Steel to CLT – [kN]					
		Thin Steel[2]			Thick Steel[3]		
		Maximum Thickness [mm]	Pre-Drill	$R_{v,k}$	Minimum Thickness [mm]	Pre-Drill	$R_{v,k}$
SSH8.0X40	3,6	4,0	With pre-drill	3,04	8,0	With pre-drill	4,75
			Without pre-drill	1,77		Without pre-drill	3,54
SSH8.0X50	4,7	4,0	With pre-drill	3,89	8,0	With pre-drill	5,67
			Without pre-drill	2,26		Without pre-drill	4,12
SSH8.0x60	4,7	4,0	With pre-drill	4,73	8,0	With pre-drill	6,39
			Without pre-drill	2,76		Without pre-drill	4,48
SSH8.0x70	4,7	4,0	With pre-drill	4,93	8,0	With pre-drill	6,48
			Without pre-drill	3,25		Without pre-drill	4,89
SSH8.0X80	4,7	4,0	With pre-drill	4,93	8,0	With pre-drill	6,48
			Without pre-drill	3,74		Without pre-drill	5,23
SSH8.0X90	4,7	4,0	With pre-drill	4,93	8,0	With pre-drill	6,48
			Without pre-drill	4,04		Without pre-drill	5,23
SSH8.0X100	6,1	4,0	With pre-drill	5,29	8,0	With pre-drill	6,85
			Without pre-drill	4,40		Without pre-drill	5,59
SSH8.0X120	9,5	4,0	With pre-drill	6,12	8,0	With pre-drill	7,68
			Without pre-drill	5,23		Without pre-drill	6,42
SSH8.0X140	9,5	4,0	With pre-drill	6,12	8,0	With pre-drill	7,68
			Without pre-drill	5,23		Without pre-drill	6,42
SSH8.0X160	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X180	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X200	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X240	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X260	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X280	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH8.0X300	12,2	4,0	With pre-drill	6,82	8,0	With pre-drill	8,38
			Without pre-drill	5,74		Without pre-drill	7,12
SSH10.0X50	3,9	5,0	With pre-drill	3,62	10,0	With pre-drill	5,87
			Without pre-drill	2,59		Without pre-drill	4,92
SSH10.0X60	5,1	5,0	With pre-drill	5,68	10,0	With pre-drill	7,68
			Without pre-drill	3,16		Without pre-drill	5,29
SSH10.0X80	5,1	5,0	With pre-drill	6,41	10,0	With pre-drill	8,54
			Without pre-drill	4,32		Without pre-drill	6,20
SSH10.0X90	5,1	5,0	With pre-drill	6,41	10,0	With pre-drill	8,54
			Without pre-drill	4,89		Without pre-drill	6,70
SSH10.0X100	6,7	5,0	With pre-drill	6,81	10,0	With pre-drill	8,94
			Without pre-drill	5,47		Without pre-drill	7,09
SSH10.0X120	10,3	5,0	With pre-drill	7,71	10,0	With pre-drill	9,84
			Without pre-drill	6,41		Without pre-drill	8,00
SSH10.0X140	10,3	5,0	With pre-drill	7,71	10,0	With pre-drill	9,84
			Without pre-drill	6,41		Without pre-drill	8,00
SSH10.0X160	13,3	5,0	With pre-drill	8,47	10,0	With pre-drill	10,60
			Without pre-drill	7,16		Without pre-drill	8,75
SSH10.0X180	13,3	5,0	With pre-drill	8,47	10,0	With pre-drill	10,60
			Without pre-drill	7,16		Without pre-drill	8,75
SSH10.0X200	13,3	5,0	With pre-drill	8,47	10,0	With pre-drill	10,60
			Without pre-drill	7,16		Without pre-drill	8,75
SSH10.0X240	15,1	5,0	With pre-drill	8,92	10,0	With pre-drill	11,05
			Without pre-drill	7,62		Without pre-drill	9,21
SSH10.0X280	15,1	5,0	With pre-drill	8,92	10,0	With pre-drill	11,05
			Without pre-drill	7,62		Without pre-drill	9,21

[1] For steel thickness ≤ d
[2] Thin plate: thickness ≤ 0.5xd
[3] Thick plate: thickness ≥ d
For intermediate steel thicknesses, the capacity can be obtained by interpolation.
For recommended hole diameter in steel, see chapter 10.

Table continues on next page.

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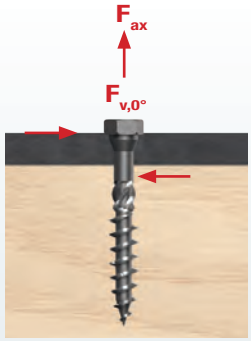
Structural Hex-Head Screw

Steel Profile to CLT Panel – SSH Screws at 90° (cont.)

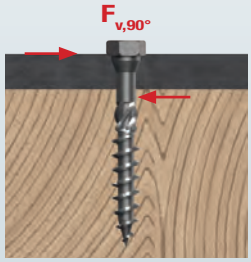
Product Reference	Tension Capacity – Steel to CLT – $R_{ax,k}$ [kN][1]	Shear Capacity – Steel to CLT – [kN]					
		Thin Steel[2]			Thick Steel[3]		
		Maximum Thickness [mm]	Pre-Drill	$R_{v,k}$	Minimum Thickness [mm]	Pre-Drill	$R_{v,k}$
SSH12.0X60	7,0	6,0	With pre-drill	6,55	12,0	With pre-drill	9,27
			Without pre-drill	3,53		Without pre-drill	6,45
SSH12.0X80	7,0	6,0	With pre-drill	8,23	12,0	With pre-drill	10,91
			Without pre-drill	4,84		Without pre-drill	7,41
SSH12.0X90	7,0	6,0	With pre-drill	8,23	12,0	With pre-drill	10,91
			Without pre-drill	5,49		Without pre-drill	7,96
SSH12.0X100	8,1	6,0	With pre-drill	8,49	12,0	With pre-drill	11,17
			Without pre-drill	6,14		Without pre-drill	8,74
SSH12.0X120	12,4	6,0	With pre-drill	9,59	12,0	With pre-drill	12,27
			Without pre-drill	7,45		Without pre-drill	9,84
SSH12.0X140	12,4	6,0	With pre-drill	9,59	12,0	With pre-drill	12,27
			Without pre-drill	7,87		Without pre-drill	9,84
SSH12.0X160	16,1	6,0	With pre-drill	10,50	12,0	With pre-drill	13,18
			Without pre-drill	8,78		Without pre-drill	10,75
SSH12.0X180	16,1	6,0	With pre-drill	10,50	12,0	With pre-drill	13,18
			Without pre-drill	8,78		Without pre-drill	10,75
SSH12.0X200	16,1	6,0	With pre-drill	10,50	12,0	With pre-drill	13,18
			Without pre-drill	8,78		Without pre-drill	10,75

[1] For steel thickness ≤ d
[2] Thin plate: thickness ≤ 0.5xd
[3] Thick plate: thickness ≥ d
For intermediate steel thicknesses, the capacity can be obtained by interpolation.
For recommended hole diameter in steel, see chapter 10.

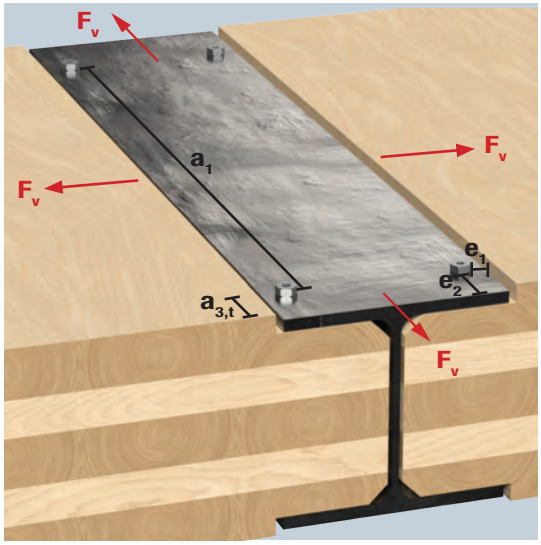
Characteristic parameters of fasteners and more information are included in chapter 10.



Shear Parallel (0°) to the Grain



Shear Perpendicular (90°) to the Grain



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Structural Hex-Head Screw

SSH – Recommended Maximum Steel Hole Diameter

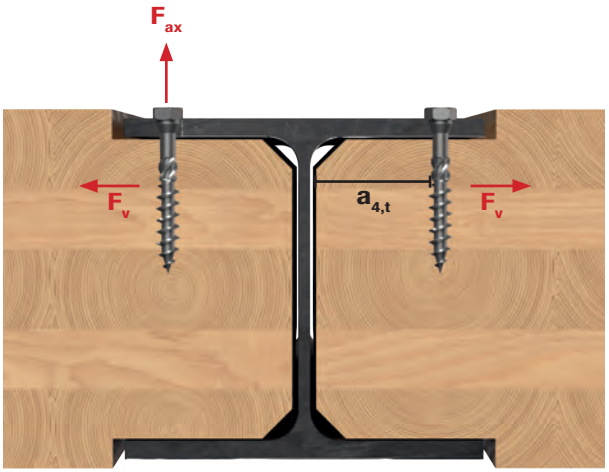
SSH6,0	SSH8,0	SSH10,0	SSH12,0
SSH6,0	SSH8,0	SSH10,0	SSH12,0
Ø7 mm	Ø9 mm	Ø11 mm	Ø13 mm

Note: The cone under the head have the same diameter as the outer thread.

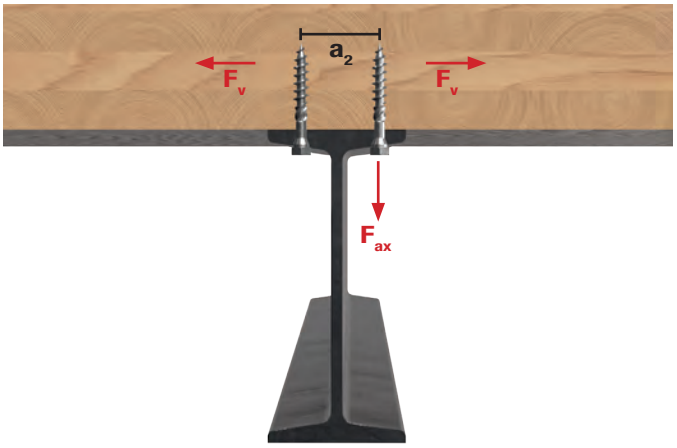
SSH – Minimum Spacings and Edge and End Distances

Spacing or distance [mm]		SSH6,0	SSH8,0	SSH10,0	SSH12,0
CLT	a_2	15	20	25	30
	$a_{3,t}$	36	48	60	72
	$a_{4,t}$	36	48	60	72
Steel *	e_1	8	10	12	15
	e_2	8	10	12	15
	a_1	14	18	22	27
	a_2 *	15	20	24	29

Note: Both CLT and Steel edge distances need to be fulfilled.
* According to EN 1993-1-8 §3.5



CLT supported within steel I-Beam



CLT Floor supported above Steel I-Beam

Note: Size of the clearance between I-Beam flanges to be checked to make sure that the installation is possible.

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The Simpson Strong-Tie® Difference

Making the connector or fastener is only the start of the journey. We guide our products all the way to their ultimate place in a construction project.

From residential to commercial construction and off-site fabrication, a Simpson Strong-Tie product brings with it bespoke design services, on-site technical support and industry leading customer and after-care service.

External Insulation to CLT Wall

For improved thermal performance at exterior CLT wall panels, insulation can be mounted via battens.

This section describes a fastener solution for fixing battens to CLT via the insulation layer.

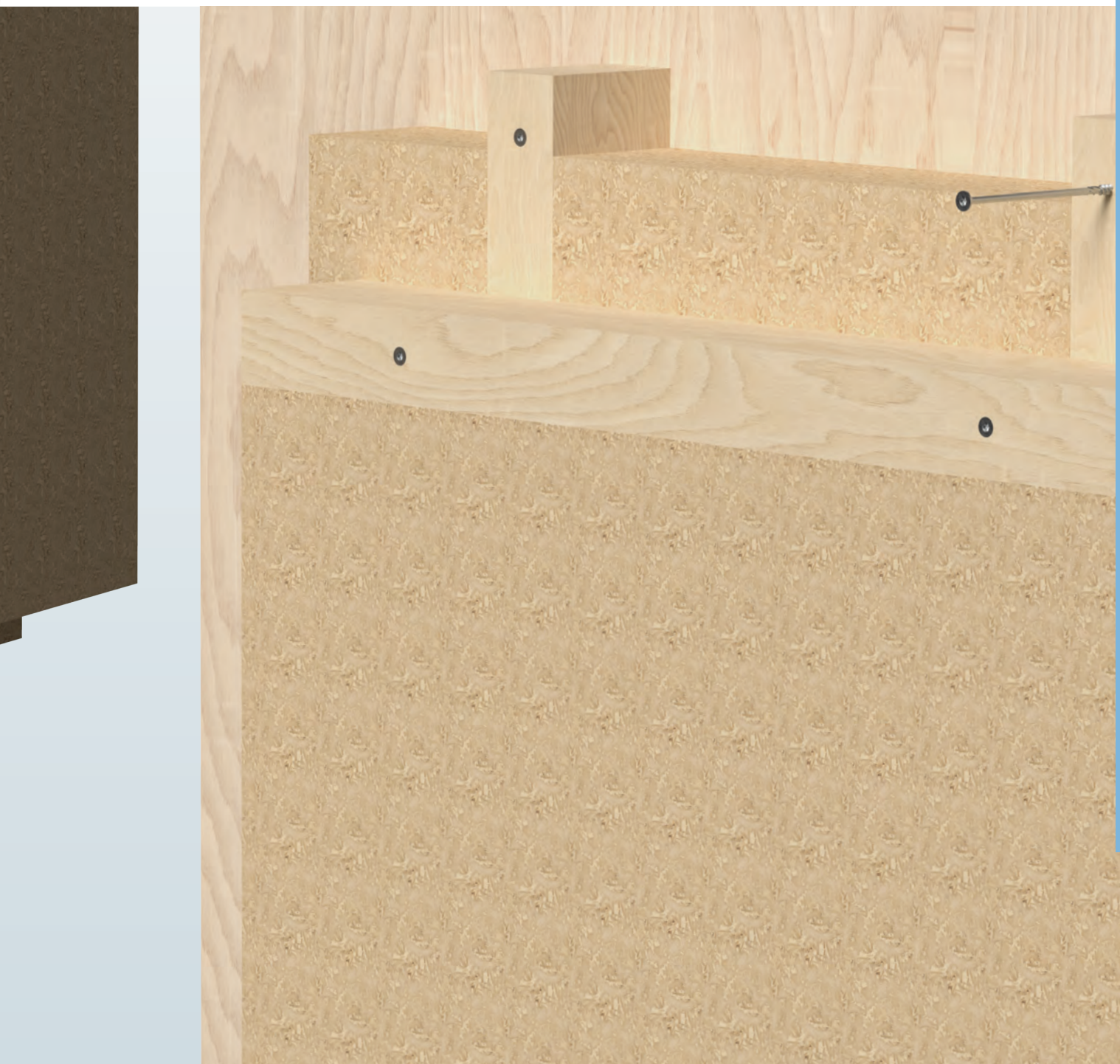
External Insulation to CLT Wall Solutions

Structural Countersunk Wood Screw

Product Options:

TTUFS see page 205

Easy and fast method for installing insulation layers and battens to CLT wall panels.



Structural Countersunk Wood Screw

Easy and fast method for installing insulation layers and battens to CLT wall panels.

Items Required

Timber Fasteners
TTUFS Countersunk Screw

TTUFS

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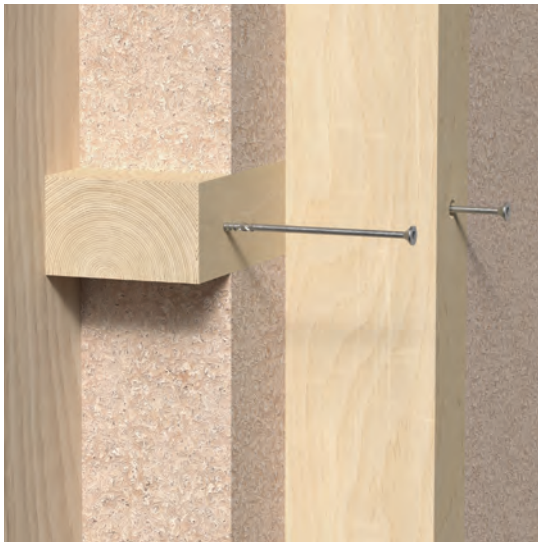
Structural Countersunk Wood Screw

TTUFS – Countersunk Screw

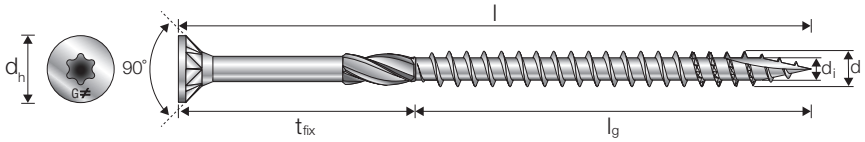
TTUFS is a high-performance and cost effective solution for mounting installation to CLT walls. It features a partially-threaded profile that provides a tightening effect between the timber stud and the CLT panel, as well as a countersunk head to leave a clean, flush surface.

Advantages:

- Countersunk head provides a flush finish
- Milling thread reduces the drive-in torque, reducing effort
- No pre-drilling required



ETA-21/0670



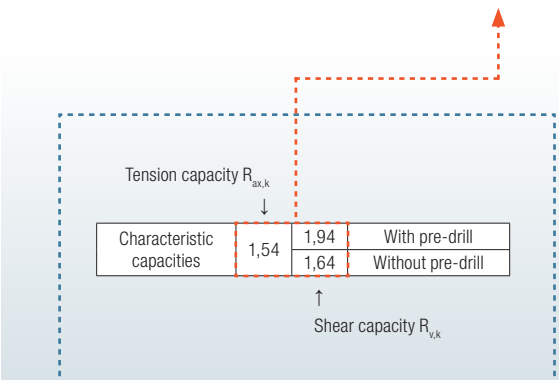
TTUFS – Range Overview

Product Reference	Dimensions [mm]					
	d	l	l_g	d_h	d_i	t_{fix}
TTUFS4.5xℓ	4,5	25 - 80	20 - 50	8,4	2,8	5 - 5
TTUFS5.0xℓ	5,0	30 - 120	25 - 60	9,5	3,1	5 - 60
TTUFS6.0xℓ	6,0	40 - 180	34 - 70	11,6	3,7	6 - 110

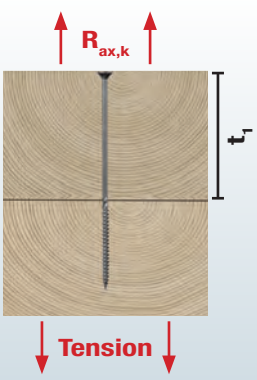
TTUFS – Characteristic Tension and Shear Capacities, Parallel (0°) to the Grain Timber to Timber C24

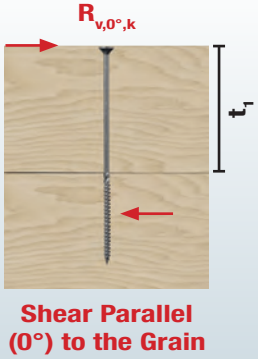
Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_1 [mm]	Tension Capacity $R_{ax,k}$ and Shear Capacity $R_{v,0°,k}$ Parallel to the Grain Depending on t_1 [kN]															
			Wood Thickness t_1 [mm]															
			36		45		50		60		63		70		75		80		100	
TTUFS5.0X80	40	40	1,54	1,94 1,64	1,54	1,94 1,64	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TTUFS5.0X90	45	45	1,54	1,94 1,64	1,54	1,94 1,64	1,54	1,94 1,64	-	-	-	-	-	-	-	-	-	-	-	-
TTUFS5.0X100	60	40	1,54	1,94 1,64	1,54	1,94 1,64	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TTUFS5.0X120	60	60	1,54	1,94 1,64	1,54	1,94 1,64	1,54	1,94 1,64	1,54	1,94 1,64	1,54	1,94 1,64	-	-	-	-	-	-	-	-

Table continues on next page.



For pre-drilling recommendations, see chapter 10.





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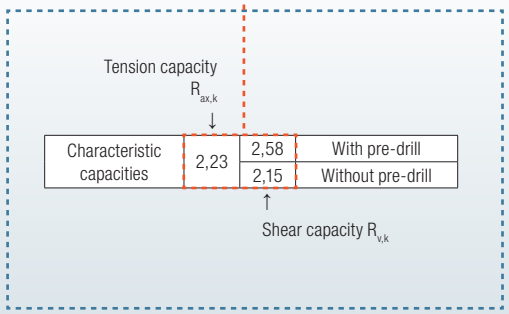
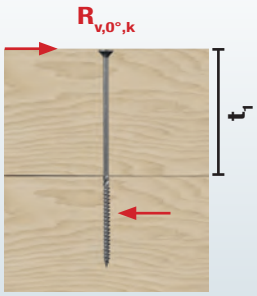
Structural Countersunk Wood Screw

TTUFS – Characteristic Tension and Shear Capacities, Parallel (0°) to the Grain
Timber to Timber C24

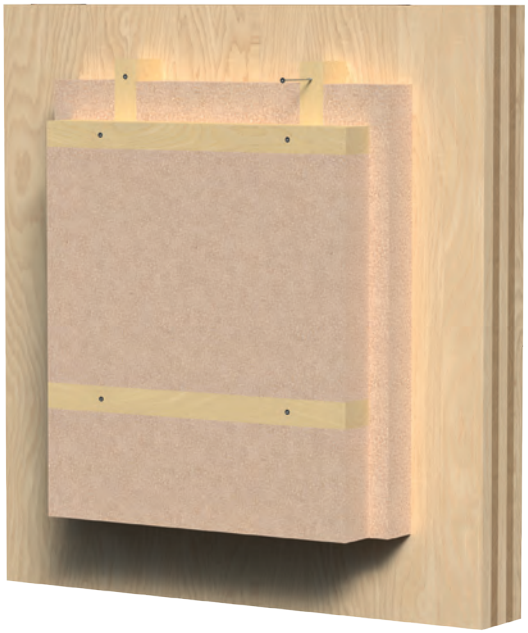
Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_1 [mm]	Tension Capacity $R_{ax,k}$ and Shear Capacity $R_{v,0°,k}$ Parallel to the Grain Depending on t_1 [kN]																	
			Wood Thickness t_1 [mm]																	
			36		45		50		60		63		70		75		80		100	
TTUFS6.0X80	40	40	2,23	2,58 2,09	2,23	2,58 2,06	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X90	45	45	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X100	60	40	2,23	2,58 2,09	2,23	2,58 2,15	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X120	70	50	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X140	70	70	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	-	- -	-	- -
TTUFS6.0X160	70	90	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	-	- -
TTUFS6.0X180	70	110	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15

Characteristic parameters of fasteners and more information are included in chapter 10.





For pre-drilling recommendations, see chapter 10.



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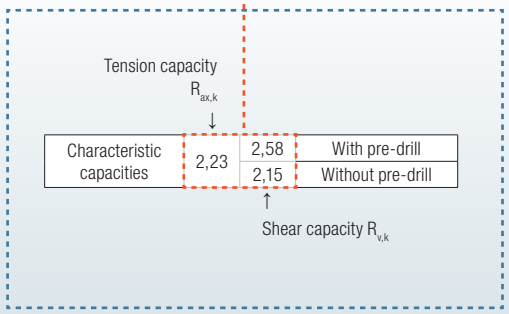
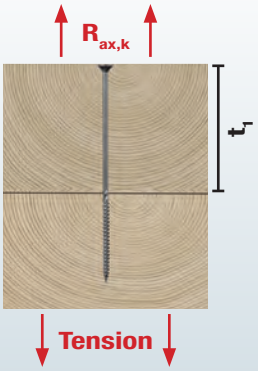
Structural Countersunk Wood Screw

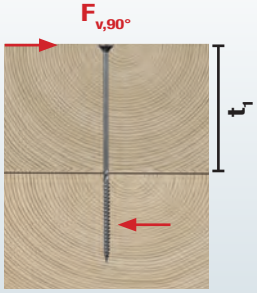
TTUFS – Characteristic Tension and Shear Capacities, Perpendicular (90°) to the Grain
Timber to Timber C24

Product Reference	Thread Length L_g [mm]	Max Advised Wood Thickness t_1 [mm]	Tension Capacity $R_{ax,k}$ and Shear Capacity $R_{v,90°,k}$ Perpendicular to the Grain Depending on t_1 [kN]																	
			Wood Thickness t_1 [mm]																	
			36		45		50		60		63		70		75		80		100	
TTUFS5.0X80	40	40	1,54	1,94 1,64	1,54	1,94 1,64	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS5.0X90	45	45	1,54	1,94 1,64	1,54	1,94 1,64	1,54	1,94 1,64	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS5.0X100	60	40	1,54	1,94 1,64	1,54	1,94 1,64	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS5.0X120	60	60	1,54	1,94 1,64	1,54	1,94 1,64	1,54	1,94 1,64	1,54	1,94 1,64	1,54	1,94 1,64	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X80	40	40	2,23	2,58 2,09	2,23	2,58 2,06	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X90	45	45	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X100	60	40	2,23	2,58 2,09	2,23	2,58 2,15	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X120	70	50	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	-	- -	-	- -	-	- -	-	- -	-	- -	-	- -
TTUFS6.0X140	70	70	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	-	- -	-	- -
TTUFS6.0X160	70	90	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	-	- -
TTUFS6.0X180	70	110	2,23	2,58 2,09	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15	2,23	2,58 2,15

Characteristic parameters of fasteners and more information are included in chapter 10.







For pre-drilling recommendations, see chapter 10.

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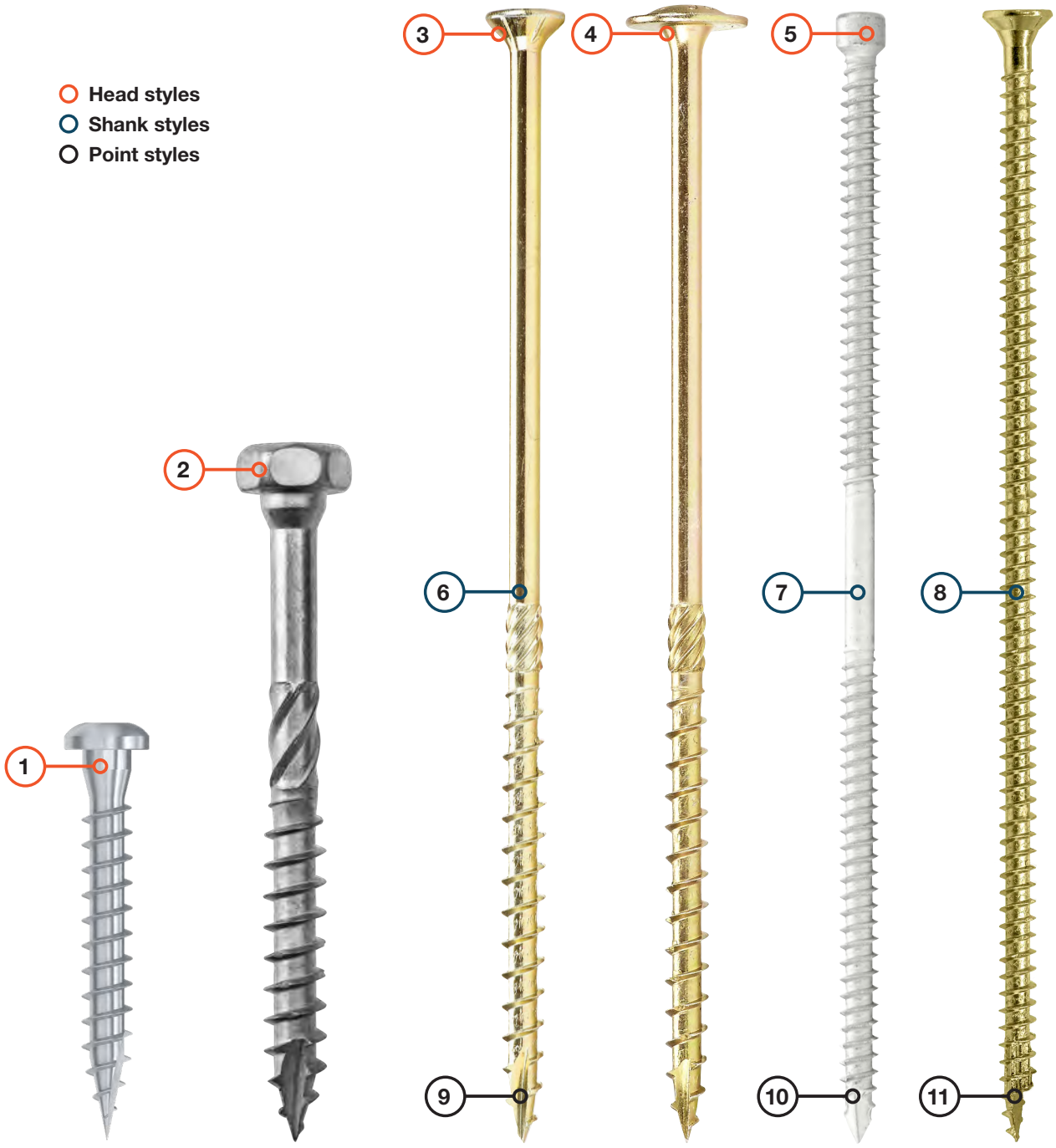
Fastener Features



1. **Conical shape** under the head for maximum fit in metal holes
2. **Hex-head** with 6-lobe recess allows for the convenience of driving with either a hex-driver bit or 6-lobe driver bit
3. **Countersunk head** with underhead nibs creates a flush finish
4. **Washer head** creates high pull-through resistance
5. **Small cylinder head** sinks into the wood allowing for hidden assemblies
6. **Partial thread** with milling thread reduces the drive-in torque
7. **Double thread** with differentiated thread pitch creates a clamping effect that pulls the wood members together
8. **Full thread** for excellent pull-out values and high load-bearing capacities
9. **Type 17 cut point** reduces the risk of wood splitting during the installation
10. **Chisel point** allows for skewed installations
11. **Half-cut point** gives low installation torque and no pre-drilling is required

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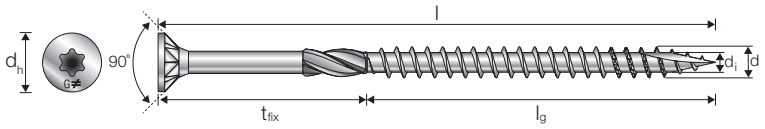
Solid·Drive™ TTUFS Countersunk **WOOD** Screw



ETA-21/0670

Electro Galvanised
C1 acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

TTUFS – Range Overview

Reference	Article code	Dimensions [mm]					
		d	l	l_g	d_h	d_i	t_{fix}
TTUFS4.5X25	74434	4,5	25	20	8,4	2,8	5
TTUFS4.5X30	74435	4,5	30	25	8,4	2,8	5
TTUFS4.5X35	74436	4,5	35	30	8,4	2,8	5
TTUFS4.5X40	74437	4,5	40	35	8,4	2,8	5
TTUFS4.5X45	74438	4,5	45	29	8,4	2,8	16
TTUFS4.5X50	74439	4,5	50	30	8,4	2,8	20
TTUFS4.5X60	74440	4,5	60	35	8,4	2,8	25
TTUFS4.5X70	74441	4,5	70	40	8,4	2,8	30
TTUFS4.5X80	74442	4,5	80	50	8,4	2,8	30
TTUFS5.0X30	74373	5,0	30	25	9,5	3,1	5
TTUFS5.0X40	74374	5,0	40	35	9,5	3,1	5
TTUFS5.0X50	74375	5,0	50	30	9,5	3,1	20
TTUFS5.0X60	74376	5,0	60	35	9,5	3,1	25
TTUFS5.0X70	74377	5,0	70	40	9,5	3,1	30
TTUFS5.0X80	74378	5,0	80	40	9,5	3,1	40
TTUFS5.0X90	74379	5,0	90	45	9,5	3,1	45
TTUFS5.0X100	74443	5,0	100	60	9,5	3,1	40
TTUFS5.0X120	74372	5,0	120	60	9,5	3,1	60
TTUFS6.0X40	74455	6,0	40	34	11,6	3,7	6
TTUFS6.0X50	74457	6,0	50	30	11,6	3,7	20
TTUFS6.0X60	74458	6,0	60	35	11,6	3,7	25
TTUFS6.0X70	74459	6,0	70	40	11,6	3,7	30
TTUFS6.0X80	74460	6,0	80	40	11,6	3,7	40
TTUFS6.0X90	74461	6,0	90	45	11,6	3,7	45
TTUFS6.0X100	74380	6,0	100	60	11,6	3,7	40
TTUFS6.0X120	74451	6,0	120	70	11,6	3,7	50
TTUFS6.0X140	74452	6,0	140	70	11,6	3,7	70
TTUFS6.0X160	74453	6,0	160	70	11,6	3,7	90
TTUFS6.0X180	74454	6,0	180	70	11,6	3,7	110

TTUFS – Characteristic Parameters

Reference	Characteristic Parameters				
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]
TTUFS4.5	4660	14,7	7,8	4,7	15,6
TTUFS5.0	6720	15,0	7,9	6,0	17,1
TTUFS6.0	9500	12,5	11,1	9,4	16,6

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

SW Solid Wood

Use Solid Wood to make your calculations.

Go to solidwood.strongtie.eu

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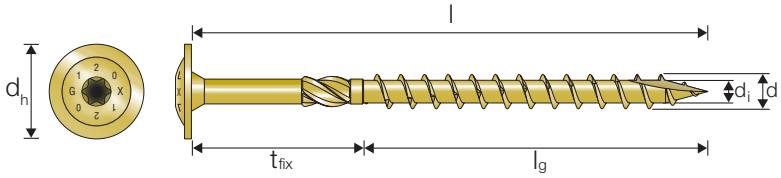
Solid·Drive™
SWW Washer-Head **WOOD** Screw

ETA-21/0670



Yellow Zinc Plated
C2 acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

SWW – Range Overview

Reference	Article code	Dimensions [mm]					
		d	l	l_g	d_h	d_i	t_{fix}
SWW6.0X60	75382	6.0	60	42	14	3,9	18
SWW6.0X80	75383	6.0	80	50	14	3,9	30
SWW6.0X100	75384	6.0	100	50	14	3,9	50
SWW6.0X120	75385	6.0	120	50	14	3,9	70
SWW6.0X140	75386	6.0	140	70	14	3,9	70
SWW6.0X160	75387	6.0	160	70	14	3,9	90
SWW6.0X180	75388	6.0	180	70	14	3,9	110
SWW6.0X200	75389	6.0	200	70	14	3,9	130
SWW6.0X220	75390	6.0	220	70	14	3,9	150
SWW6.0X240	75391	6.0	240	70	14	3,9	170
SWW6.0X260	75392	6.0	260	70	14	3,9	190
SWW6.0X280	75393	6.0	280	70	14	3,9	210
SWW6.0X300	75394	6.0	300	70	14	3,9	230
SWW8.0X80	75395	8.0	80	50	22	5,2	30
SWW8.0X100	75396	8.0	100	50	22	5,2	50
SWW8.0X120	75397	8.0	120	80	22	5,2	40
SWW8.0X140	75398	8.0	140	80	22	5,2	60
SWW8.0X160	75399	8.0	160	80	22	5,2	80
SWW8.0X180	75400	8.0	180	80	22	5,2	100
SWW8.0X200	75401	8.0	200	80	22	5,2	120
SWW8.0X220	75402	8.0	220	80	22	5,2	140
SWW8.0X240	75403	8.0	240	80	22	5,2	160
SWW8.0X260	75404	8.0	260	80	22	5,2	180
SWW8.0X280	75405	8.0	280	80	22	5,2	200
SWW8.0X300	75406	8.0	300	80	22	5,2	220
SWW8.0X320	75407	8.0	320	80	22	5,2	240
SWW8.0X340	75408	8.0	340	80	22	5,2	260
SWW8.0X360	75409	8.0	360	80	22	5,2	280
SWW8.0X380	75410	8.0	380	80	22	5,2	300
SWW8.0X400	75411	8.0	400	80	22	5,2	320

Table continues on next page.

SWW – Characteristic Parameters

Reference	Characteristic Parameters				
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]
SWW6.0	10500	13,0	12,3	11,0	16,1
SWW8.0	25900	12,6	23,7	27,4	10,5
SWW10.0	43700	12,2	33,8	48,9	10,2

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

SW Solid Wood

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SWW – Range Overview (continued)

Reference	Article code	Dimensions [mm]					
		d	l	l_g	d_h	d_i	t_{fix}
SWW10.0X100	76912	10.0	100	50	25	6,2	50
SWW10.0X120	76913	10.0	120	50	25	6,2	70
SWW10.0X140	76914	10.0	140	80	25	6,2	60
SWW10.0X160	75412	10.0	160	80	25	6,2	80
SWW10.0X180	75413	10.0	180	80	25	6,2	100
SWW10.0X200	75414	10.0	200	80	25	6,2	120
SWW10.0X220	75415	10.0	220	80	25	6,2	140
SWW10.0X240	75416	10.0	240	80	25	6,2	160
SWW10.0X260	75417	10.0	260	80	25	6,2	180
SWW10.0X280	75418	10.0	280	80	25	6,2	200
SWW10.0X300	75419	10.0	300	80	25	6,2	220
SWW10.0X320	75420	10.0	320	80	25	6,2	240
SWW10.0X340	75421	10.0	340	80	25	6,2	260
SWW10.0X360	75422	10.0	360	80	25	6,2	280
SWW10.0X380	75423	10.0	380	80	25	6,2	300
SWW10.0X400	75424	10.0	400	80	25	6,2	320

SWW – Characteristic Parameters

Reference	Characteristic Parameters				
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]
SWW6.0	10500	13,0	12,3	11,0	16,1
SWW8.0	25900	12,6	23,7	27,4	10,5
SWW10.0	43700	12,2	33,8	48,9	10,2

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

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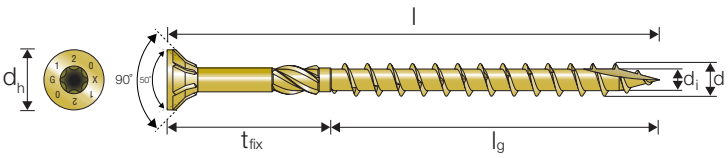
Solid·Drive™
SWC Countersunk **WOOD** Screw

ETA-21/0670



Yellow Zinc Plated
C2 acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

SWC – Range Overview

Reference	Article code	Dimensions [mm]					
		d	l	l_g	d_h	d_i	t_{fix}
SWC6.0X200	75346	6,0	200	70	11,8	3,9	130
SWC6.0X220	75347	6,0	220	70	11,8	3,9	150
SWC6.0X240	75348	6,0	240	70	11,8	3,9	170
SWC6.0X260	75349	6,0	260	70	11,8	3,9	190
SWC6.0X280	75350	6,0	280	70	11,8	3,9	210
SWC6.0X300	75351	6,0	300	70	11,8	3,9	230
SWC8.0X80	75352	8,0	80	50	14,6	5,2	30
SWC8.0X100	75353	8,0	100	50	14,6	5,2	50
SWC8.0X120	75354	8,0	120	80	14,6	5,2	40
SWC8.0X140	75355	8,0	140	80	14,6	5,2	60
SWC8.0X160	75356	8,0	160	80	14,6	5,2	80
SWC8.0X180	75357	8,0	180	80	14,6	5,2	100
SWC8.0X200	75358	8,0	200	80	14,6	5,2	120
SWC8.0X220	75359	8,0	220	80	14,6	5,2	140
SWC8.0X240	75360	8,0	240	80	14,6	5,2	160
SWC8.0X260	75361	8,0	260	80	14,6	5,2	180
SWC8.0X280	75362	8,0	280	80	14,6	5,2	200
SWC8.0X300	75363	8,0	300	80	14,6	5,2	220
SWC8.0X320	75364	8,0	320	80	14,6	5,2	240
SWC8.0X340	75365	8,0	340	80	14,6	5,2	260
SWC8.0X360	75366	8,0	360	80	14,6	5,2	280
SWC8.0X380	75367	8,0	380	80	14,6	5,2	300
SWC8.0X400	75368	8,0	400	80	14,6	5,2	320
SWC10.0X100	76916	10,0	100	50	17,8	6,2	50
SWC10.0X120	76917	10,0	120	50	17,8	6,2	70
SWC10.0X140	76918	10,0	140	80	17,8	6,2	60
SWC10.0X160	75369	10,0	160	80	17,8	6,2	80
SWC10.0X180	75370	10,0	180	80	17,8	6,2	100
SWC10.0X200	75371	10,0	200	80	17,8	6,2	120
SWC10.0X220	75372	10,0	220	80	17,8	6,2	140
SWC10.0X240	75373	10,0	240	80	17,8	6,2	160
SWC10.0X260	75374	10,0	260	80	17,8	6,2	180
SWC10.0X280	75375	10,0	280	80	17,8	6,2	200
SWC10.0X300	75376	10,0	300	80	17,8	6,2	220
SWC10.0X320	75377	10,0	320	80	17,8	6,2	240
SWC10.0X340	75378	10,0	340	80	17,8	6,2	260
SWC10.0X360	75379	10,0	360	80	17,8	6,2	280
SWC10.0X380	75380	10,0	380	80	17,8	6,2	300
SWC10.0X400	75381	10,0	400	80	17,8	6,2	320

SWC – Characteristic Parameters

Reference	Characteristic Parameters				
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]
SWC6.0	10500	13,0	12,3	11,0	11,9
SWC8.0	25900	12,6	23,7	27,4	12,5
SWC10.0	43700	12,2	33,8	48,9	11,2

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

Use Solid Wood to make your calculations.
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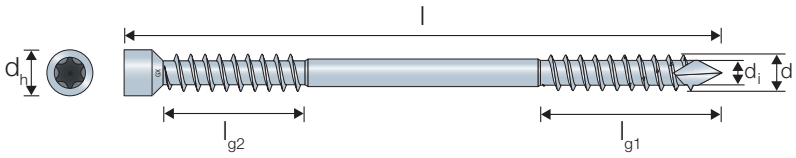
Solid·Drive™
SWD Double Threaded **WOOD** Screw



ETA-21/0670

Protec® +
C3 acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

SWD – Range Overview

Reference	Article code	Dimensions [mm]					
		d	l	l_{g1}	l_{g2}	d_h	d_i
SWD6.5X65	75425	6,5	65	28	21,5	8	4
SWD6.5X90	75426	6,5	90	40	33,5	8	4
SWD6.5X130	75427	6,5	130	40	33,5	8	4
SWD6.5X160	75428	6,5	160	65	58,5	8	4
SWD6.5X190	75429	6,5	190	80	73,5	8	4
SWD6.5X220	75430	6,5	220	95	88,5	8	4
SWD8.0X90	75431	8,0	90	40	31,5	10	5,4
SWD8.0X130	75432	8,0	130	40	31,5	10	5,4
SWD8.0X160	75433	8,0	160	65	56,5	10	5,4
SWD8.0X190	75434	8,0	190	80	71,5	10	5,4
SWD8.0X220	75435	8,0	220	95	86,5	10	5,4
SWD8.0X245	75436	8,0	245	107	99	10	5,4
SWD8.0X275	75437	8,0	275	107	99	10	5,4
SWD8.0X300	75438	8,0	300	135	126,5	10	5,4
SWD8.0X330	75439	8,0	330	135	126,5	10	5,4

SWD – Characteristic Parameters

Reference	Characteristic Parameters				
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]
SWD6.5	12400	13,7	14,5	12,6	1000
SWD8.0	26800	13,1	25,3	27,7	1000

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

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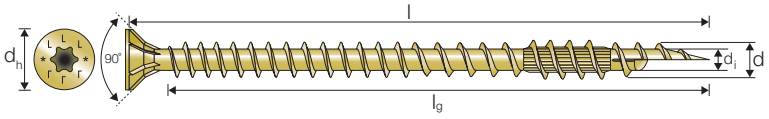
Solid·Drive™
ESCRFTC Fully Threaded Countersunk **WOOD** Screw



ETA-13/0796

Yellow Zinc Plated
C2 acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

ESCRFTC – Range Overview

Reference	Dimensions [mm]				
	d	l	l_g	d_h	d_i
ESCRFTC8.0X120	8,0	120	110	15,0	5,1
ESCRFTC8.0X140	8,0	140	130	15,0	5,1
ESCRFTC8.0X160	8,0	160	150	15,0	5,1
ESCRFTC8.0X180	8,0	180	170	15,0	5,1
ESCRFTC8.0X200	8,0	200	190	15,0	5,1
ESCRFTC8.0X220	8,0	220	210	15,0	5,1
ESCRFTC8.0X240	8,0	240	230	15,0	5,1
ESCRFTC8.0X260	8,0	260	250	15,0	5,1
ESCRFTC8.0X280	8,0	280	270	15,0	5,1
ESCRFTC8.0X300	8,0	300	290	15,0	5,1
ESCRFTC8.0X350	8,0	350	340	15,0	5,1
ESCRFTC8.0X400	8,0	400	390	15,0	5,1
ESCRFTC8.0X450	8,0	450	427	15,0	5,1
ESCRFTC10.0X120	10,0	120	108	18,5	6,3
ESCRFTC10,0X160	10,0	160	148	18,5	6,3
ESCRFTC10.0X180	10,0	180	168	18,5	6,3
ESCRFTC10.0X200	10,0	200	188	18,5	6,3
ESCRFTC10.0X220	10,0	220	208	18,5	6,3
ESCRFTC10.0X240	10,0	240	228	18,5	6,3
ESCRFTC10.0X260	10,0	260	248	18,5	6,3
ESCRFTC10.0X280	10,0	280	268	18,5	6,3
ESCRFTC10.0X300	10,0	300	288	18,5	6,3
ESCRFTC10.0X350	10,0	350	338	18,5	6,3
ESCRFTC10.0X400	10,0	400	388	18,5	6,3
ESCRFTC10.0X450	10,0	450	426	18,5	6,3
ESCRFTC12.0X200	12,0	200	180	21,0	7,0
ESCRFTC12.0X220	12,0	220	200	21,0	7,0
ESCRFTC12.0X240	12,0	240	220	21,0	7,0
ESCRFTC12.0X260	12,0	260	240	21,0	7,0
ESCRFTC12.0X280	12,0	280	260	21,0	7,0
ESCRFTC12.0X300	12,0	300	280	21,0	7,0
ESCRFTC12.0X350	12,0	350	330	21,0	7,0
ESCRFTC12.0X400	12,0	400	380	21,0	7,0
ESCRFTC12.0X450	12,0	450	430	21,0	7,0
ESCRFTC12.0X500	12,0	500	480	21,0	7,0
ESCRFTC12.0X600	12,0	600	580	21,0	7,0

ESCRFTC – Characteristic Parameters

Reference	Characteristic Parameters					
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]	$f_{y,k}$ [N/mm²]
ESCRFTC8.0	20300	13,1	24,1	25,8	12,4	950
ESCRFTC10.0	36700	12,5	40,0	55,0	12,2	950
ESCRFTC12.0	48500	11,2	46,7	73,0	10,3	950

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

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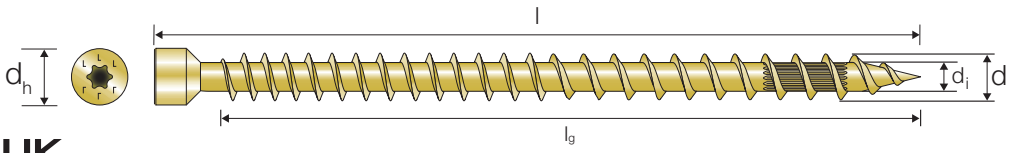
Solid·Drive™ ESCRFTZ Fully Threaded Cylinder-Head **WOOD** Screw



ETA-13/0796

Yellow Zinc Plated
C2 acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

ESCRFTZ – Range Overview

Reference	Dimensions [mm]				
	d	l	l_g	d_h	d_i
ESCRFTZ8.0X120	8.0	120	110	10,2	5,1
ESCRFTZ8.0X140	8.0	140	130	10,2	5,1
ESCRFTZ8.0X160	8.0	160	150	10,2	5,1
ESCRFTZ8.0X180	8.0	180	170	10,2	5,1
ESCRFTZ8.0X200	8.0	200	190	10,2	5,1
ESCRFTZ8.0X220	8.0	220	210	10,2	5,1
ESCRFTZ8.0X240	8.0	240	230	10,2	5,1
ESCRFTZ8.0X260	8.0	260	250	10,2	5,1
ESCRFTZ8.0X280	8.0	280	270	10,2	5,1
ESCRFTZ8.0X300	8.0	300	290	10,2	5,1
ESCRFTZ8.0X350	8.0	350	340	10,2	5,1
ESCRFTZ8.0X400	8.0	400	390	10,2	5,1

ESCRFTZ – Characteristic Parameters

Reference	Characteristic Parameters					
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]	$f_{y,k}$ [N/mm²]
ESCRFTZ8.0	20300	13,1	24,1	25,8	-	950

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

SW Solid Wood

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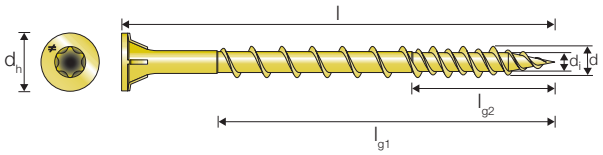
Solid·Drive™
WSV Quik Drive® Collated **WOOD** Screw



Yellow Zinc Plated
C2 acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

WSV – Range Overview

Reference	Dimensions [mm]					
	d	l	l_{g1}	l_{g2}	d_h	d_i
WSV44E	4,6	44	31	18	8,5	3,1
WSV51E	4,6	51	37	21	8,5	3,1
WSV64E	4,6	64	50	21	8,5	3,1
WSV76E	4,6	76	55	21	8,5	3,1

WSV – Characteristic Parameters

Reference	Characteristic Parameters					
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]	$f_{y,k}$ [N/mm²]
WSV4.6	3500	14,7	8,2	6,1	31,3	900

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

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Space and Edge Distance

Minimum Space and Edge Distances – Laterally or Combined Loaded Screws

For screws arranged at angles $\alpha \leq 90°$ between screw axis and grain direction minimum spacing and distances are defined as follows:

Minimum spacing a_1 or a_2 is defined perpendicular to the fastener axis, minimum end or edge distances $a_{3,c}$, $a_{3,t}$, $a_{4,c}$ or $a_{4,t}$ parallel or perpendicular to the grain, respectively, are defined between the centre of the threaded length (axial loading) or the length (lateral loading) in the respective timber member and the member surface as for axially loaded screws in EN 1995-1-1, Figure 8.11.a.

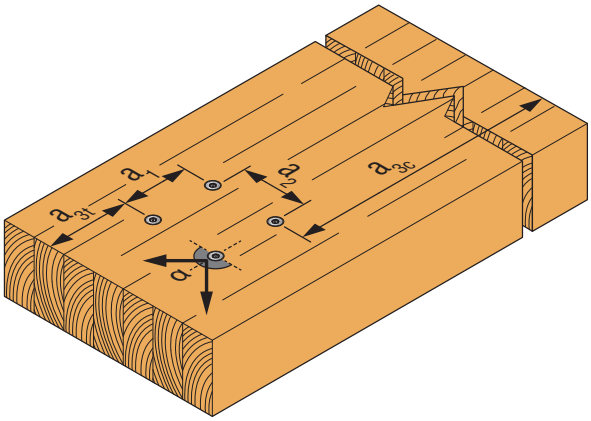


Illustration above shows angle between load direction and grain = 0°

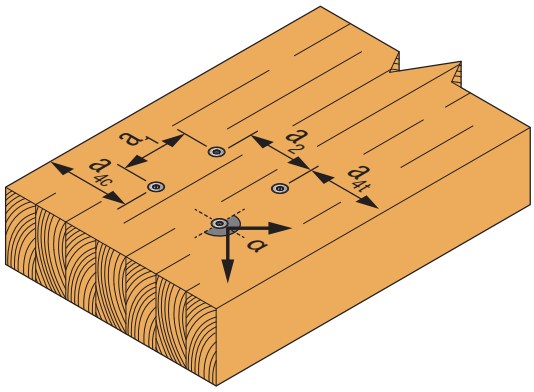
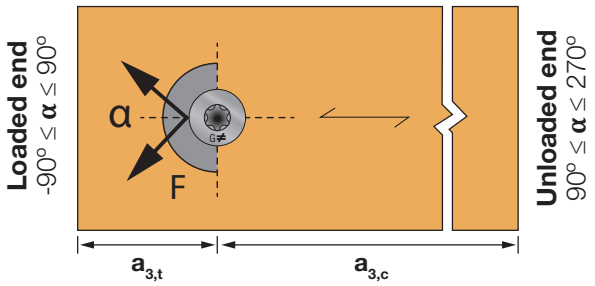
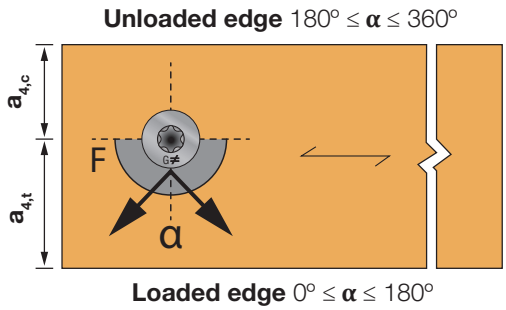


Illustration above shows angle between load direction and grain = 90°





Laterally Loaded Screws - Minimum spacing or end/edge distance				
	Angle α	Without predrilled holes		With predrilled holes
		$\rho k \leq 420$ kg/m³	420 kg/m³ < $\rho k \leq 500$ kg/m³	
a_1 Spacing (parallel to grain)	$0° \leq \alpha \leq 360°$	d < 5 mm: (5 + 5 |cos α|) d d ≥ 5 mm: (5 + 7 |cos α|) d	(7 + 8 |cos α|) d	(4 + | cos α |) d
a_2 Spacing (perpendicualr to grain)	$0° \leq \alpha \leq 360°$	5 d	7 d	(3 + | sin α |) d
$a_{3,t}$ Distance (loaded end)	$-90° \leq \alpha \leq 90°$	(10 + 5 cos α) d	(15 + 5 cos α) d	(7 + 5 cos α) d
$a_{3,c}$ Distance (unloaded end)	$90° \leq \alpha \leq 270°$	10 d	15 d	7 d
$a_{4,t}$ Distance (loaded edge)	$0° \leq \alpha \leq 180°$	d < 5 mm: (5 + 2 sin α) d d ≥ 5 mm: (5 + 5 sin α) d	d < 5 mm: (7 + 2 sin α) d d ≥ 5 mm: (7 + 5 sin α) d	d < 5 mm: (3 + 2 sin α) d d ≥ 5 mm: (3 + 4 sin α) d
$a_{4,c}$ Distance (unloaded edge)	$180° \leq \alpha \leq 360°$	5 d	7 d	3 d

Notes:
EN 1995-1-1 (Eurocode 5) clause 8.3.1.2, table 8.2
For "Board to Timber" case, the space distances in the timber element can be multiplied by a factor 0.85
For "Steel to Timber" case, the space distances in the timber element can be multiplied by a factor 0.7
d = Outer thread diameter of the screw
ρk = characteristic timber density in kg/m³
For Douglas fir members minimum spacing and distances parallel to the grain shall be increased by 50% if the members not are pre-drilled.

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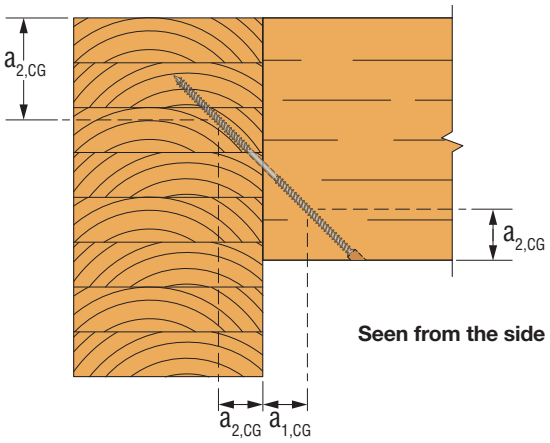
Space and Edge Distance

Minimum Space and Edge Distance – Axially Loaded Screws

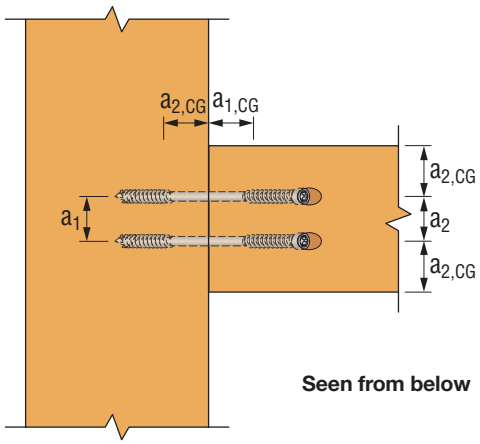
Axially Loaded Screws - Minimum spacing or end/edge distance	
a_1 Minimum screw spacing parallel to the grain	7 d
a_2 Minimum screw spacing perpendicular to the grain	5 d
$a_{1,cg}$ Minimum end distance of the centre of gravity of the threaded part of the screw in the member	10 d
$a_{2,cg}$ Minimum edge distance of the centre of gravity of the threaded part of the screw in the member	4 d

For axially loaded screws installed perpendicular to the surface table 8.6 is used. Note that $a_{1,cg}$ is shown as $a_{3,c}$ and $a_{2,cg}$ is shown as a4,c on the illustrations for perpendicular installations in the chapter timber to timber. For axially loaded screws $a_{3,t}$ and $a_{4,t}$ are not relevant.

[1] EN 1995-1-1 (Eurocode 5) clause 8.7.2, table 8.6
[2] d = Outer thread diameter of the screw
[3] Minimum timber thickness t ≥ 12 d



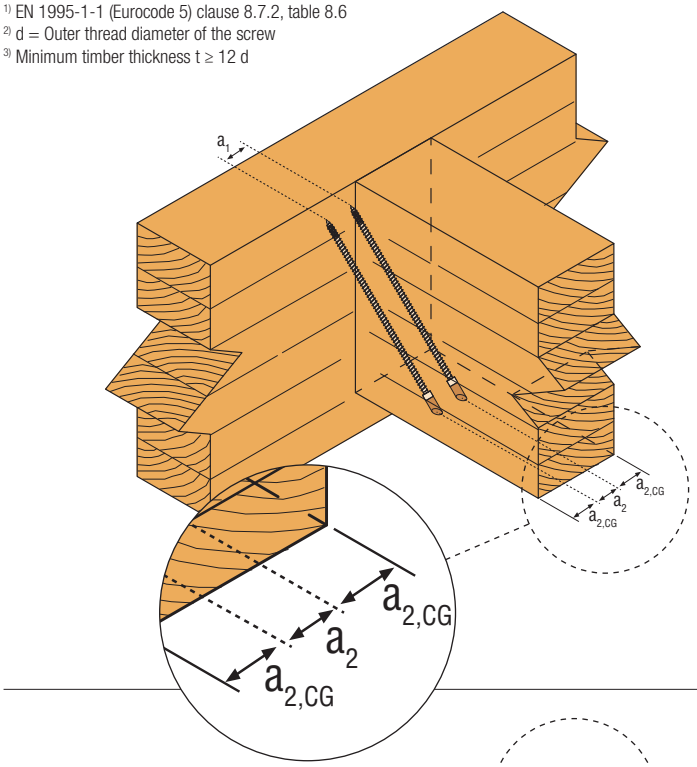
Seen from the side

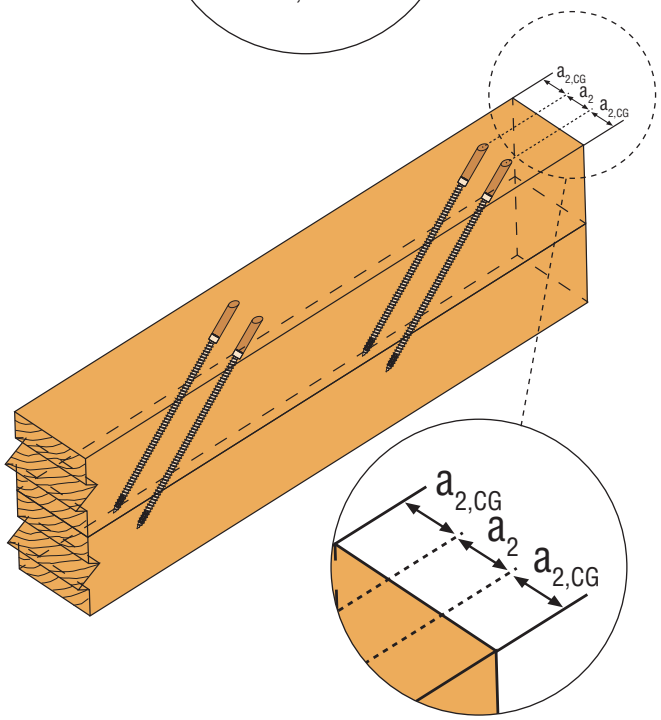


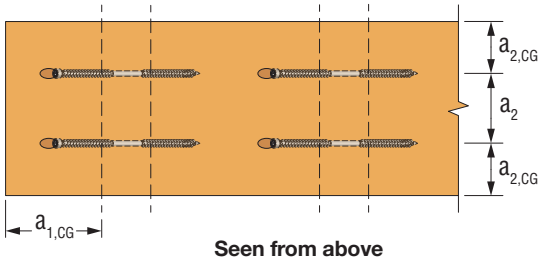
Seen from below

a_1 is taken in the header when the screws are distributed along the grain

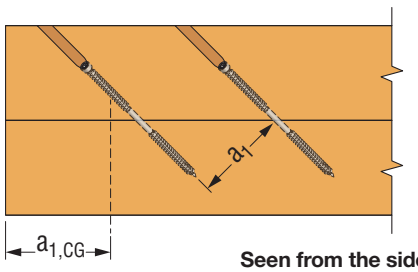
a_2 in the joist where the screw are distributed perpendicularly to the grain.







Seen from above



Seen from the side

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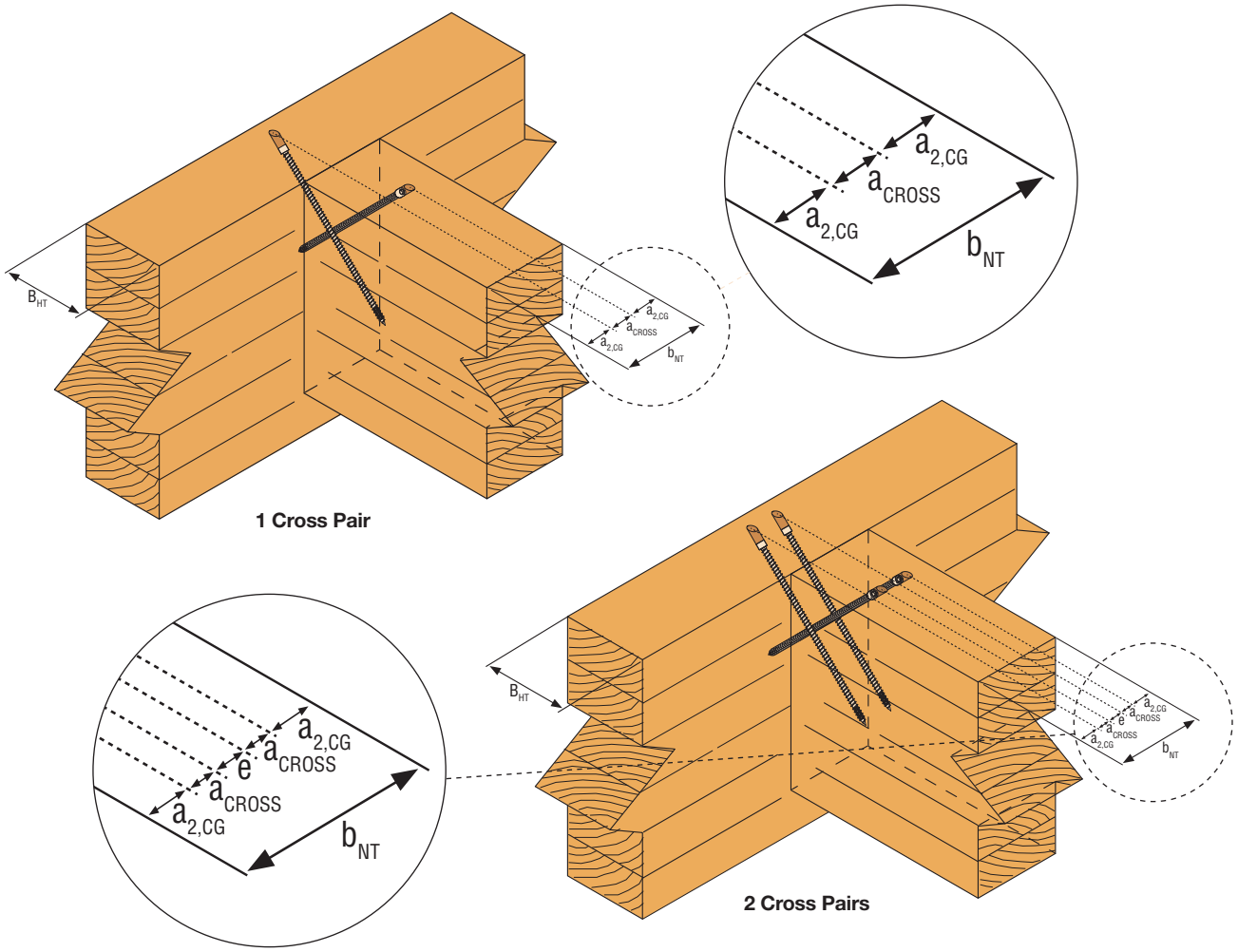
Space and Edge Distance



Double- & Full Threaded Screws

Alternative Axially Loaded Screws - Minimum spacing or end/edge distance		
	Screw Family	
	SWD	ESCRFTZ / ESCRFT / ESCRFTC
a_1 Minimum screw spacing parallel to the grain	10 d	5 d
a_2 Minimum screw spacing perpendicular to the grain	3 d	5 d / 3 d* / 2,5 d**
a_{cross} Minimum spacing between crossing screws for a crossed screw couple perpendicualr to the grain	1.5 d	1.5 d
$a_{1,cg}$ Minimum end distance of the centre of gravity of the threaded part of the screw in the member	8 d	5 d
$a_{2,cg}$ Minimum edge distance of the centre of gravity of the threaded part of the screw in the member	3 d	4 d

- If $a_1 * a_2 \geq 21\ d^2$ can be kept for every screw
- If $a_1 * a_2 \geq 25\ d^2$ can be kept for every screw

Notes:
d = Outer thread diameter of the screw.

For a crossed screw couple in solid timber, glued laminated timber and similar glued products or in laminated veneer lumber the minimum distance between the screws (across) are 1,5*d. Ensure that the crossed screw threads do not touch each other when being driven into the timber member.

SWD screws has been tested and approved for reduced space and edge distance according to ETA-21/0670, minimum timber thickness t ≥ 10 d, in pre-drilled and non-predrilled holes.

ESCRFTC/ESCRFT/ESCRFTZ screws has been tested and approved for reduced space and edge distance according to ETA-13/0796, minimum timber thickness t ≥ 12 d, in non-predrilled holes.

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Space and Edge Distance

Space and Edge Distance – Screw Placement m_i

Installation of inclined screws require high accuracy to achieve the performance calculated. One of the key elements is the placement of the screw and the insertion angle. In order to achieve this, the distance m_i must be calculated.

m_i depends of several elements: the length of the screw (l), the threaded length (l_g),the head diameter of the screw (d_h) the angle of insertion (α).

This calculation works in case of the screw fully inserted in the timber element. As a reminder half the thread should be in each element.

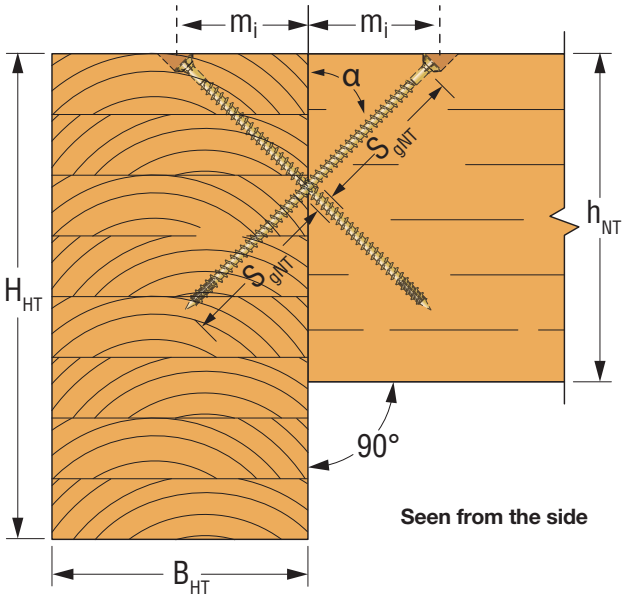
The minimum distance m_i is:

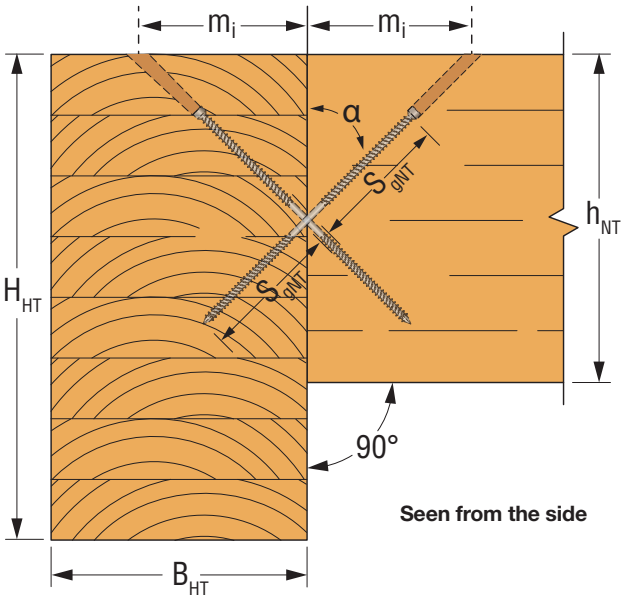
$$m_i = (l - l_g / 2 + d_h / 2 * \tan \alpha) * \sin \alpha$$

In this case the head of the screw is flushed to the top face.

If the screw pair is placed so it is in the middle of the height (h/2) of the joist or the panel thickness, the equation is:

$$m_i = h / 2 \tan \alpha$$





m_i = Distance betweem the shear plane and the insertion point
b_{nt} = Min. width of the secondary beam in [mm]
h_{nt} = Min. height of the secondary beam in [mm]
B_{HT} = Min. width of the main beam in [mm]

H_{HT} = Min. height of the main beam in [mm]
S_{gNT} = Effective thread length
α = the angle of insertion

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Space and Edge Distance

CLT - Plane Surface/Lateral Face

Unless specified otherwise in the technical specification (ETA or hEN) of CLT, minimum distances and spacing for laterally or axially loaded screws in non-predrilled holes, in the wide face of cross laminated timber members with a minimum thickness $t = 10 \times d$ may be taken as:

Minimum spacing or end/edge distance CLT - Plane surface/Lateral face	
a_1 Minimum screw spacing parallel to the grain	4 d
a_2 Minimum screw spacing perpendicular to the grain	2.5 d
$a_{3,t}$ Minimum distance from centre of the screw in timber to the loaded end grain	6 d
$a_{3,c}$ Minimum distance from centre of the screw in timber to the unloaded end grain	6 d
$a_{4,t}$ Minimum distance from centre of the screw in timber to the loaded edge	6 d
$a_{4,c}$ Minimum distance from centre of the screw in timber to the unloaded edge	2.5 d

Compliant with ETA-21/0670

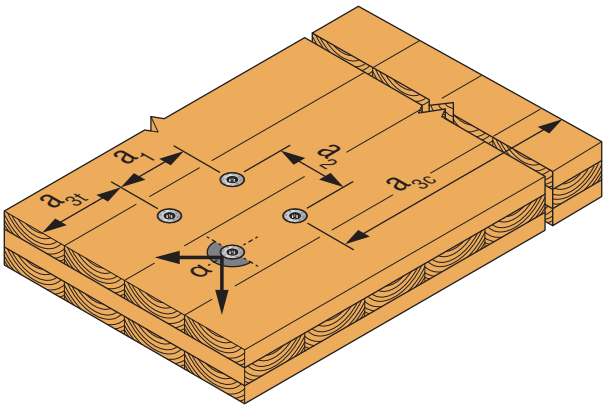


Illustration above shows angle between load direction and grain = 0°

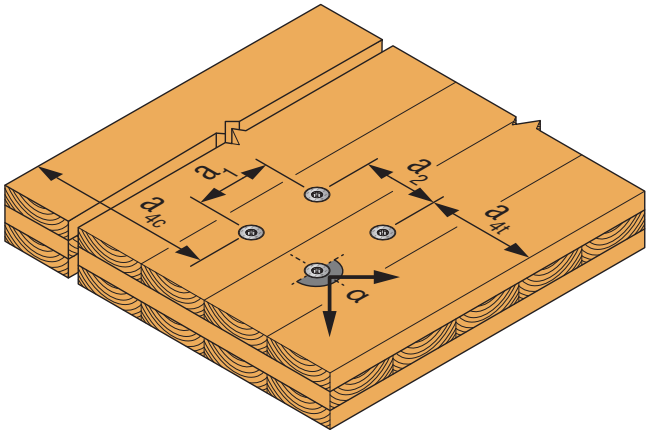
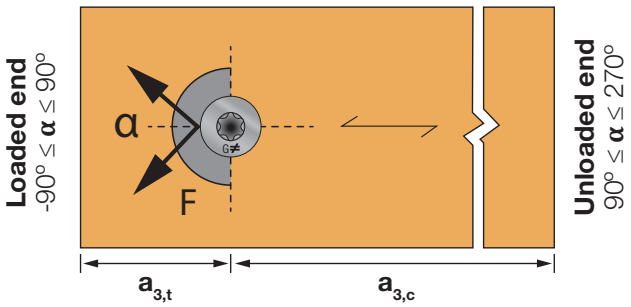
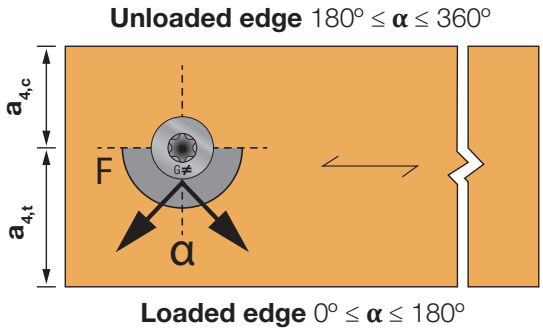


Illustration above shows angle between load direction and grain = 90°





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Space and Edge Distance

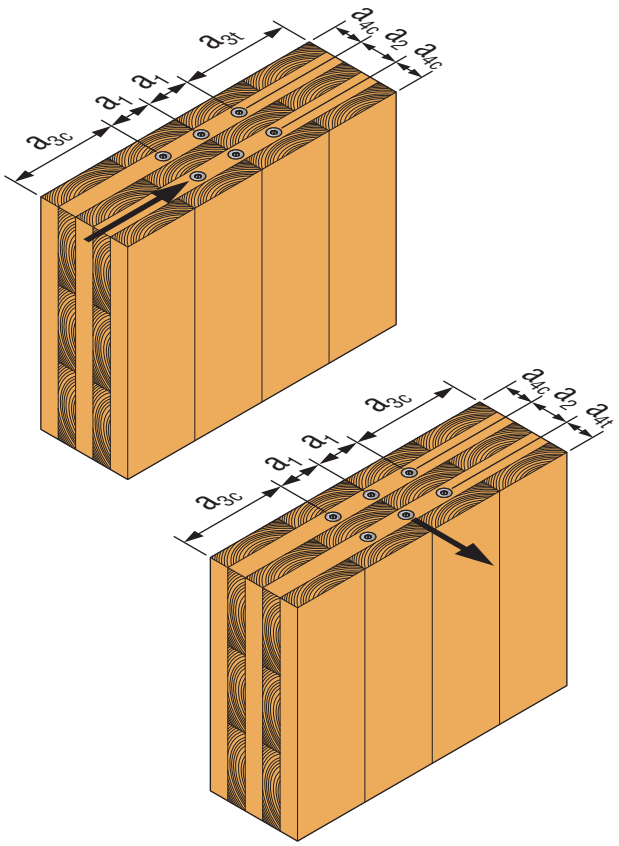
Space and Edge Distance CLT

CLT - Edge Surface/Narrow Face

Unless specified otherwise in the technical specification (ETA or hEN) of the CLT panels, minimum distances and spacing for laterally or axially loaded screws in non-predrilled holes, in the edge surface of CLT members with a minimum thickness $t = 10 \times d$ and a minimum penetration depth perpendicular to the edge surface of $10 \times d$ may be taken as:

Minimum spacing or end/edge distance CLT - Edge surface/Narrow face	
a_1 Minimum screw spacing parallel to the CLT plane	10 d
a_2 Minimum screw spacing perpendicular to the CLT plane	4 d
$a_{3,t}$ Minimum distance from centre of the screw in timber to the loaded end	12 d
$a_{3,c}$ Minimum distance from centre of the screw in timber to the unloaded end	7 d
$a_{4,t}$ Minimum distance from centre of the screw in timber to the loaded edge	6 d
$a_{4,c}$ Minimum distance from centre of the screw in timber to the unloaded edge	3 d

Compliant with ETA-21/0670



Recommended Pre-Drilling Hole Diameter Wood

All ETA approved fasteners can be driven into the wood with or without pre-drilling as long as the characteristic density of the member not exceed 550 kg/m³ for carbon steel, and 500 kg/m³ for stainless steel. The benefits of pre-drilling is reduced space & edge distances and increased shear capacity of the connection.

Recommended Max. Pre-Drill Hole Diameter Wood

Fastener	Fastener diameter d						
	Ø4,5	Ø5,0	Ø6,0	Ø6,5	Ø8,0	Ø10,0	Ø12,0
TTUFS / TTZNFS	Ø2,5	Ø3,0	Ø3,5	-	-	-	-
TTSFS	-	Ø3,0	Ø3,5	-	-	-	-
TTUFP / TTZNFP	-	Ø3,0	Ø3,5	-	-	-	-
SWW	-	-	Ø3,5	-	Ø5,0	Ø6,0	-
SWC	-	-	Ø3,5	-	Ø5,0	Ø6,0	-
SWD	-	-	-	Ø3,5	Ø5,0	-	-
SSH/SSF	-	-	Ø3,5	-	Ø5,0	Ø6,0	Ø6,5
ESCRFTC / ESCRFTZ / ESCRFT	-	-	Ø3,5	-	Ø5,0	Ø6,0	Ø6,5
ESCRT2R	-	-	-	-	Ø5,0	-	-
SDW / SDWS	-	-	-	-	Ø5,0	-	-

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Fire Calculation for Screws

Only screws in tension may be justified to fire. So we generally choose fully threaded screws or double threaded screws.

General information

As hidden connectors, screws are also placed in the middle of the timber, the way to calculate is mainly based on the edge distances. EN1995-1-2 (Eurocode 5 Part 2) is the main document that explain it.

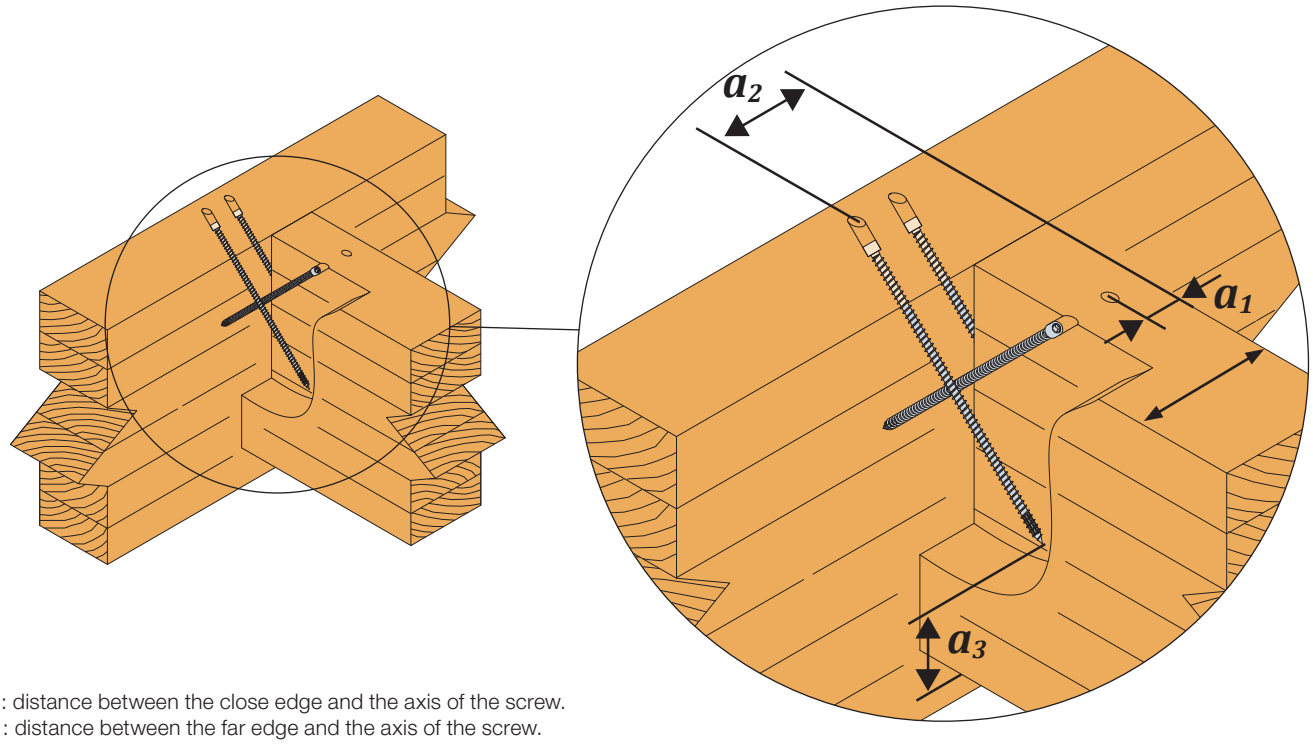
We need to check that :

$$E_{d.fi} \leq R_{d.30.fi} = \eta \; x \; \frac{R_{20}}{\gamma_{M.fi}} = \eta \; x \; k_{fi} \; x \; \frac{R_{ax.k}}{\gamma_{M.fi}}$$

With :

$E_{d.fi}$ = The load under fire.
$R_{d.fi}$ = The resistance under fire.
η = Conversion factor.
R_{20} = 20% fractal of the resistance capacity.
$\gamma_{M.fi}$ = Partial factor of timber in case of fire (equal to 1).
k_{fi} = factor to go from the 20% fractal to the 5% fractal for tension loaded connection.
$R_{ax.k}$ = characteristic capacity of the screw in tension.

η depends on the edge distance a1 (see drawing for the definition of a_1 drawing.



a_1 : distance between the close edge and the axis of the screw.
a_2 : distance between the far edge and the axis of the screw.
a_3 : distance between the close edge and the point of the screw.

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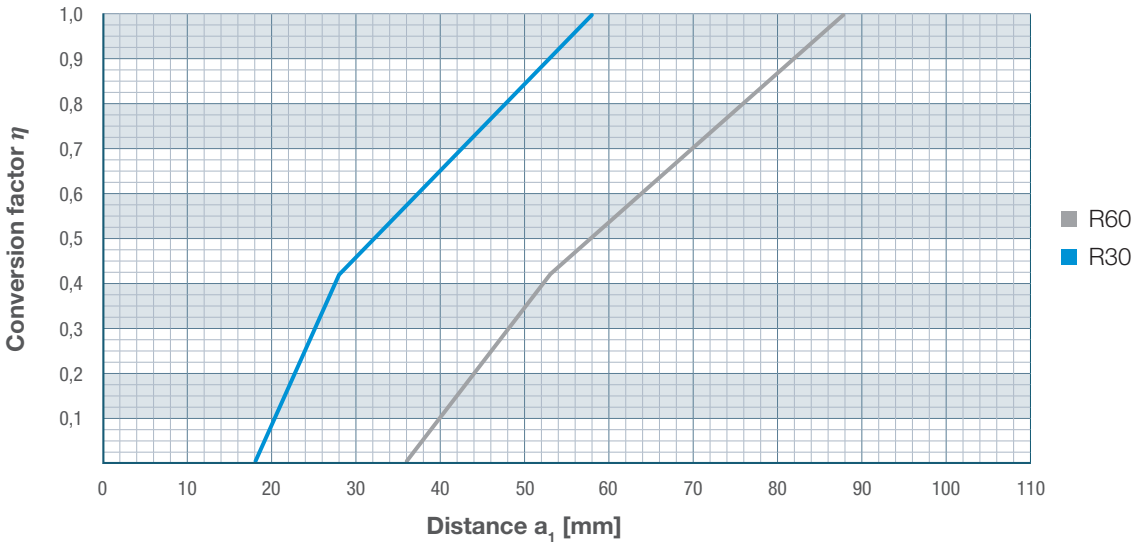
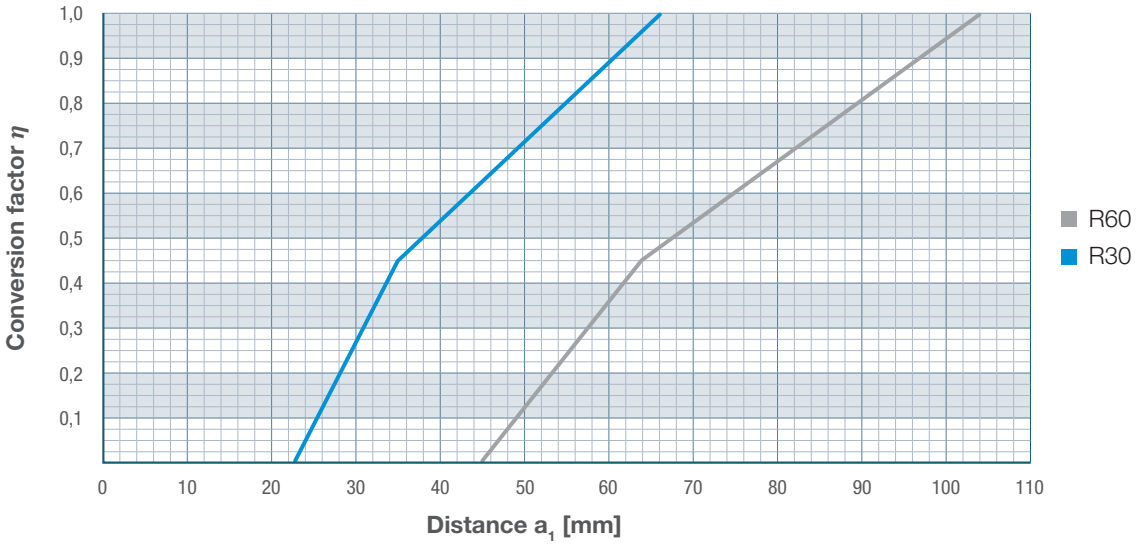
Fire Calculation for Screws

The curve below allows to find the η value.



Note: the graph above is only valid for $a_2 \geq a_1+40$ and $a_3 \geq a_1+20$.
if $a_2 \geq a_1$ and $a_3 \geq a_1+20$ the graph below must be used:



Note: the equation is given below and in EN1995-1-2 6.4 (6.11).

$$\eta = \begin{cases} 0 & \text{for } a_1 \leq 0{,}6\ t_{fi.d} \quad \text{(a)} \\ \dfrac{0{,}44\ a_1 - 0{,}264\ t_{d.fi}}{0{,}2\ t_{d.fi}+5} & \text{for } 0{,}6\ t_{d.fi} \leq a_1 \leq 0{,}8\ t_{d.fi}+5 \quad \text{(b)} \\ \dfrac{0{,}56\ a_1 - 0{,}36\ t_{d.fi}+ 7{,}32}{0{,}2\ t_{d.fi}+23} & \text{for } 0{,}8\ t_{d.fi}\ 5 \leq a_1 \leq t_{d.fi}+28 \quad \text{(c)} \\ 1{,}0 & \text{for } a_1 \geq t_{d.fi}+28 \quad \text{(d)} \end{cases}$$

The gap between the beams must be reduced at maximum. The edge distance must be checked both, in fire condition and in cold condition.

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Fire Calculation for Screws

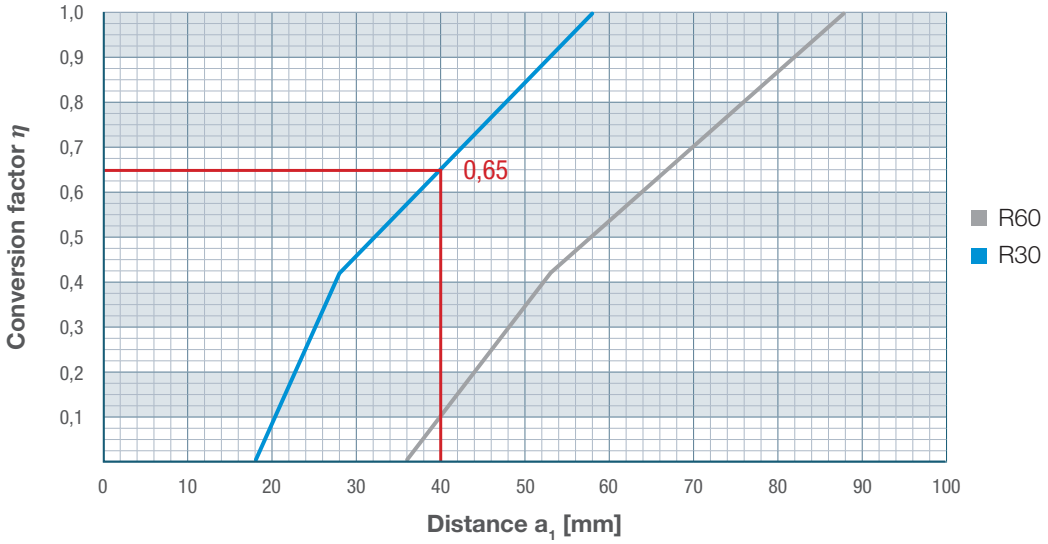
Example of calculation.

Hypothesis:

- Used screw: ESCRFTZ8.0x300
- Half of the thread is in each element
- a_1 = 40 mm, a_2 = 85 mm, a_3 = 60 mm
- Characteristic capacity of the screw in tension in cold condition : $R_{ax.k}$ = 14.67 kN
- Calculation of the capacity after 30 minutes of fire

Calculation of the capacity:

- The graph below must be used beacause of the distance a_1, a_2 and a_3
- So we got $\eta \approx 0.65$
- The tension capacity of the screw after half an hour in fire condition is:



$$R_{d.fi} = \eta \times \frac{R_{20}}{\gamma_{M.fi}} = \eta \times k_{fi} \times \frac{R_{ax.k}}{\gamma_{M.fi}} \simeq 0.65 \times 1.05 \times \frac{14.67}{1} \simeq 10.01 \text{ kN}$$

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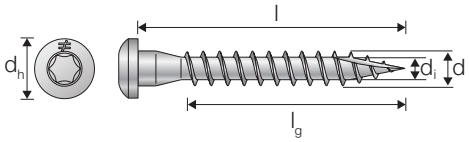
Solid·Drive™ CSA/CSA-Z/CSA-S **CONNECTOR** Screws

ETA-04/0013



Electro Galvanised
C1 acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

CSA – Range Overview

Reference	Dimensions [mm]				
	d	l	l_g	d_h	d_i
CSA5.0X25	4,85	25	19	8,3	3,15
CSA5.0X35	4,85	35	29	8,3	3,15
CSA5.0X40	4,85	40	34	8,3	3,15
CSA5.0X50	4,85	50	44	8,3	3,15
CSA5.0X80	4,85	80	74	8,3	3,15

CSA/CSA-Z/CSA-S – Characteristic Parameters

Reference	Characteristic Parameters				
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]
CSA5.0	5000	15,0	6,8	-	-

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

SW Solid Wood

Use Solid Wood to make your calculations.

Go to solidwood.strongtie.eu

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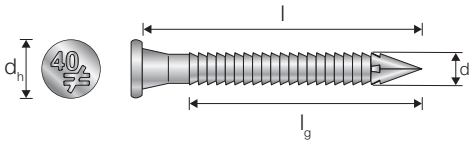
Solid·Drive™ CNA/CNA-G/CNA-S **CONNECTOR** Nail

ETA-04/0013



Electro Galvanised
C1 acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

CNA – Range Overview

Reference	Dimensions [mm]			
	d	l	l_g	d_h
CNA4.0X35	4,4	35	20	7
CNA4.0X40	4,4	40	25	7
CNA4.0X50	4,4	50	35	7
CNA4.0X60	4,4	60	45	7
CNA4.0X75	4,4	75	59	7
CNA4.0X100	4,4	100	65	7

CNA/CNA-G/CNA-S – Characteristic Parameters

Reference	Characteristic Parameters				
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]
CNA4.0	6617	*	7,5	-	-

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$
* see ETA-04/0013

Use Solid Wood to make your calculations.

Go to solidwood.strongtie.eu

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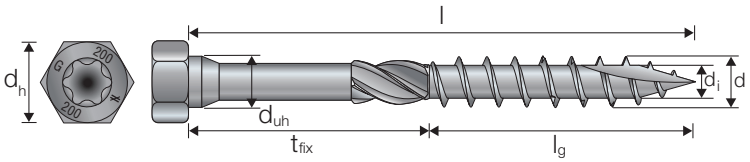
Solid·Drive™ SSH Hex-Head **CONNECTOR** Screw



ETA-21/0670

Impreg®+
C4 – 15 years acc. to EN ISO 12944-2
SC2 – 50 years acc. to EC5

SSH – Range Overview

Reference	Article code	Dimensions [mm]					
		d/d_{uh}	l	l_g	d_h	d_i	t_{fix}
SSH6.0X40*	75128	6,0	40	24	14,5 (10)	3,65	16
SSH6.0X50*	75129	6,0	50	33	14,5 (10)	3,65	17
SSH6.0X60*	75130	6,0	60	42	14,5 (10)	3,65	18
SSH6.0X75*	75131	6,0	75	42	14,5 (10)	3,65	33
SSH6.0X90*	75132	6,0	90	42	14,5 (10)	3,65	48
SSH6.0X120*	75133	6,0	120	75	14,5 (10)	3,65	45
SSH8.0X40	75134	8,0	40	32	13	5,1	8
SSH8.0X50	75135	8,0	50	42	13	5,1	8
SSH8.0X60	75136	8,0	60	42	13	5,1	18
SSH8.0X80	75137	8,0	70	42	13	5,1	38
SSH8.0X90	75138	8,0	80	42	13	5,1	35
SSH8.0X100	75139	8,0	90	55	13	5,1	15
SSH8.0X120	75140	8,0	100	85	13	5,1	35
SSH8.0X140	75141	8,0	120	85	13	5,1	30
SSH8.0X160	75142	8,0	140	110	13	5,1	50
SSH8.0X180	75143	8,0	160	110	13	5,1	70
SSH8.0X200	75144	8,0	180	110	13	5,1	90
SSH8.0X240	75145	8,0	200	110	13	5,1	130
SSH8.0X260	75146	8,0	240	110	13	5,1	150
SSH8.0X280	75147	8,0	260	110	13	5,1	170
SSH8.0X300	75148	8,0	280	110	13	5,1	190
SSH10.0X50	75150	10,0	50	42	15	6,15	8
SSH10.0X60	75151	10,0	60	42	15	6,15	18
SSH10.0X80	75152	10,0	80	42	15	6,15	38
SSH10.0X90	75153	10,0	90	42	15	6,15	48
SSH10.0X100	75154	10,0	100	55	15	6,15	45
SSH10.0X120	75155	10,0	120	85	15	6,15	35
SSH10.0X140	75156	10,0	140	85	15	6,15	55
SSH10.0X160	75157	10,0	160	110	15	6,15	50
SSH10.0X180	75158	10,0	180	110	15	6,15	70
SSH10.0X200	75159	10,0	200	110	15	6,15	90
SSH10.0X240	75160	10,0	240	125	15	6,15	115
SSH10.0X280	75161	10,0	280	125	15	6,15	155

Reference	Article code	Dimensions [mm]					
		d/d_{uh}	l	l_g	d_h	d_i	t_{fix}
SSH12.0X60	75162	12,0	60	48	17	6,7	12
SSH12.0X80	75163	12,0	80	48	17	6,7	32
SSH12.0X90	75164	12,0	90	48	17	6,7	42
SSH12.0X100	75165	12,0	100	55	17	6,7	45
SSH12.0X120	75166	12,0	120	85	17	6,7	35
SSH12.0X140	75167	12,0	140	85	17	6,7	55
SSH12.0X160	75168	12,0	160	110	17	6,7	50
SSH12.0X180	75169	12,0	180	110	17	6,7	70
SSH12.0X200	75170	12,0	200	110	17	6,7	

* Different head design.

SSH – Characteristic Parameters

Reference	Characteristic Parameters				
	$M_{y,k}$ [Nmm]	$f_{ax,k}$ [N/mm²]	$f_{tens,k}$ [kN]	$f_{tor,k}$ [Nm]	$f_{head,k}$ [N/mm²]
SSH6.0	10400	13,3	13,1	11,0	17,9
SSH8.0	25300	13,9	24,1	26,4	19,5
SSH10.0	38700	12,1	32,8	43,0	19,3
SSH12.0	52300	12,2	40,4	62,4	18,8

$f_{ax,k}$ is the characteristic withdrawal parameter for timber with a characteristic density of 350 kg/m³
$f_{head,k}$ is the characteristic head pull through parameter for timber with a characteristic density of 350 kg/m³ at max. 15 mm embedment.
Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$

SW Solid Wood
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Hole Diameter Steel / Space and Edge Distance Steel

Recommended Hole Diameter Steel

Recommended hole diameters in steel plates, all our screws developed for connectors have a cone under the head to ensure the connection between the fastener and the steel. The cone have the same diameter as the outer thread.

All our fasteners are tested and approved together as a system for our connectors.

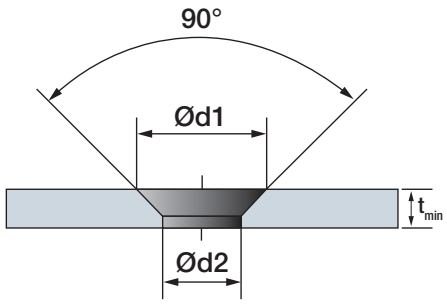
If you need a solution where the screw head is flush to the steel surface you can use countersunk screws, below is the recommended hole design for:

Recommended Max. Hole Diameter Steel

Fastener	Fastener diameter d					
	Ø4,0	Ø5,0	Ø6,0	Ø8,0	Ø10,0	Ø12,0
SSH	-	-	Ø7,0	Ø9,0	Ø11,0	Ø13,0
CSA	Ø4,0	Ø5,0	-	-	-	-
CNA	Ø5,0	-	Ø7,5	-	-	-

Recommended Hole Design in Steel Countersunk Screws (TTUFS / TTZNFS / SWC / ESCRFTC)

Diameter of screw	$Ød1_{min}$	$Ød2_{min}$	t_{min}
Ø4,5	12,0	5,0	3,0
Ø5,0	13,0	5,5	3,0
Ø6,0	15,5	6,5	3,5
Ø8,0	19,0	9,0	6,0
Ø10,0	22,5	11,0	7,0
Ø12,0	25,0	13,0	7,5



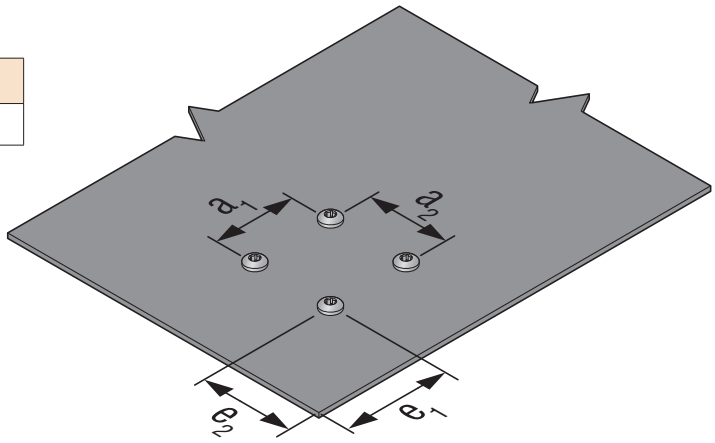
Calculations with Steel to Wood do not take the strength of the steel in consideration, but only the wood and the fastener, see Eurocode 3 for steel plate design.

Space and Edge Distances Steel

The table below gives the values for pure steel according to Eurocode 3.
In steel to timber connections, the limiting factor will always be the timber.

a_1*	a_2*	e_1*	e_2*
2.2d	2.4d	1.2d	1.2d

*according to EN 1993-1-8 §3.5



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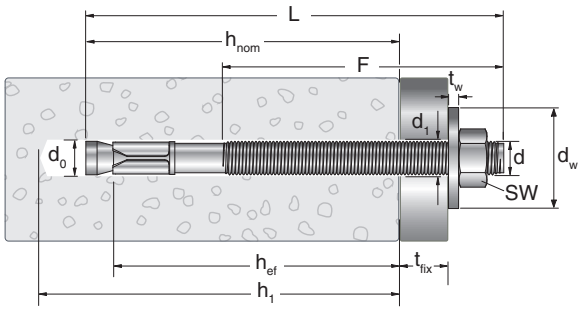
FM 753 evo – Heavy Duty Through Anchor



ETA-22/0792
Option 7

FM 753 evo – Range Overview

Product Reference	Item code	Dimensions [mm]					
		Thread diameter [d]	Length [L]	Hole Ø x min hole depth [d_0 x h_1]	Max thickness of the plate [t_{fix}]	Max Ø hole in the plate [d_f]	Effective embedment depth [h_{ef}]
FM 753 evo M8x68	75340B0806800	8	68	8x65	5	9	45
FM 753 evo M8x73	75340B0807300	8	73	8x65	10	9	45
FM 753 evo M8x83	75340B0808300	8	83	8x65	20	9	45
FM 753 evo M8x93	75340B0809300	8	93	8x65	30	9	45
FM 753 evo M8x103	75340B0810300	8	103	8x65	40	9	45
FM 753 evo M8x113	75340B0811300	8	113	8x65	50	9	45
FM 753 evo M8x133	75340B0813300	8	133	8x65	70	9	45
FM 753 evo M8x163	75340B0816300	8	163	8x65	100	9	45
FM 753 evo M10x78	75340B1007800	10	78	10x70	5	12	50
FM 753 evo M10x83	75340B1008300	10	83	10x70	10	12	50
FM 753 evo M10x93	75340B1009300	10	93	10x70	20	12	50
FM 753 evo M10x103	75340B1010300	10	103	10x70	30	12	50
FM 753 evo M10x113	75340B1011300	10	113	10x70	40	12	50
FM 753 evo M10x123	75340B1012300	10	123	10x70	50	12	50
FM 753 evo M10x143	75340B1014300	10	143	10x70	70	12	50
FM 753 evo M10x173	75340B1017300	10	173	10x70	100	12	50
FM 753 evo M10x213	75340B1021300	10	213	10x70	140	12	50
FM 753 evo M12x104	75340B1210400	12	104	12x90	5	14	65
FM 753 evo M12x109	75340B1210900	12	109	12x90	10	14	65
FM 753 evo M12x119	75340B1211900	12	119	12x90	20	14	65
FM 753 evo M12x129	75340B1212900	12	129	12x90	30	14	65
FM 753 evo M12x139	75340B1213900	12	139	12x90	40	14	65
FM 753 evo M12x149	75340B1214900	12	149	12x90	50	14	65
FM 753 evo M12x179	75340B1217900	12	179	12x90	80	14	65
FM 753 evo M12x199	75340B1219900	12	199	12x90	100	14	65
FM 753 evo M12x219	75340B1221900	12	219	12x90	120	14	65
FM 753 evo M12x239	75340B1223900	12	239	12x90	140	14	65
FM 753 evo M12x259	75340B1225900	12	259	12x90	160	14	65
FM 753 evo M12x269	75340B1226900	12	269	12x90	170	14	65
FM 753 evo M12x299	75340B1229900	12	299	12x90	200	14	65
FM 753 evo M12x319	75340B1231900	12	319	12x90	220	14	65
FM 753 evo M12x339	75340B1233900	12	339	12x90	240	14	65
FM 753 evo M12x369	75340B1236900	12	369	12x90	270	14	65

Table continues on next page.

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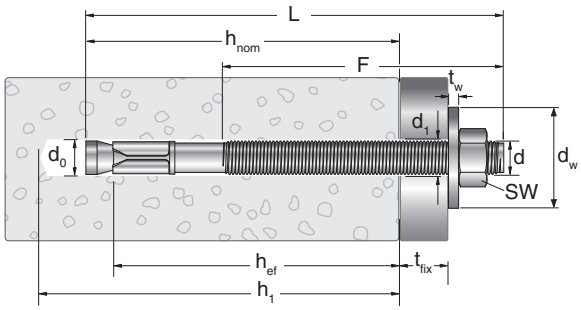
Concrete Fastening



ETA-22/0792
Option 7

FM 753 evo – Range Overview (cont.)

Product Reference	Item code	Dimensions [mm]					
		Thread diameter [d]	Length [L]	Hole Ø x min hole depth [d_0 x h_1]	Max thickness of the plate [t_{fix}]	Max Ø hole in the plate [d_f]	Effective embedment depth [h_{ef}]
FM 753 evo M16x131	75340B1613100	16	131	16x110	10	18	80
FM 753 evo M16x151	75340B1615100	16	151	16x110	30	18	80
FM 753 evo M16x171	75340B1617100	16	171	16x110	50	18	80
FM 753 evo M16x201	75340B1620100	16	201	16x110	80	18	80
FM 753 evo M16x221	75340B1622100	16	221	16x110	100	18	80
FM 753 evo M16x241	75340B1624100	16	241	16x110	120	18	80
FM 753 evo M16x261	75340B1626100	16	261	16x110	140	18	80
FM 753 evo M16x281	75340B1628100	16	281	16x110	160	18	80
FM 753 evo M16x321	75340B1632100	16	321	16x110	200	18	80

FM 753 evo – Design Values

Reference	Design values – Non cracked concrete	
	Tension N_{Rd} [kN]	Shear V_{Rd} [kN]
	C20/25	
FM753 evo M8	8	7,9
FM753 evo M10	11,6	11,6
FM753 evo M12	17,2	20,1
FM753 evo M16	23,5	37,5

FM 753 evo – Installation Parameters

Reference	Wrench Size SW [mm]	Installation Torque T_{inst} [Nm]	Min. thickness of concrete h_{min} [mm]	Min. edge distance c_{min} [mm]	Min. spacing s_{min} [mm]	Characteristic edge distance $c_{cr,N}$ [mm]	Characteristic spacing $s_{cr,N}$ [mm]
FM753 evo M8	13	15	100	40	40	67,5	135
FM753 evo M10	17	30	100	50	50	75	150
FM753 evo M12	19	50	130	70	70	97,5	195
FM753 evo M16	24	100	160	90	90	120	240

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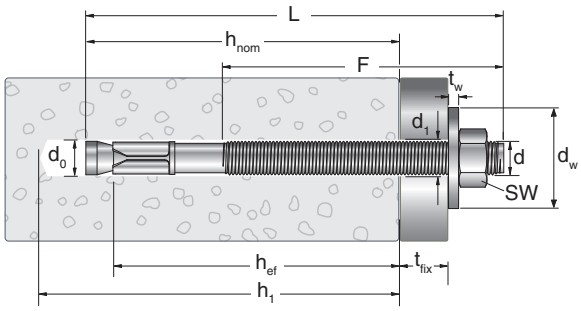
FM-753 crack – Heavy Duty Through Anchor (Seismic)



ETA-09/0056
Option 1 - C1/C2

FM-753 CRACK 3DG – Wedge Anchor Dimensions

Product Reference	Item code	Dimensions [mm]						
		Thread diameter [d]	Length [L]	Hole Ø x min hole depth [d_0 x h_1]	Max thick-ness of the plate [t_{fix}]	Max Ø hole in the plate [d_f]	Effective embedment depth [h_{ef}]	Seismic category
FM-753 CRACK 3DG M8x75	75350B0807500	8	75	8x70	10	9	48	C1
FM-753 CRACK 3DG M8x90	75350B0809000	8	90	8x70	25	9	48	C1
FM-753 CRACK 3DG M10x90	75350B1009000	10	90	10x80	10	12	60	C1/C2
FM-753 CRACK 3DG M10x105	75350B1010500	10	105	10x80	25	12	60	C1/C2
FM-753 CRACK 3DG M10x115	75350B1011500	10	115	10x80	35	12	60	C1/C2
FM-753 CRACK 3DG M10x135	75350B1013500	10	135	10x80	55	12	60	C1/C2
FM-753 CRACK 3DG M10x155	75350B1015500	10	155	10x80	75	12	60	C1/C2
FM-753 CRACK 3DG M12x110	75350B1211000	12	110	12x100	10	14	72	C1/C2
FM-753 CRACK 3DG M12x120	75350B1212000	12	120	12x100	20	14	72	C1/C2
FM-753 CRACK 3DG M12x145	75350B1214500	12	145	12x100	45	14	72	C1/C2
FM-753 CRACK 3DG M12x200	75350B1220000	12	200	12x100	100	14	72	C1/C2
FM-753 CRACK 3DG M16x150	75350B1615000	16	150	16x115	30	18	86	C1/C2
FM-753 CRACK 3DG M16x220	75350B1622000	16	220	16x115	100	18	86	C1/C2

FM-753 CRACK 3DG – Design Values

Reference	Design Values			
	Tension – N_{Rd} [kN]		Shear – V_{Rd} [kN]	
	Cracked concrete	Non cracked concrete	Cracked concrete	Non cracked concrete
	C20/25		C20/25	
FM-753 CRACK 3DG M8	4,0	6,0	7,6	8,6
FM-753 CRACK 3DG M10	8,0	10,7	16,1	16,1
FM-753 CRACK 3DG M12	10,7	13,3	22,5	22,5
FM-753 CRACK 3DG M16	13,3	23,3	36,0	44,3

FM-753 CRACK 3DG – Installation Parameters

Reference	Wrench Size SW [mm]	Installation Torque T_{inst} [Nm]	Min. thickness of concrete h_{min} [mm]	Min. distance from edge		Min. distance between anchors		Characteristic edge distance $c_{cr,N}$ [mm]	Characteristic spacing $s_{cr,N}$ [mm]
				c_{min} [mm]	for $S_{min} \geq$ [mm]	S_{min} [mm]	for $C_{min} \geq$ [mm]		
FM-753 CRACK 3DG M8	13	20	100	50	50	50	50	72	144
FM-753 CRACK 3DG M10	17	40	120	60	60	60	60	90	180
FM-753 CRACK 3DG M12	19	60	150	70	70	70	70	110	220
FM-753 CRACK 3DG M16	24	120	170	85	85	80	80	120	120

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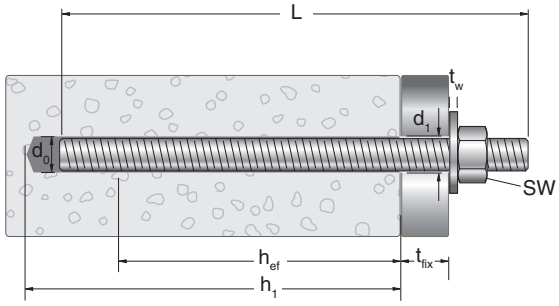
AT-HP + LMAS – Heavy Duty Chemical Anchor

ETA-23/0253
Option 1



AT-HP – Range Overview

Product Reference	Hole Ø d_0 [mm]	Max Ø hole in the plate d_f [mm]	Hole depth $h_0 = h_{ef} = 8d$ [mm]
AT-HP + LMAS M8	10	9	64
AT-HP + LMAS M10	12	12	80
AT-HP + LMAS M12	14	14	96
AT-HP + LMAS M16	18	18	128
AT-HP + LMAS M20	22	22	160
AT-HP + LMAS M24	28	26	192

AT-HP – Design Values – Tension

Reference	Design Values – $h_{ef} = 8d$ – LMAS			
	Tension – N_{Rd} [kN]		Shear – V_{Rd} [kN]	
	Cracked concrete	Non cracked concrete	Cracked concrete	Non cracked concrete
	C20/25		C20/25	
AT-HP + LMAS M8	3,8	11,8	7,2	7,2
AT-HP + LMAS M10	5,9	16,7	11,7	12
AT-HP + LMAS M12	7,2	24,1	14,5	16,8
AT-HP + LMAS M16	15	40,7	30	31,2
AT-HP + LMAS M20	23,4	60,3	46,9	48,8
AT-HP + LMAS M24	33,8	82	67,5	70,4

AT-HP – Installation Parameters

Reference	Wrench Size SW [mm]	Installation Torque T_{inst} [Nm]	Min. thickness of concrete h_{min} for $h_{ef,8d}$ [mm]	Min. edge distance c_{min} [mm]	Min. spacing s_{min} [mm]	Characteristic edge distance $c_{cr,N}$ for $h_{ef,8d}$ [mm]	Characteristic spacing $s_{cr,N}$ for $h_{ef,8d}$ [mm]
AT-HP + LMAS M8	13	10	100	35	40	96	128
AT-HP + LMAS M10	17	12	110	40	40	120	160
AT-HP + LMAS M12	19	20	126	45	60	144	192
AT-HP + LMAS M16	24	40	164	50	75	192	256
AT-HP + LMAS M20	30	70	204	60	95	240	320
AT-HP + LMAS M24	36	90	248	65	115	288	384

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Solution Finder

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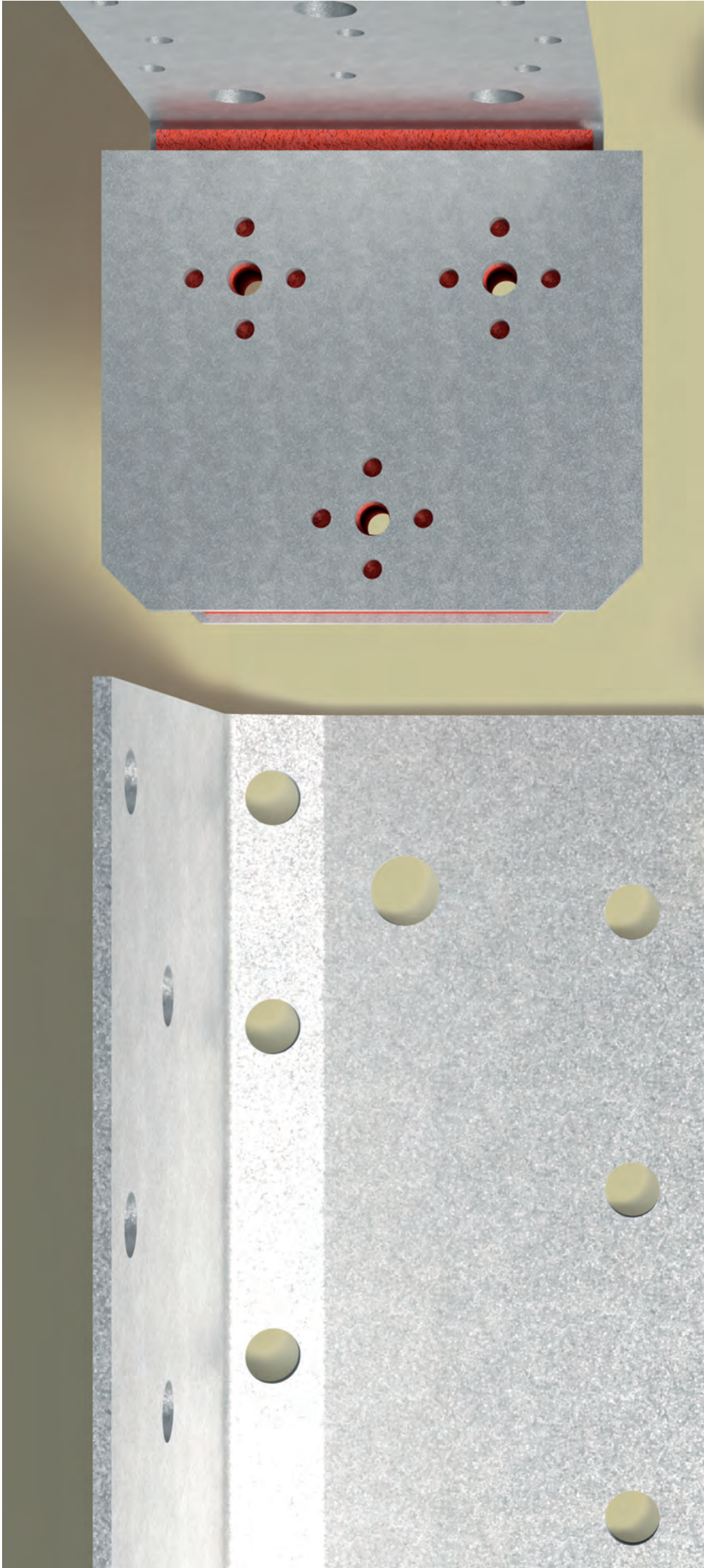

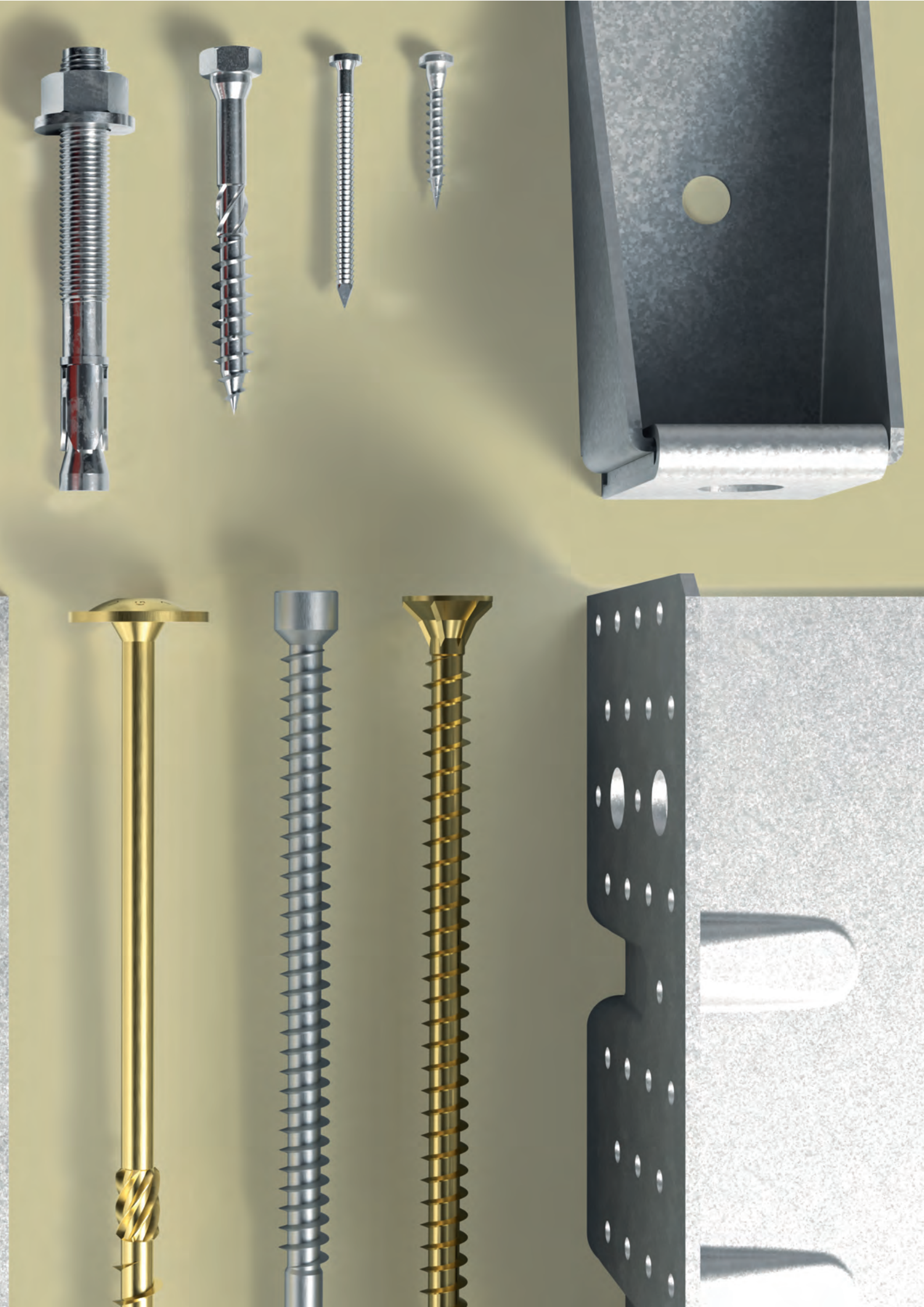

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