Paslode® DUO-FAST® haubold®

Technical Data

Appendix to be used in conjunction with datasheets in selecting appropriate fasteners according to the parameters of Eurocode 5

Eurocode 5 (EN 1995-1-1:2004 Design of timber structures)
Eurocode 5 provides a holistic methodology for designing timber structures, expressed in a number of European Standards, to be adopted across Europe during 2010. This supercedes previous National Standards and incorporates updated best practices in timber engineering.

Subsidiary to Eurocode 5 itself, a number of European Standards and ETAGs (European Technical Approval Guidelines) relate to the choice of fasteners for various applications. These include;-
EN14592 Dowel type fasteners (nails, staples, screws)
EN14566 Gypsum fasteners
EN14545 2D nailing plates
ETAG 015 3D connectors
ETAG 011 Light composite wood based beams and columns
ETAG 007 Timber frame building kits

Eurocode 5 is complemented by 9 other Eurocodes covering all forms of construction. Eurocode 5 must always be used in conjunction with EN1990 Eurocode 0 which deals with structural safety, serviceability and durability and EN1991 Eurocode 1 which deals with actions on structures. Where a structure combines both timber and masonry or steel elements it may be necessary to refer to elements of other Eurocodes, for example EN1992 Eurocode 2: Design of concrete structures and its subsidiary product standards and ETAGs, such as;-
ETAG 001 Metal anchors for use in concrete (where fixing timber sole plates or wall plates to masonry structures)

Performance data for ring shank and screw shank nails derived from results of independent testing at VHT Darmstadt, Germany and Strojírenský zkušební Ústav. s.p. Czech Republic. Smooth shank performance data calculated in accordance with Eurocode 5 rules

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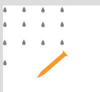
Corrosion Resistance

Paramount in determining the appropriate corrosion resistance of any element of a timber structure is the EC5 requirement to design for a minimum life, normally 50 years (10 years for temporary structures, 100 years for monumental structures or bridges).

Eurocode 5 provides three Service Classes, relating to the moisture content of timber. Within EN14592 minimum standards are set for fastener materials and coatings;-

	Eurocode 5 Service Class[b]		
	1	2	3
Average moisture content in softwood	≤ 12%	≤ 20%	≥ 20%
Fastener			
Nails and screws with d ≤ 4mm	None	Fe/Zn 12c[a]	Fe/Zn 25c[a]
Nails and screws with d > 4mm	None	None	Fe/Zn 25c[a]
Staples	Fe/Zn 12c[a]	Fe/Zn 12c[a]	Stainless steel

[a] If hot dip zinc coating is used, Fe/Zn 12c should be replaced by Z275 and FE/Zn 25c by Z350 in accordance with EN10147

[b] For more corrosive conditions heavier hot dip coatings or stainless steel may be necessary

It is important to note that these Service Classes do not take into account;-

- local environmental conditions
- the interaction between some specific wood types and certain metals or coatings
- the interactions between timber treatments, climatic conditions and fastener material or coating

It is also necessary to consider wood treatments and wood species as these can react with different coatings. For instance, it is always recommended to use stainless steel fasteners to attach Western Red Cedar, Douglas Fir and Oak cladding.

We strongly recommend reference to ISO12944 part 2 which deals with the life expectancy of various metals and coatings under a variety of environmental conditions;-

Environmental classification	Typical conditions (temperate climate)
C1	Inside heated or air-conditioned buildings with clean atmosphere, low relative humidity and no likelihood of damp or condensation.
C2	Internal occasional damp or wet conditions, unheated buildings where condensation may occur. External environment with low level of pollution and dry climate, mostly rural areas, sheltered conditions.
C3	Urban and industrial environments, moderate sulphur dioxide pollution. Coastal areas with low salinity.
C4	Industrial areas with high sulphur dioxide and coastal areas with moderate salinity.
C5	Industrial areas with high humidity and aggressive atmospheres. Coastal areas with high salinity.

To help in the choice of fastener, Paslode, DuoFast and Haubold utilise the following colour code on product labels;-

Bright steel = no corrosion protection

Meets Eurocode 5 Service Class 1 requirements for dry internal locations

Electro galvanised 5µm

Meets Eurocode 5 Service Class 1 requirements. Typical life in C2 environmental class is 7 years or 2.5 years in C3

Electro galvanised 12µm

Meets Eurocode 5 Service Class 2 requirements for nails and staples. This is the minimum protection for staples, even in Service Class 1.Typical life in C2 environmental class is 17 years or 6 years in C3

Galv-Plus™ (ITW proprietary system)

Galv-Plus is a zinc-aluminium alloy which gives a 70% better corrosion protection than a pure zinc coating. A 15µm coating is applied to wire before fastener is formed. Surpasses Eurocode 5 Service Class 2 requirements. Typical life in C2 environmental class is 28 years or 10 years in C3

Hot dip galvanised

Fasteners are dipped in a bath of molten zinc to achieve a minimum coating of 55µm. Meets Eurocode 5 Service Class 3 requirements. Typical life in C2 environmental class is 70 years or 25 years in C3

Stainless steel A2-304

Meets Eurocode 5 Service Class 3 requirements. Will provide over 50 years life in C3 environment. Superficial discolouration can occur. To avoid this select A4-316.

Stainless steel A4-316

Meets Eurocode 5 Service Class 3 requirements. Suitable for C4 and C5 environmental classes. Will not discolour.

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Characteristic vs. design values

The load parameters stated in the Technical Data Sheets are characteristic values. These values shall always be used in accordance with the partial factor method as described in Eurocode 5.

With the partial factor method security is built into the construction as:

1. Security on the load parameters
2. Security on the material parameters

The design value of a nail is found by the following expression:

$$\chi_d = k_{mod} \frac{\chi_k}{\gamma_M}$$

d indicates a design value, parameter or load

k_{mod} is a modification factor taking the load duration and service class (moisture content) into consideration, e.g. for solid timber, service class 1, permanent action is 0,60

γ_M is the partial factor for a material property – e.g. for fastener connections is 1,3 (see National Annex for partial factors for material properties and resistances)

χ can be expressed by e.g. a load carrying capacity (R) or a force (F)

Values for k_{mod}

Material	Service Class	Load duration class: Permanent action	Long term action	Medium term action	Short term action	Instantaneous action
Timber	1	0.60	0.70	0.80	0.90	1.10
Glulam	2	0.60	0.70	0.80	0.90	1.10
and LVL	3	0.50	0.55	0.65	0.70	0.90
Plywood	1	0.60	0.70	0.80	0.90	1.10
	2	0.60	0.70	0.80	0.90	1.10
	3	0.50	0.55	0.65	0.70	0.90
OSB/2	1	0.30	0.45	0.65	0.85	1.10
OSB/3	1	0.40	0.50	0.70	0.90	1.10
OSB/3	2	0.30	0.40	0.55	0.70	0.90
OSB/4	2	0.30	0.40	0.55	0.70	0.90

for other boards see EC5 Table 3.1

Yield Moment - smooth shank nails

For smooth round nails produced from a wire with a minimum tensile strength of 600 N/mm² the yield moment i.e. the bending moment of the nail is calculated from the formula in Eurocode 5. Paslode nails have a minimum tensile strength of 700 N/mm².

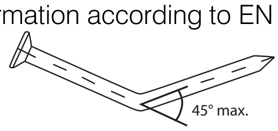
$$M_{y,Rk} = 0{,}3 \cdot f_u \cdot d^{2,6}$$

$M_{y,Rk}$ is the characteristic bending moment, in Nmm

f_u is the tensile strength of the wire, in N/mm²

d is the nail diameter as defined in EN 14592, in mm

Max. nail deformation according to EN 409 is 45°



Example, calculation for a 3,1 x 90 mm smooth shank nail

f_u = minimum wire tensile strength 700 N/mm²

$M_{y,Rk} = 0{,}3 \cdot f_u \cdot d^{2,6} = 0{,}3 \cdot 700 \cdot 3{,}1^{2,6} = 3979$ Nmm

Yield Moment – threaded nails (including ring shank)

The yield moment of threaded nails cannot be calculated, so tests according to EN 409:2009 (Timber structures – test methods – Determination of the yield moment of dowel-type fasteners) have to be carried out. The test provides the yield moment directly in Nmm without any preceding calculations.

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Appendix to be used in conjunction with datasheets in selecting appropriate fasteners according to the parameters of Eurocode 5

Fastener spacing as detailed in EN1995-1-1

Because timber is a natural material, subject to considerable variation, it is necessary to take particular care to consider the individual timber when determining how closely fasteners may be spaced to each other or to the edges of timber. The following are absolute minimum distances. Performance will be severely diminished where timber is split and care must be taken to avoid this.

Special rules for laterally loaded connections

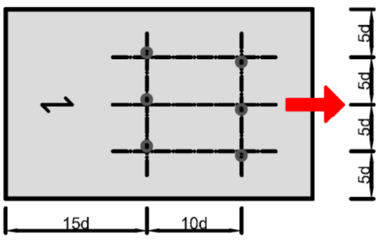
Smooth nails and staples in end grain should not be considered capable of transmitting lateral forces. Under certain conditions other fasteners may be allowed.

Fastener minimum spacing rules for lateral loads

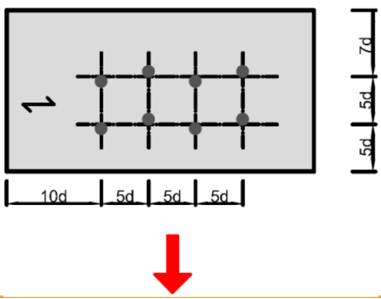
without pre-drilling in timber density ≤ 420 kg/m³. Nails and screws < 5.0mm diameter. Minimum angle of staple crown to grain = 30°. (See EC5 for rules on ≥ 5mm fasteners.)

	Nails		Staples	Screws
	Smooth	Threaded		
Penetration in pointside timber	$8d$	$6d$	$14d$	$4d$
Minimum distance to loaded edge of member	$7d$	$7d$	$20d$	$7d$
Minimum distance to unloaded edge of member	$5d$	$5d$	$10d$	$5d$
Minimum distance to loaded end of member	$15d$	$15d$	$10d$	$15d$
Minimum distance to unloaded end of member	$10d$	$10d$	$15d$	$10d$
Minimum spacing of fixings parallel to grain	$10d$	$10d$	$15d$	$10d$
Minimum spacing of fixings 90° to grain	$5d$	$5d$	$15d$	$5d$

Loaded end,
unloaded edge



Loaded edge,
unloaded end



Special rules for axially loaded connections

Smooth nails or staples shall not be used to resist permanent or long term axial loading. For threaded nails only the threaded part should be considered capable of transmitting axial load. Nails in end grain should be considered incapable of transmitting axial load.

Fastener minimum spacing rules for axial loads

For screws it is necessary that timber thickness $t \geq 12d$

	Nails		Staples	Screws
	Smooth	Threaded		
Penetration in pointside timber	$12d$*	$8d$	$14d$*	$4d$
Minimum distance to unloaded edge of member	$5d$	$5d$	$10d$	$4d$
Minimum distance to unloaded end of member	$10d$	$10d$	$15d$	$10d$
Minimum spacing of fixings parallel to grain	$5d$	$5d$	$10d$	$7d$
Minimum spacing of fixings 90° to grain	$5d$	$5d$	$15d$	$5d$

* Only for medium term, short term and instantaneous loads

Pre-drilling

Timber should be pre-drilled in any of these cases:

- where the characteristic density of the timber is greater than 500 kg/m3
- where the diameter of the nail exceeds 6mm
- where the thickness of the pointside member is less than

$$t = \max \begin{cases} 7d \\ (13d - 30)\dfrac{\rho_k}{400} \end{cases}$$

Some timber species are more prone to splitting than others, for these minimum spacings should be increased or holes pre-drilled, for example; Fir, Douglas Fir and Spruce.

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Fastener spacing for floor, roof and wall diaphragms

Number of fasteners required to provide sufficient rigidity in these elements must be calculated using alternative methods detailed in Eurocode 5 and the National Annex, but should always be subject to the minimum spacings shown on previous page and these maximum spacings:

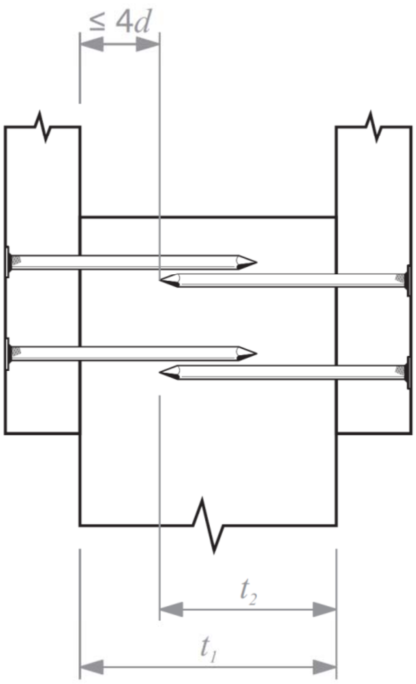
	Threaded nails	Smooth nails for walls only	Screws for walls
Along the edges of the sheathing panels	150mm	150mm*	200mm
Internal studs and elsewhere	300mm	300mm*	300mm

* Smooth nails may be used for all lateral loads, but only for medium-term, short-term and instantaneous axial loads

Fasteners used in panel-to-timber connections are to be considered as relating to an unloaded edge.

Nailing into a timber member from both sides

In a three-member connection, nails may overlap in the central member provided $(t_1 - t_2)$ is greater than $4d$.



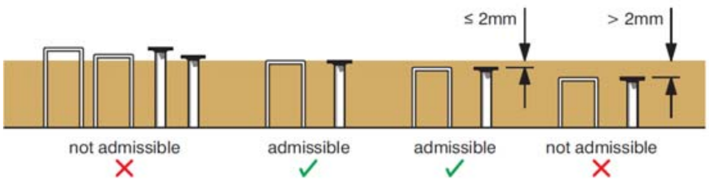
Fastening timber members

Unless otherwise specified, nails should be driven in at right angles to the grain and to such depth that the surfaces of the nail heads are flush with the timber surface.

Fastening wood based boards, such as OSB, plywood etc…

It is recommended that fastener head should not penetrate deeper than 2mm into the connected panel or board. Board manufacturers' instructions should be adhered to.

HEADSIDE PENETRATION FOR WOOD-BASED BOARDS



TIMBER-TO-TIMBER CONNECTIONS

Nails and staples

There must always be at least two nails or staples in any connection.

Staples and smooth shank nails must not be used to resist permanent or long term axial loading!

For threaded nails only the threaded part should be considered capable of transmitting axial load

Nails and staples in end grain should be considered incapable of transmitting axial load.

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Withdrawal and head pull-through - smooth shank nails

The characteristic withdrawal capacity of nails, $F_{ax,Rk}$ can be calculated by using the formulas in Eurocode 5, chapter 8, Connections with Metal Fasteners.

The embedment length of the nail in the piece of wood where the nail point is located must be minimum 12 x the nail diameter to have the full withdrawal strength.

$F_{ax,Rk}$ = the smaller of the following values:

withdrawal: $f_{ax,k} \cdot d \cdot t_{pen}$

or pull-through: $f_{ax,k} \cdot d \cdot t + f_{head,k} \cdot d_h^2$

$f_{ax,k}$ is the characteristic pointside withdrawal strength,

$$f_{ax,k} = 20 \cdot 10^{-6} \cdot \rho_k^2$$

$f_{head,k}$ is the characteristic headside pull-through strength,

$$f_{head,k} = 70 \cdot 10^{-6} \cdot \rho_k^2$$

d is the nail diameter

t_{pen} is the pointside penetration length in the piece of wood where the nail tip is located

t is the thickness of the piece of wood where the nail head is located

d_h is the head diameter

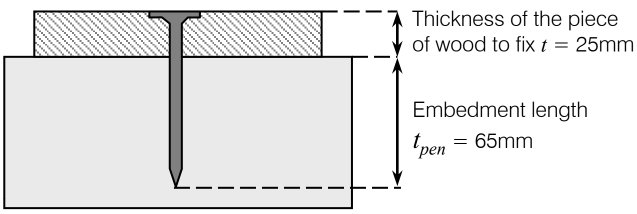
Example, calculations for a 3,1 x 90 mm smooth shank nail

Nail dimensions

d = nominal nail diameter = 3,1 mm

d_h = head diameter = 6,80 mm

ρ_k = the characteristic wood density = 350 kg/m³



$f_{ax,k} = 20 \cdot 10^{-6} \cdot \rho_k^2 = 20 \cdot 10^{-6} \cdot 350^2 = 2{,}45$ N/mm²

$f_{head,k} = 70 \cdot 10^{-6} \cdot \rho_k^2 = 70 \cdot 10^{-6} \cdot 350^2 = 8{,}58$ N/mm²

$F_{ax,Rk} = f_{ax,k} \cdot d \cdot t_{pen} = 2{,}45 \cdot 3{,}1 \cdot 65 = 493{,}7$ N

or $f_{ax,k} \cdot d \cdot t + f_{head,k} \cdot d_h^2$

$= 2{,}45 \cdot 3{,}1 \cdot 25 + 8{,}58 \cdot 6{,}8^2 = 586{,}6$ N

Result: The withdrawal strength is 493,7 N at a wood density of 350 kg/m³

Withdrawal and head pull-through – ring shank nails

For ring shank nails the characteristic strengths - called $f_{ax,k}$ (withdrawal) and $f_{head,k}$ (head pull-through) - must be determined by tests according to EN 1382 and EN 1383.

The embedment length of the nail in the piece of wood where the nail point is located must be minimum 8 x the nail diameter to have the full withdrawal strength.

$F_{ax,Rk}$ = the smaller of the following values:

withdrawal: $f_{ax,k} \cdot d \cdot t_{pen}$

or pull-through: $f_{head,k} \cdot d_h^2$

$f_{ax,k}$ is the characteristic pointside withdrawal strength, determined by tests

$f_{head,k}$ is the characteristic headside pull-through strength, determined by tests

d is the nail diameter

t_{pen} is the pointside penetration length in the piece of wood where the nail tip is located (only l_g - the profiled length - of the fastener can be considered)

d_h is the head diameter

Example, calculations for a 3,1 x 90 mm ring shank nail

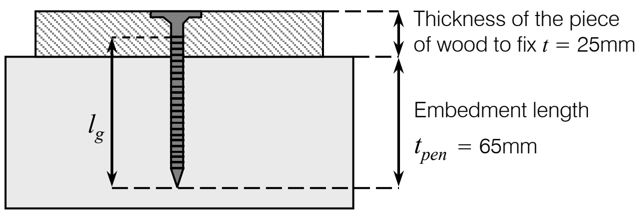
Nail dimensions

d = nominal nail diameter = 3,1 mm

d_h = head diameter = 6,80 mm

ρ_k = the characteristic wood density = 350 kg/m³

l_g = profiled (threaded) length of nail = 75mm



$f_{ax,k}$ = 7,28 N/mm² (test result)

$f_{head,k}$ = 28,03 N/mm² (test result)

$F_{ax,Rk} = f_{ax,k} \cdot d \cdot t_{pen} = 7{,}28 \cdot 3{,}1 \cdot 65 = 1466{,}9$ N

or $f_{head,k} \cdot d_h^2 = 28{,}03 \cdot 6{,}8^2 = 1296{,}1$ N

Result: The withdrawal strength is 1296,1 N at a wood density of 350 kg/m³

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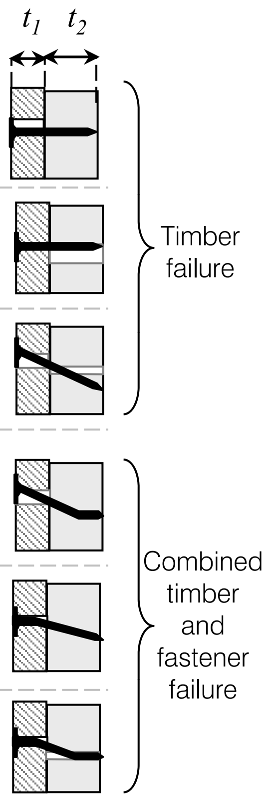
Shear – timber-to-timber and panel-to-timber connections

Calculate characteristic load-carrying capacity for nails per shear plane per fastener from the following expressions in EC5.

For a single shear plane there are 6 different combinations and the minimum value of the 6 expressions should be taken (the letters correspond to the drawings):

$$F_{v,Rk} = \min \begin{cases} f_{h,1,k}\, t_1\, d & \text{(a)} \\ f_{h,2,k}\, t_2\, d & \text{(b)} \\ \dfrac{f_{h,1,k}\, t_1\, d}{1+\beta}\left[\sqrt{\beta + 2\beta^2\left[1 + \dfrac{t_2}{t_1} + \left(\dfrac{t_2}{t_1}\right)^2\right] + \beta^3\left(\dfrac{t_2}{t_1}\right)^2} - \beta\left(1 + \dfrac{t_2}{t_1}\right)\right] + \dfrac{F_{ax,Rk}}{4} & \text{(c)} \\ 1{,}05\,\dfrac{f_{h,1,k}\, t_1\, d}{2+\beta}\left[\sqrt{2\beta(1+\beta) + \dfrac{4\beta(2+\beta)\,M_{y,Rk}}{f_{h,1,k}\, d \cdot t_1^2}} - \beta\right] + \dfrac{F_{ax,Rk}}{4} & \text{(d)} \\ 1{,}05\,\dfrac{f_{h,1,k}\, t_2\, d}{1+2\beta}\left[\sqrt{2\beta^2(1+\beta) + \dfrac{4\beta(1+2\beta)\,M_{y,Rk}}{f_{h,1,k}\, d \cdot t_2^2}} - \beta\right] + \dfrac{F_{ax,Rk}}{4} & \text{(e)} \\ 1{,}15\sqrt{\dfrac{2\beta}{1+\beta}}\sqrt{2M_{y,Rk}\, f_{h,1,k}\, d} + \dfrac{F_{ax,Rk}}{4} & \text{(f)} \end{cases}$$



The rope effect

Equations (c), (d), (e), (f) include the rope effect;- $\dfrac{F_{ax,Rk}}{4}$

In each case this must be limited to 15% of the value of the other contributing factors for smooth shank nails or 50% for threaded nails. If $F_{ax,Rk}$ is not known, the contribution from the rope effect should be taken as zero.

$F_{v,Rk}$	is the characteristic load-carrying capacity per shear plane per nail
t_1	is the thickness of the (headside) piece of timber to fasten
t_2	is the thickness of the second (pointside) piece of timber, or the penetration depth of the nail – use the lower value of the two
$f_{h,1,k}$	is the characteristic embedment strength in timber piece 1
$f_{h,2,k}$	is the characteristic embedment strength in timber piece 2
d	nail diameter
$M_{y,Rk}$	the characteristic yield moment
β	the ratio between the embedment strength of the two timber pieces, see example on following page
$F_{ax,Rk}$	the characteristic withdrawal capacity of the nail (see the “withdrawal and pull-through” section)

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Characteristic embedment strength

The characteristic embedment strength is an expression which includes the pressure from the wood onto the nail and it is calculated from the formulas in Eurocode 5:

$f_{h,1,k} = 0{,}082 \cdot \rho_k \cdot d^{-0{,}3}$ N/mm^2
(For timber and LVL; for nails with a diameter < 8 mm. For other materials or dimensions see Eurocode 5)

The β-value is an expression which describes the ratio between the strength of the two different pieces of wood (the determining factor is the characteristic wood density, ρ_k);-

$$\beta = \frac{f_{h,2,k}}{f_{h,1,k}}$$

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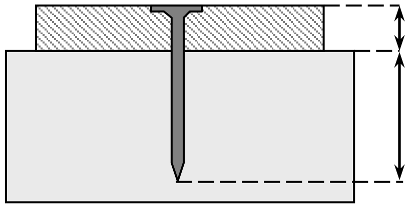
Example calculation: Shear – timber-to-timber and panel-to-timber connections

For formulae on previous page



Nail; 3,1 x 90mm smooth shank nail

d = nominal nail diameter = 3,1 mm

Timber used: Piece to fix, C24 => ρ_k = 350 kg/ m³

Second piece, C30 => ρ_k = 380 kg/ m³

$F_{ax,Rk}$ = 493,7 N (characteristic withdrawal capacity; see page 4)

$M_{y,Rk}$ = 3979 Nmm (characteristic yield moment; see page 3)

t_1 : 25 mm (timber to fix / headside)

t_2 : 65 mm (embedment depth of the nail in the second piece of wood / pointside)

The characteristic embedment strength is calculated;-

For timber piece 1, density ρ_k = 350 kg/m³: $f_{h,1,k} = 0{,}082 \cdot \rho_k \cdot d^{-0,3} = 0{,}082 \times 350 \times 3{,}1^{-0,3} = 20{,}44$ N/mm²

For timber piece 2, density ρ_k = 380 kg/m³: $f_{h,2,k} = 0{,}082 \cdot \rho_k \cdot d^{-0,3} = 0{,}082 \times 380 \times 3{,}1^{-0,3} = 22{,}19$ N/mm²

The expression β is calculated as;- $\beta = \dfrac{f_{h,2,k}}{f_{h,1,k}} = \dfrac{22{,}19}{20{,}44} = 1{,}086$

Results for the six formulae are;-

(a) 20,44 x 25 x 3,1 = <u>1584N</u>

(b) 22,19 x 65 x 3,1 = <u>4471N</u>

(c)
$$\frac{20{,}44 \times 25 \times 3{,}1}{1 + 1{,}086}\left[\sqrt{1{,}086 + 2 \times 1{,}086^2\left[1 + \frac{65}{25} + \left(\frac{65}{25}\right)^2\right] + 1{,}086^2\left(\frac{65}{25}\right)^2} - 1{,}086\left(1 + \frac{65}{25}\right)\right] + \frac{493{,}7}{4} = \underline{2211\text{N}}$$

Rope effect = $\dfrac{F_{ax,Rk}}{4} = \dfrac{493{,}7}{4} = 123{,}43$ Other factors = 2211 – 123,43 = 2087,57

Rope effect check: 2087,57 x 15% = 313,14 > 123,43, therefore rope effect can be included in full

(d)
$$1.05\ \frac{20{,}44 \times 25 \times 3{,}1}{2 + 1{,}086}\left[\sqrt{2 \times 1{,}086\ (1 + 1{,}086 + \frac{4 \times 1{,}086\ (2 + 1{,}086)\ 3979}{20{,}44 \times 3{,}1 \times 25^2}} - 1{,}086\right] + \frac{493{,}7}{4} = 844{,}83\text{N}$$

Rope effect = $\dfrac{F_{ax,Rk}}{4} = \dfrac{493{,}7}{4} = 123{,}43$ Other factors = 844,83 – 123,43 = 721,4

Rope effect check: 721,4 x 15% = 108,21 < 123,43, therefore rope effect can only contribute 108,21

108,21 + 721,4 = <u>830N</u>

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Appendix to be used in conjunction with datasheets in selecting appropriate fasteners according to the parameters of Eurocode 5

Example calculation: Shear – timber-to-timber and panel-to-timber connections - continued

(e) $$1{,}05\ \frac{20{,}44 \times 65 \times 3{,}1}{1 + (2 \times 1{,}086)}\left[\sqrt{2 \times 1{,}086^2\ (1 + 1{,}086) + \frac{4 \times 1{,}086\ (\ 1 + (2 \times 1{,}086))\ 3979}{20{,}44 \times 3{,}1 \times 65^2}} - 1{,}086\right] + \frac{493{,}7}{4} = \underline{1729N}$$

Rope effect $= \frac{F_{ax,Rk}}{4} = \frac{493{,}7}{4} = 123{,}43$ Other factors $= 1729 - 123{,}43 = 1605{,}57$

Rope effect check: 1605,57 x 15% = 240,84 > 123,43, therefore rope effect can be included in full

(f) $$1{,}15\ \sqrt{\frac{2 \times 1{,}086}{1 + 1{,}086}}\ \sqrt{2 \times 3979 \times 20{,}44 \times 3{,}1} + \frac{493{,}7}{4} = \underline{956N}$$

Rope effect $= \frac{F_{ax,Rk}}{4} = \frac{493{,}7}{4} = 123{,}43$ Other factors $= 956 - 123{,}43 = 832{,}57$

Rope effect check: 832,57 x 15% = 124,89 > 123,43, therefore rope effect can be included in full

Summary;-

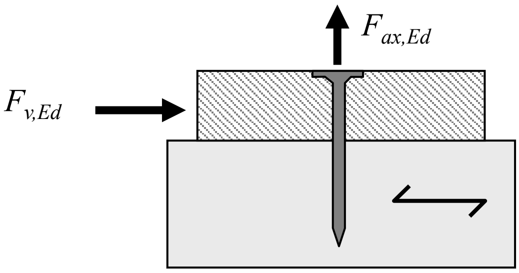
(a)	1584 N
(b)	4471 N
(c)	2211 N
(d)	830 N
(e)	1729 N
(f)	956 N

As $F_{v,Rk}$ is defined as the lowest value of the 6 expressions above, the load bearing capacity per nail per shear plane for this construction is 830 N.

Technical Data

Appendix to be used in conjunction with datasheets in selecting appropriate fasteners according to the parameters of Eurocode 5

Combined lateral and axial loading



For connections subjected to a combination of axial load $(F_{ax,Ed})$ and lateral load $(F_{v,Ed})$ the following expression should be satisfied;-

$$\left(\frac{F_{ax,Ed}}{F_{ax,Rd}}\right)^m + \left(\frac{F_{v,Ed}}{F_{v,Rd}}\right)^m \leq 1$$

where;-

$m = 1$ for smooth nails or staples
$m = 2$ for threaded nails

$F_{ax,Ed}$ is axial applied design load
$F_{ax,Rd}$ is axial load carrying capacity of the fastener
$F_{v,Ed}$ is laterally applied design load
$F_{v,Rd}$ is lateral load carrying capacity of the fastener

Technical Data

Appendix to be used in conjunction with datasheets in selecting appropriate fasteners according to the parameters of Eurocode 5

Density correction

The density of all the test results has been reduced according to EN28970. Use* the expression $\left(\frac{\rho_k}{350}\right)^2$ to correct between actual characteristic timber density and a characteristic density of 350 kg/m^3 ;-

ρ_k is the actual characteristic wood density

Example calculation:

Characteristic withdrawal force = 1500 N
Actual characteristic timber density = 310 kg/m^3
The withdrawal force should be modified by a factor of $\left(\frac{310}{350}\right)^2 = 0,78$

=> The characteristic withdrawal force is 1500 x 0,78 = 1170 N

Strength classes and timber densities

Strength classes – characteristic densities according to EN 338
(The number following the "C" is the bending strength of the wood, $f_{m,k}$ in N/mm^2)

Strength class	C14	C16	C18	C20	C22	C24	C30	C35	C40
Characteristic density ρ_k [kg/m^3]	290	310	320	330	340	350	380	400	420
Mean density ρ_{mean} [kg/m^3]	350	370	380	390	410	420	460	480	500

Typical densities for construction wood, Northern Europe (source: Teknologisk Institut, Denmark):

Wood	Density min-max. [kg/m^3]
European spruce	370 - 440
Douglas fir	440 - 530
Larch	520 - 600
Red Cedar	380
Pine	450 - 500

For further values and hardwood species, see EN 338.

Equivalent head diameters for Paslode "D" head nails

The following table provides equivalent d_h head diameters for Paslode "D" head nails to calculate $F_{ax,Rk}$

Shank diameter (mm)	2.2	2.5	2.8	3.1	3.4	3.8	4.2
Eq. Head diameter (mm)	4.77	6.05	6.29	6.56	6.58	7.47	7.47

*this is our interpretation of EC5, using the precedent of DIN1052 and should be used cautiously respecting the specific nature of the timber being used