



COST E55 : Modelling the performance of timber structures

Working Group 2: Vulnerability of components

Timber Connections



Connections

Dowel type fasteners

Plate connectors

Glued connections

Traditional carpentry connections

Wood "welding"

*

nails

staples

screws

traditional

hexagon

(full) threaded

specialities

INDUO

Rivets

*

dowels

bolts

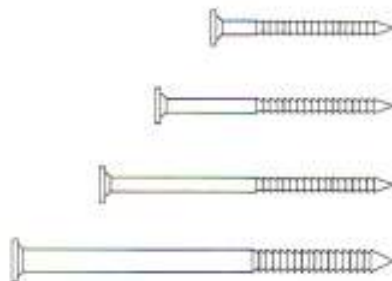
tubes

glued in rods

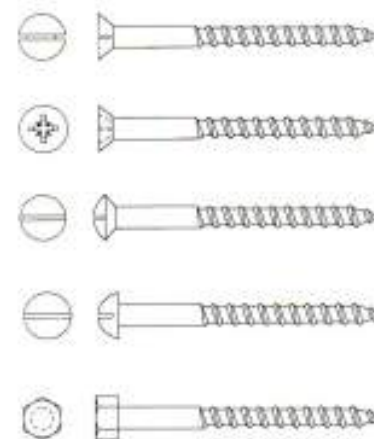
*



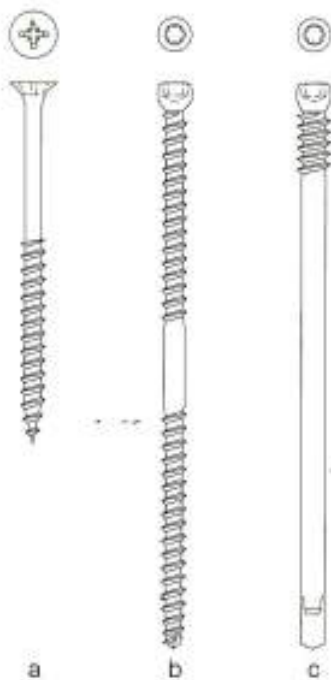
Round smooth nailsgels



threated nails

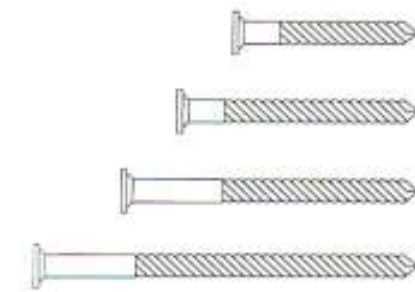


traditional wood screws
hexagon wood screws



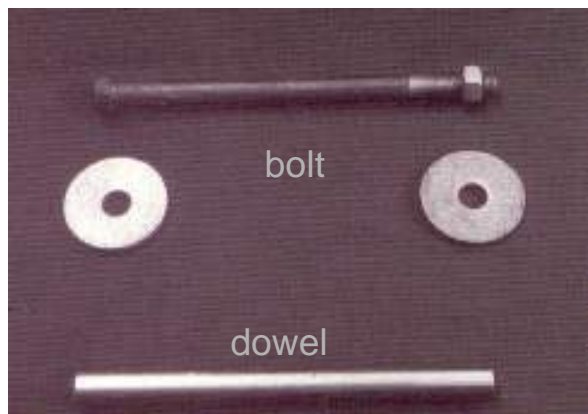
Self-tapping screws

- a. "Spax"
- b. "SFS"
- c. dowel



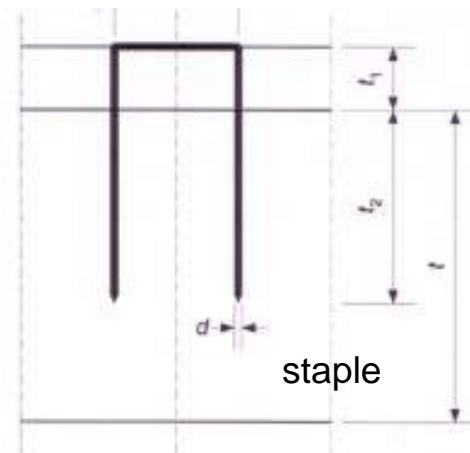
Helical-threaded shank nails

threated nailes



bolt

dowel



staple

Dowel type fasteners

European Yield Model (EYM)

- K.W. Johansen (1949)
- A. Meyer (1957)

- parallel to grain loading

- single fastener

- ductile failures

-



nails	
staples	
screws	traditional
	hexagon
	(full) threaded
specialities	INDUO
	Rivets
	*
dowels	
bolts	
tubes	
glued in rods	
	*

Dowel type fasteners



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-

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha}$$

$$F_{multiple} = n^{0,9} \sqrt[4]{\frac{a}{13d}} * F_{single}$$

- nails
 - staples
 - screws
 - specialities
 - dowels
 - bolts
 - tubes
 - glued in rods
 - *
- traditional hexagon (full) threaded
 - INDUO
 - Rivets
 - *

Dowel type fasteners



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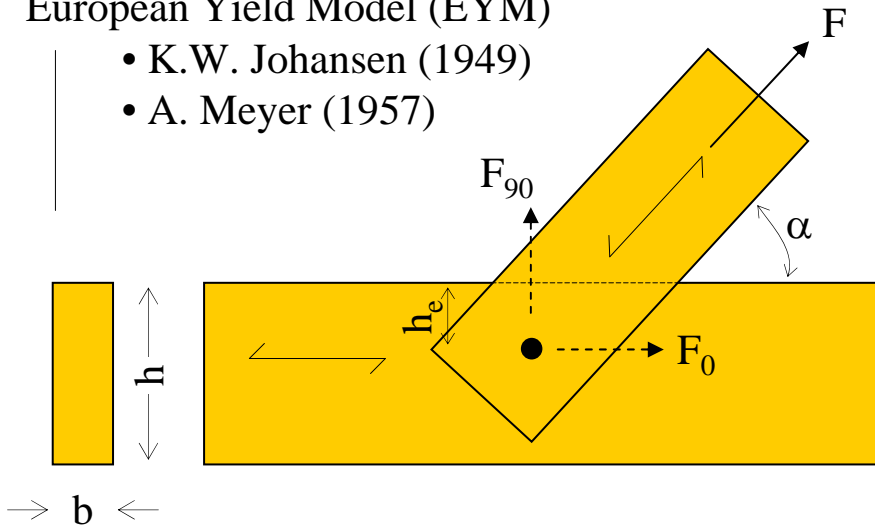
only for parallel to grain loading

- nails
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 - dowels
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Dowel type fasteners

European Yield Model (EYM)

- K.W. Johansen (1949)
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F_0 : parallel to the grain : $F_{multiple,0} = n^{0,9} \sqrt[4]{\frac{a}{13d}} * F_{single,0}$

F_{90} : perpendicular to the grain : $F_{multiple,90} = n * F_{single,90}$

F : α° to the grain : $F_{multiple,\alpha} = n * F_{single,\alpha}$



nails	
staples	
screws	traditional
	hexagon
	(full) threaded
specialities	INDUO
	Rivets
	*
dowels	
bolts	
tubes	
glued in rods	
	*

Dowel type fasteners

European Yield Model (EYM)

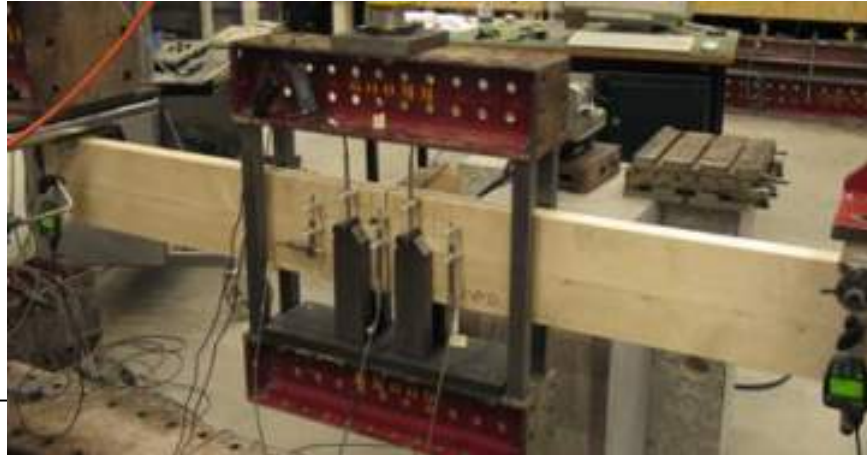
- K.W. Johansen (1949)
- A. Meyer (1957)

- parallel to grain loading

- single fastener

- ductile failures ?

-



$$F_{90,Rk} = 14b \sqrt{\frac{h_e}{1 - \frac{h_e}{h}}}$$

not depending on n.

Dowel type fasteners

European Yield Model (EYM)

- K.W. Johansen (1949)
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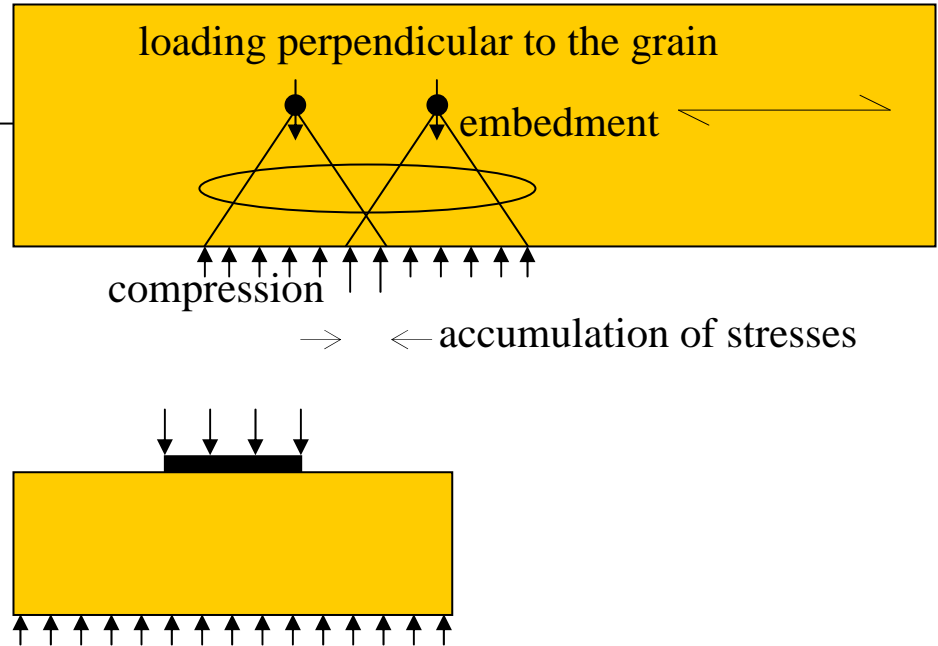


- parallel to grain loading

- single fastener

- ductile failures

-



Dowel type fasteners

European Yield Model (EYM)

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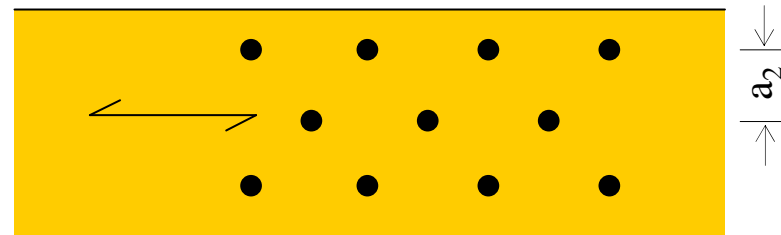
- parallel to grain loading

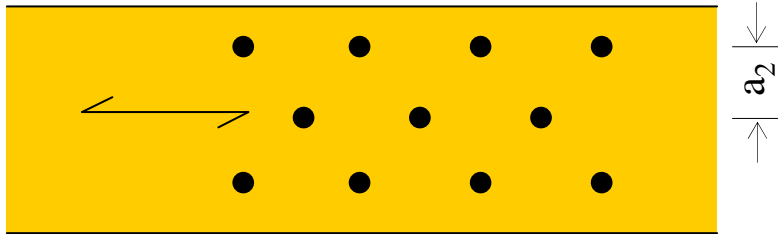
- single fastener

staggered patterns

- ductile failures ?

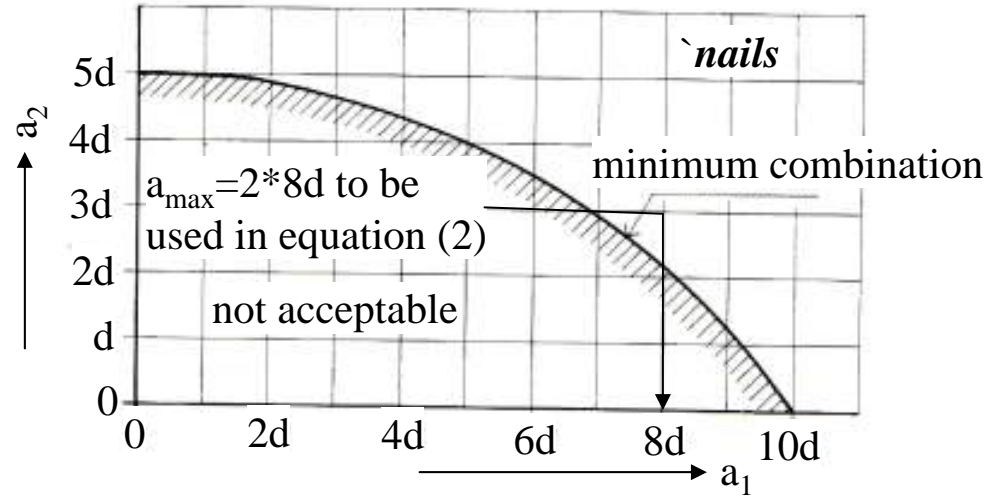
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 $\rightarrow | a_1 | \leftarrow$

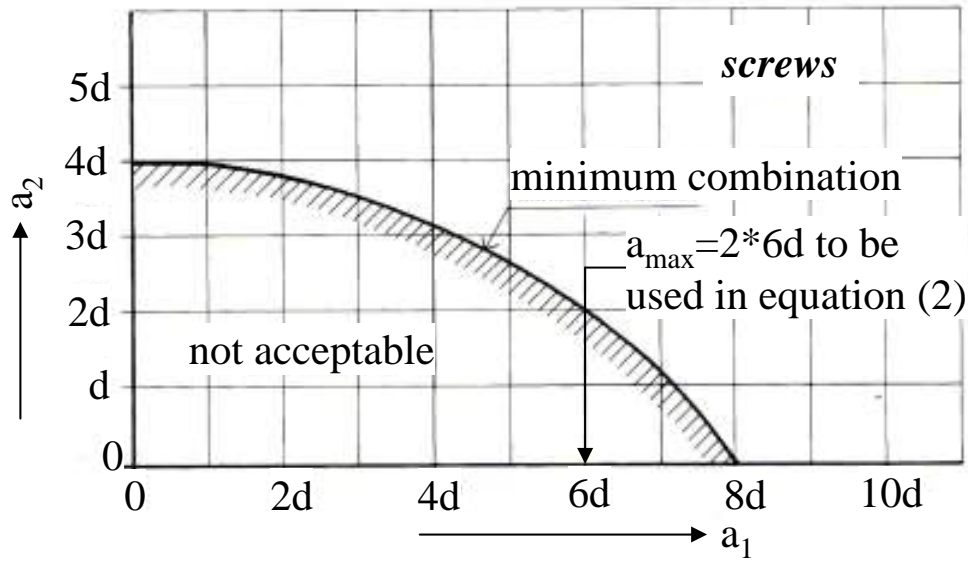


$\Rightarrow |a_1| \leftarrow$

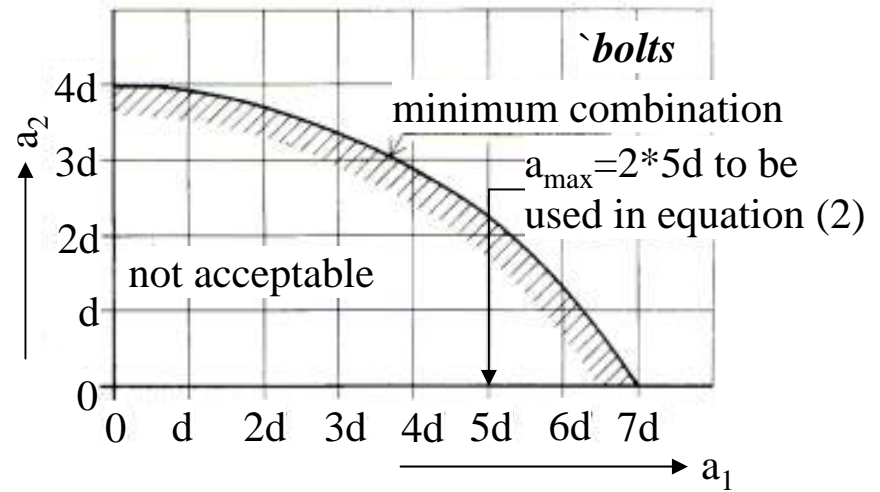
equation (2): $F_{multiple} = n^{0,9} \sqrt[4]{\frac{a}{13d}} * F_{single}$



$a_{max} > 2 * 8d$ if $a_2 > 5d$ and $a_1 > 16d$



$a_{max} > 2 * 6d$ if $a_2 > 4d$ and $a_1 > 12d$



$a_{max} > 2 * 6d$ if $a_2 > 4d$ and $a_1 > 10d$



Self-tapping screws

- high withdrawal and push-in strength



TU/e

Spax



Hexagon wood screw



Rapid



Tecfi

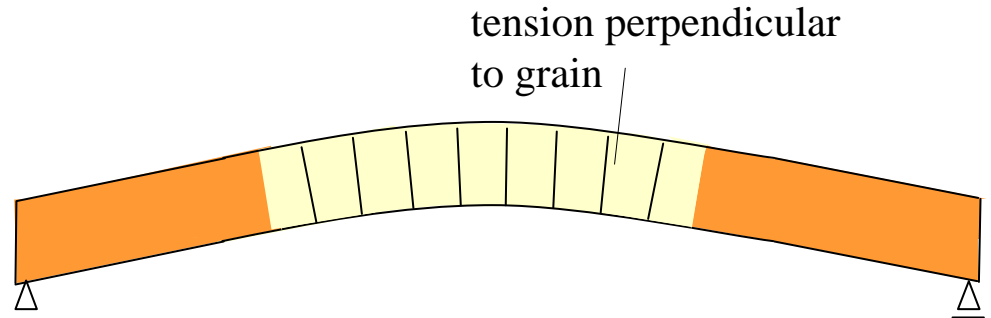
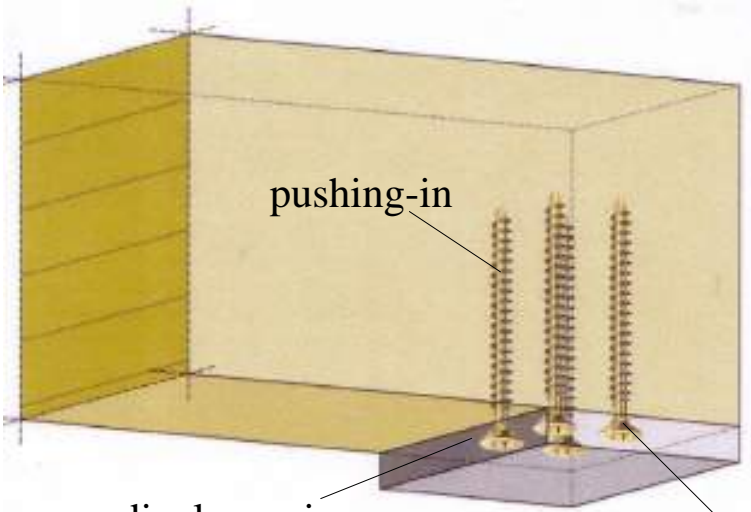
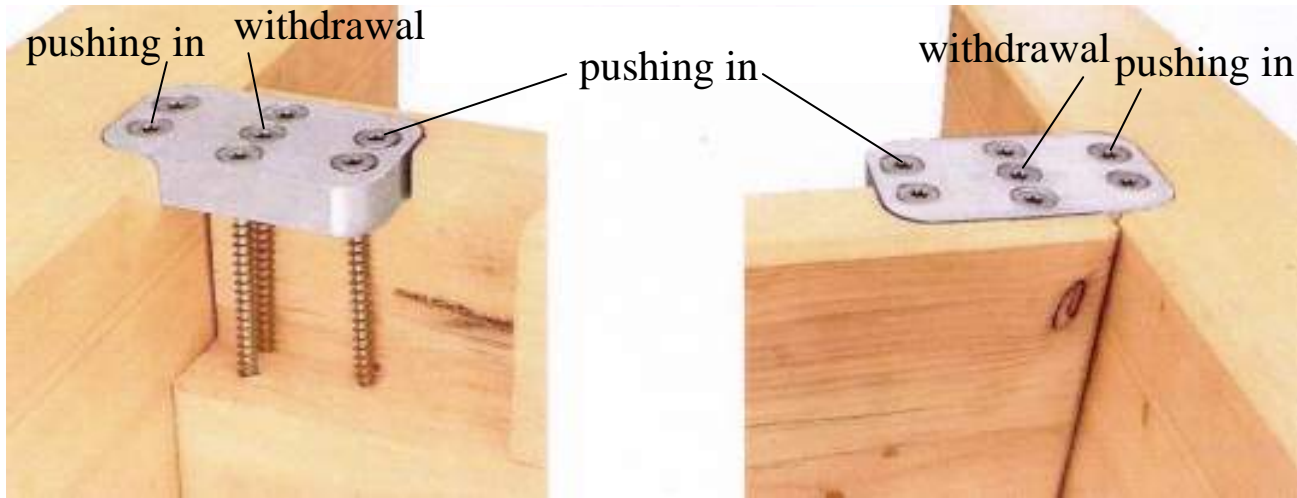


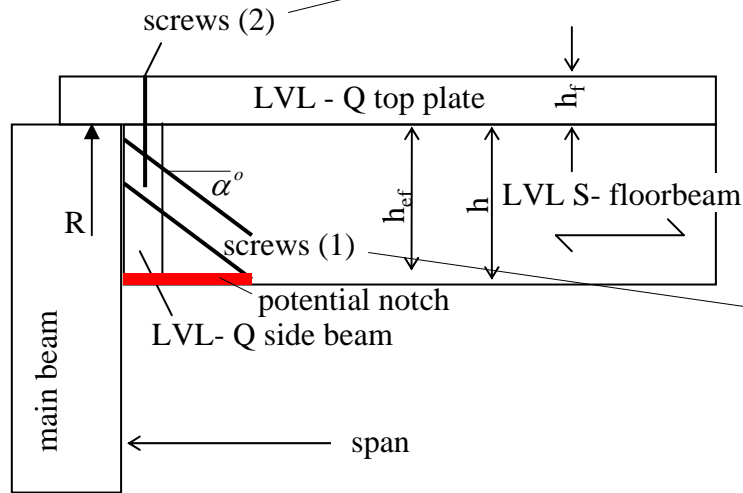
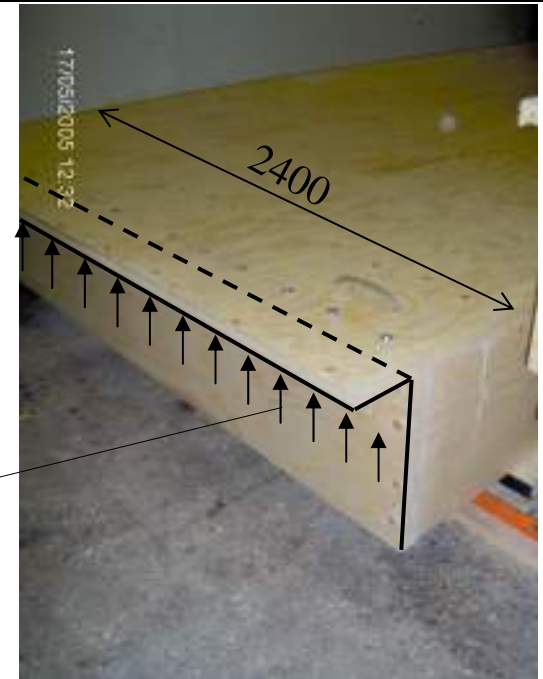
Heco

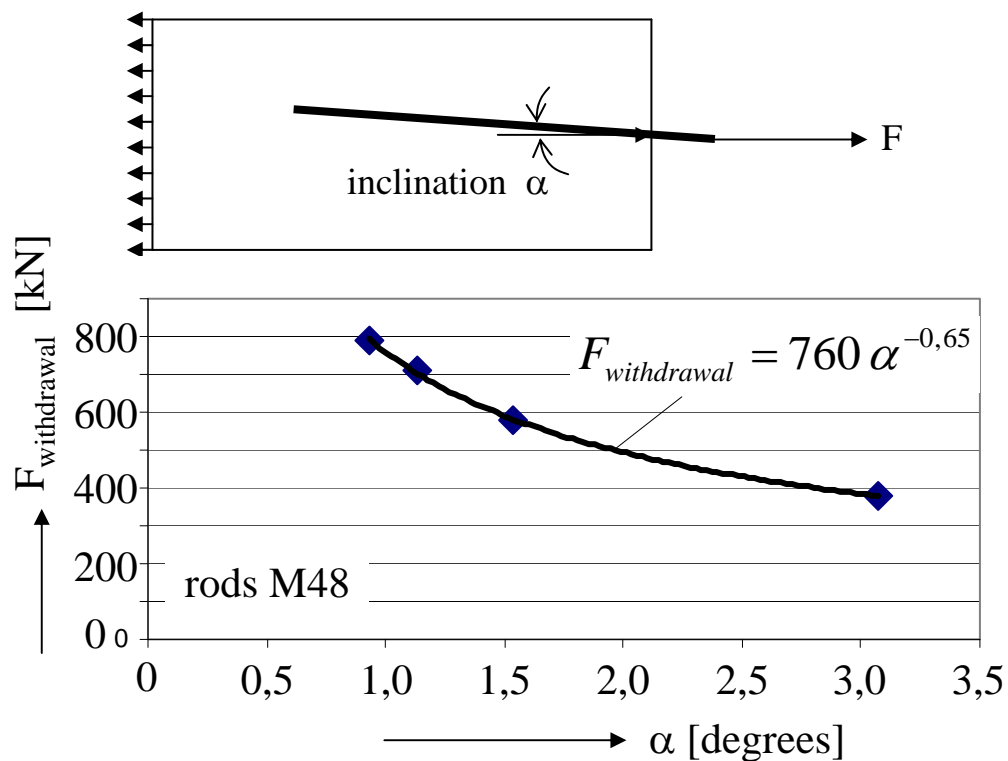


- nails
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 - specialities
 - dowels
 - bolts
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 - glued in rods
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- traditional hexagon (full) threaded
 - INDUO
 - Rivets
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example: steel to timber connection







- nails
 - staples
 - screws
 - specialities
 - dowels
 - bolts
 - tubes
 - glued in rods *
- traditional hexagon (full) threaded INDUO Rivets *



TU/e



Thank you for your attention.