

Design training for demanding wood structures

SFS – Puurakenteiden kiinnikkeet/Fasteners For Wood Products

Peter Åsman, Vantaa/Vanda, 2019-01-17



Design training for demanding wood structures

viceonardo destina -bridge



Topics covered

- SFS wood / wood joints and wood / steel joints:
 - Typical joining of heavy load bearing structures (CLT, glulam, LVL)
 - Outbuildings, balconies and terraces
 - Screw life / Corrosion protection
- SFS products for reinforcing wooden structures:
 - Cross-press in the wooden structure
 - Transverse pull in the tree structure
- ➡ SFS products for wood-concrete joinery:
 - Dowel
- ➡ SFS dimensioning of the products according to the euro code:
 - Sizing Tables
 - Sizing Software



Träinfästningar

Peter Åsman - Introduktion

- Gymnasieingenjör husbyggnad (Lycksele/Umeå)
 - Praktikarbete inom avvägning (SCA),
- Första fasta anställningen som virkesmätare (Umeå VMF)
- Civilingenjör Maskinteknik med inriktning på Träteknik (Luleå/Skellefteå)
 - Praktikarbete inom limträtillverkning (Martinsons)
 - Examensarbete simulering av råvarukvalitet vid trägolvtillverkning (Tarkett)
 - Vikarierade två terminer som högstadie lärare (Jörn)



Peter Åsman - Introduktion

- 5 år som arbetsledare på Annebergssågen (Derome)
- 5 år som sågverksingenjör på Värösågen (Södra)
- Konsult uppdrag inom sågverksoptimering (Domtar)
- 3 år som processingenjör på Timmins sågverk (Tembec)
- 11 år som industriell rådgivare för träindustrin in Ontario (FPInnovations)
 - Passive House Designer
- SFS Product Manager Wood Fasteners



SFS intec: The history of the company

1960 - 1979

1960:

Incorporation of operations and installation of first machines.



1965: License FABCO construction fasteners

1966:

Installation of the first multi-stage cold forming machines

1971:

Completion of the first production structure in the current Heerbrugg factory area

1979:

The world's first RST drill screw was developed and brought to market







1980 - 1999

1984: Certification of quality control system



Creation of new sales organizations Europe

1987:

Hinge products included in the product family, Acquisition of Sassba, IT



Extensive innovation projects in the automobile industry were carried out

1996: According to plastic product technology





2000 =>

2001: The acquisition

2002: Name change



2005: According to deep drawing technology

2007: Share holder of Dekim Metal, TR



GESIPA°

Suni

INDO

2008: Acquisition of the GESIPA Group

2008: 50% investment in Sunil SFS intec, CN

2012: Placement in Indo Schöttle, IN

2012: Acquisition of the Unisteel Group

2014: Stock exchange listing, Switzerland

2015 / 2018: 30% / 51 % Heco-Schrauben, DE



Turn ideas into reality. **<u>SFS</u>** intec



S intec





SFS group industries

Fastening Systems Engineered Components Automotive Industrial Construction **Riveting Electronics** UNISTEEL ° **SFS** intec **SFS** intec SFS in

Distribution & Logistics









SFS unimarket









SFS group 2017



2018: +13.7%, 9478 employees



Division Construction





Construction: Worldwide Manufacturing



80+ locations world wide



Design – CE mark and specifications





- CE-marked product
- Product approved through the ETA process:
 - ETA (European Technical Assessment) technical information

- CE-marked product
- Product approved by EN 14592:
 - DoP (Declaration of Performance) can provide technical assistance

ETA and the CE marking

- Harmonized standard EN 14592 defines the requirements and test methods for timber material, geometry, strength and durability in load bearing timber structures
- ETA also defines:
 - Product Verification System
 - Difference between the screws and the edge distances, e.g. for WT-T-6,5xL in certain cases the minimum edge distance = 2,5d when EN = 5d
 - Installation angle

12

- Additional accessory otherwise applications only in accordance with EN 14592
- Slide module (usually better than EN)
- According to the German EC5 National Annex, only a certain part of the values obtained on the basis of the EN can be taken into account in the calculations of the bearing structures
- Therefore, it is advisable to use ETA as a tapered structural screws
- Almost all suppliers have applied for CE marking through the ETA process for structural screws:
- It is worth noting when defining / accepting screws



ETA – where can I find?

The ETA No. is listed in the SFS catalog:

WT-T, hiiliteräs C2-luokan pinnoitteella

Nimike	Koodi	Hinta / 100 kpl	Pakkaus- koko	CE ETA-12/0063
WT-T-6,5x65	1501730	1730 41,50 100		Durocoat pinnoite
WT-T-6,5x90	1501731	44,60	100	Käyttöluokka: C1-C2
WT-T-6,5x130/40	1501732	65,70	100	Ruuvauspää: 6,5 mm = T3
WT-T-6,5x130/55	1501733	65,60	100	Ruuvauspää: 8,2 mm = T4
WT-T-6,5x160	1501734	112,50	100	
WT-T-6,5x190	1501735	199,50	100	
WT-T-6,5x220	1501736	235,00	100	
WT-T-8,2x160	1512756	152,85	100	
WT-T-8,2x190	1512757	161,10	100	
WT-T-8,2x220	1512785	176,60	50	
WT-T-8,2x245	1512786	186,50	50	
WT-T-8,2x275	1512787	194,50	50	
WT-T-8,2x300	1512788	201,50	50	
WT-T-8,2x330	1512790	210,40	50	

Search by ETA number:

^[PDF] European technical approval ETA-12/0063 - SFS intec

https://www.sfsintec.biz/.../european_technical_approval_eta_12... - Översätt den här sidan Europäische Organisation für Technische Zulassungen. Organisation Européenne pour l' Agrément Technique. European technical approval. ETA-12/0063.

[PDF] ETA-12/0063 WT - SFS intec

www.sfsintec.biz/.../eta_12_0063_en_sfs_self_tapping_screws_... ▼ Översätt den här sidan 18 juni 2012 - Page 2 of European technical approval ETA-12/0063 I. Validity from 18.06.2012 to 17.06.2017 Member of EOTA. 1 LEGAL BASES AND ...

[PDF] Europäische technische Zulassung ETA-12/0063

https://sfs.biz/sfs../media/.../WT_**ETA-12_0063_**de.pdf - Översätt den här sidan Seite 2 der Europäischen technischen Zulassung ETA-12/0063. Geltungsdauer vom ... ETA-12/0063 mit Geltungsdauer vom 18.06.2012 bis zum 17.06.2017.

Home page (www.sfsintec.fi):





SFS wood connectors



New generation WT screw

- WT = twin-screw screw for wood-tree joint
- Material:
 - Coated carbon steel
 - Stainless Steel (A2 / AISI 304)
- Benefits:
 - Small installation costs
 - Easy to use
 - High capacity
 - Many uses
- System:
 - Brackets
 - Installation machines and equipment
 - Technical documentation
 - Calculation software





ETA-12/0063

F



WT – Range

Fastener range

WT-<mark>S</mark>-6,5 x L

Material: stainless steel A2 (1,4567) Surface finish: Durocoat Thread Dia.: 6.5 mm

WT-T-6,5 x L

Material: carbon steel Surface finish: Zink Thread Dia.: 6.5 mm

WT-T-8,2 x L

Material: carbon steel Surface finish: Zink Thread Dia. 8.2 mm (sg) and Dia. 8.9 mm (sclamp)

The Duracoat coating is on the way out and the following coatings will replace

- Electroplated zink (Zn)
- ZnNi

Туре	S=: T	Materia stainless sta = carbon st	 eel A2 eel	Diameter d1 [mm]		Length [mm]	Sg [mm]	S _{clamp} [mm]	d _k [mm]
WT	-	S	-	6,5	х	65	28	28	8.0
WT	-	S	-	6,5	х	90	40	40	8.0
WT	-	S	-	6,5	х	130	55	55	8.0
WT	-	Т	-	6,5	х	65	28	28	8.0
WT	-	Т	-	6,5	х	90	40	40	8.0
WT	-	Т	-	6,5	х	130	55	55	8.0
WT	-	Т	-	6,5	х	160	65	65	8.0
WT	-	Т	-	6,5	х	190	80	80	8.0
WT	-	Т	-	6,5	х	220	95	95	8.0
WT	-	Т	-	8,2	х	160	65	65	10.0
WT	-	Т	-	8,2	х	190	80	80	10.0
WT	-	Т	-	8,2	х	220	95	95	10.0
WT	-	Т	-	8,2	х	245	107	107	10.0
WT	-	Т	-	8,2	х	275	122	122	10.0
WT	-	Т	-	8,2	х	300	135	135	10.0
WT	-	Т	-	8,2	х	330	135	135	10.0



Excellent capacity





Tested by students







WT-T – Examples from Norway









Leonardo da Vinci-bridge, Ås

Trädet-apartment building, Bergen (51 m high, 12 floors)



Aspen Art Museum, Colorado, USA









WR – Full thread screw

ETA-12/0062





WR – Typical uses (1)





WR – Typical uses (2)















WR – Range

Nimike	ŀ	Koodi	Pakkaus- koko	CE
WR-T-9x250	15	512718	50	Durocoat pinnoite
WR-T-9x300	15	512719	50	Käyttöluokka: C1-2 Ruuvauspää: T40 ja T50
WR-T-9x350	15	512741	50	AAAA
WR-T-9x400	14	490435	50	
WR-T-9x450	14	190436	50	
WR-T-9x500	14	190437	50	
WR-T-13x400	14	190438	25	
WR-T-13x500	14	190439	25	
WR-T-13x600	14	490461	25	
WR-T-13x700	14	190462	25	
WR-T-13x800	14	490463	25	vv
WR-T-13x900	14	190466	25	
WR-T-13x1000	14	490468	25	

- Full-fledged, flush-mounted and drilled screw with Durocoat® DP1 coating:
 - ETA also has a cylinder base
- High connection capacity
- There is no decrease in load carrying capacity at 90 ° to 45 ° in the installation angle
- Can be installed at depths of 0 °
- No pre-drilling is required
- Low cracking risk

Hall of Fame, Zürich Zoo











Bauhof, Feldkirch



VB – Timber-concrete composite fasteners



System components and typical installation



- VB-fastener
 - VB-48-7,5x100
 - VB-48-7,5x165
 - Black oxide coating
 - Electro galvnized (New)

 $\mathbf{C}\mathbf{E}$

- Suitability:
 - Solid wood
 - Glulam
 - Kerto LVL beams, etc.
- Calculation software



WS – self-drilling dowel / fastener for wood / steel





WS – Features





CE

- 1. Installing steel plates
- 2. Coordination and in place
- 3. Installing fasteners



Finish



WS – Range



Wood thickness	Fastener	Steel plate thickness m	m/pcs
Puun vahvuus B [mm]	Kiinnike WS-T-7xL [L = mm]	Teräslevyn vahvuus S [mm] / kpl	•
80	WS-T-7x73	5 / 1	I
100	WS-T-7x93	5 / 1	
120	WS-T-7x113	5 / 1	
140	WS-T-7x133	5 / 2	I
160	WS-T-7x153	5 / max. 3	
180	WS-T-7x173	5 / max. 3	C
200	WS-T-7x193	5 / max. 3	,
220	WS-T-7x213	5 / max. 3	1
240	WS-T-7x233	5 / max. 3	



Porautuvuus:

- Steel quality S235: 3 sheet x 5 mm or 1 plate x 10 mm
- Steel Quality S355: 1 plate x 6 mm

or

- Hidden aluminum profile
- Zink plated
- Tensile strength: 550 N/mm²
- No product under ETA
- ➡ EN 14592:2008

WS – Typical uses

















WS – Kuokkalan kirkko, Jyväskylä









Bauhof, Feldkirch

WB – Beam reinforcements

WB = <u>Wood Bar</u> (puutanko)

- Twisted steel bar with wooden thread:
 - \emptyset = 16 mm and 20 mm
 - L = 3000 mm, individually cut
 - Tensile strenght: 800 N/mm^2
 - Electroplated
- Pre-drilled:
 - $\emptyset = 12 \text{ mm}$ and 15 mm
- Installation using power drill
- No gluing is required
- No product under ETA
- German Approval DIBt Z-9.1-777

WB – Typical uses

WB – Pyramidenkogel panoramic tower, Austria

Mini-WT facades and terraces

Mini WT – typical uses

- Store fronts
- Teracess
- Board
- Sidings
- Wood flooring
- ➡ …and so on.

Mini-WT – Range

- ➡ Steel (Durocoat[®] S):
 - WT-T-4.5 x 40
 - WT-T-4.5 x 60
 - WT-T-4.5 x 70
- Stainless steel (A2 / AISI 304):
 - WT-S-5.0 x 45
 - WT-S-5.0 x 60
 - WT-S-5.0 x 70
- No CE marked product:
 - Not bearing wood structures

Twin UD – insulation fixing screw ETA-12/0038

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NELHARAMANA ANAL

Twin UD: features

- A twin-screw screw for fixing the battens through the insulated roof
- Also used for fixing insulated walls

- Benefits:
 - Lower cost
 - High capacity
 - A durable solution
 - Less cold bridges

Twin UD – Range

Туре	l _{ef}	Packing size
Twin UD-7,5x170	47,5	50
Twin UD-7,5x190	73,5	50
Twin UD-7,5x210	97	50
Twin UD-7,5x230	97	50
Twin UD-7,5x250	97	50
Twin UD-7,5x270	97	50
Twin UD-7,5x300	97	50
Twin UD-7,5x330	97	50
Twin UD-7,5x360	97	50
Twin UD-7,5x400	97	50
Twin UD-7,5x440	97	50
Twin UD-7,5x480	97	50
Twin UD-7,5x520	97	50

- Same threads/pitch
- Different outer diameters:
 - Lower: 7,5 mm
 - Middle: 7,05 mm
 - Upper: 8,5 mm
- T40-drive
- Material: steel
- ➡ Coating:
 - HP (ZnNi) 12 µm
 - Durocoat[®] DP1 5 µm or more

Heco – Wood and concrete screws

- Heco Schrauben, Schramberg, Germany:
 - Founded in 1888
 - The screw manufacturing started in 1936
 - belongs to the SFS group
- German wood and concrete screw manufacturer
- Product Catalog with over 200 pages
- All products from SFS:
 - All most common products in stock
- Calculation software
- Wood and concrete screws ETAapproved
- Mounting Materials

Heco Unix

ETA-11/0452

- No damage to the fitting surface
- Improved milling features in wood due to milling grooves
- The thread premits full and partial thread applications. This allows a reduction of the product range
- Driving without a gap, even in tough applications
- Fixing the wood components via the thread
- Higher loads are achievable as the head does not pull through the fixture if the fixture thickness is >4d

Heco Fix-plus

ETA-11/0284

CE

Toothed tread design for minimal driving torque

Toothed tip for improved positioning and faster starting on hard surfaces

- Screw for many applications:
 - Natural wood
 - Industrial wood
 - Plastic
 - Masonry
 - Thin metal (<2 mm)
- High thread profile, fast installation
- Full or partial threaded
- Toothed tread design to reduce torque
- Plus tip
- Can be used in combination with nylon plugs
- Steel and A2

Turn ideas into reality. **<u>5F5</u>** intec

Несо Торіх

ETA-11/0284

- Top-kärki (Top = Topix)
- Part and full thread
 - 20mm up to 500mm length
- Revolutionary shank design to reduce the friction, ie the fastening torque
- High threading fast installation
- Flange, cylinder and countersunk head
- Steel, A2 and A4:
 - A2: Countersunk head up to 400mm
 - A2: Flange head up to 300mm
 - A4: Decking screw

Heco Multi-Monti TC

- For fixing wood to concrete
- Steel / galvanized
- Invisible connection
- German ApprovalDIBt Z-21.1-1879

Connection options: CLT, glulam and LVL

- Data sheet for CLT design
- Data sheets for glulam and LVL are missing
- Mounting options:
 - WT-T: Double threaded screw
 - WR-T: Full threaded screw
 - WS-T: Drilling wrench
- Calculation Formulas
- Minimum Distances:
 - To edge
 - To 2nd screw

Datasheets and calculation software

- Technical data sheets:
 - WT-T/WT-S
 - WR-T
 - WB-T
 - WS-T
 - Twin-UD
 - VB
- Software:
 - WT-T/WT-S
 - WR-T
 - Twin-UD (roof insulation)
 - WB (confirmation)
 - VB

DIN 1052 2008-12

Calculation software

Functions:

- Attachment of roof insulation
- Primary / secondary beam connection
- Combination of beam
- Confirmation for a perpendicular load
- Compression gain
- Confirmation
- Confirmation of bushings

Attachment of rafters at roof insulation

SE		÷	SFS Ti	mber Work Software EC5		SFS int	tec – æ ×
Roo	Application	Tension Compression Notch H	Image: Second	User Update			** 6
	Ap	plication	Design	Settings			
Project Project details Project customer	Project Joist/Beam connect	tion 1 × Tension perp. reinforcen	e e e e e e e e e e e e e e e e e e e	Doubled-up beam 4 × Roof i	40 mm	Roof configuration Insulation Counter battens Rafters Loads Fixing configuration Screws R Model ▲ Dimensions System Twin UD 7.5x190mm Twin UD 7.5x210mm Twin UD 7.5x220mm Twin UD 7.5x220mm Twin UD 7.5x230mm Twin UD 7.5x230mm Twin UD 7.5x330mm Twin UD 7.5x360mm Twin UD 7.5x360mm Twin UD 7.5x360mm	
	Information Title	Number of screws per T	atal number of screws Spacing	End spacing Density N	otec		
	Normal screws		2178 77 cm	38.5 cm 2.08/m ²			
	Uplift screws - Area 1	2	139 2780.4 cm	5 cm 0.06/m ²			
	Uplift screws - Area 2	2	468 499.9 cm	5 cm 0.32/m ²			
	Unlift screws - Area 3	2	34 1201.9 cm	5 cm 0.13/m ²			
	Information	2		0120/11			

The primary / secondary beam connection

Transmit	- (SFS Timber	Work Softwar	e EC5				SFS intec -	- в × ж п
Application Despr Setting: PDL1 L1 - 1 × L1 - 1	Ro	Joist/Beam Doubled-up Tension Compression Notch Hole	 ♦ FFS EN 1995-1-1+A1+A2 Oesign Print ▼ 	User preferences	슬 Update					
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Dowelled purlins

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				WR-T 9.0x450mm 6 98.7%	
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Reinforcement of a straightforward load

Confirmation of compression

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	Application			() ***
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Notches

Reinforcement at hole and cut out

SF		88	Ŧ				SFS	Timber W	ork Software I	C5						SFS	intec -	ъх
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Corrosion protection / EN 14592

- Wood Connectors in Material Classes (C1-C3) In the current price list of SFS, comply with the wood standard (Eurocode 5)
 - C1: A wooden structure that is heated in indoors or in similar humidity conditions
 - C2: Wood structure dry in the open air (eg dehumidifiers, cold attic)
 - C3: Wooden structure exposed to the weather, in a humid space or under the direct influence of water
- These will be removed and replaced with the EN 14592 standard (standard update is still under construction)
- In chapter 5.2 of the updated EN 14592, the definition of the corrosion protection level (C1-C5)
- The norm also comes with the "Timber class" (T1-T5), the "wood class"
- Once the fastener coating is known, it is possible to determine what kind of wood connection fits in the environment

Corrosion Protection / Coating Replacement

- EN 14592 update is under construction, so it is unclear whether these tables can be found in the final standard
- The annual average moisture content defines the tree classes T1-T5
- Environmental classes C1 to C5 depend on the strength of the coating
- With the upgrade of the standard, the wood fasteners with Durocoat coating will gradually be removed and replaced with the 8 µm Zn coating with Cr3 + Pass-Guarantee for the T2 / C2nw class (EC5: old C1-C2):
- Long and expensive testing where required if continue with Durocoat
- A C4 coating (Zn/Ni) is being developed, after which Durocoat is completely removed from our wood fasteners

T1	T2	T3	T3(15)	T4	T5		
ω < 10 %	10 % ≤ ω ≤ 16 %		$16 \le \omega \le 20 \%$				
-	-	Untreated and pH > 4 Tre		Treated ^a or pH ≤ 4	-		
_ b	10 µm	20 µm	n/a	55 µm	n/a		
-	-	CRC II	n/a	CRC II/ CRC III ^c	CRC III		
-	Annex A A.4	Annex A A.2	Annex A A.4	Annex A A.3	n/a		
	T1 ω<10% - _b -	T1 T2 $\omega < 10\%$ $10\% \le \omega \le 16\%$ - - _b $10\mu m$ - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -	T1 T2 T3 $\omega < 10\%$ $10\% \le \omega \le 16\%$ 10 - - Untreated -b $10\mu m$ $20\mu m$ - - CRC II - - Annex A A4 A2	T1 T2 T3 T3(15) $\omega < 10\%$ $10\% \le \omega \le 16\%$ $16 < \omega \le 20\%$ - - Untreated and pH > 4 - ^b 10 µm 20 µm n/a - - CRC II n/a - Annex A Annex A Annex A A4 A2 A4	T1 T2 T3 T3(15) T4 $\omega < 10\%$ $10\% \le \omega \le 16\%$ $16 < \omega \le 20\%$ Treated a or pH > 4 Treated a or pH > 4 - - Untreated and pH > 4 Treated a or pH ≤ 4 σ pH ≤ 4 - 10 µm 20 µm n/a 55 µm - - CRC II n/a CRC II/CRC III c - Annex A AA Annex A AA Annex A A3		

Table 1 — Classes for corrosion resistant materials, zinc coatings and alternative materials or

coatings for dowel-type fasteners in the timber — Minimum requirements

The assignment is taken from EN 1993-1-4:2006/A1:2015, Annex A.

Table 2 — Classes for corrosion resistant materials and coatings in atmospheres according to EN
ISO 9223 based on maximum mean zinc corrosion rates according to EN ISO 9224 — Minimum
requirements

Atmosphere	C1	C2nw not weathere ^d	C2w Weathere ^d	C3	C4	C4(15)	C5
Minimum zinc thickness on carbon steel	_ ª	10 µm ^b	20 µm	55 µm	110 µm	n/a	-
Corrosion Resistance Class for Stainless Steel ^d	-	CRC II	CRC II	CRC II/ CRC III ^C	CRC III / CRC IV ^c	n/a	CRC IV / CRC V ^C
Alternative materials or coatings	-	Annex A A.4	Annex A A.2	Annex A A.3	n/a	Annex A A.4	n/a

NOTE Classes for corrosion-resistant materials and coatings in atmospheres are in accordance with EN ISO 9223 based on the upper limit of the average steady corrosion rate for zinc in the first 30 years and linearly extended to 50 years

^a The appearance may change without a protective coating.

d

^b EN ISO 9224 provides no information. Based on experience, zinc has about a two times higher corrosion rate for weathered connectors compared to not weathered.

c In case of a cleaning regime or exposure to washing by rain, the lower stainless steel grade may be used.

The assignment is taken from EN 1993-1-4:2006/A1:2015, Annex A.

The effect of the environment on corrosion

Indoors and outdoors have their own effects on corrosion

Table B.1 — Corrosivity of atmospheric environments

(indoor = no rain access, i.e. not weathered, nw)

Corrosivity		Climate/humidity	Exposure to pollutions	Typical environment	
C1	Very low	Dry climate/low relative humidity	Insignificant pollution	Heated spaces	
C2 (C2nw)	Low	Varying temperature and relative humidity/low frequency of condensation	Low pollution	Unheated spaces (storage, sport halls, areas of heated and unheated stables where condensation is not taking place and pollution has no access)	
		Like outdoor climates C2-C3 but not weathered/rarely condensation		Halls/storage areas/parking decks which are open to the outside	
C3	Medium	Elevated relative humidity/ moderate frequency of condensation	Moderate pollution from production process	Food-processing plants, laundries, breweries, dairies, unheated stables	
		Like outdoor climates C2-C3 but not weathered/occasional or frequent condensation	Moderate pollution	Parking decks which are open to the outside (frame constructions)	
C4 C4(15)	High	Elevated relative humidity/high frequency of condensation	High pollution from production process	Industrial processing plants, heated stables	
		Extreme elevated relative humidity/frequent condensation	Elevated pollution	Damp or wet spaces	
		No elevated relative humidity/infrequent condensation	High level of hygroscopic salt in the air	Salt storage, pools with salty water in ventilated spaces	
		Approximately 30 °C and max. 60 % relative humidity/ condensation	Treatment with disinfection, high level of chlorides	Swimming pools	
C5	Very high	High relative humidity/very high frequency of condensation	High pollution from production process	Unventilated spaces in subtropical and tropical zones in extreme contaminated environment or close to coastline	

Table B.2 — Corrosivity of atmospheric environments (outdoor = structures exposed to rain, i.e. weathered, w)

Corrosivity			Exposure to chlorides		Exposure to polluting agents		
		Climate/humidity	Typical environment	Cl- deposition rate (mg/m ² ·d)	Typical environment	Level of pollution/ SO2 content (µg/m3)	
C1	Very low	Dry or cold/infrequent condensation	Regions far from coastline	approximately 0	Certain deserts, central Arctic/ Antarctica	Very low approximately 0	
C2 (C2w)	Low	Temperate/infrequent condensation	> 10 km from coastline	≤3	Low polluted rural areas, small towns	Low<5	
C3 Medi- um		Temperate/occasional	approximately 10 to 3 km from coastline		Medium polluted urban and industrial areas	Medium 5 to 30	
	Medi- um	condensation	Spray near streets (approximately 10 to 100 m)	3 to 60			
		Subtropical, tropical	Low pollution of chlorides and other contamination (like C2)				
C4 C4(15)		Temperate/frequent condensation	approximately 3 to 0,25 km from coastline (without spray of salt water)	60 to 300	High polluted urban and industrial areas	High 30 to 90	
	High		Strong effect of de-icing salts (approximately 0 to 10 m)				
		Subtropical, tropical	Medium pollution of chlorides and other contamination (like C3)				
C5	Very high	Temperate, subtropical/very high – permanent frequency of condensation	<0,25 km from coastline, occasionally spray of salt water	300 to 1500	Environment with very high industrial pollution	Very high 90 to 250	

Turn ideas into reality. 5

Corrosion protection - wood fasteners

- Stainless steel (A2 / AISI 304 and A4 / AISI 316)
 - EC5: C1-C3, new: T1-T5 / C1-C5
 - For impregnated wood, heat treated wood and corrosive wood species (eg Siberian larch or oak)
 - Limited range (A2: WT-S and Heco basic, exterior and terrace applications, A4: Application for terraces)
- → Durocoat[®]

Corrosion testing

- Kesternich-test (DIN EN ISO 6988):
 - Accelerated corrosion test in cycles: 35°C, 5% saline, pH 6,5 – 7,2
- Salt Spray Test (DIN EN ISO 9227 NSS):
 - Simulated acid rain
- Test results:
 - Kesternich: cycle does not correspond to service life
 - Salt Spray: 100 h probably simulates 1 year
- However, the reality is a combination of both - A standardized test method is missing
- The corrosion resistance of a screw embedded in wood also depends on wood (moisture, impregnation, wood species, etc.)
- Wood can even protect against corrosion

- Based on the tests, a screw service life is estimated:
 - Standardized tests can not be translated directly into years
 - No one has tested the screws for the promised lifetime
 - On the basis of the tests, different screws can be compared
 - Mechanical damage caused by installation, such as scratching, naturally affects the service life
 - There are screws that are said to last for xx years as long as there is no scratch on the surface

WT-T corrosion resistance of screws

- The corrosion resistance of the Durocoat screw is estimated to be between 10 and 15 years
- The high performance (HP, or ZnNi) coated screw has a corrosion resistance of at least the same 10 to 15 years
- When immersed in a wood only the screw base is in contact with the environment, ie the only part whose corrosion resistance corresponds to the corrosion resistance of the loose screw, but:
 - The base / recess may be mechanically damaged during installation, with corrosion resistance being affected
 - The WT-T screws do not have a bearing on functionality

- The lifetime of the Durocoat coated wood screw is 50 years according to the ETA:
 - WT-T screws have been in use at the pier in the Paraista/Pargas archipelago for more than 10 years and no corrosion has been detected at all
- According to the new ETA, the starting point is that the screws installed have 50 years of service regardless of the coating

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the screws of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

Thank you!

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