



EUROCODES

EN 1995

Design of timber structures



Stefan Winter

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EN 1995

Design of timber structures

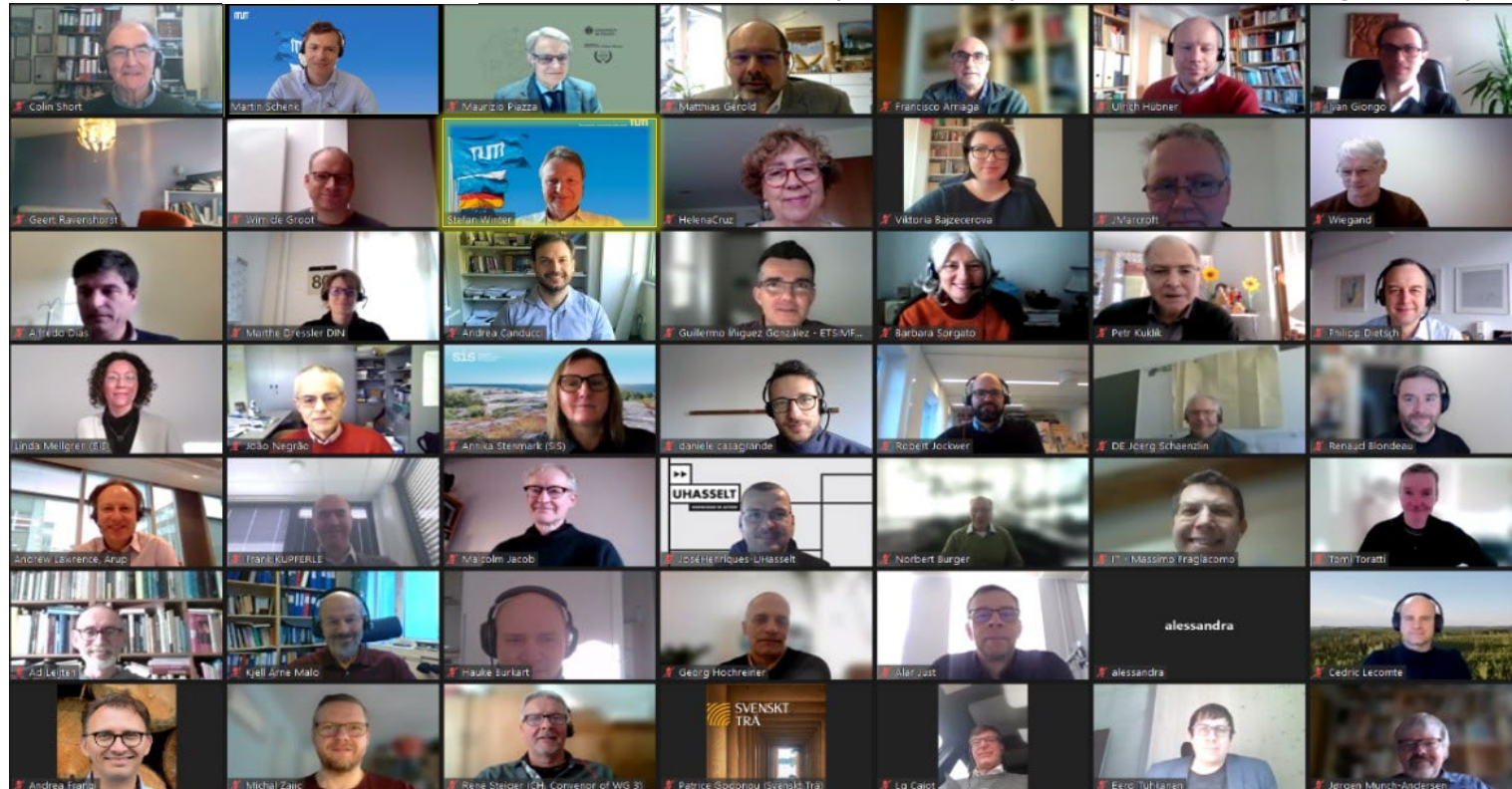


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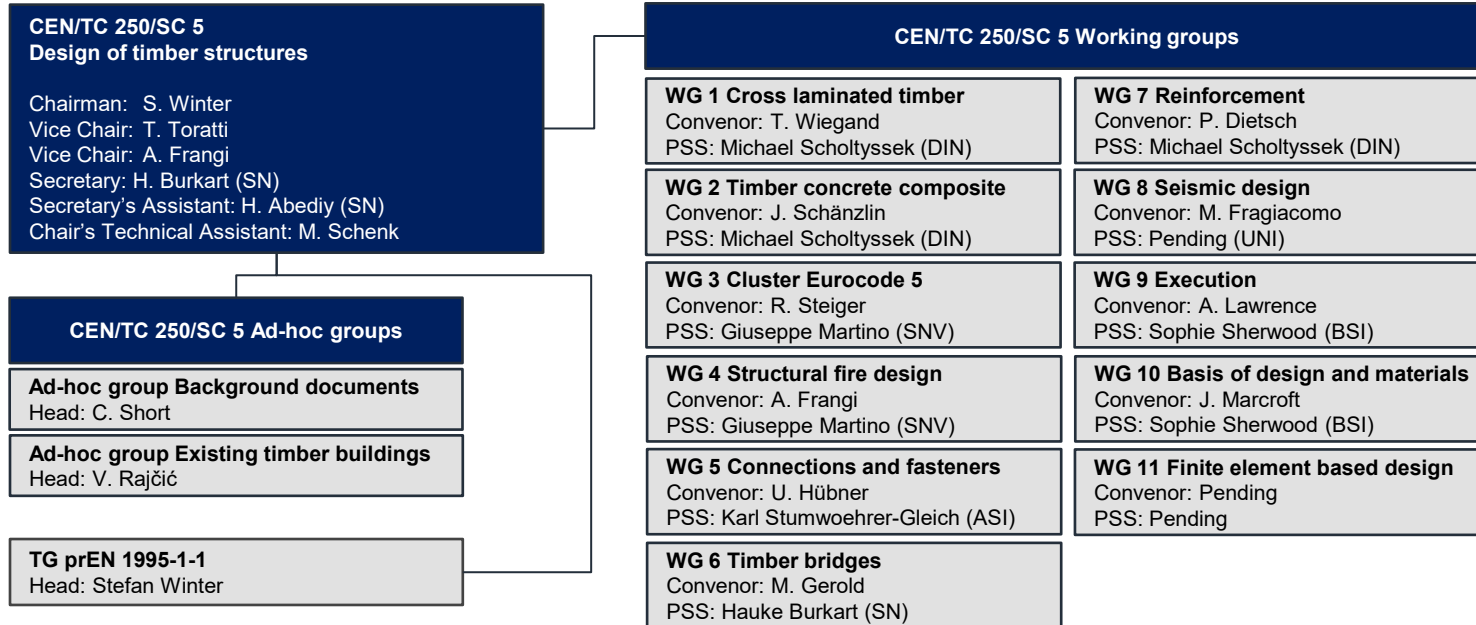
CEN/TC 250/SC 5 Design of timber structures

- A team of ~200 subcommittee members (and many more in the subgroups)



CEN/TC 250/SC 5 Design of timber structures

■ Organization



The second generation of Eurocode 5: An overview

- EN 1995-1:
 - Part 1: General rules and rules for buildings
 - Part 2: Fire Design
 - Part 3: Timber Concrete Composite Structures (currently CEN/TS19103)
- EN 1995-2: Bridges
- EN 1995-3: Execution

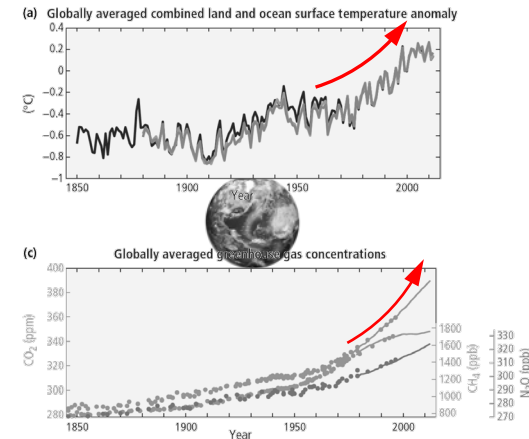


The second generation of Eurocode 5: An overview

- Harmonization with the whole Eurocode family
- Tremendous developments of timber structures in the past 30 years
 - Extensions and revision of several rules for timber design
 - Low-threshold interface between EN 1995 and product standards
- Reduction of NDPs and alternative design methods
- Outsourcing of very specific design rules to normative Annexes



Sensations Strasbourg; Source: KOZ Architectes



prEN 1995-1-1: General rules and rules for building



Prinz Eugen Park Munich; Source: Stefan Winter



prEN 1995-1-1: General rules and rules for building

■ A variety of (new) construction products



Strength graded structural timber with rectangular cross-section



Structural Finger Jointed Solid Timber



Glued Solid Timber



Glued Laminated Timber



Cross Laminated Timber



Multi-layered solid wood panel



Laminated Veneer Lumber



Plywood



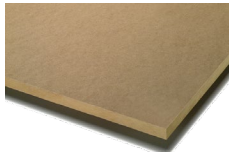
Oriented Strand Board



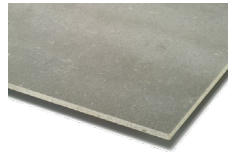
Fibreboard, hard



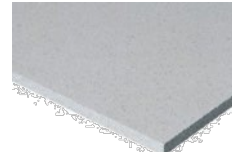
Fibreboard, medium



Softboard



Cement Bonded Particle Board



Gypsum fibreboards



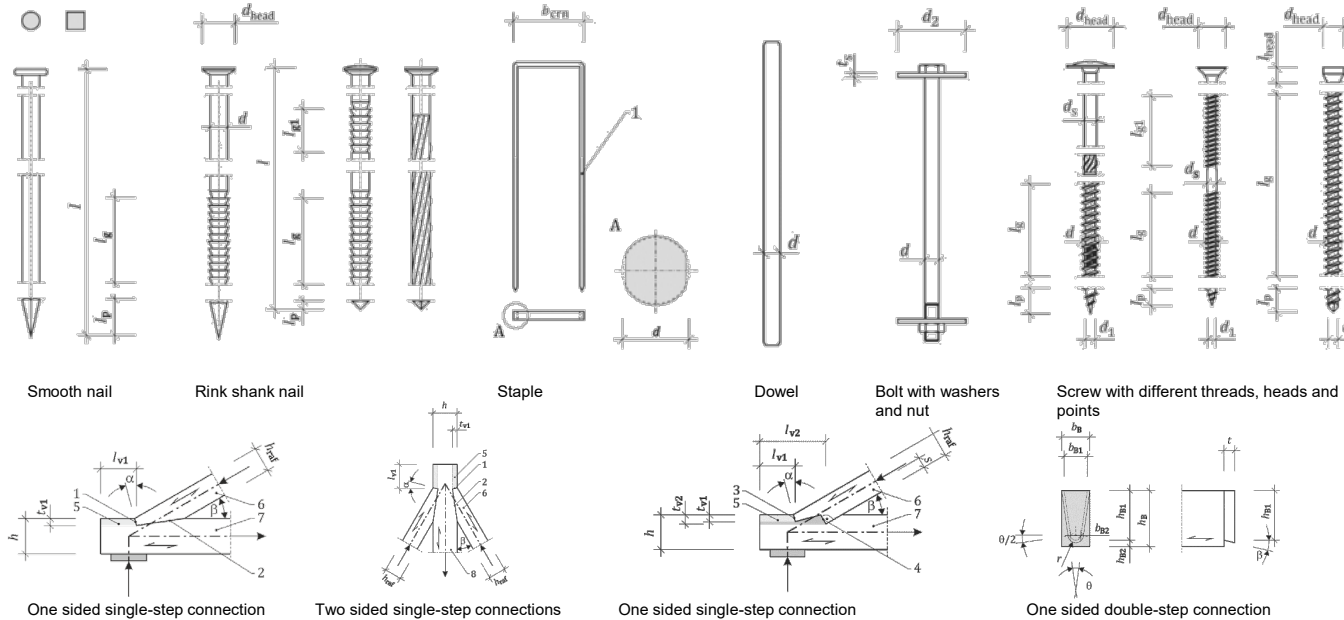
I-Joist

Source: dataholz.eu



prEN 1995-1-1: General rules and rules for building

■ A variety of connection types

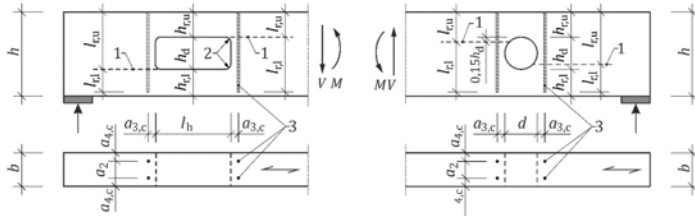


Source: prEN 1995-1-1:2023



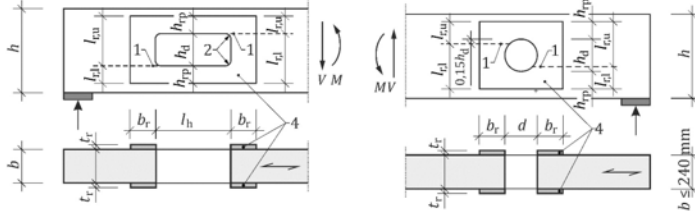
prEN 1995-1-1: General rules and rules for building

- new content, e.g. holes in beams and reinforcement



a) Rectangular hole with internal dowel-type reinforcement

b) Circular hole with internal dowel-type reinforcement



c) Rectangular hole with external plane reinforcement

d) Circular hole with external plane reinforcement



Source: Zukunft Bau Project SWD-10.08.18.7-17.22

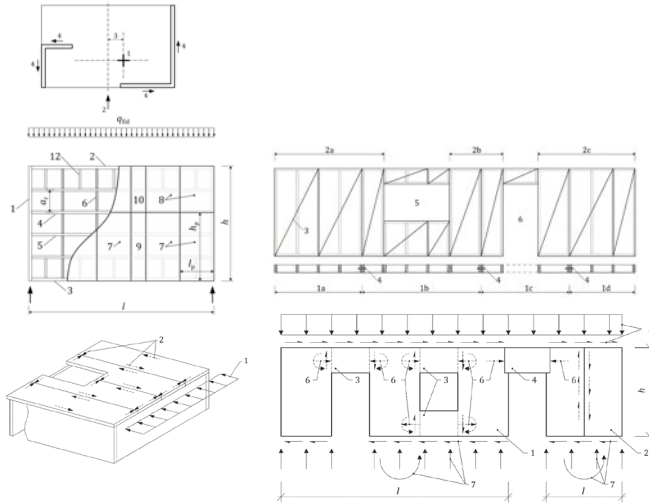
Source: prEN 1995-1-1:2023



prEN 1995-1-1: General rules and rules for building

■ Diaphragms

- Eccentricities in the ground plan
- Floors, roofs and walls



Source: prEN 1995-1-1:2023

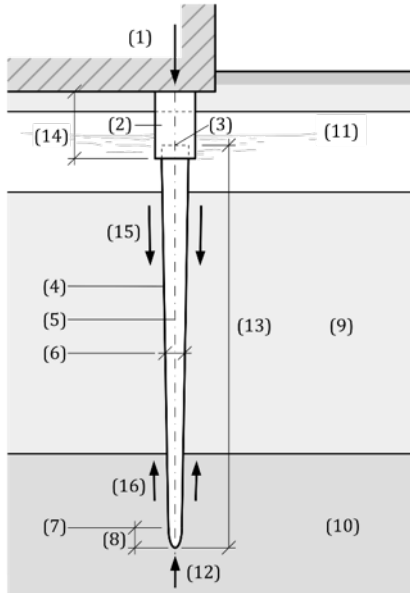


Kampa K8, Aalen, GER. Source: Thomas Wellner, Kampa

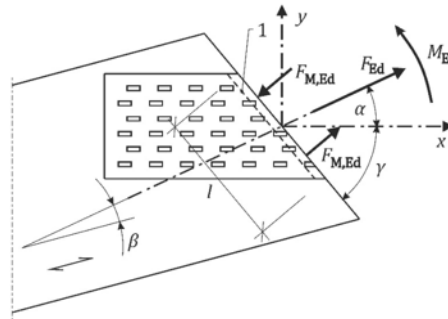


prEN 1995-1-1: General rules and rules for building

- Outsourcing of very specific design rules to normative Annexes:
e.g. foundations with timber piles and connections with punched metal plate fasteners



Source: prEN 1995-1-1:2023



Source: prEN 1995-1-1:2023



prEN 1995-1-2: Fire design

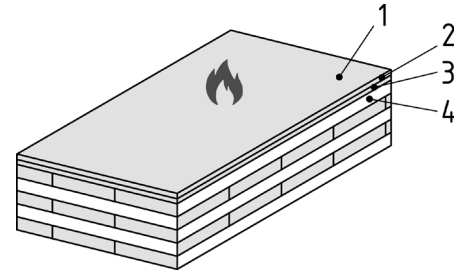


Cross laminated timber before (left) and after (right) a 30 minutes fire occasion



prEN 1995-1-2: Fire design

- Extension of design rules for:
 - Effective cross-section method (application i.e. on timber I-joists, cross laminated timber, timber-concrete composite elements, etc.)
 - Design model for the verification of the separating function of wall and floor assemblies
 - Failure time (falling off) of the fire protection system

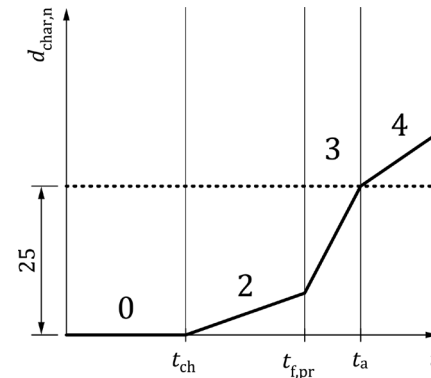


Source: prEN 1995-1-2:2023



prEN 1995-1-2: Fire design

- Revision of design rules for:
 - Charring
 - Timber-frame assemblies
 - Connections in fire
 - Detailing
 - Design of timber structures exposed to physically based design fires



b) Initially protected sides of timber members
when $t_{f,pr} > t_{ch}$

Key

- 0 encapsulated phase (Phase 0)
- 1 normal charring phase (Phase 1)
- 2 protected charring phase (Phase 2)
- 3 post-protected charring phase (Phase 3)
- 4 consolidated charring phase (Phase 4)

Source: prEN 1995-1-2:2023



prEN 1995-1-3: Timber-Concrete composite structures



E3, Berlin. Source: Heinrich Kreuzinger



prEN 1995-1-3: Timber-Concrete composite structures

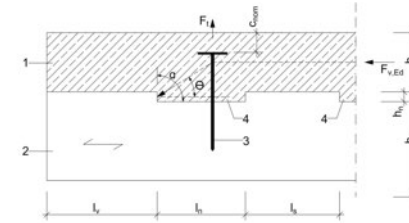


LCT one, Dornbirn, Austria. Source: Hermann Kaufmann ZT



prEN 1995-1-3: Timber-Concrete composite structures

- Pilot stage period as CEN/TS 19103
- Load-carrying capacity and slip modulus of connections made with:
 - Dowel-type fasteners
 - Bonded-in rods
 - Notched connections
- Modification of creep coefficients for composite action in slab systems and in beam systems
- Calculation method for the effect of inelastic strains



Key
1 concrete
2 timber
3 fastener loaded axially
4 notch

Figure 10.2 — Notched connection dimensions

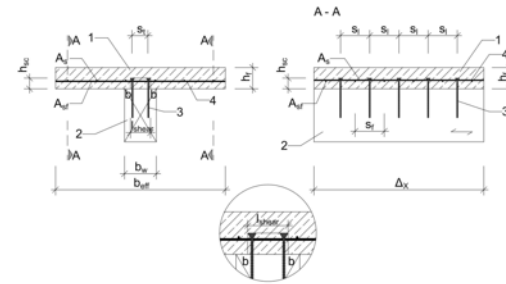


Figure 8.1 — The connection between flange and web

Source: CEN/TS 19103



prEN 1995-2: Bridges



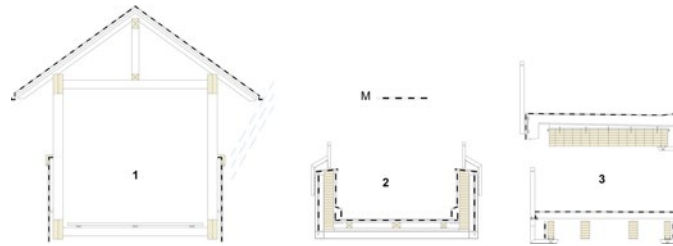
König-Ludwig-Brücke Kempten; Source: Stadt Kempten



prEN 1995-2: Bridges

■ Extension of design rules:

- Durability and detailing, sealing
- Deck plates
- Integral bridges



Source: prEN 1995-2:2023

■ Revision of design rules for:

- Timber-concrete composites (TCC)
- Laminated veneer lumber (LVL)
- Vibrations and damping
- Fatigue



Blockträgerbrücke Neckartenzlingen; Source: holzbrueckenbau.com @ Fotograf Walther



Sprengwerkbrücke Benneckenstein; Source: holzbrueckenbau.com



prEN 1995-3: Execution



Skaio Heilbronn, GER. Source: baurt Konstruktions GmbH&Co KG, Klaus Rainer Klebe



prEN 1995-3: Execution

- Execution rules on which Eurocode 5 design directly relies
 - Tolerances in connections
 - Tolerances for member dimensions
 - Tolerances of erected members
 - Moisture control



Source: Informationsdienst Holz

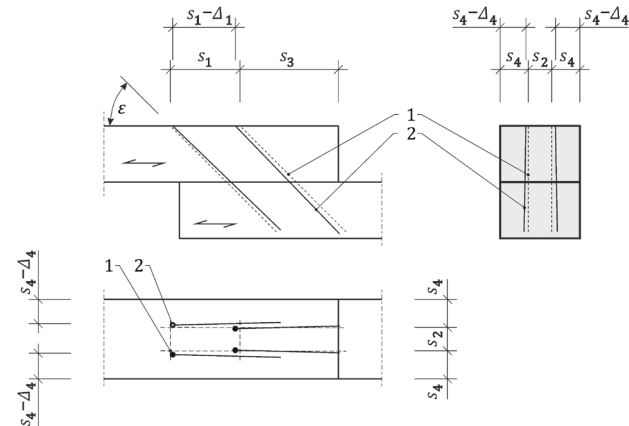


Figure 6.4 — Deviations $\Delta_{n,max}$ from the specified spacings, end and edge distances s_n (for screw axes at angle ϵ to the grain and parallel to the edge)

Source: prEN 1995-3:2023



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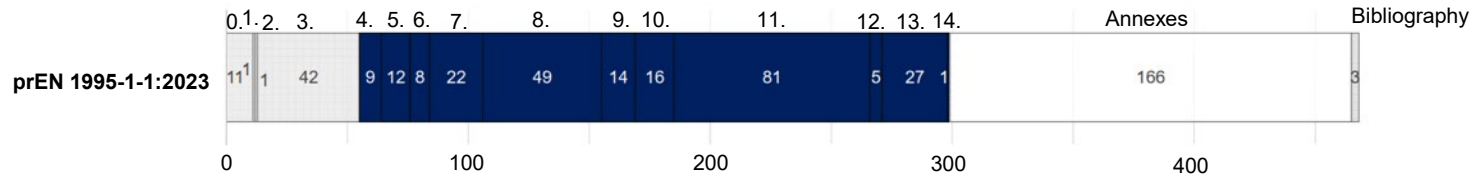


The second generation of Eurocode 5: A conclusion

■ Evolution of the document

EN 1995-1-1:2010	prEN 1995-1-1:2023
General	1. Scope
	2. Normative references
	3. Terms, definitions and symbols
Basis of design	4. Basis of design
Material properties	5. Materials
Durability	6. Durability
Basis of structural analysis	7. Structural analysis
Ultimate limit states	8. Ultimate limit states
Serviceability limit states	9. Serviceability limit states
	10. Fatigue
Connections with metal fasteners	11. Connections
Components and assemblies	12. Mechanically and glued webbed or flanged beams
	13. Diaphragms
	14. Foundations with timber piles
Structural detailing and control	10.
Annexes	Annexes
	Bibliography

244 pages
main text



The second generation of Eurocode 5: A conclusion



TUM kindergarden, Munich, GER. Source: Hermann Kaufmann ZT





Thank you for your attention.





Presented by
Stefan Winter
Chair of CEN/TC 250/SC 5

Technical University of Munich
TUM School of Engineering and Design
Chair of Timber Structures and
Building Construction
Arcisstraße 21
D-80333 Munich

Phone: +49.89.289.22416
Email: hbb@tum.de
www.cee.ed.tum.de/en/hbb