2023-2025

ADVANCE

ACCOMPANYING MEASURE FOR DISSEMINATION, VALORISATION AND COLLABORATIVE EXPLOITATION OF CIRCULARITY OF CONSTRUCTIONAL STEEL PRODUCTS

Recommendations for Reuse of Reclaimed Steel Products

Viorel Ungureanu

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2017-2020

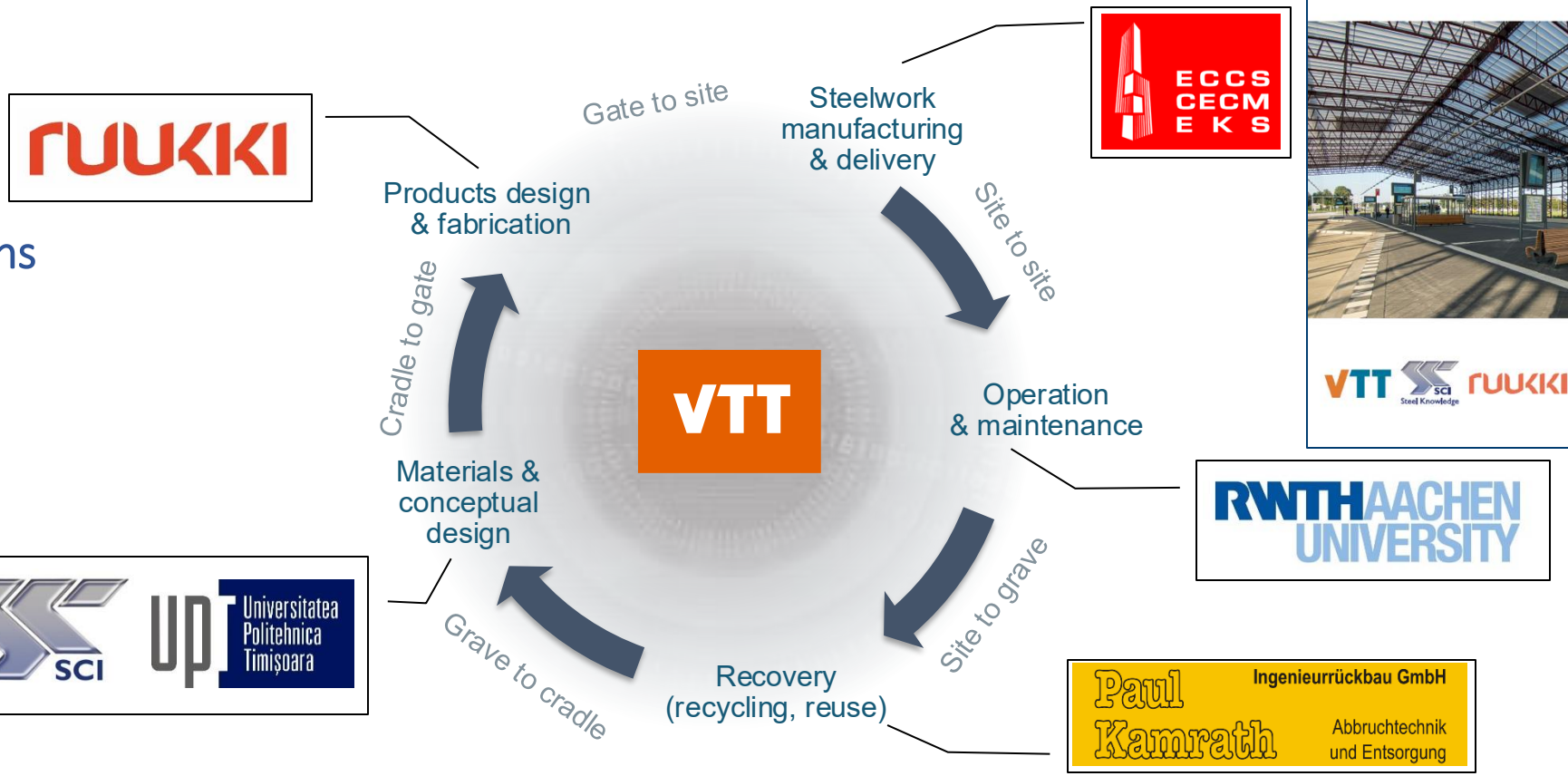
PROGRESS

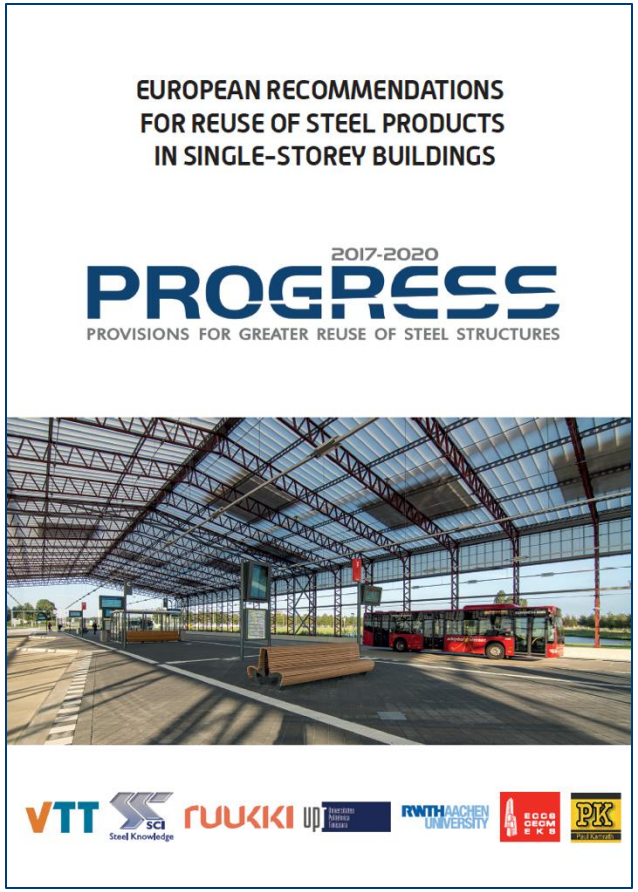
PROVISIONS FOR GREATER REUSE OF STEEL STRUCTURES

https://www.steelconstruct.com/eu-projects/progress/

- Budget 1 M€
- 7 partners

- Recommendations
- Methodologies
- Protocols
- Case studies





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Outcomes of PROGRESS project

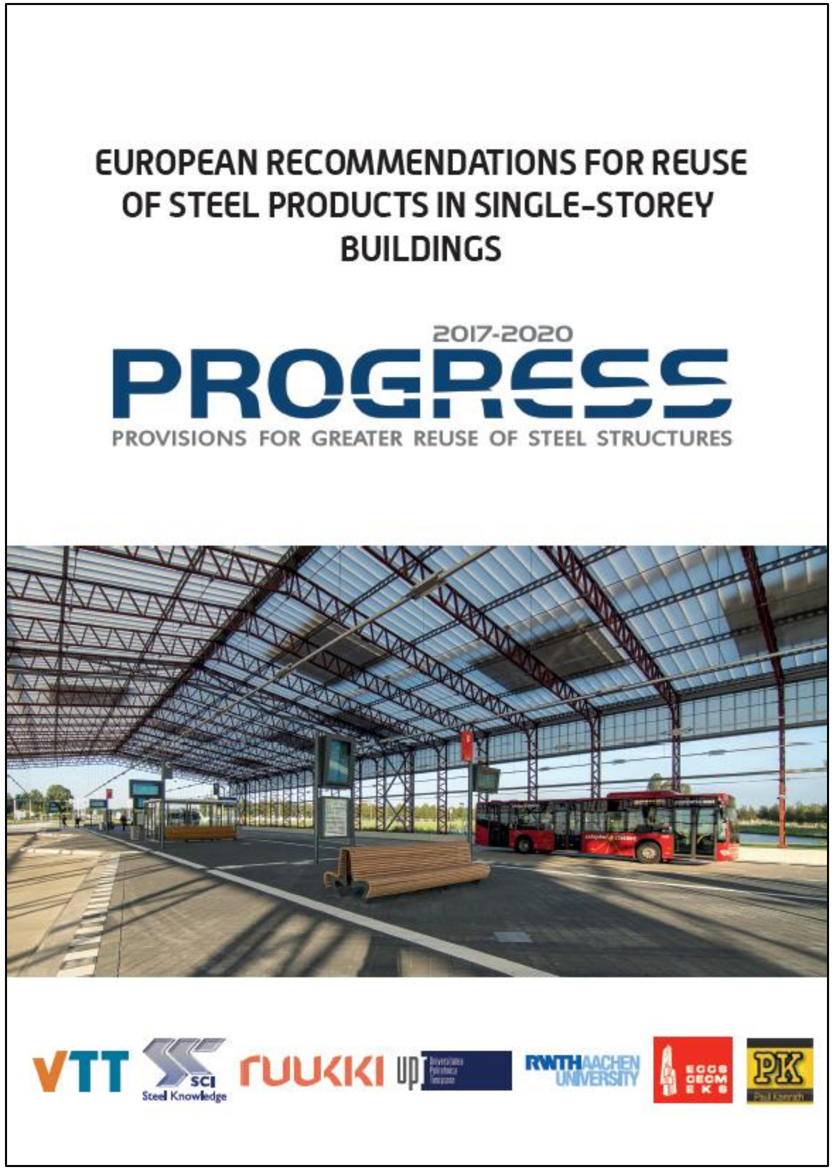
Design guides Design from reused elements
Design for deconstruction and reuse

Methodologies Assessment of reusability
Declaration of environmental impacts
Economic assessment

Protocols Pre-demolition inspection
Deconstruction protocol
Material testing protocol

Prototype tools Online trading portal
Mobile app

Case studies Testing of methods and protocols
Design for improved reusability
Design from reused elements



https://www.steelconstruct.com/eu-projects/progress/design-guide/

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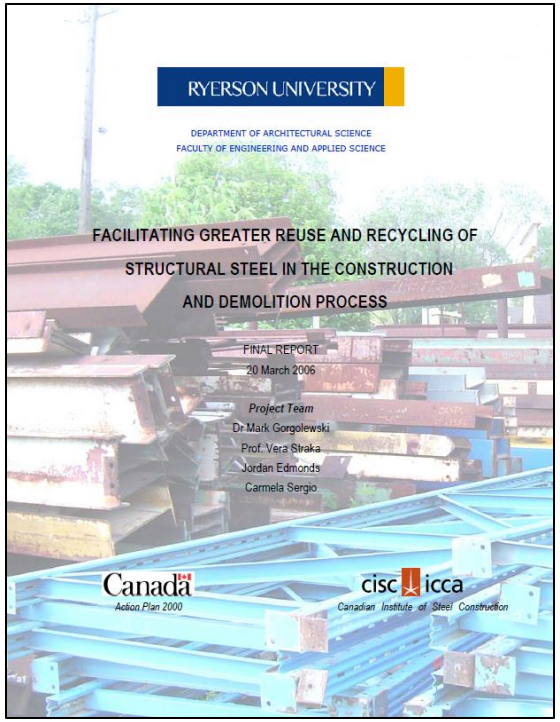
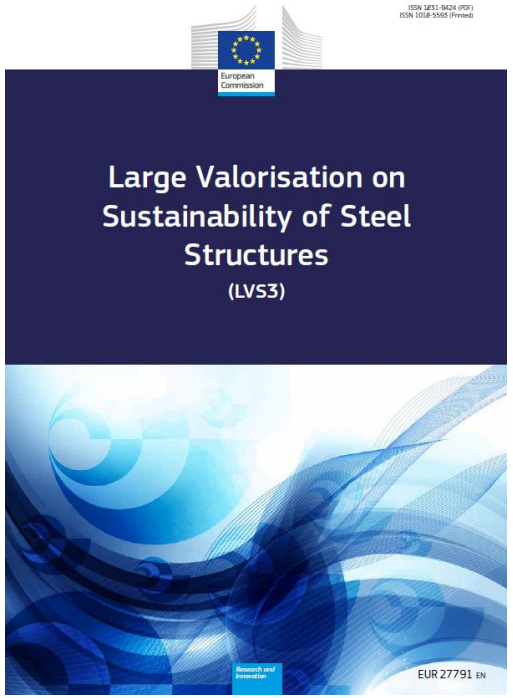
Background projects

- 2006: Facilitating Greater Reuse and Recycling of Structural Steel in the Construction and Demolition Process Methodologies
- 2013: Sustainable building project in steel (**SB_STEEL**)
- 2014: Large Valorisation on Sustainability of Steel Structures (**LVS3**)
- 2019: Reuse and demountability using steel structures and the circular economy (**REDUCE**)
- 2023: Delivering Innovative Steel Reuse Project (**DISRUPT**)





ASBP The Alliance for Sustainable Building Products

DISRUPT Delivering Innovative Steel ReUse ProjecT

DISRUPT PROJECT ON STEEL REUSE

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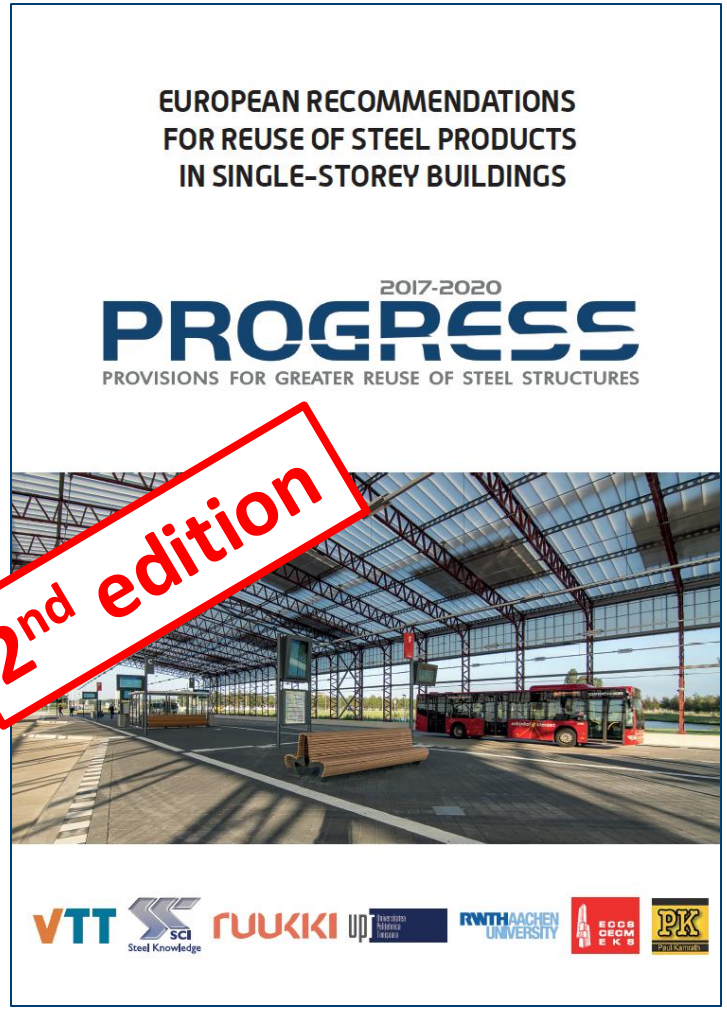
The Recommendations for Reuse of Constructional Steel Products

- based on PROGRESS guide for single storey buildings
- extended to cover all constructional steel
- shorter, more concise
- updated to reflect new standards and regulations



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The scope

limited to:

- Members to be reused should not be subjected to damages, inclusive plastic deformations, and reduced cross-sections (e.g. through holes, openings, cracks or excessive corrosion),
- All members to be reused should come from a building structure built with elements produced in or after 1970, which is about the time when the Limit State Design became common practice,
- All salvaged primary members are rolled steel sections. Welded and built-up members are not included in the scope of this document,
- For the members to be reused, they must be recovered as much as possible in their original shape, although some additional fabrication and preparation work may be required.

The recommendations

- **Volume 1: Reusing existing steel products and buildings,**
- **Volume 2: Building design recommendations to facilitate future deconstruction and reuse,**
- Volume 3: Environmental aspects and practical implementation.

Part 1: Reuse of existing steelwork

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Picture credits: Politehnica University Timisoara

- Historical review of codes of practice and product standards
- Evaluation of structural reusability
- Practical implementation of steel reuse
- Structural analysis and design for existing steelwork

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Part 2: Design for future reuse

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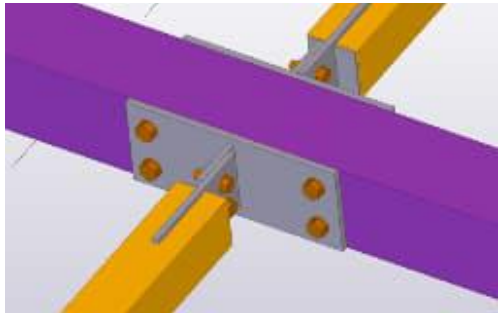
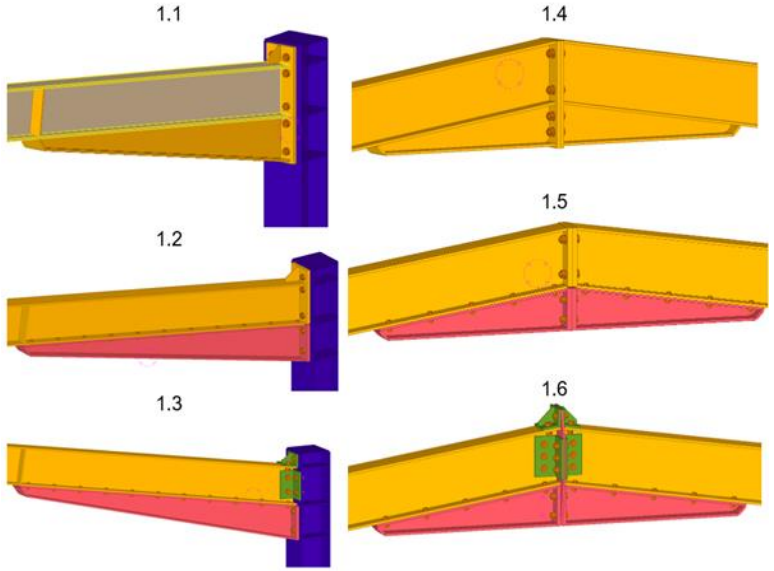
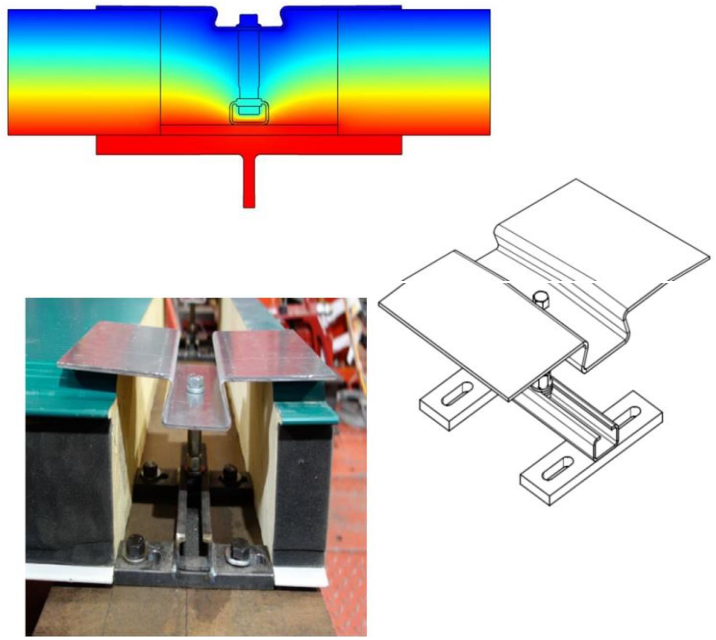


Picture credits: Ruukki Construction



Picture credits: Politehnica University Timisoara



Picture credits: RWTH Aachen University

- Recommendations for buildings designed to be reused
- Loading and combination of actions
- Reuse through design and better construction details

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Volume 1: Reusing existing steel products and buildings

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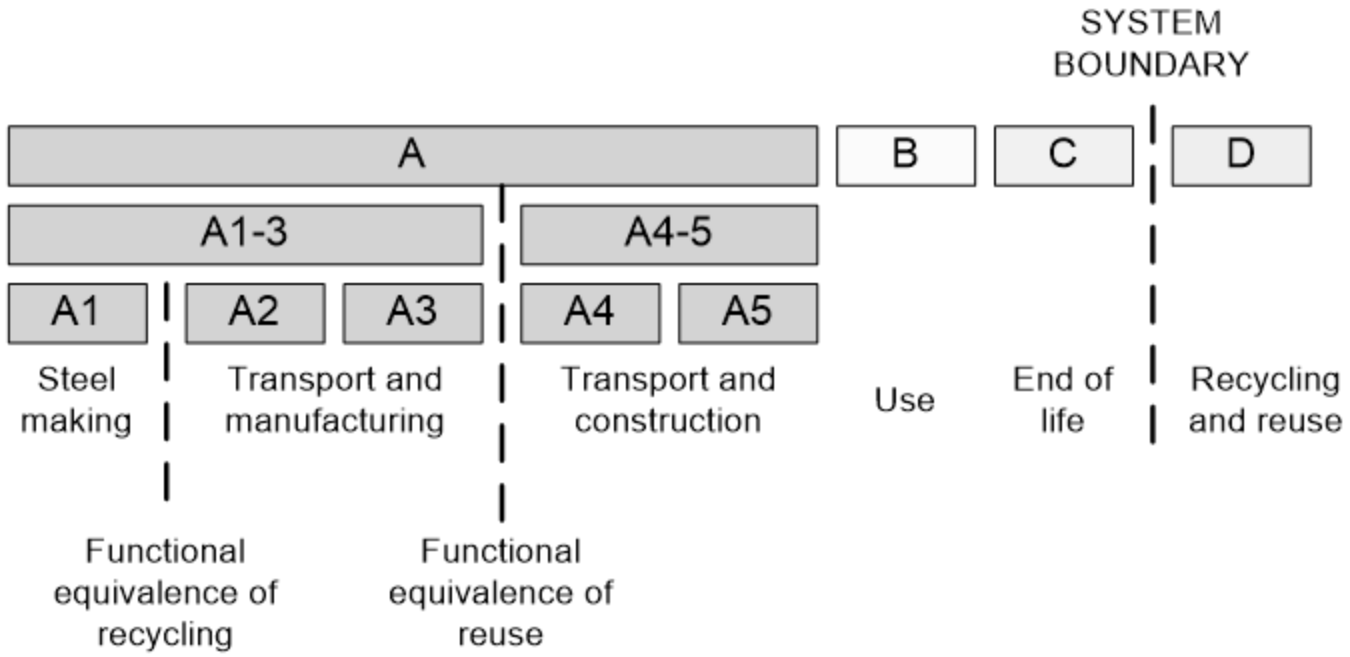
Classification of steel reuse

Life cycle stages of constructional steel components



A: Product and construction stage

A_0: Pre-construction stage

A_1: Raw materials supply

A_2: Transport

A_3: Manufacturing

A_4: Transport

A_5: Construction-installation process

B: Use stage

B_1: Use

B_2: Maintenance

B_3: Repair

B_4: Replacement

B_5: Refurbishment

C: End-of-life stage

C_1: Deconstruction, demolition

C_2: Transport

C_3: Waste processing

C_4: Disposal

D: Reuse, recovery and recycling potential

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Classification of steel reuse

Reuse scenarios

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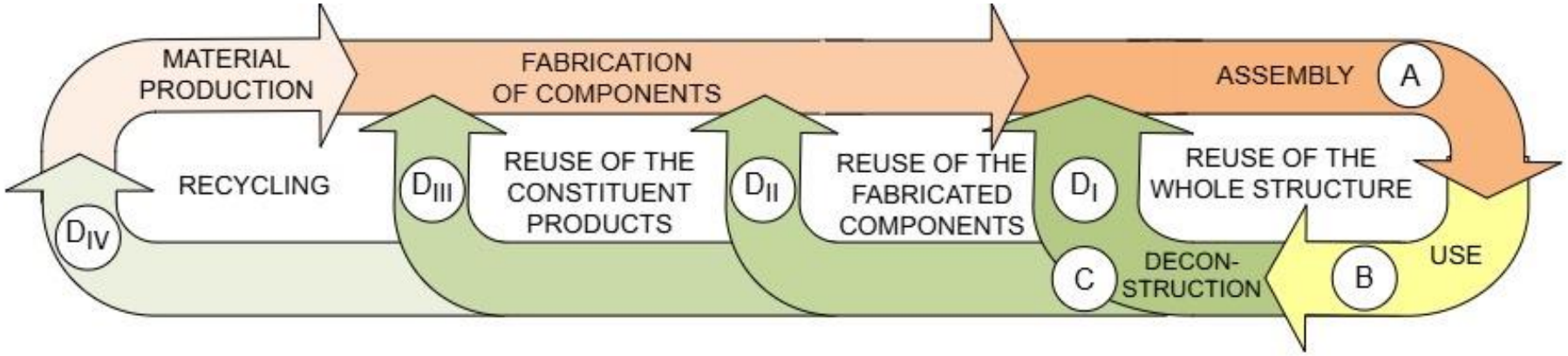

D_0: Reuse of the entire steelwork or its part (e.g., several bays) in-situ without disassembly,
D_I: Reuse of the disassembled steelwork (may include the envelope),
D_{II}: Reuse of the fabricated components (e.g. sandwich panels, columns),
D_{III}: Reuse of the constituent products (e.g. sections, plates).

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Classification of steel reuse

Reuse scenarios

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Case	In-situ reuse	Relocated reuse			
		Same site		Different site	
		Same configuration	Different configuration	Same configuration	Different configuration
Entire steelwork	$D_{0\text{-}A}$	-[a]	-	$D_{0\text{-}D}$[b]	-
Disassembled steelwork	-	$D_{I\text{-}B}$	$D_{I\text{-}C}$	$D_{I\text{-}D}$	$D_{I\text{-}E}$
Fabricated components	-	$D_{II\text{-}B}$	$D_{II\text{-}C}$	$D_{II\text{-}D}$	$D_{II\text{-}E}$
Constituent products	-	$D_{III\text{-}B}$	$D_{III\text{-}C}$	$D_{III\text{-}D}$	$D_{III\text{-}E}$

[a] This scenario is unlikely since if the structure was deconstructed, it is unlikely that it would be re-erected in the same configuration on the same site;
[b] Only the case of single-storey steel buildings.

D_A: In-situ reuse without disassembly,

D_B: Reuse on the same site in the same configuration,

D_C: Reuse on the same site in different configuration,

D_D: Reuse on a different site in the same configuration,

D_E: Reuse on a different site in different configuration.

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Evaluation of structural reusability (Ch 5)

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- **Parameters influencing reusability** - free of deterioration (should not have significant imperfections or permanent deformations, nor local damages, including plastic deformations, and reduced cross sections and should not have been subjected to extreme events such as impact, or fatigue, or be damaged by fire),
- **Structural steel for reuse**,
- **Constituent products**,
- **Structural components or entire primary structure**,
- **Cold-formed structural steelwork elements**,
- **Composite floor decking**,
- **Claddings**.

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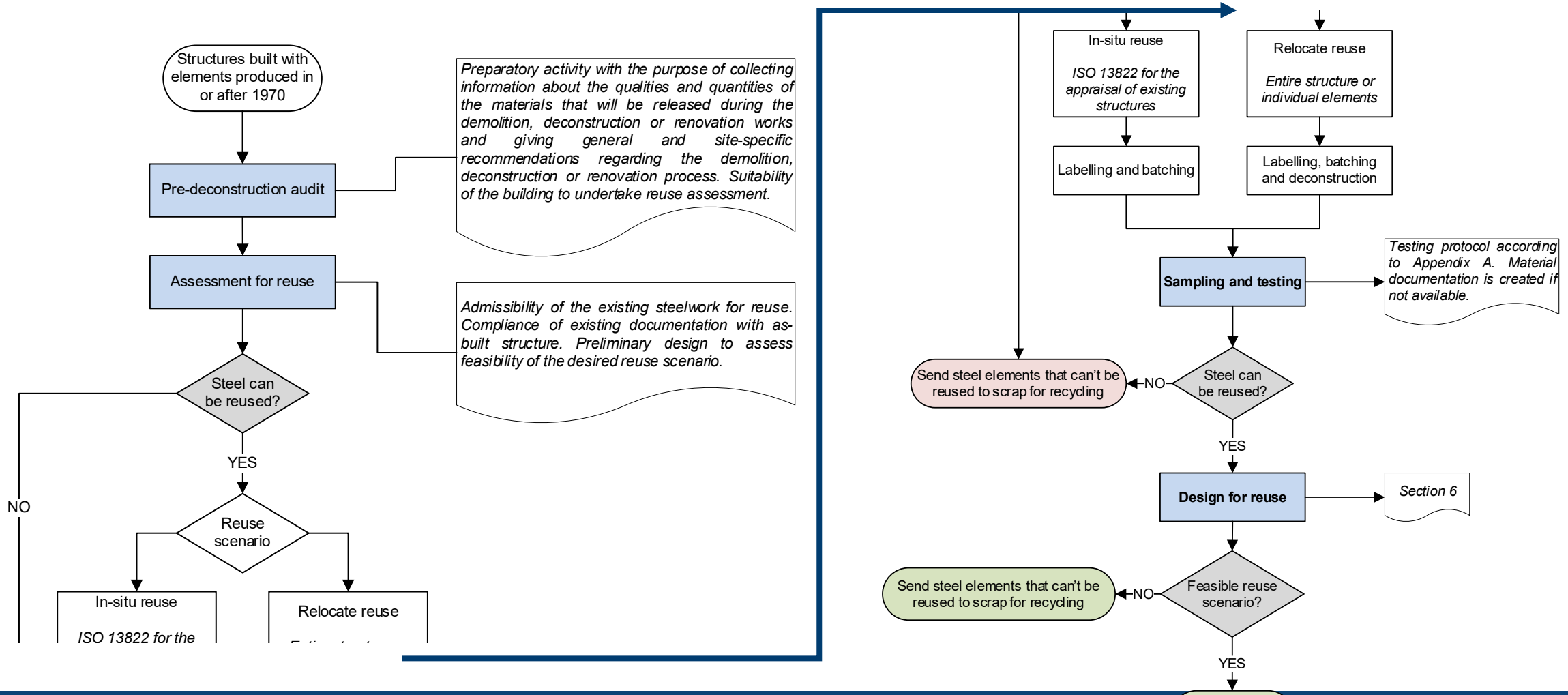
Evaluation of structural reusability

General approach



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Classification of reclaimed steelwork

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- **Class A**: steel materials that meet performance requirements and with approved quality assurance from original certificates;
- **Class B**: steel materials that meet all performance requirements through comprehensive material testing (see Appendix A) and with approved quality assurance, i.e. certificates of compliance to the relevant European Product Standards, by re-certification;
- **Class C**: steel materials classified as the most conservative grade according to the age and location of the structure (unidentified steel).

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Material performance requirements
Steel properties to be declared for hot rolled steel reclaimed elements

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Strength

Elongation

Tolerances on dimensions and shape

Through thickness requirements

Impact strength or toughness

Heat treatment delivery condition

Declaration of chemical composition

clause 5.1 of EN 1090-2

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Assessment of material properties

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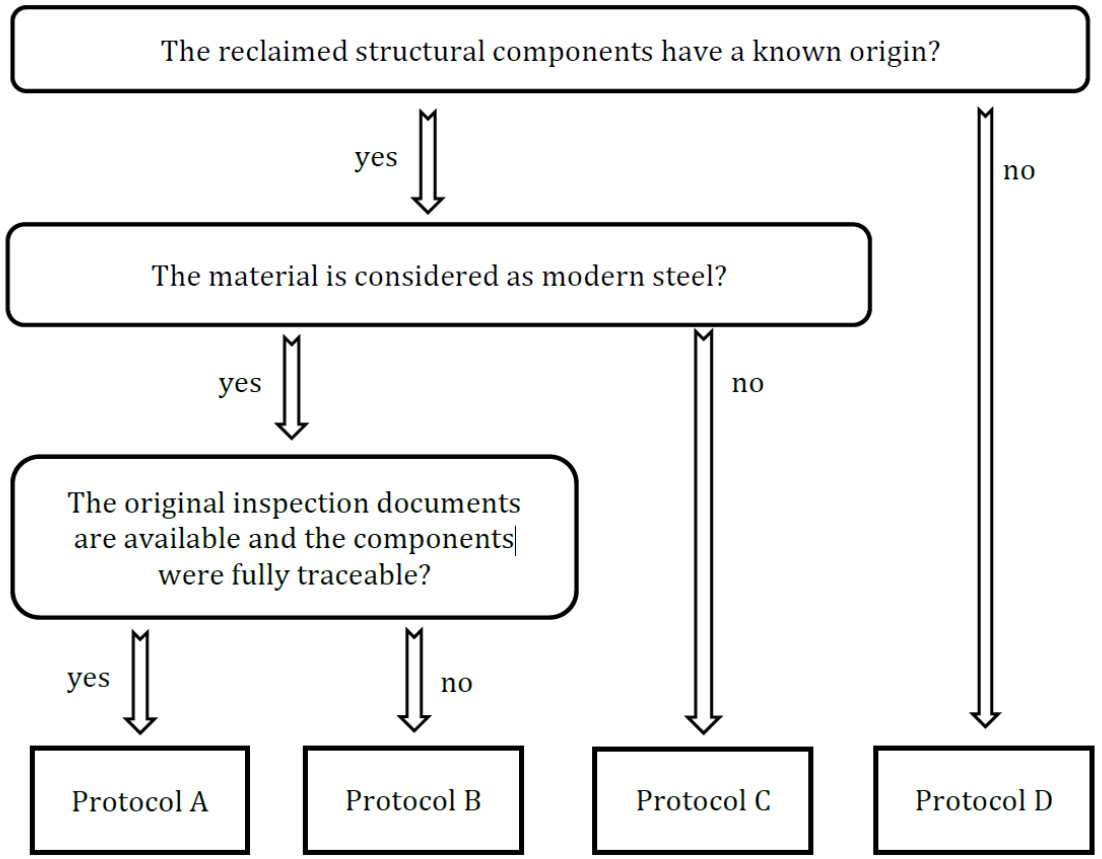
CEN/TS 1090-201: Execution of steel structures and aluminium structures - Reuse of structural steel

Protocols A to D, are defined for the assessment of material properties:

- **Protocol A**: Documentation available (Type 1 structural steel with original inspection documents);
- **Protocol B:** Single sample DT (Type 1 structural steel with known provenance);
- **Protocol C:** Statistically representative DT (Type 2 structural steel with known provenance);
- **Protocol D:** Comprehensive DT (Structural steel with unknown provenance).



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Assessment of material properties

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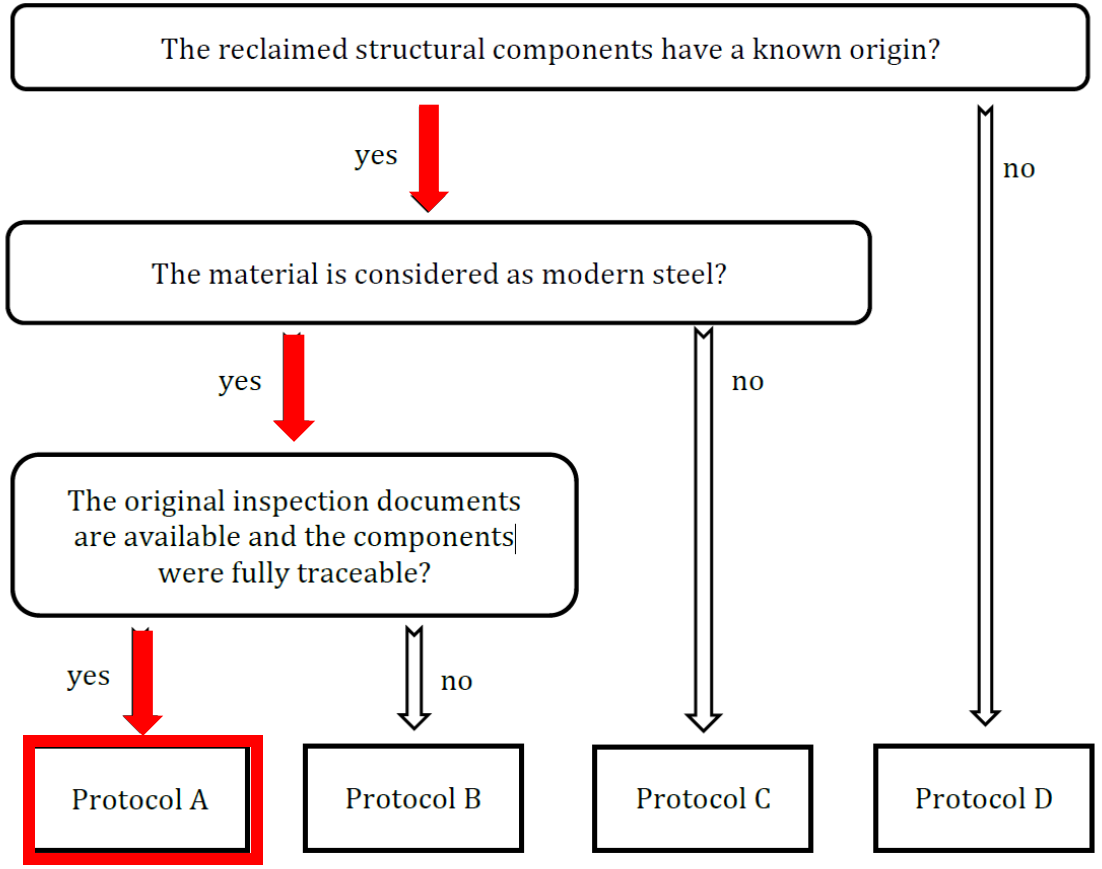
Protocol A: Documentation available (Type 1 structural steel with original inspection documents) covers the case of products that are traceable and for which the original documentation is available. According to Protocol A, steel material can be designed according to EN 1993, as the appropriate assessment of adequacy and reliability is justified by existing documentation. An optional minimal testing procedure for Class A steel can be used to confirm the grade of the reclaimed steel.



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Assessment of material properties

CEN/TS 1090-201: Execution of steel structures and aluminium structures - Reuse of structural steel

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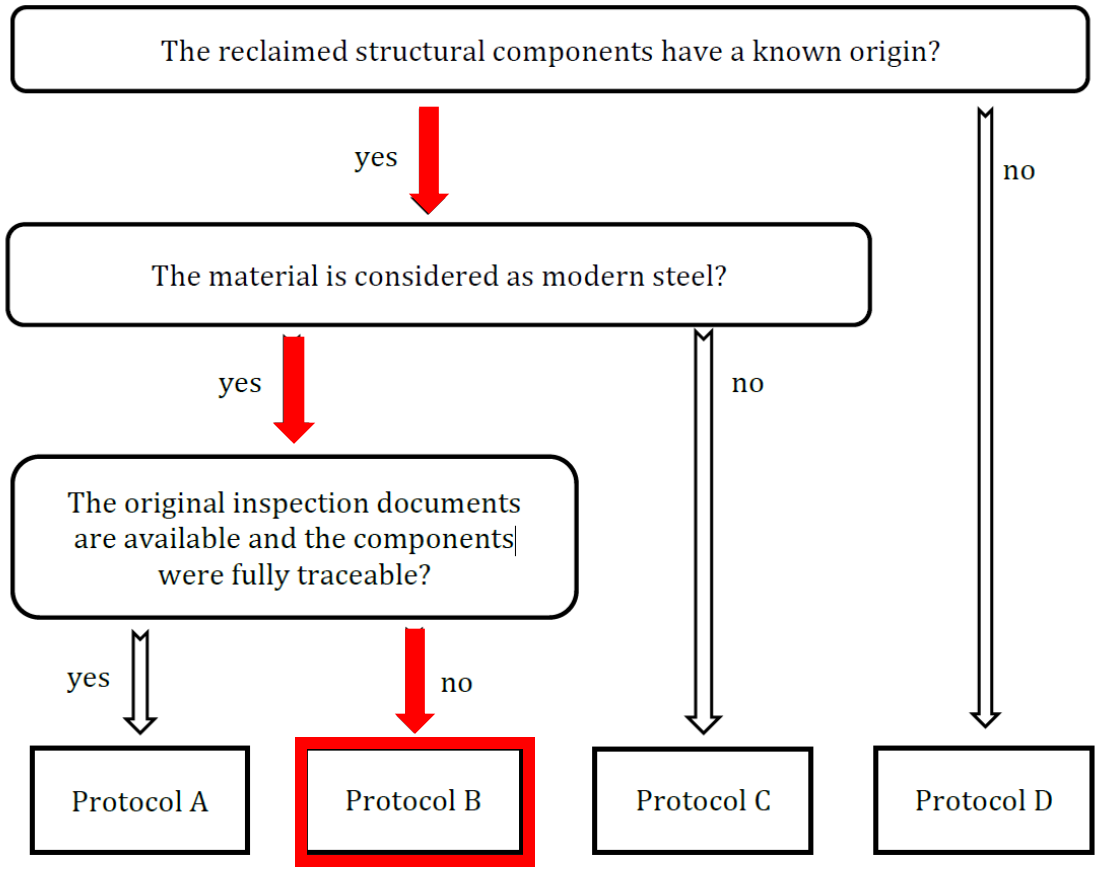
Protocol B: Single sample DT (Type 1 structural steel with known provenance). An important distinction is made regarding the age of the material that is assessed. Components that were produced more recently are indeed likely to have properties, including their variability, matching those assumed in design with current steel grades. These can be assessed based on a single test (Protocol B).

When protocol B is applied, the properties assigned to all members of a valid test unit can be declared as a reference to a steel grade. The requirements on yield and ultimate strength above represent the 95% fractiles based on the means and variances given in Annex E of EN 1993-1-1.



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Assessment of material properties

CEN/TS 1090-201: Execution of steel structures and aluminium structures - Reuse of structural steel

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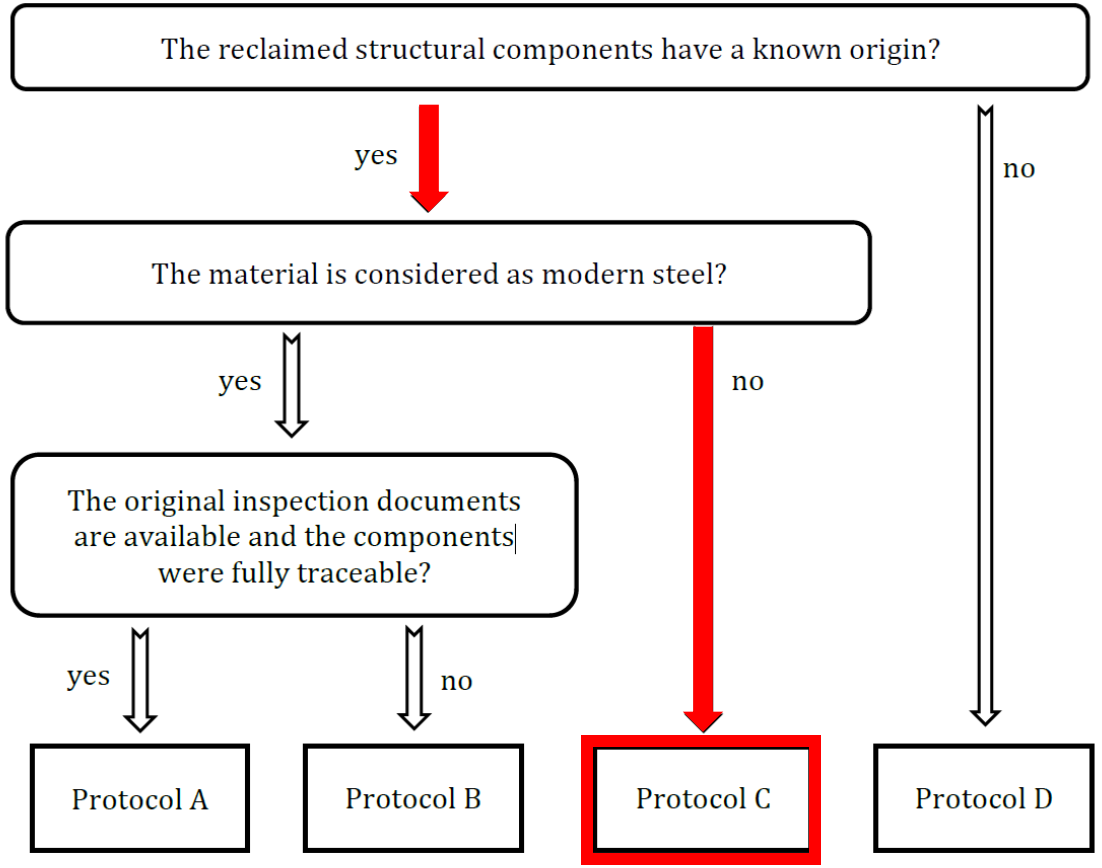
Protocol C: Statistically representative DT (Type 2 structural steel with known provenance). When protocol C is applied, the characteristic properties assigned to all members of a valid test unit may be based on a statistical analysis in accordance with EN 1990.

For Protocols B and C, the material is shown to comply with the performance requirements through comprehensive material testing (see Appendix A). The testing procedure comprises a combination of non-destructive and destructive tests, together with inspection of geometric tolerances.



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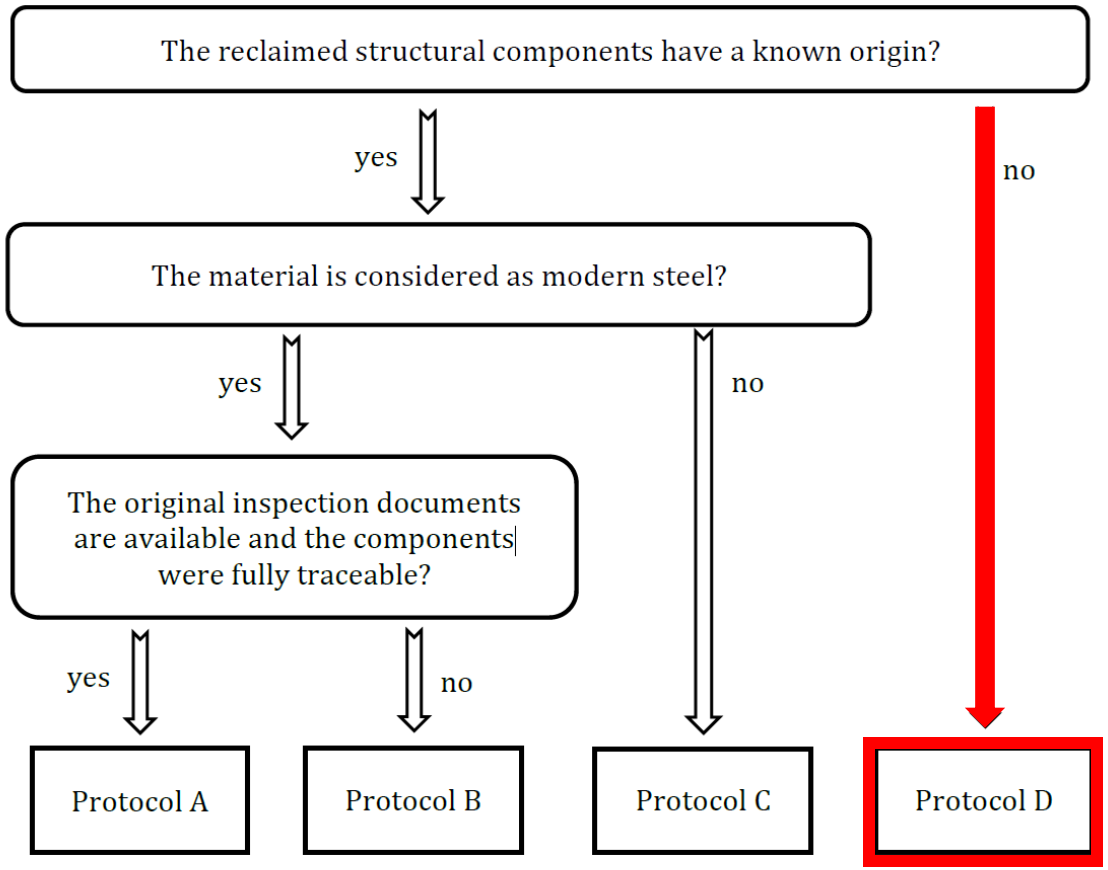
Assessment of material properties

CEN/TS 1090-201: Execution of steel structures and aluminium structures - Reuse of structural steel

Protocol D: Comprehensive DT (structural steel with unknown provenance). Protocol D requires that the components are tested individually with destructive methods. The test results can then be used directly, as characteristic values, or compared with the nominal values in a relevant product standard. When the provenance of the reclaimed products is known, components can be sorted in test units and non-destructive hardness testing is performed on all members of a test unit to safely select the members for destructive testing.

As an alternative, if the reclaimed steel material remains unidentified steel, free of damaging defects, it may be permitted to be used for non-safety critical structures.



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Constituent products

Form	Dimensions	Tolerances	Material quality	
			Non-alloy steels	Weathering steels
I and H sections	EN 10365	EN 10034		
Hot-rolled taper flange I sections	EN 10365	EN 10024		
Channels	EN 10365	EN 10279		
Rolled asymmetric beams	*See manufacturers' information.*			
Angles	EN 10056-1	EN		
Rolled Tees	EN 10055	EI		
Fabricated sections and member bow imperfections	–	EN		
Plates (reversing mill) (c)	–	EI		
Plates (cut from coil) (c)	–	EI		

(a) Steel grades S235, S275, S355 and S450. The steel grac
JR, J0 and J2. The steel grade S355 may be supplied in qu
is supplied in quality J0.
(b) Steel grades S235 and S355. The steel grade S235 may be supplied in qualities J0W and J2W. The steel grade S355 may be supplied in qualities J0W, J0WP, J2W, J2WP and K2W.
(c) The scope of EN 10029 covers plates of 3 mm up to 250 mm rolled in a reversing mill process, whereas EN 10051 covers plates up to 25 mm de-coiled continuously hot-rolled uncoated flat products.

Form(a)	Dimensions and tolerances	Material quality
Hollow sections (hot finished)	EN 10210-2	EN 10210-1
Hollow sections (cold formed)	EN 10219-2	EN 10219-1

(a) Hollow sections for use in constructional steelwork (both hot finished and cold formed) are supplied in steel grade S235 in quality JRH, steel grade S275 in qualities J0H and J2H, and S355 in qualities J0H, J2H, and K2H.
Note: Selection of either EN 10210 or EN 10219 specifies whether structural hollow sections are to be hot finished or cold formed. Hot finished structural hollow sections to EN 10210 cannot be directly replaced with cold formed structural hollow sections to EN 10219 as the properties do not correspond directly.

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Constituent products.
Procedure for verification

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- Documentation showing the **location** and building structure from where the members were recovered, including the **date** of construction of the original building, should be provided for all members,
- All products to be reused should come from a **structure constructed with elements produced in or after 1970** that was not exposed to extensive dynamic loading and other severe conditions,
- All surfaces should be **visually inspected**, to ensure that the steel surfaces are free of rust, and that there is no excessive corrosion.
- **Coatings containing toxic substances**, e.g., lead, cadmium, asbestos, and surface scaling need to be removed,
- Members from reclaimed steel should **not** include **welded splices** (unless the welds are tested) and should not have **hole**s in locations where new holes are to be drilled in the member,
- **Sectional dimensions** (if not known) should be **measured** and the **sections classified**,
- For open cross-sections (wide flange H and I- section beams), EN 10034 specifies tolerances on shape dimensions of these members.

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Constituent products.
Procedure for verification

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- For closed cross-sections that are Circular Hollow Sections (CHS) and Square (SHS) and Rectangular Hollow Sections (RHS), EN 10219-2 specifies tolerances on shape dimensions of cold-formed structural hollow sections, while EN 10210-2 specifies tolerances on shape dimensions of hot finished structural hollow sections.
- **Tolerances** on the member straightness should comply with **EN 1090-2** and for CHS and RHS should comply with **EN 10219-2** and **EN 10210-2**.
- The members should have a **smooth surface**. Surface defects may be removed by grinding, provided that the thickness(es) of the cross-section after the repair is not less than the minimum permissible thickness. Diffuse necking is not permitted for example in connections and elements in tension,
- Reclaimed sections that are outside economic repair/reconditioning should be **scrapped**,
- Reclaimed structural steel should be **classified for design purposes** – Class A to C.

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Structural components or entire primary structure. Acceptance criteria for reuse

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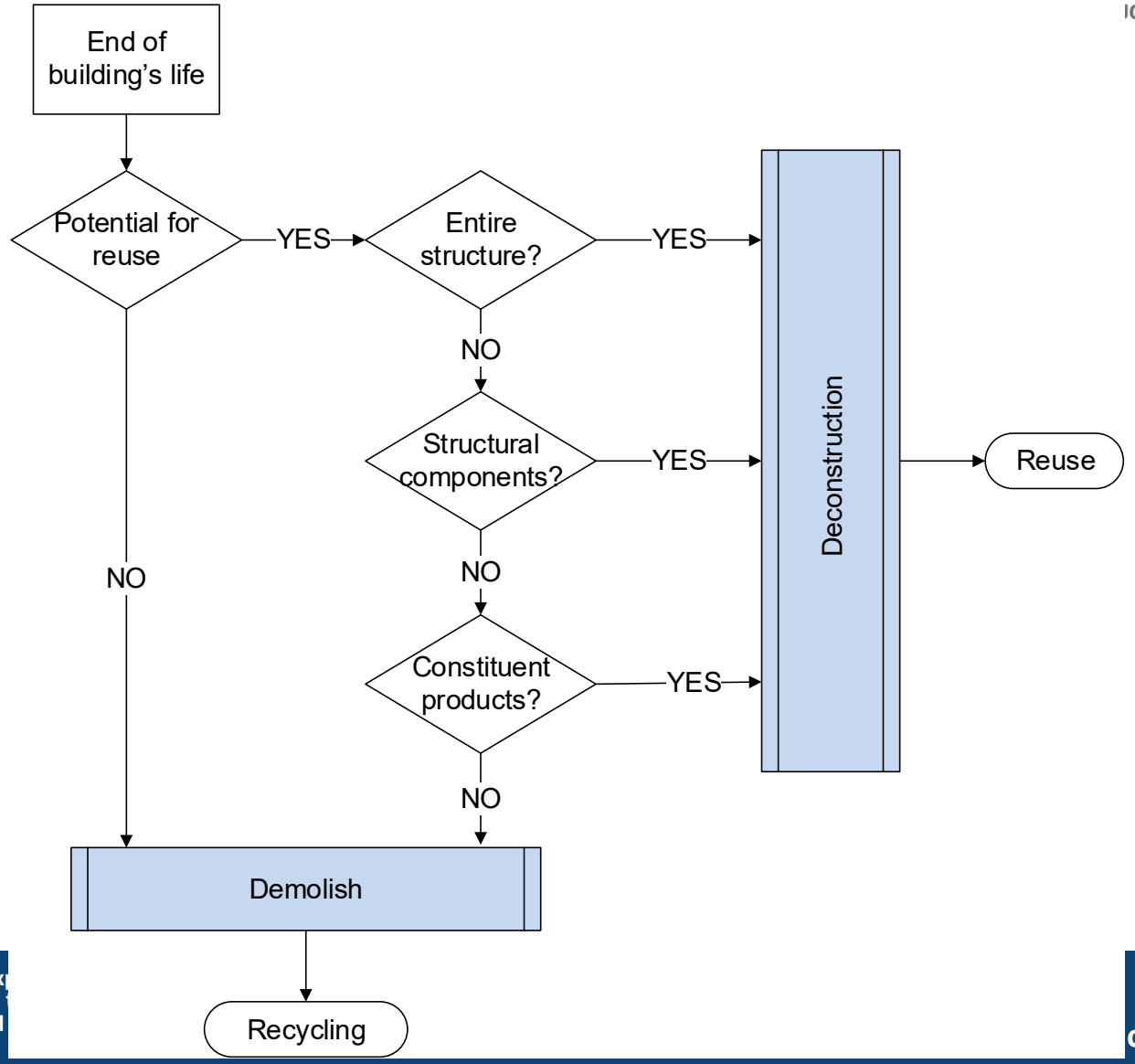

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Structural components or entire primary structure. Acceptance criteria for reuse

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- The structural components, or the entire primary structure, should belong to a steel building **constructed after 1970, using elements manufactured in or after that year**, and must not have been subjected to significant dynamic loading or other extreme conditions,
- All reclaimed steel should be **certified** to the section properties and classified – Class A to C,
- First, the individual structural members are **evaluated** to demonstrate compliance with the requirements, such as **material properties, geometry and structural characteristics**,
- In addition, all welds should be **100% visually inspected** throughout their entire length for surface imperfections. The visual inspection should be carried out before any other NDT inspection. If surface imperfections are detected, additional surface testing by liquid penetrant testing or magnetic particle inspection should be carried out on the inspected weld.
- Existing **bolts** from previous applications **should not be reused**,
- In case of remanufacturing, the reused steel component / detail / structural component or module / primary structure can be **CE marked to EN 1090-1**.

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Content

- **Loads / combinations**
- **Single-storey steel structures**
  - Portal frame
  - Trusses
  - Column connection to foundations
- **Multi-storey steel buildings**
  - Details
  - Demountable composite steel-concrete structures
  - Demountable steel-timber structures
  - Energy dissipation connections
- **Summary**

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Loads

- The imposed loads on roofs (category H) are specified in Clause 6.3.4.2 (1) of EN 1991-1-1 and countries NAs.

Country	q_k (kN/m^2)	Q_k (kN)
Belgium	0.80	1.5
Czech Republic	0.75	1
Finland	0.40	1
France	0.80	1.5
Germany	–	1
Ireland	0.6	1
Italy	0.40	1
The Netherlands	1.00	1.5
Norway	0.75	1.5
Portugal	0.40	1
Romania	0.50	1
Slovakia	0.75	1
Spain	0.40	1
Sweden	0.40	1
United Kingdom	0.60	0.9

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Loads

EN 1991 Part 1-3 divides Europe into nine different climatic regions and defines zones to compute sk as a function of the altitude.

Country	s_k (kN/m^2)			Snow Class
	Min. [a]	Country average [b]	Min. European value	
Finland	2.00	2.75	2.00	S1
Romania	1.50	2.00		
Norway	1.50	3.50		
Sweden	1.50	2.50		
Germany	0.45	0.85	1.00	S2
Italy	0.60	1.00		
United Kingdom	0.45	0.65	0.70	S3
France	0.45	0.65		
Ireland	0.40	0.55		
The Netherlands	0.70	0.70		
Belgium	0.70	0.70		
Portugal	0.10	0.30	0.40	S4
Spain	0.30	0.40		

[a] Assuming the average altitude for the less critical zone of the country

[b] Assuming the average altitude for the zone representing most area of the country

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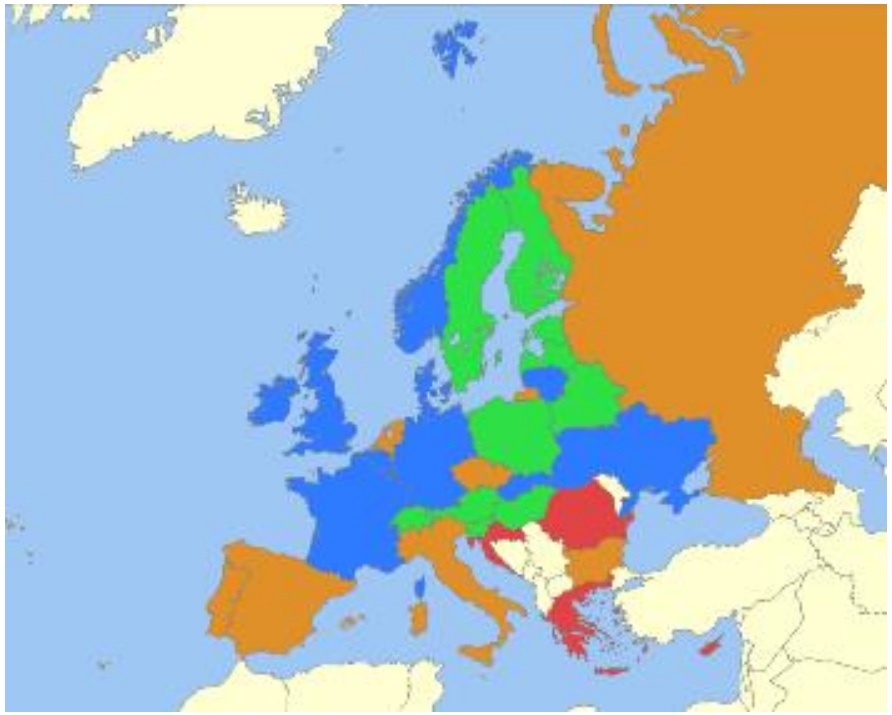
Loads

- The basic wind velocity is defined in Clause 4.2 of EN 1991-1-4.

Country	v_{b0} (m/s)			$q_{b0,mean}$ (kN/m²)	$v_{b0,class}$ (m/s)	$q_{b,class}$ (kN/m²)	Wind Class
	Min.	Max.	Average				
Croatia	20	48	29	1.05	>28	1.05	W1
Cyprus	24	40	29	1.05	>28		
Greece	27	33	29	1.05	>28		
Romania	27	35	31 a)	1.20	>28		
Bulgaria	24	36	27	0.91	28	0.98	W2
Czech Republic	23	36	27	0.91	28		
Italy	25	31	27 a)	0.91	28		
The Netherlands	25	30	27 a)	0.91	28		
Portugal	27	30	27 a)	0.91	28		
Russia	20	44	27	0.91	28		
Spain	26	29	27 a)	0.91	28		
Belgium	23	26	24	0.72	26	0.85	W3
Denmark	24	27	25	0.78	26		
France	22	28	24 a)	0.72	26		
Germany	23	30	25 a)	0.78	26		
Ireland	25	28	26	0.85	26		
Lithuania	24	32	26	0.85	26		
Luxemburg	24	24	24	0.72	26		
Norway	22	31	25	0.78	26		
Slovakia	24	26	24	0.72	26		
United Kingdom	22	32	25 a)	0.78	26		
Ukraine	24	31	26	0.85	26		
Austria	18	28	21	0.55	23	0.66	W4
Belarus	22	24	22	0.61	23		
Estonia	21	21	21	0.55	23		
Finland	21	26	22 a)	0.61	23		
Hungary	24	24	23	0.66	23		
Latvia	21	27	23	0.66	23		
Poland	22	26	23	0.66	23		
Slovenia	20	30	23	0.66	23		
Sweden	21	26	22	0.61	23		
Switzerland	20	24	21	0.55	23		

a) Usual value from the NA/local standard



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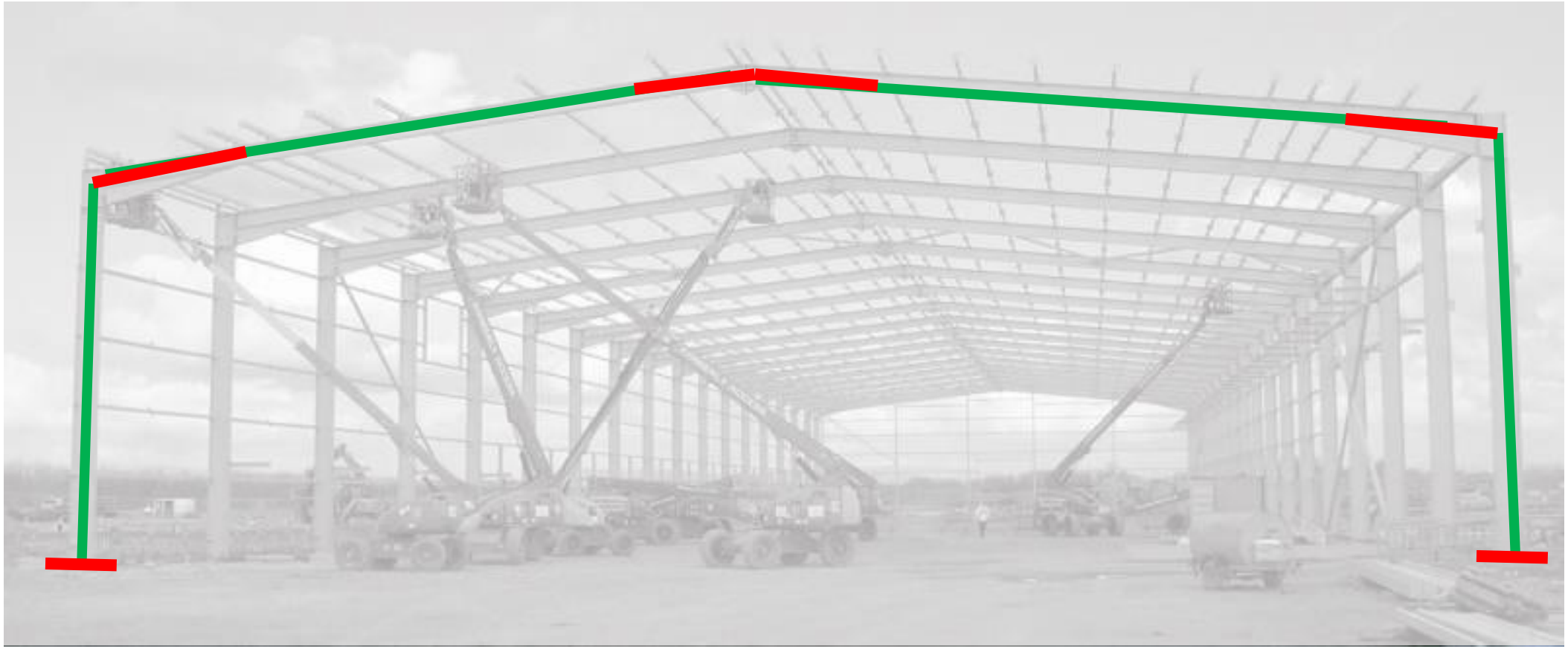
Portal frame steel structures

- Reuse options with minor modifications



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Portal frame steel structures

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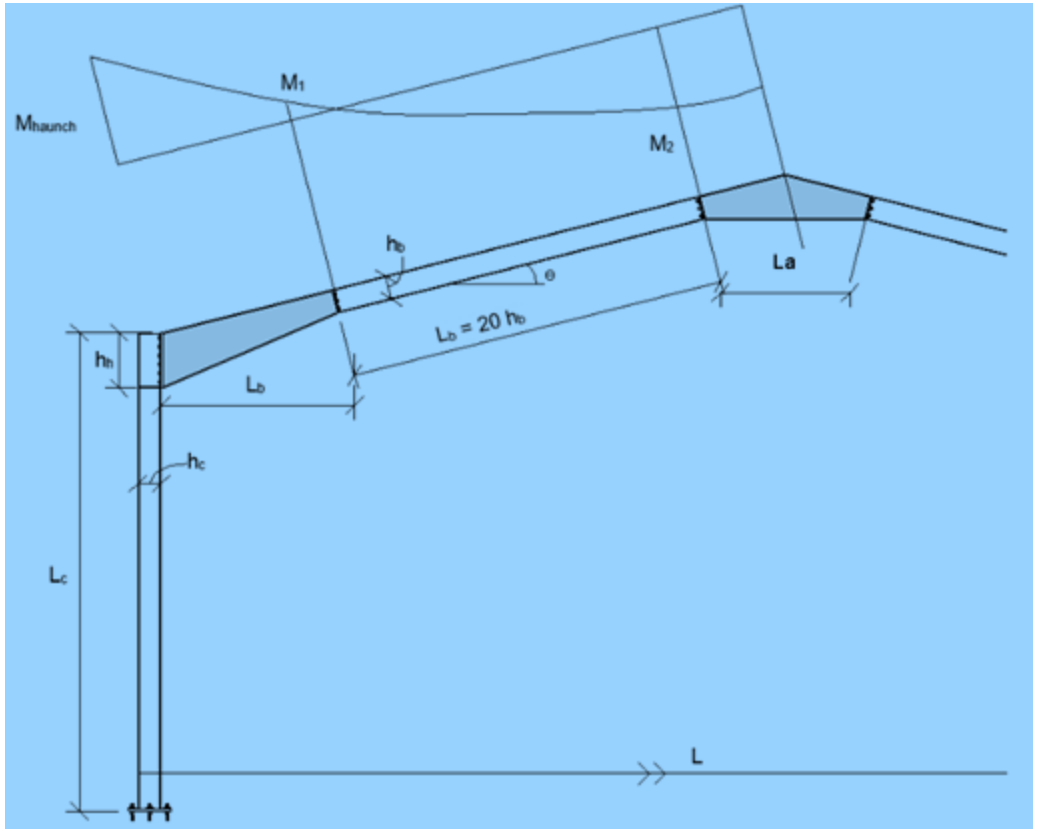
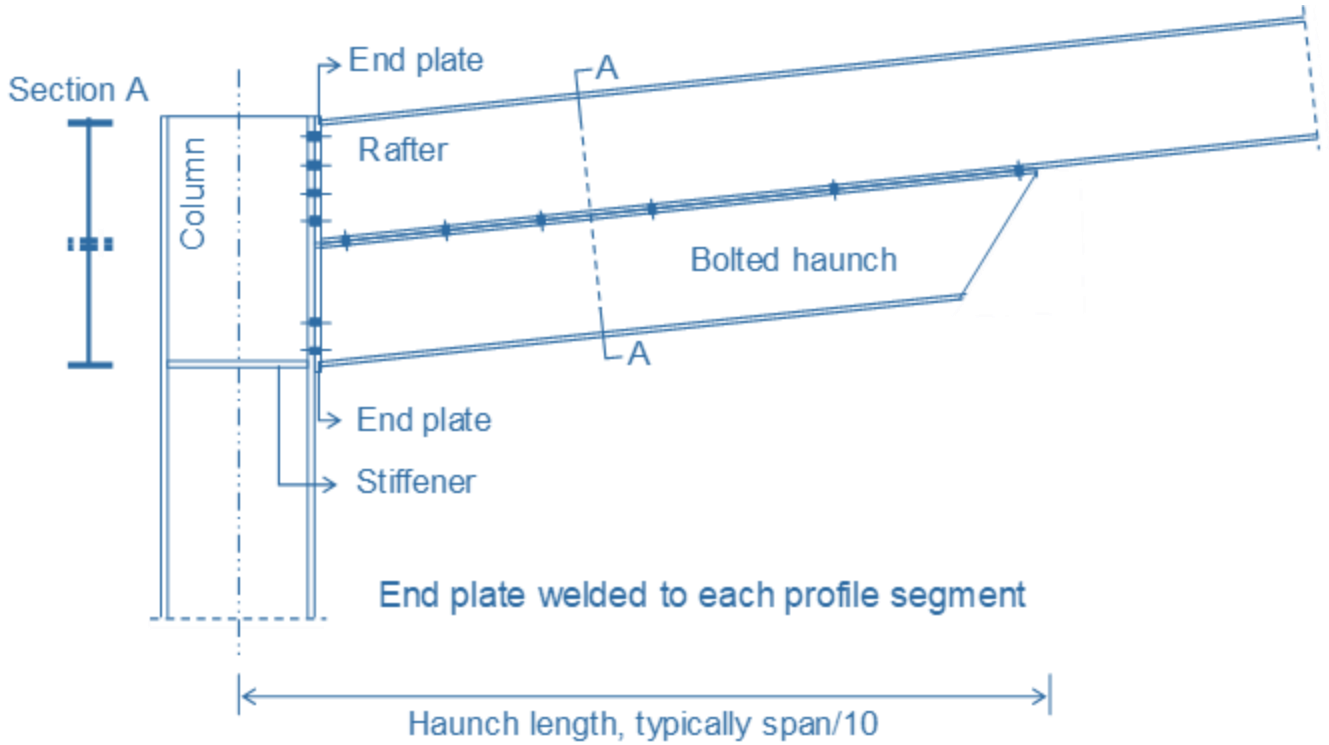
- Reusable parts





Source: http://steel-sci.com/

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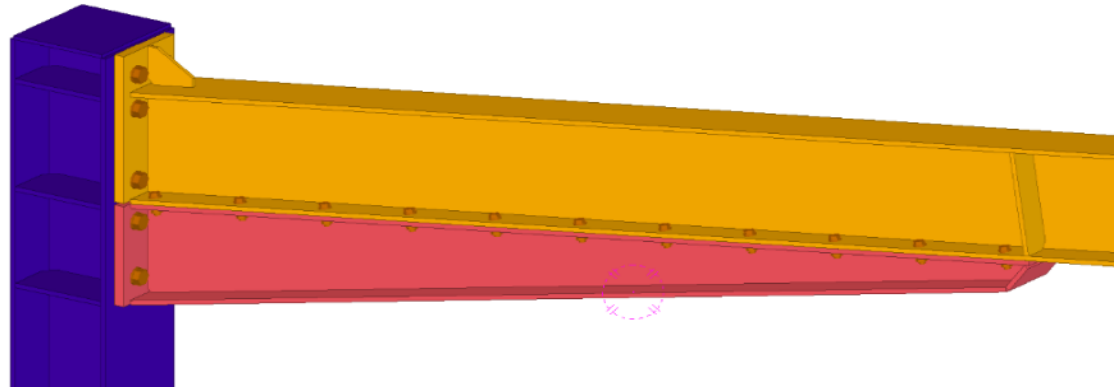
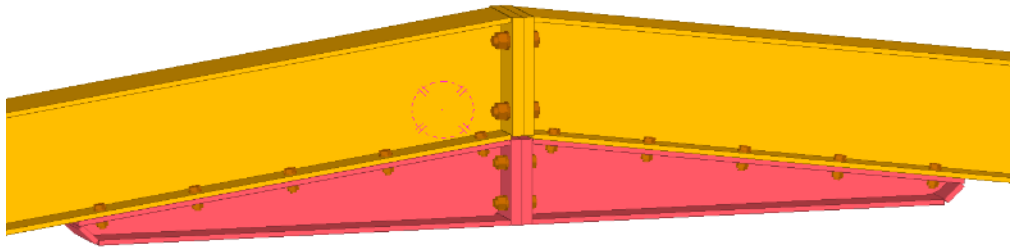
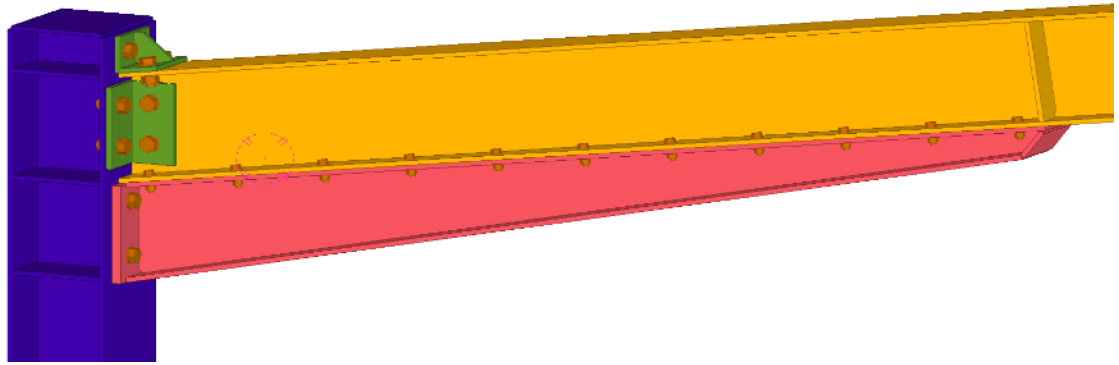
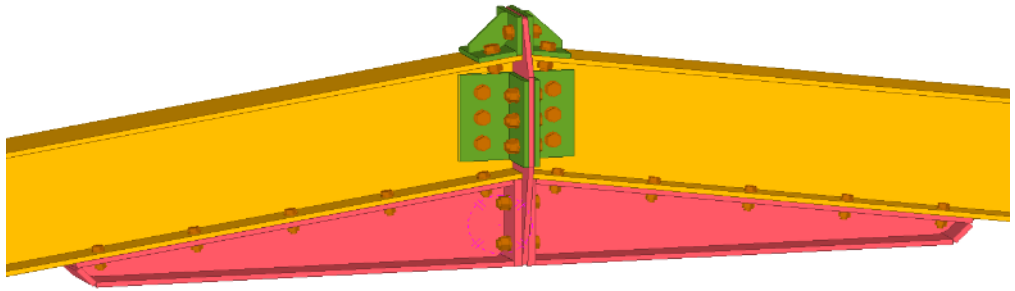
- Bolted haunch and rafter with individually welded end-plates









Source: Politehnica University Timisoara

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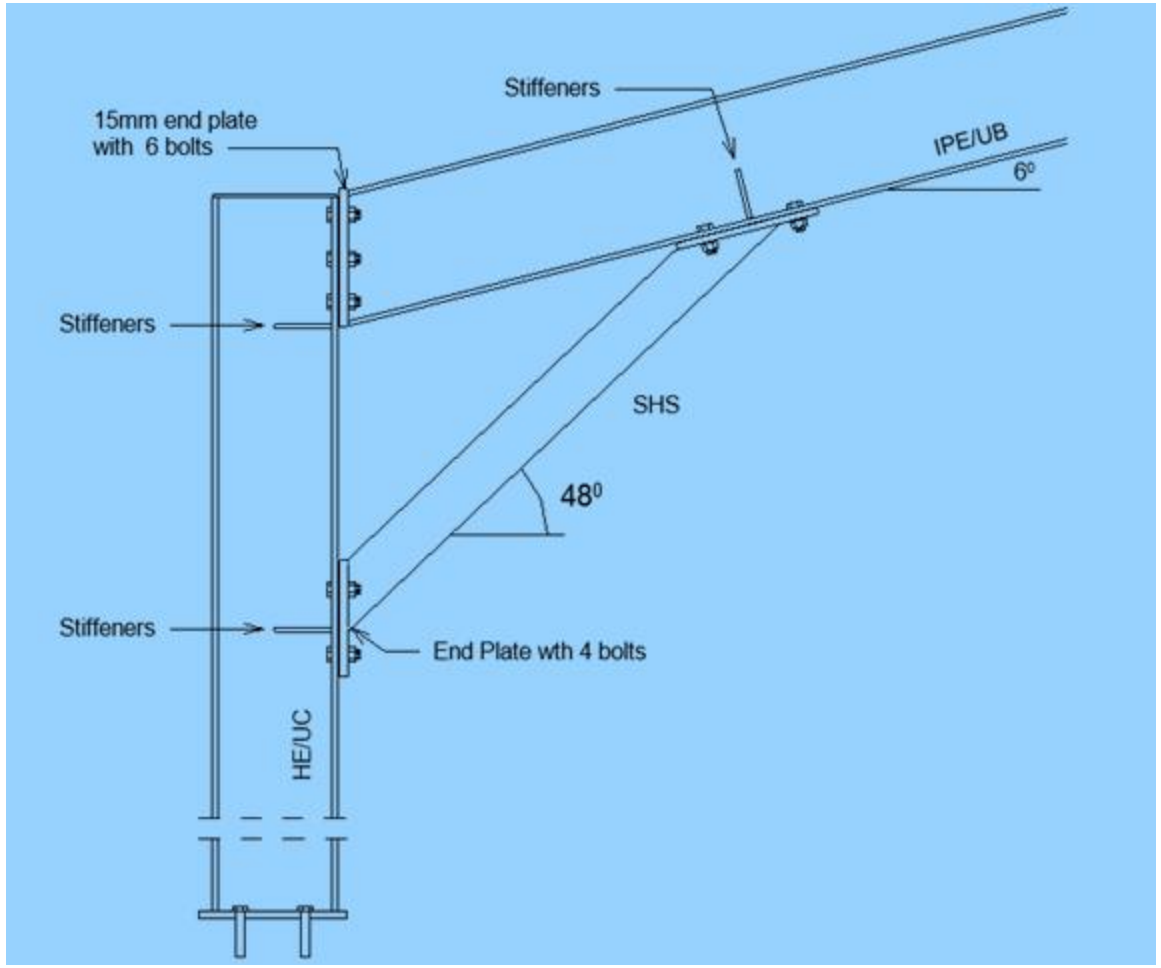
Portal frame steel structures

- Strut-type haunch in a portal frame



Source: http://steel-sci.com/

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Portal frame steel structures

- Demountable column-base connections

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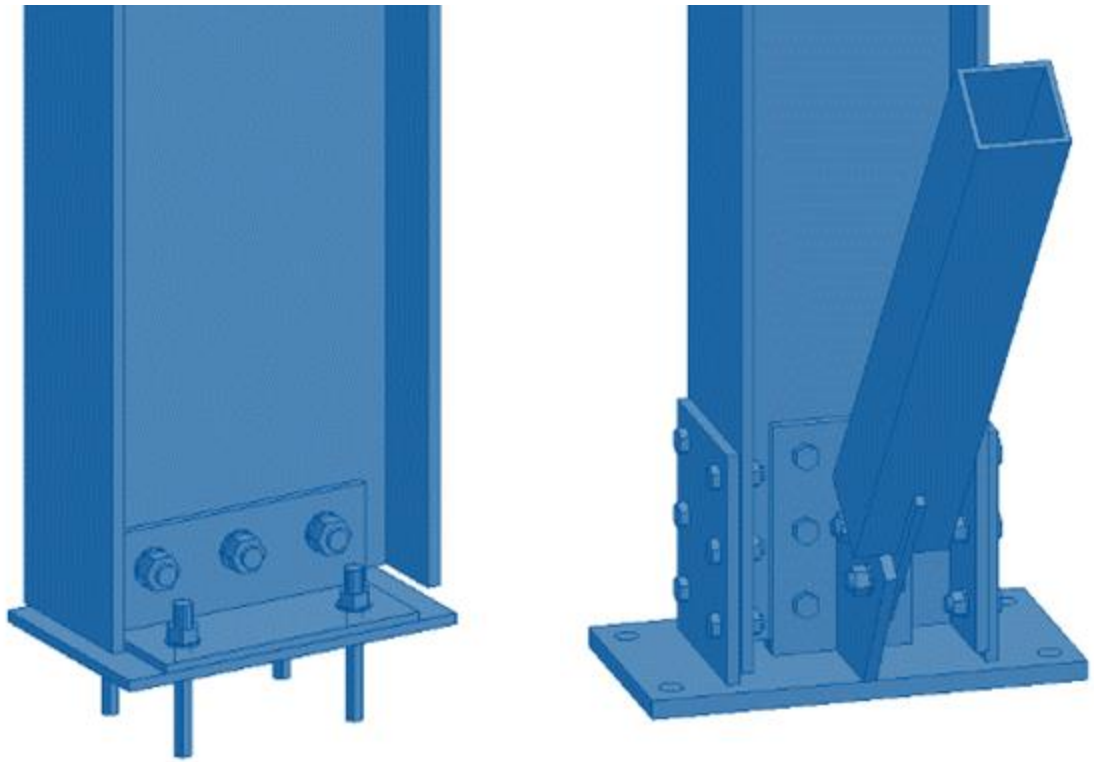

Progress – Case study Fokker 7 distribution Center Schiphol Airport; Images courtesy of Tata Steel , https://www.tatasteeleurope.com/

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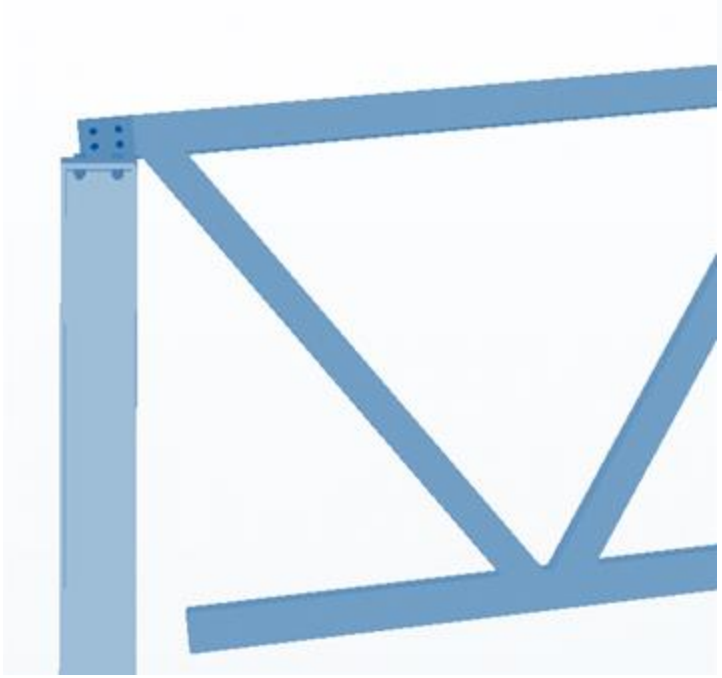
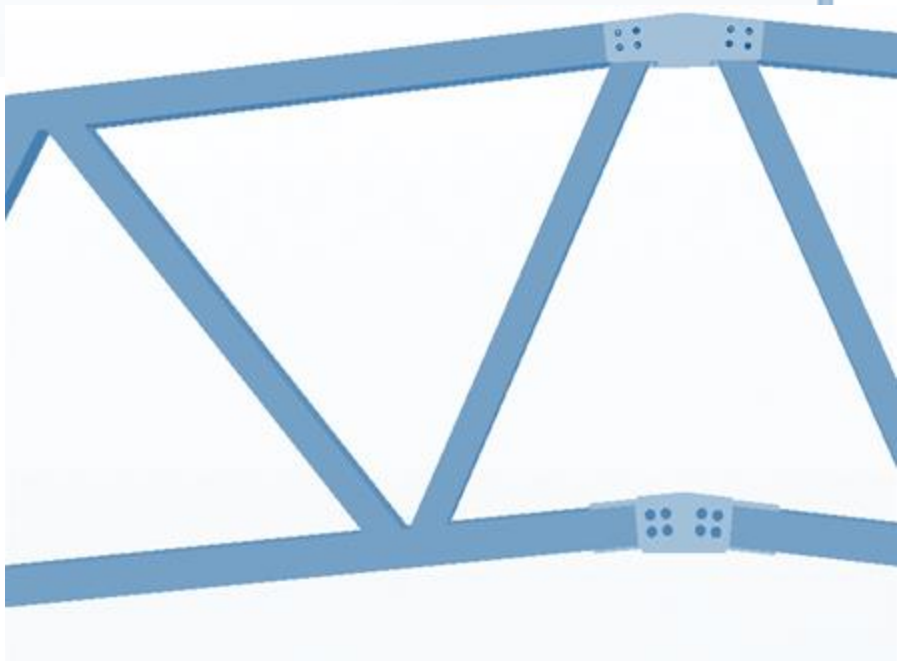
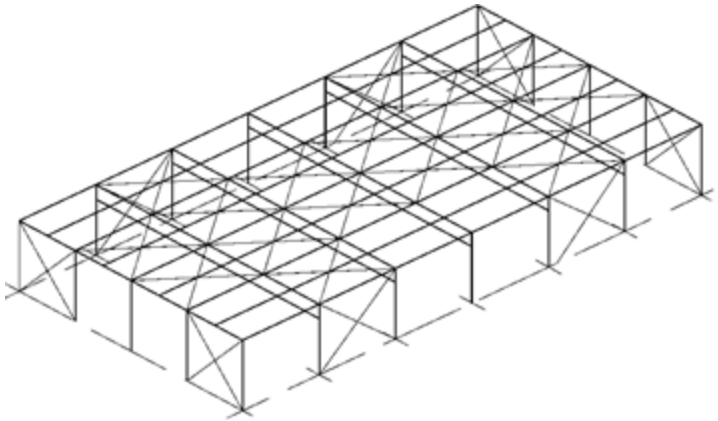
Trusses

- Steel truss system for better re-usability. Details







Source: https://www.ruukki.com

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Mezzanine / Multi-storey buildings solutions

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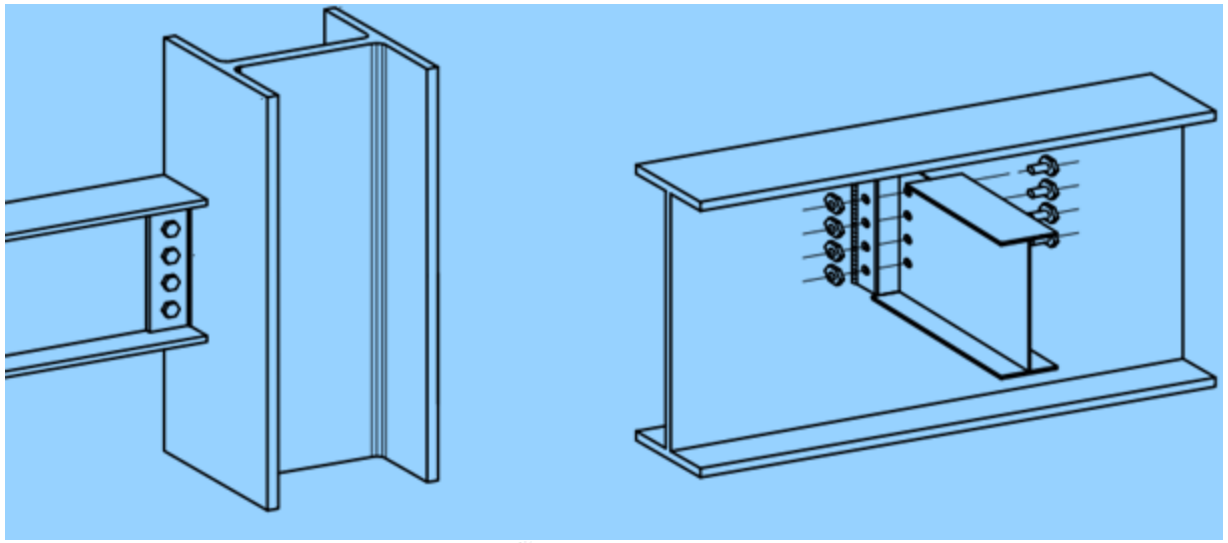
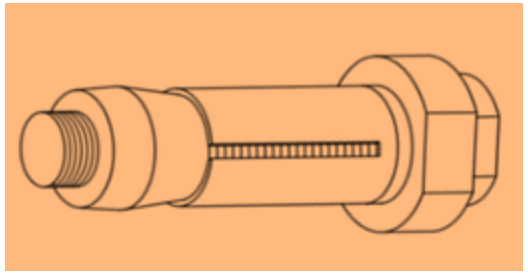
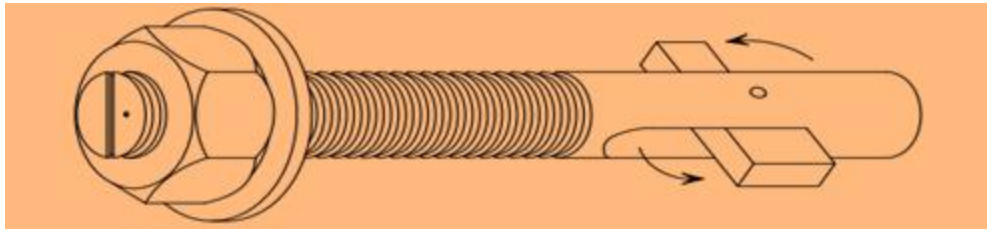
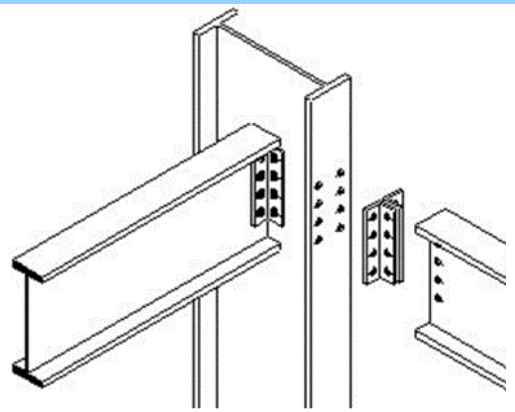
- Fin plate connections







- Hollo-Bolt and Bild Bolt solutions



- Cleated connection with angles

SCI P358 (2014). Joints in steel construction: Simple joints to Eurocode 3. The Steel Construction Institute.

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Multi-storey buildings solutions

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- Quicon connections

https://www.newsteelconstruction.com/wp/quicon-wins-contract-at-ikea/.

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Multi-storey buildings solutions
Composite steel-concrete structures

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- Demountable floor system using precast units and floor bracing

Davison B, Owens GW eds, 2012, Steel designers' manual, The Steel Construction Institute, 7th edition, Wiley-Blackwell

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Multi-storey buildings solutions
Composite steel-concrete structures

https://www.peikko.com/

- Demountable floor system using precast units

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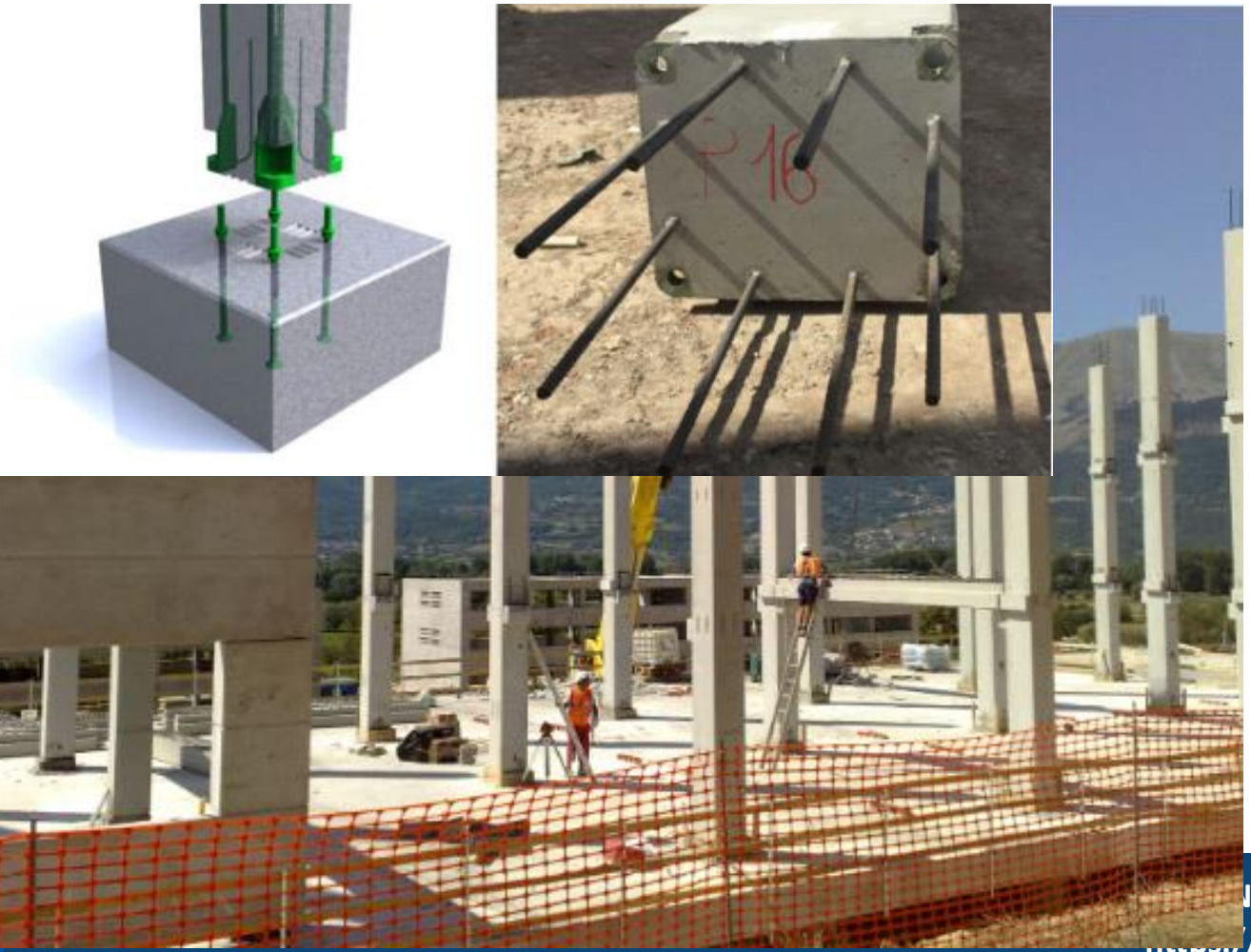
Multi-storey buildings solutions
Composite steel-concrete structures

- Demountable floor system using precast units



Peikko

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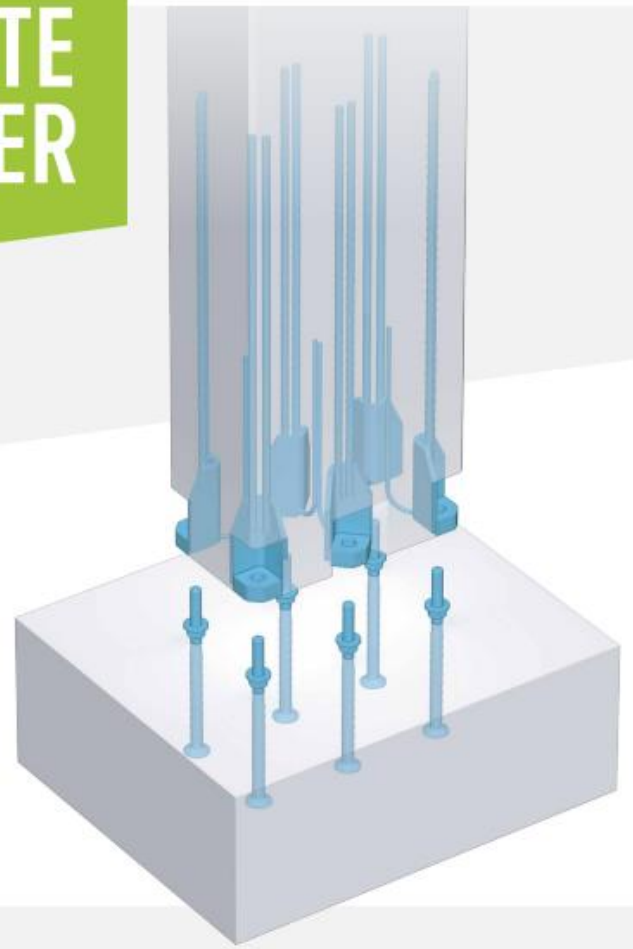
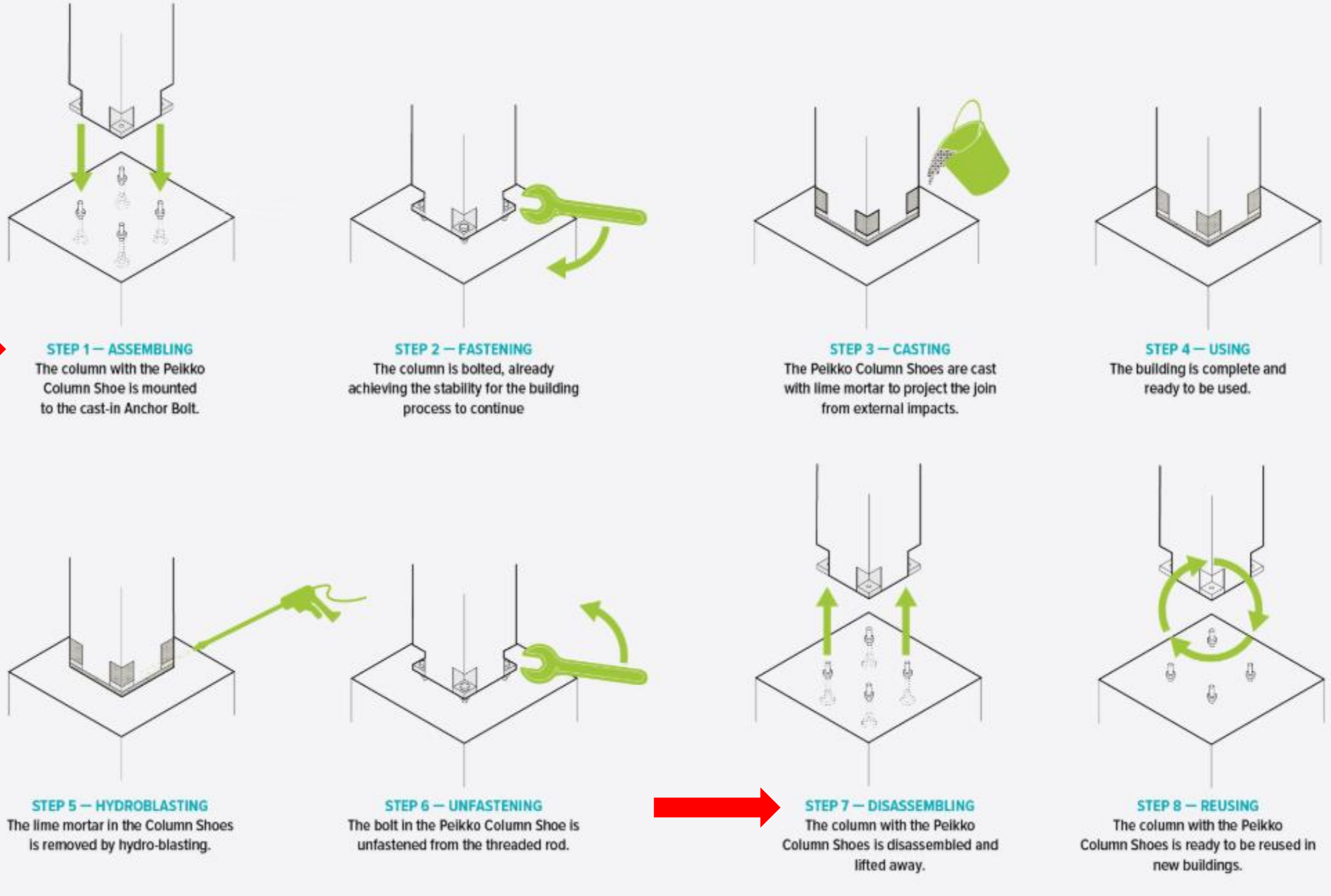


BOLTED COLUMN CONNECTION FOR SEISMIC APPLICATIONS

Elena Camnasio D.Sc. (Tech.),
R&D Engineer, Peikko Group Corporation

Multi
Comp

- Dem



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Multi-storey buildings solutions
Composite steel-concrete structures

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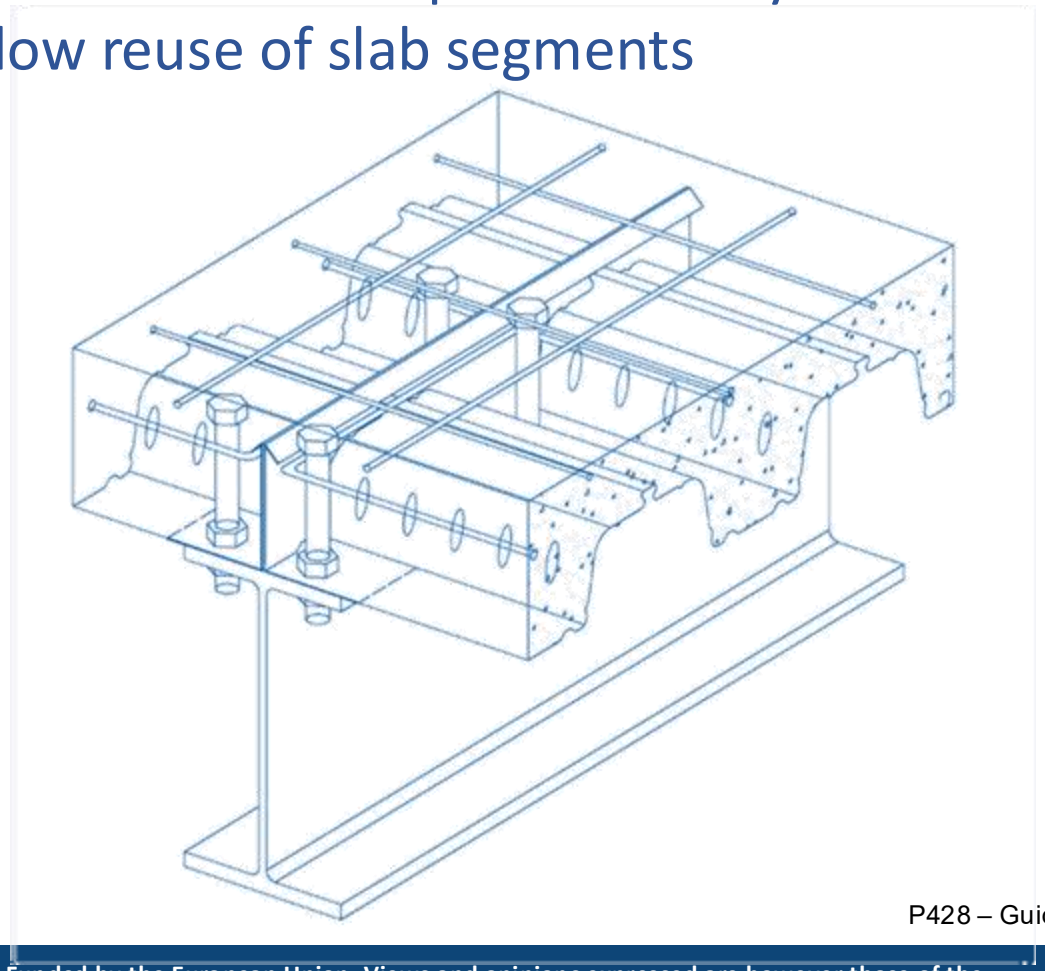
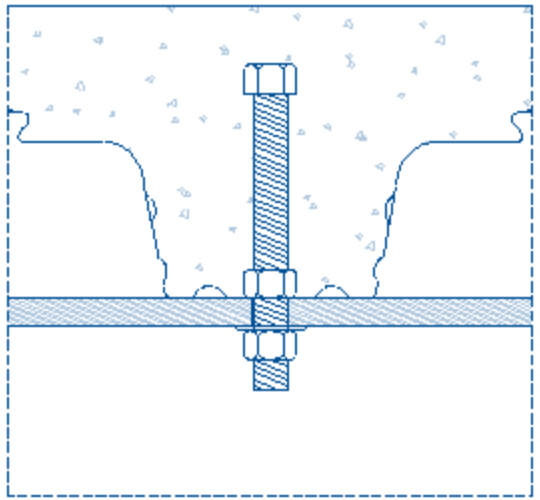
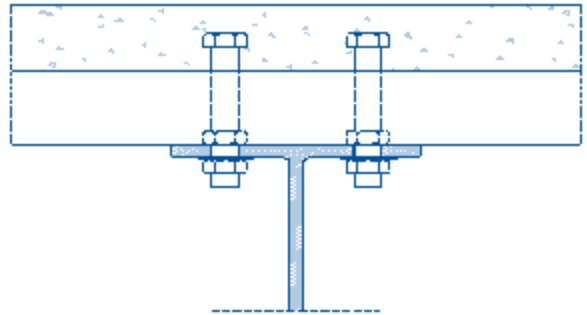
- Demountable composite floor system with a cast-in edge trim to form a cut line to allow reuse of slab segments







P428 – Guidance on Demountable Composite Construction Systems for UK Practice, 2020. The Steel Construction Institute.

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Multi-storey buildings solutions

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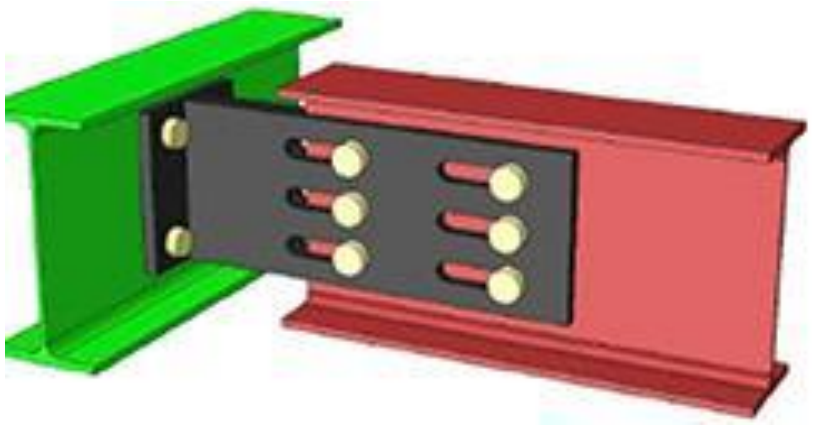
Demountable composite steel-concrete structures – Experimental test



Research Fund for Coal and Steel (RFCS): Reuse and demountability using steel structures and the circular economy - REDUCE, project number RFCS-02-2015.

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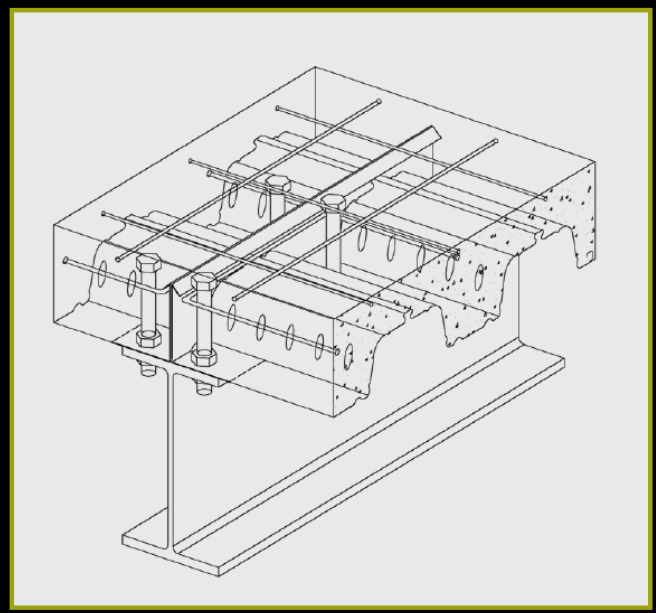
Multi-storey buildings solutions

Demountable composite steel-concrete structures

GUIDANCE ON DEMOUNTABLE COMPOSITE CONSTRUCTION SYSTEMS FOR UK PRACTICE



SCI Steel Knowledge

Research Fund for Coal and Steel (RFCS): Reuse and demountability

2-2015.

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https:

Multi-storey buildings solutions

Demountable composite steel-concrete structures

- Types of demountable bolted connectors

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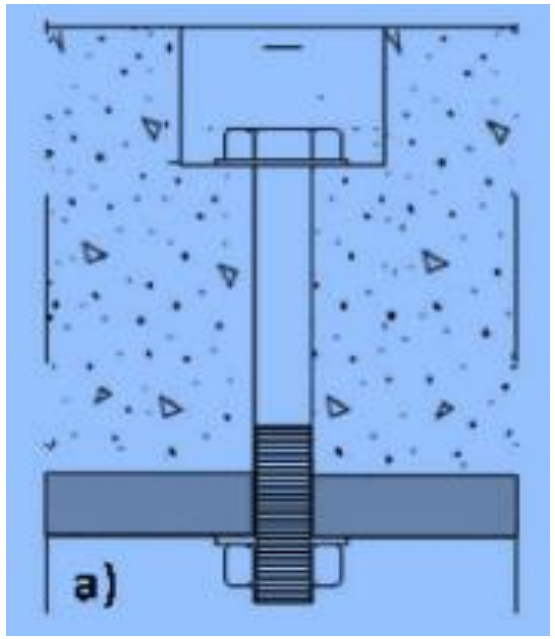
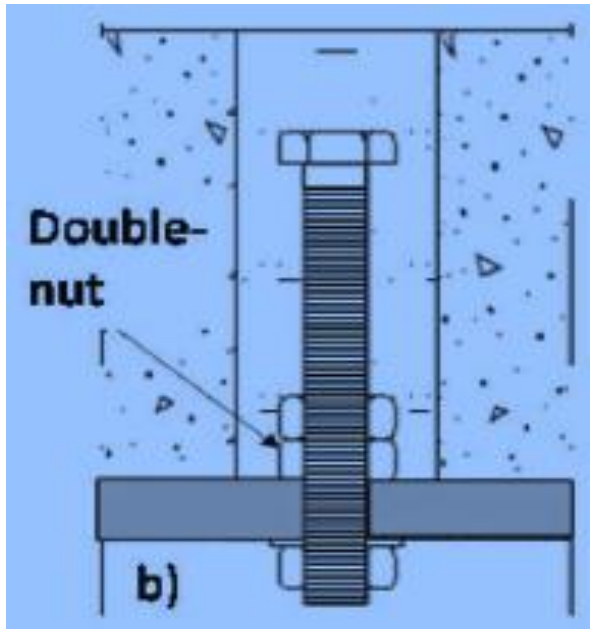
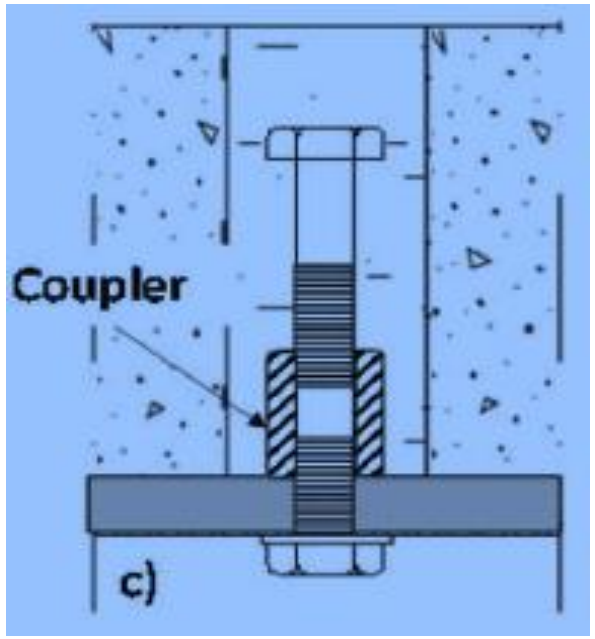


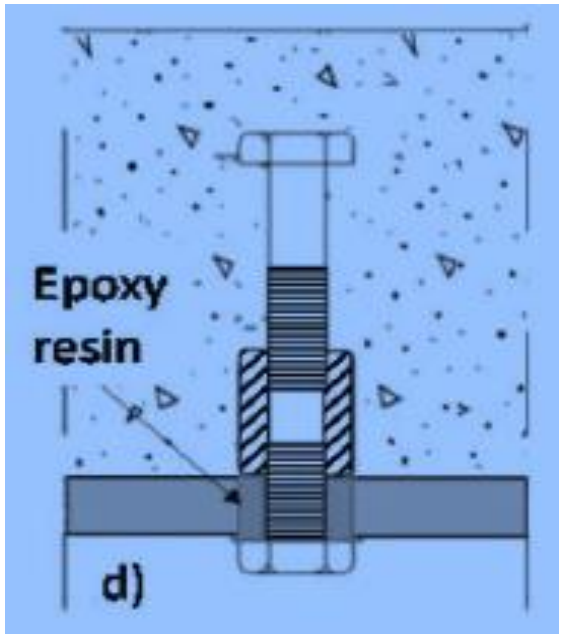
friction grip bolts



double-nut



coupler system connectors



injected bolted shear connectors

Research Fund for Coal and Steel (RFCS): Reuse and demountability using steel structures and the circular economy - REDUCE, project number RFCS-02-2015.

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Multi-storey buildings solutions

Steel-timber structures

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- Demountable floor system using cross laminated timber (CLT)

https://www.kloecknermetalsuk.com/westok/.

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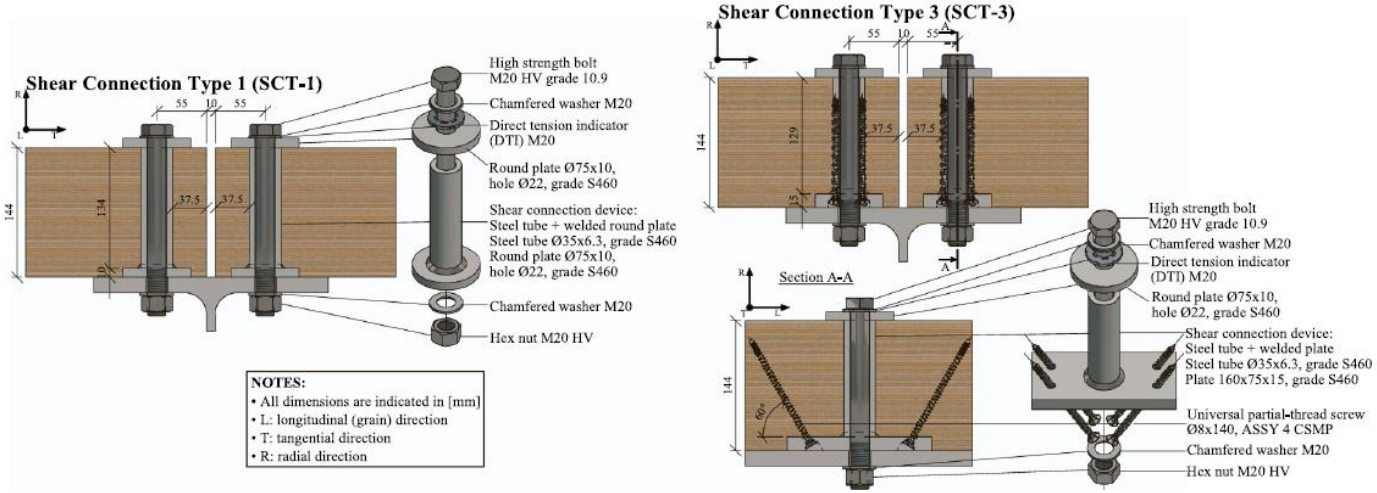
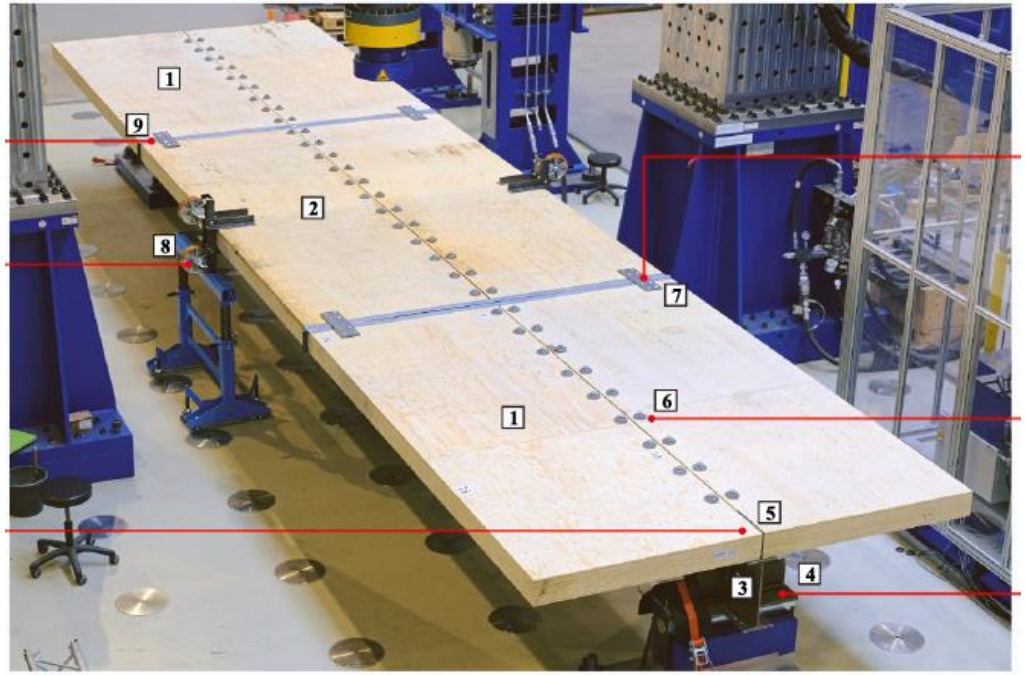
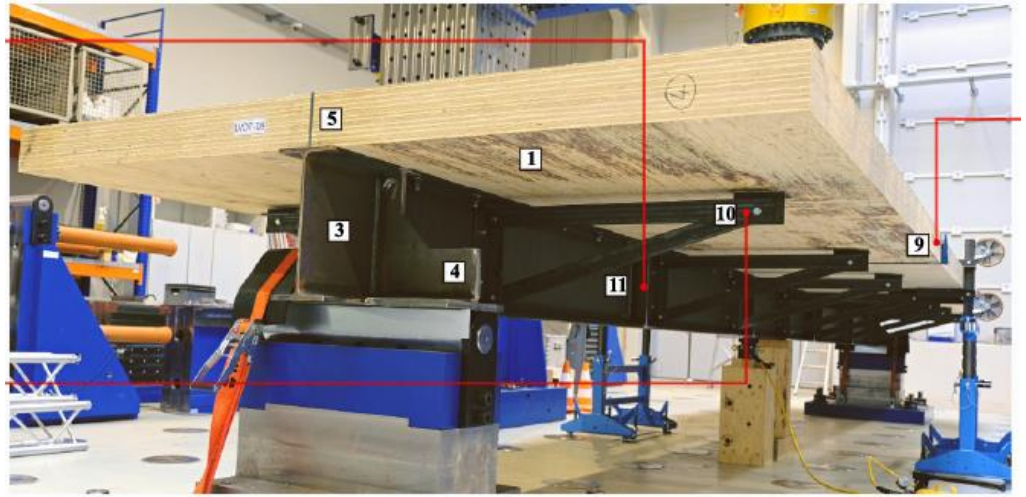
Multi-storey buildings solutions

Steel-timber structures

- Demountable floor system using LVL







- Experimental tests

Romero A, Odenbreit C (2024). Innovative demountable steel-timber composite (STC) beams: Experimental full-scale bending tests. Engineering Structures, 318, 118599.

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Steel-timber structures

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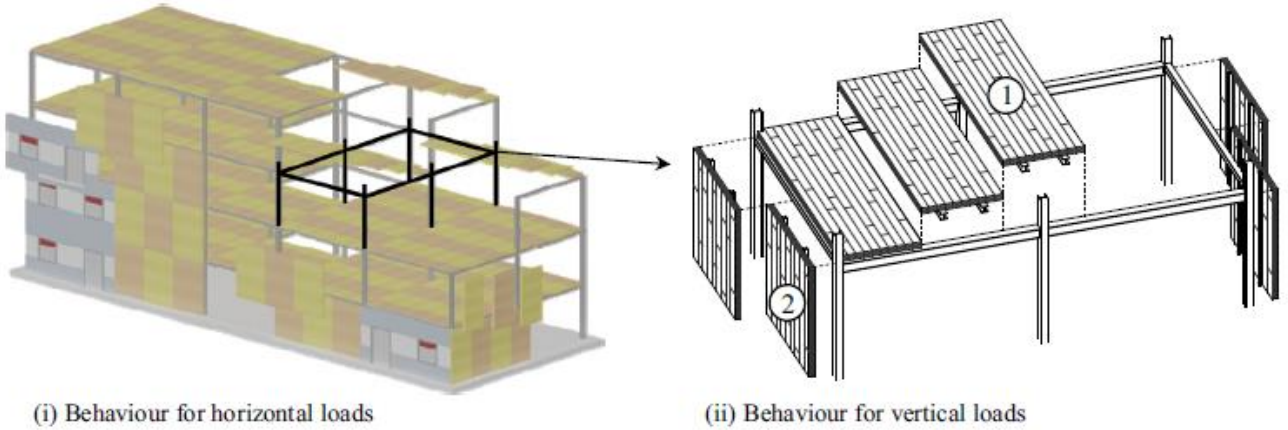
- Beam-to-panel connections for hybrid steel–CLT floors and shear wall



Loss C, Piazza M, Zandonini R (2016). Connections for steel–timber hybrid prefabricated buildings. Part I: Experimental tests. Construction and Building Materials 122, 781–795.

Loss C, Piazza M, Zandonini R (2016). Connections for steel–timber hybrid prefabricated buildings. Part II: Innovative modular structures. Construction and Building Materials 122, 796–808.

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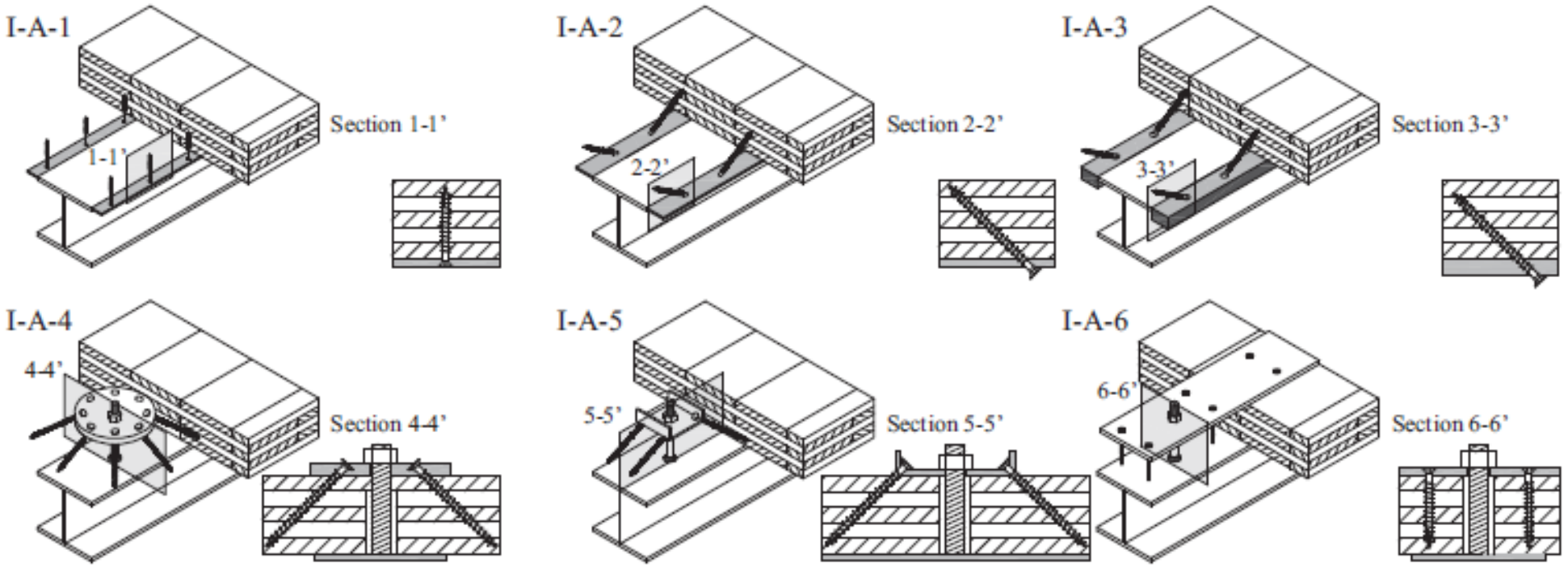

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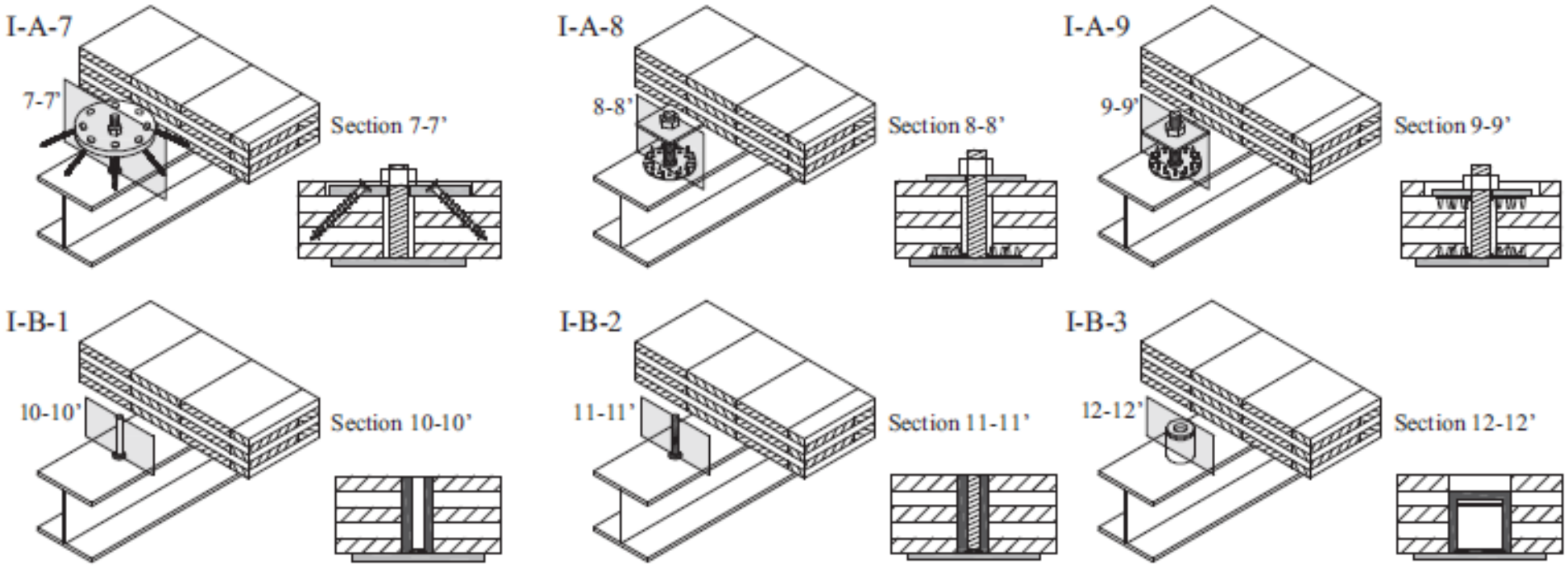

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Multi-storey buildings solutions

Steel-timber structures

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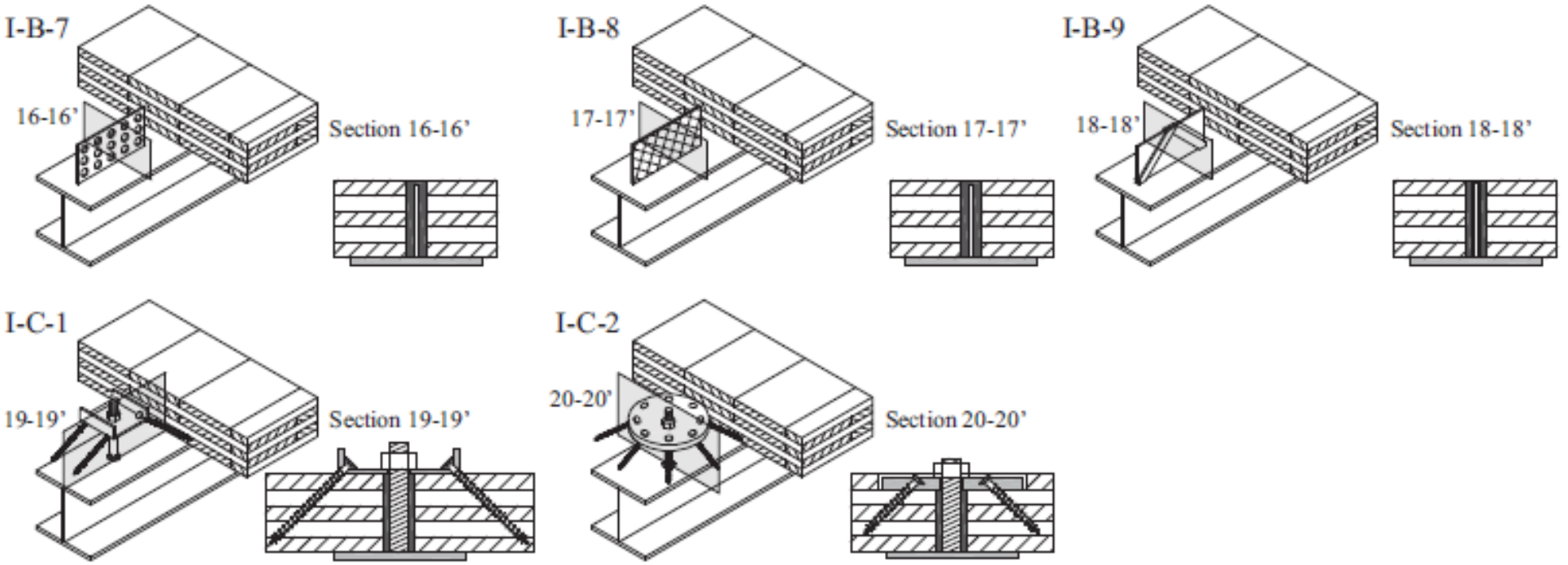

Loss C, Piazza M, Zandonini R (2016). Connections for steel–timber hybrid prefabricated buildings. Part I: Experimental tests. Construction and Building Materials 122, 781–795.

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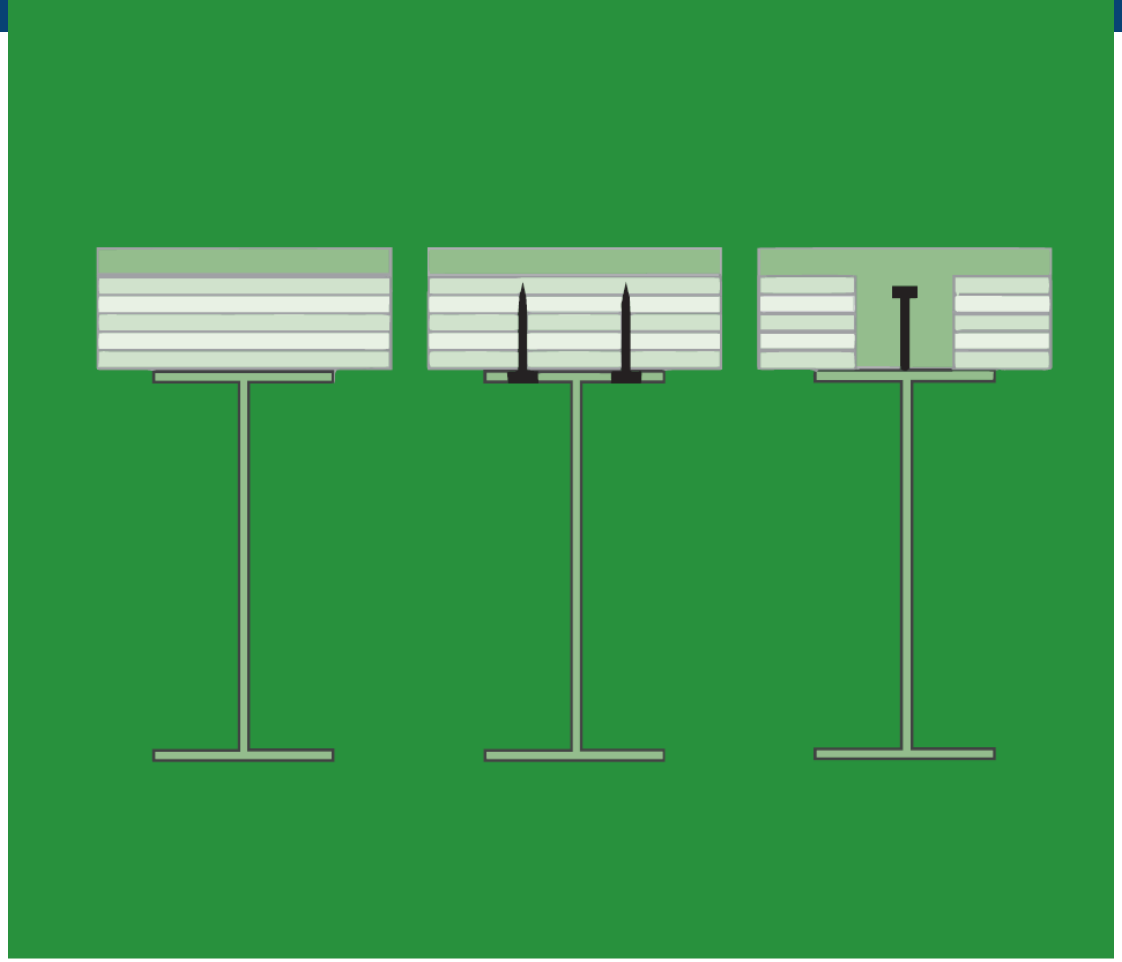
Steel-timber structures



Design Guide 37

Hybrid Steel Frames with Wood Floors

Smarter. Stronger. Steel.

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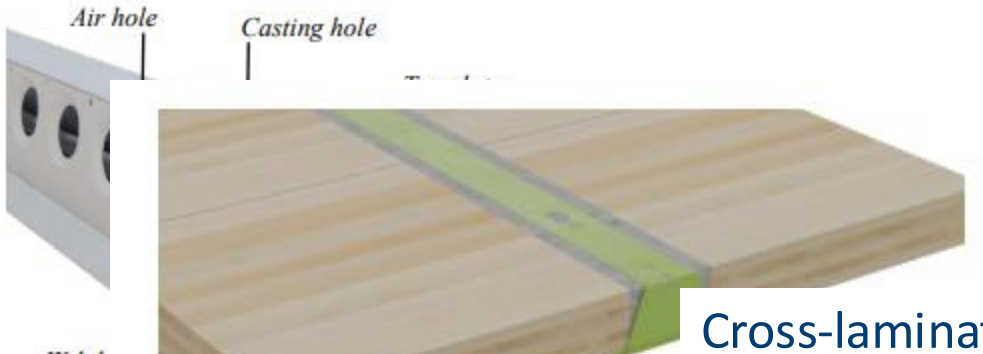
Multi-storey buildings solutions

Steel-timber structures (CLT, GLT, NLT, DLT)



Cross-laminated Timber (CLT)
Nail-laminated Timber (NLT)
Dowell-Laminated Timber (DLT)
Glue Laminated Timber (GLT) and glulam

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Multi-storey buildings solutions

- Floor using Sandwich Plate System (SPS)

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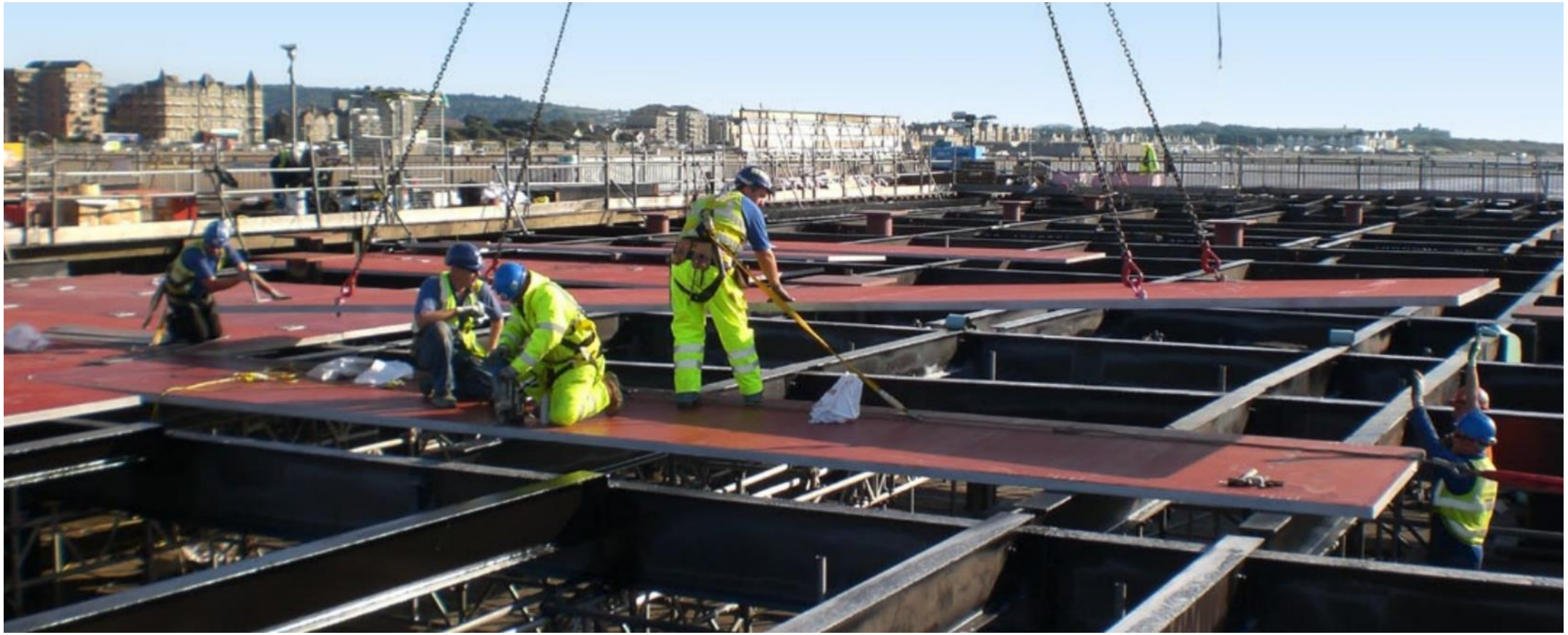

https://www.spstechnology.com/.

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Multi-storey buildings solutions

- Demountable friction joints with energy dissipation
- Horizontal friction damper

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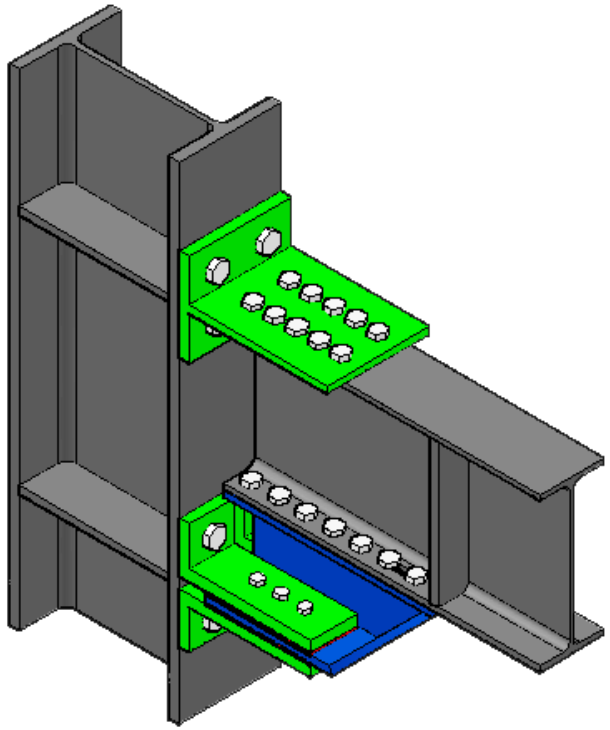

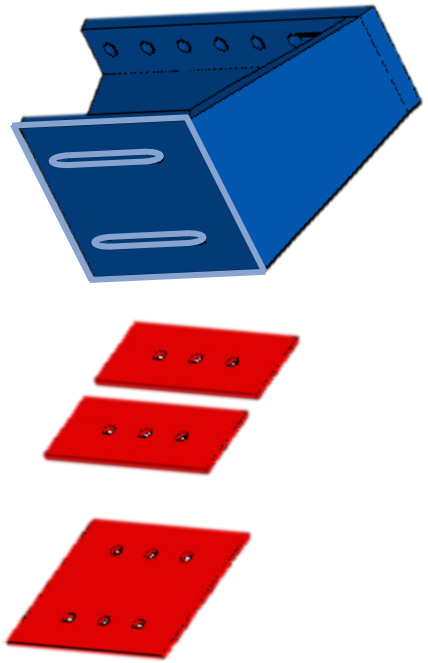

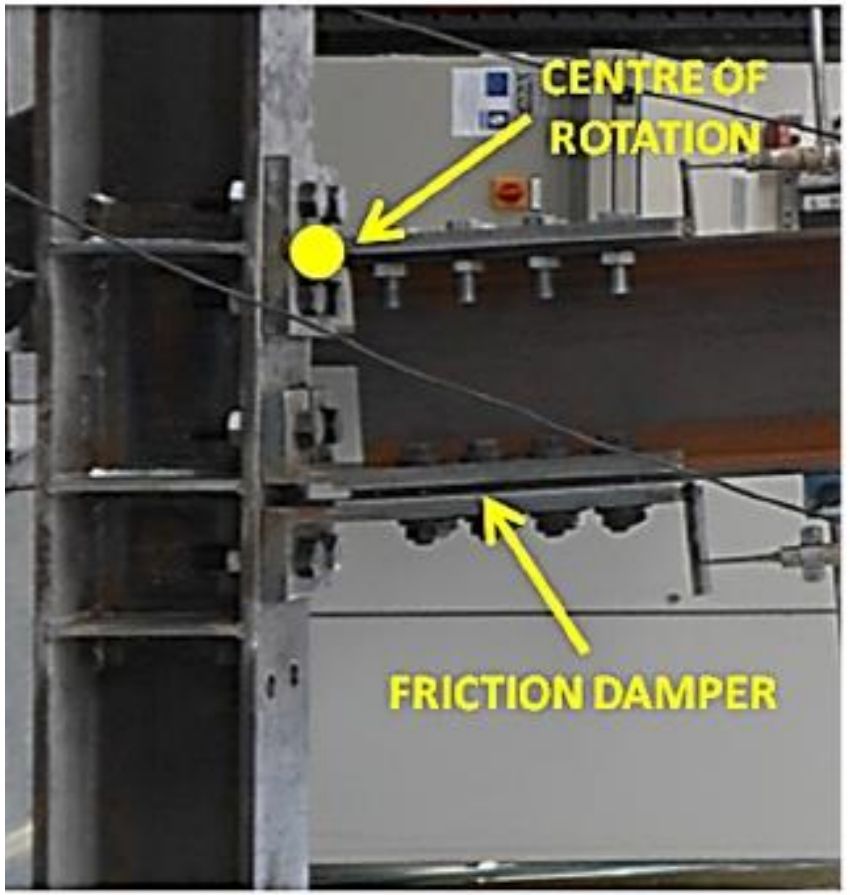

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Multi-storey buildings solutions

- Demountable friction joints with energy dissipation
- Vertical friction damper

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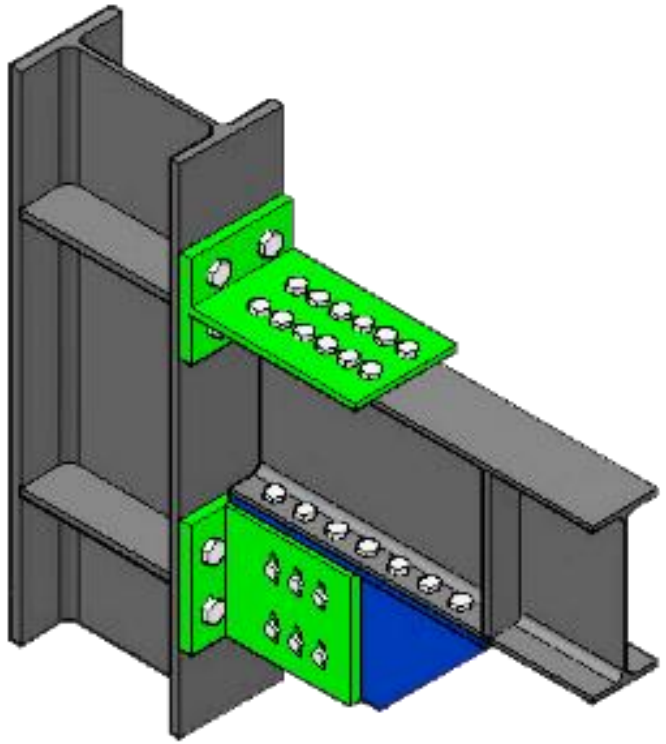

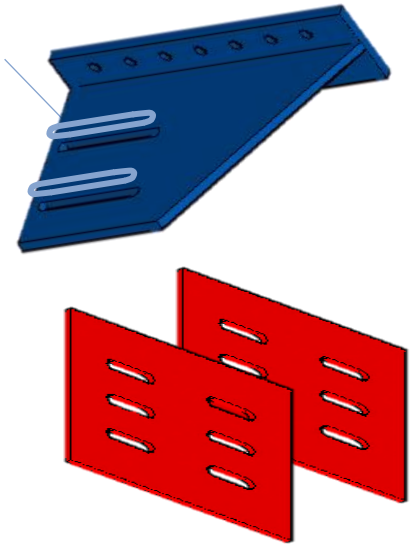

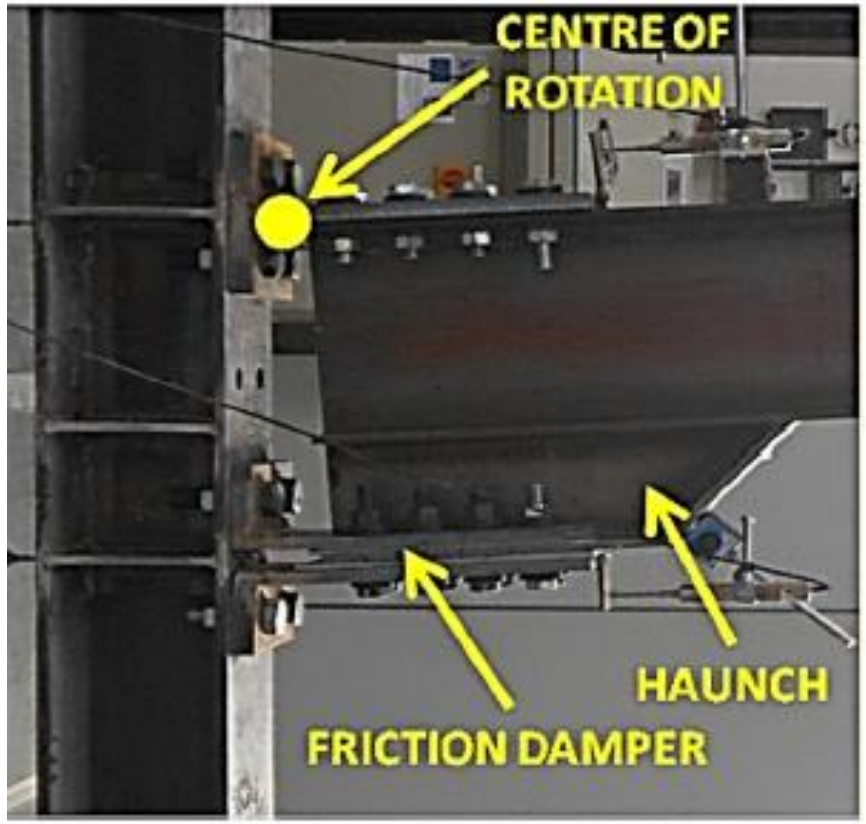

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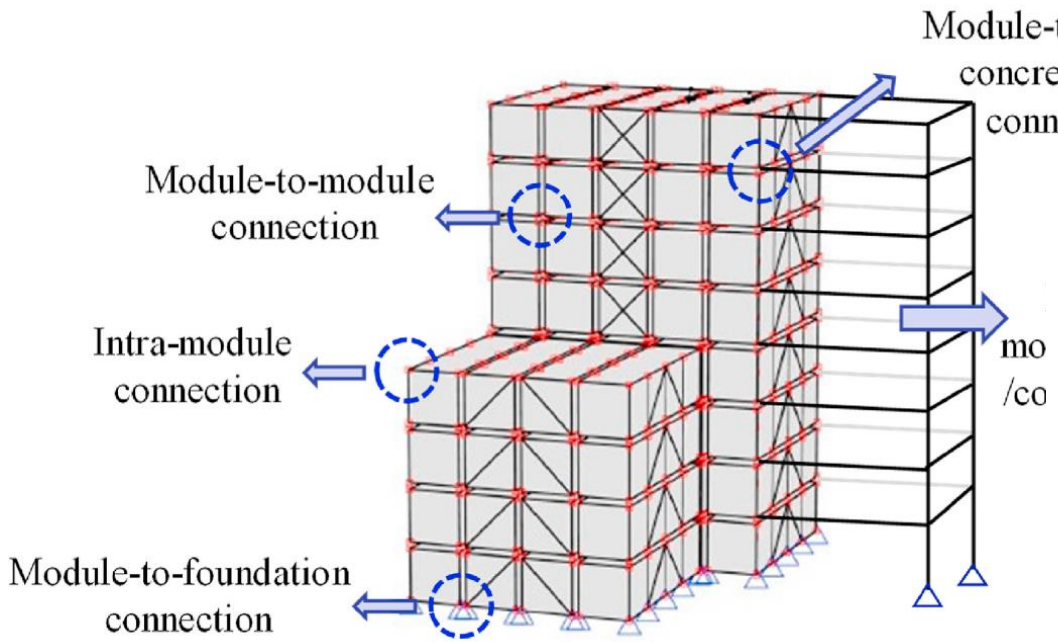
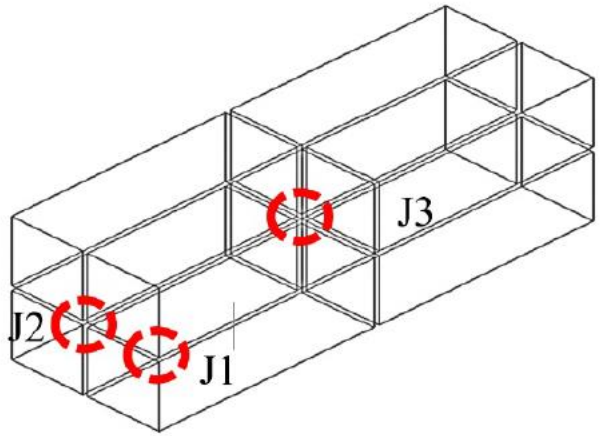
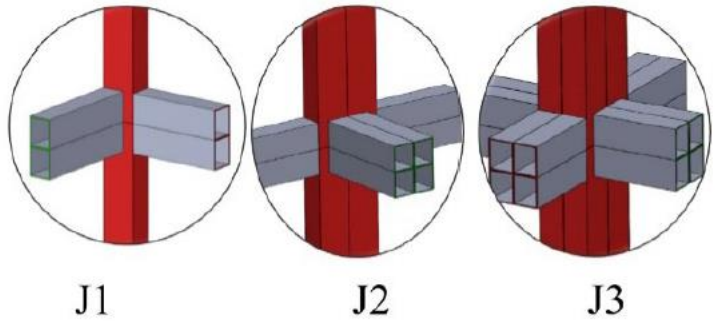
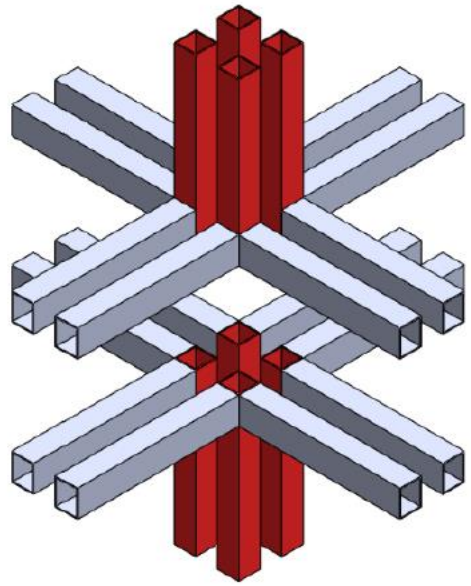
Modular constructions









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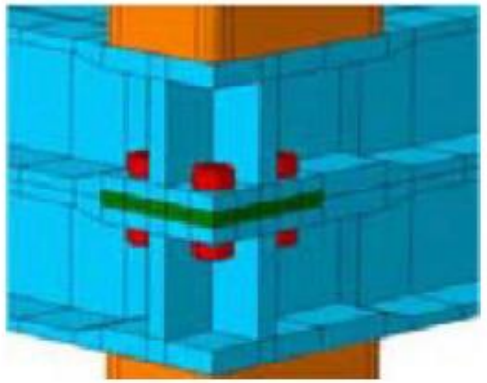
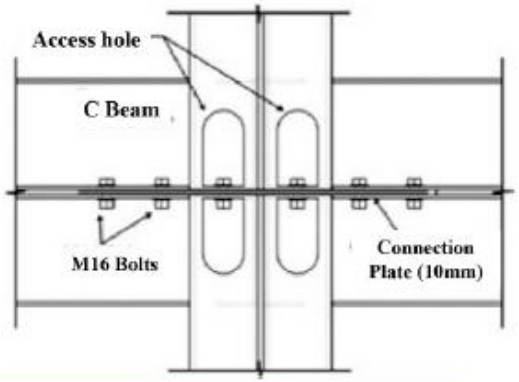
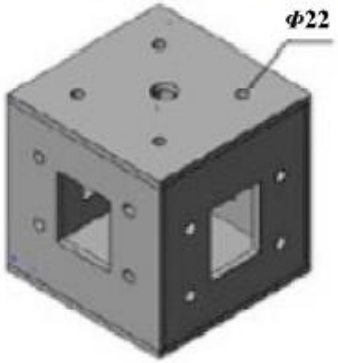
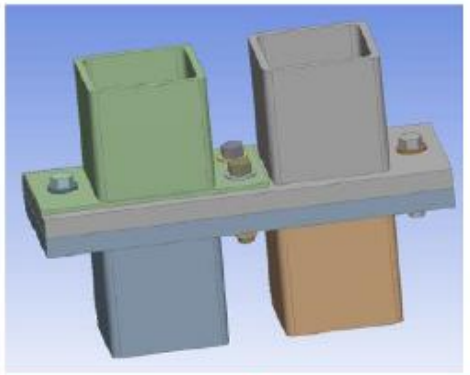
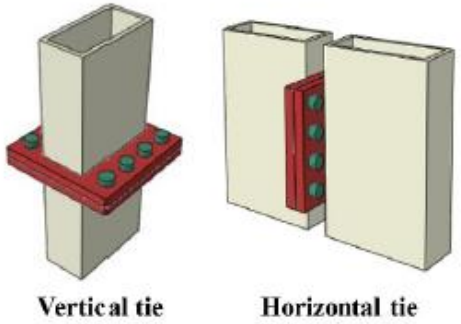
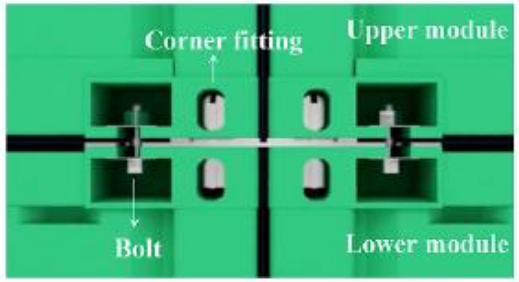
Connection type	Illustration	Reported mechanical	Connection type	Illustration	Reported mechanical
#1 VectorBloc connection (Dhanapal et al. [91, 92])			#7 Up-down connectors connection (Chen et al. [100])		1. Compression and bending behavior were simulated 2. Open steel section beams
#3 Rotary connection (Chen et al. [95,96])			#8 Bolted connection (Choi et al. [101,102])		1. Bending behavior was simulated 2. Loss section of the column
#5 Post-tensioned connection (Lacey et al. [98])			#9 Steel bracket connection (Doh et al. [103])		1. Shear behavior was tested 2. Fully bolted connection by the corner casting
			#10 End plate bolted connection (Gunawardena et al. [104])		1. Shear behavior was tested 2. Fully bolted connection
			#11 Bolted connection (Styles et al. [105])		1. Bending behavior were simulated 2. Fully bolted connection
			#12 Corner fitting connection ([106])		1. No reported mechanical property 2. Possible pinned connection
			#13 Cross-shaped plate connection		1. No reported mechanical property 2.Incompatiblewith the internal finish
			#14 Bolted connection (Lawson [12])		1. No reported mechanical property 2. Loss section of the column

(continued on next page)

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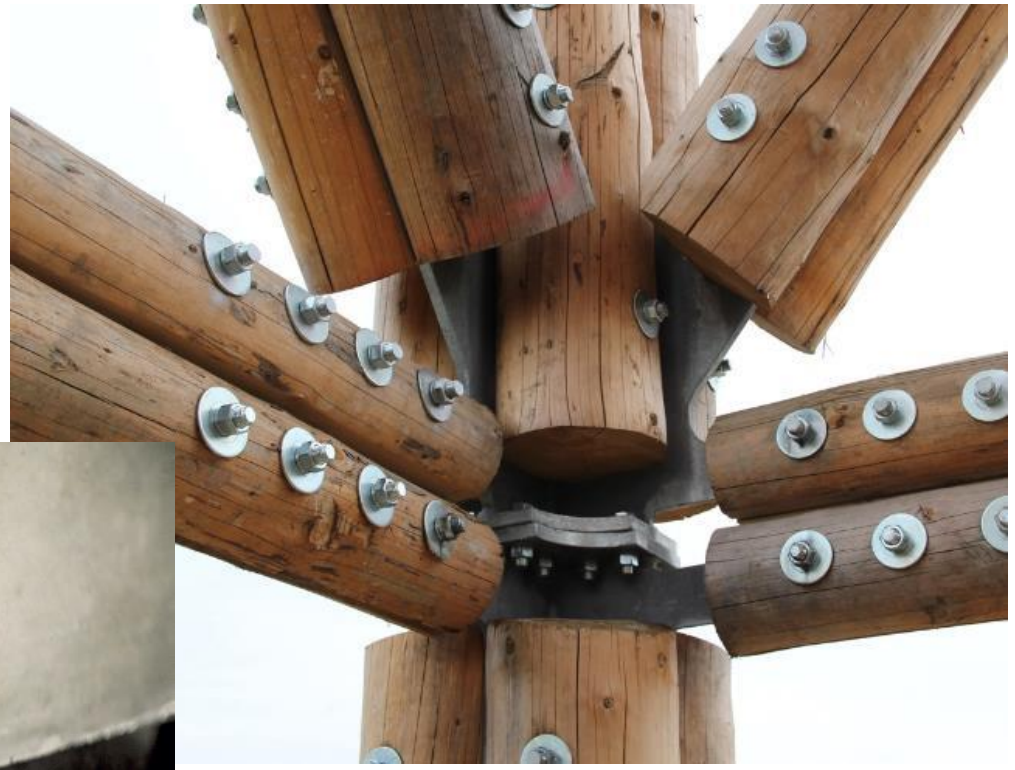
Steel enables reuse of other materials

Picture credits: Peikko Group



Picture credits: Taros Nova

Traceability for future reuse

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- Proposed information to be stored on a permanent physical label

Example of possible QR code for component tracking: (Try me)	Type: Reclaimed Origin: UK, Ascot Steel Age: 1975 ID: C10 Fabricator: Name Designer: Name Stockholder: Name Stockholder Certificate: AA001 Steel Designation: S355JR Material Standard: EN1090-2 cl. 5.1 Design Yield (MPA): 355 Design Tensile (MPA): 470 Measured Yield (MPA): 405 Measured Tensile (MPA): 520 Measured Elongation (%): 23 Measured CEV: 0.45 Profile: IPE500 Dimensions: EN 10365 Tolerances: EN 10034

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Summary

- Recommendations for buildings designed for reuse
- Reuse by designing appropriate details

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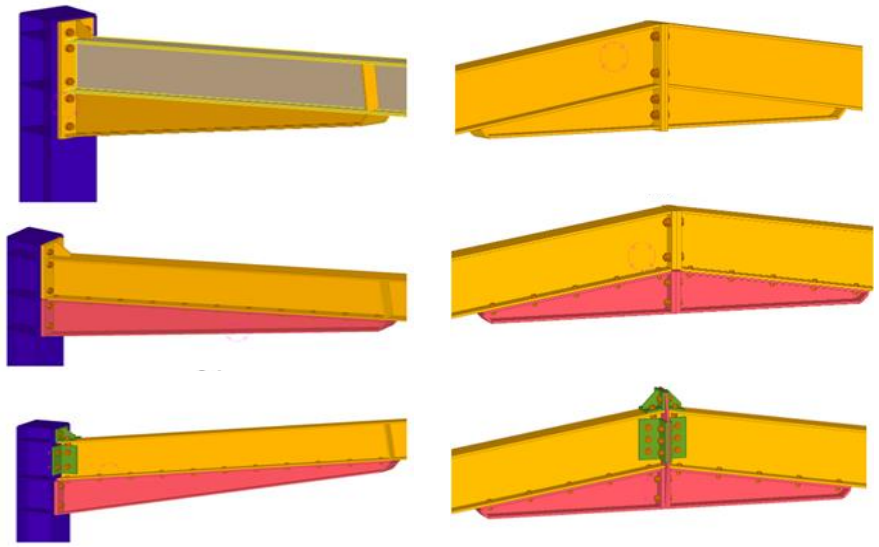
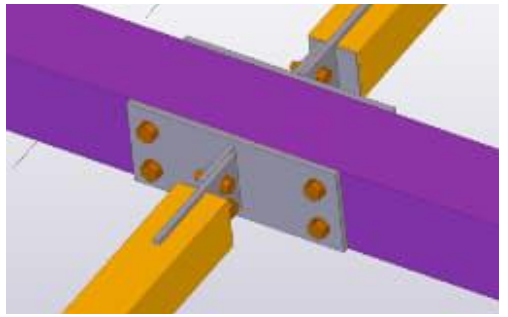
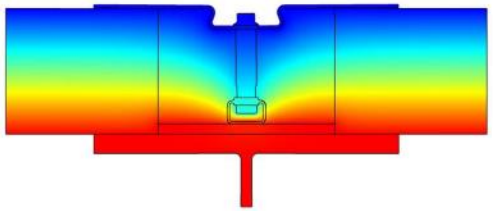
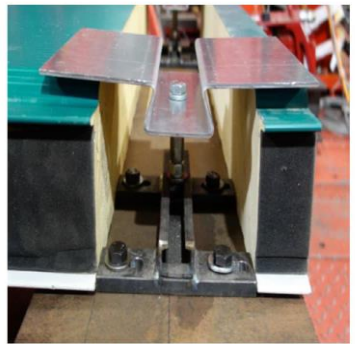


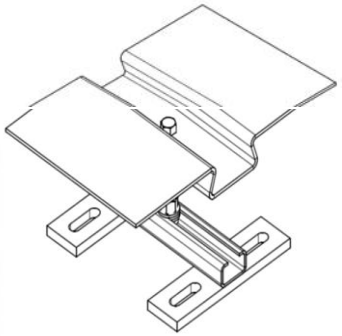
Zdroj: Politehnica University Timisoara



Zdroj: Ruukki Construction







Zdroj: RWTH Aachen University

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Workshops

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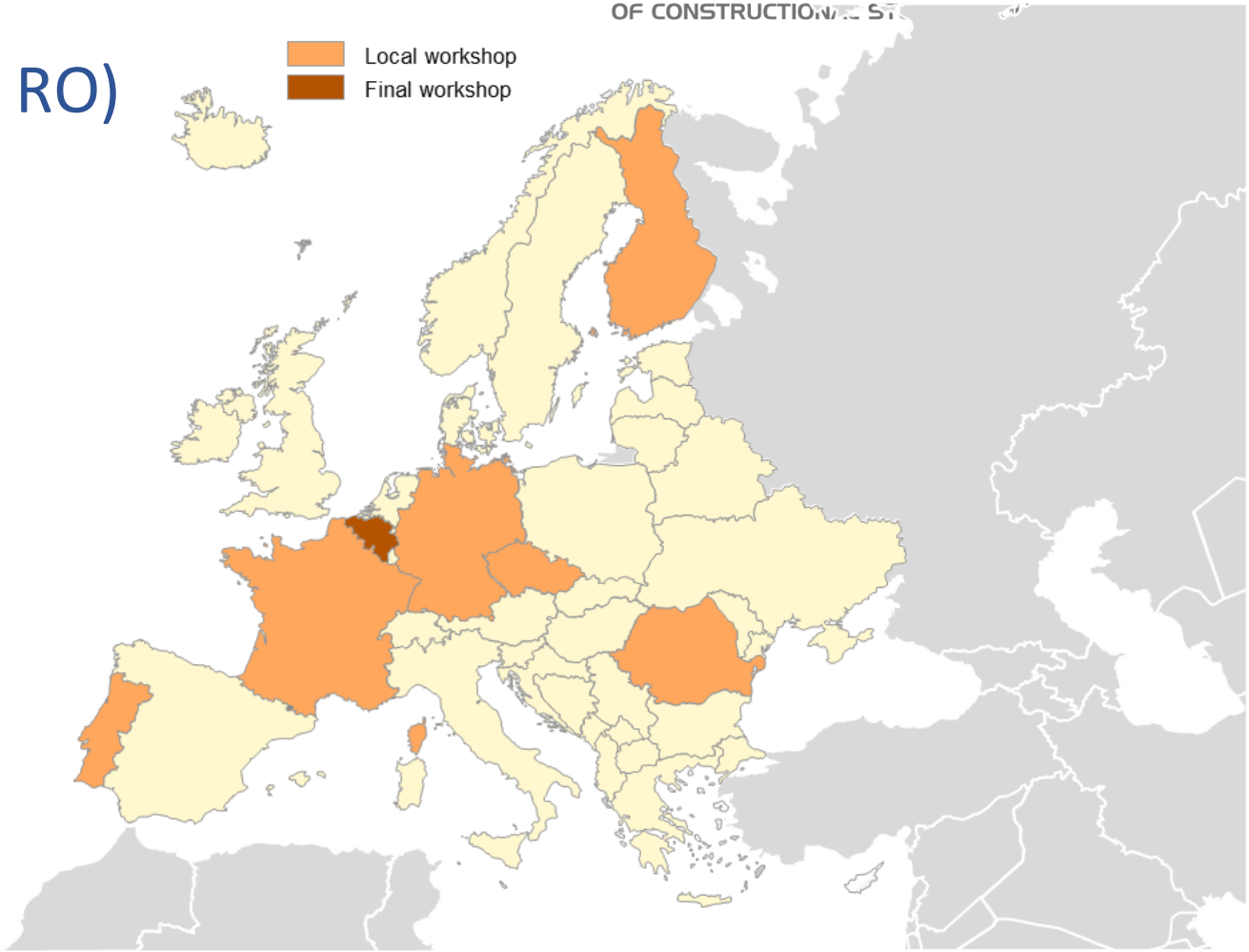
- 6 local workshops (FI, FR, DE, CZ, PT, RO)
- Final workshop (today, Brussels).



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2023-2025

ADVANCE

ACCOMPANYING MEASURE FOR DISSEMINATION, VALORISATION AND COLLABORATIVE EXPLOITATION OF CIRCULARITY OF CONSTRUCTIONAL STEEL PRODUCTS

THANK YOU !

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