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DreamFAB

Deconstruction and Refabrication for the Reuse of Steel Buildings

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TC 250 / SC 3 / WG 24 Meeting

Aachen, 07/10/2025

Project info

Title	Deconstruction and Refabrication for the Reuse of Steel Buildings (DreamFAB)
Duration	01/09/2023 – 31/08/2027
Partners	Häme University of Applied Sciences, Finland University of Coimbra, Portugal Politehnica University Timisoara, Romania FERPINTA Group, Portugal ROBOPLAN, Portugal Wurth Oy, Finland Jupa S. A., Spain SSAB Europe Oy, Finland STAR Institute, Portugal
Funding	European Research Fund for Coal and Steel (RFCS)
Budget	2 500 000 €

Project objectives

Structural safety

- Increased imperfections
- Multiple welding-cutting cycles

Demountable solutions

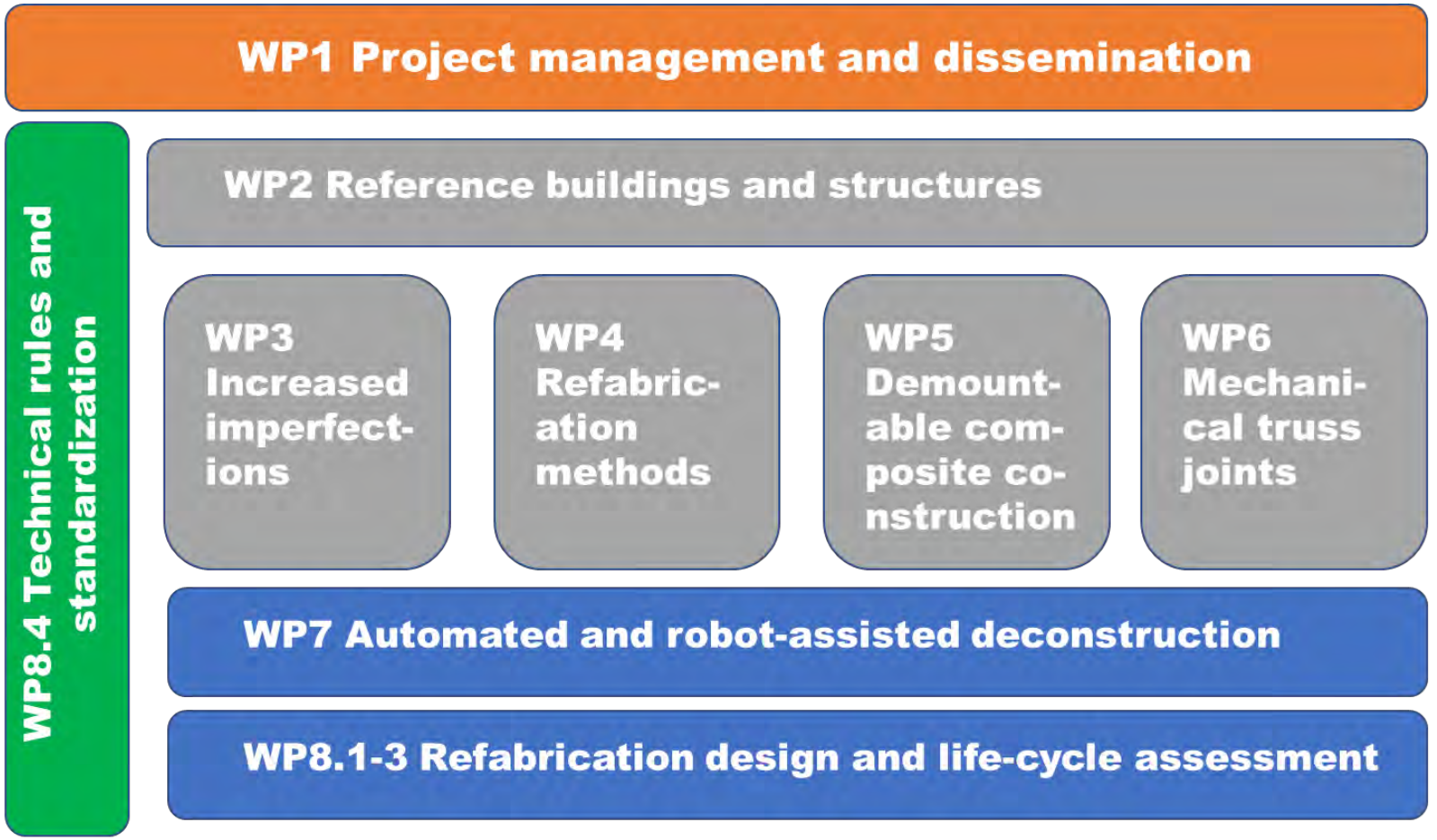
- Composite beams
- Joints in tubular trusses

Robot-assisted deconstruction

- Framework & architecture
- AI, digital twin & mixed reality
- Demonstrators

Design rules and standardization

Work plan



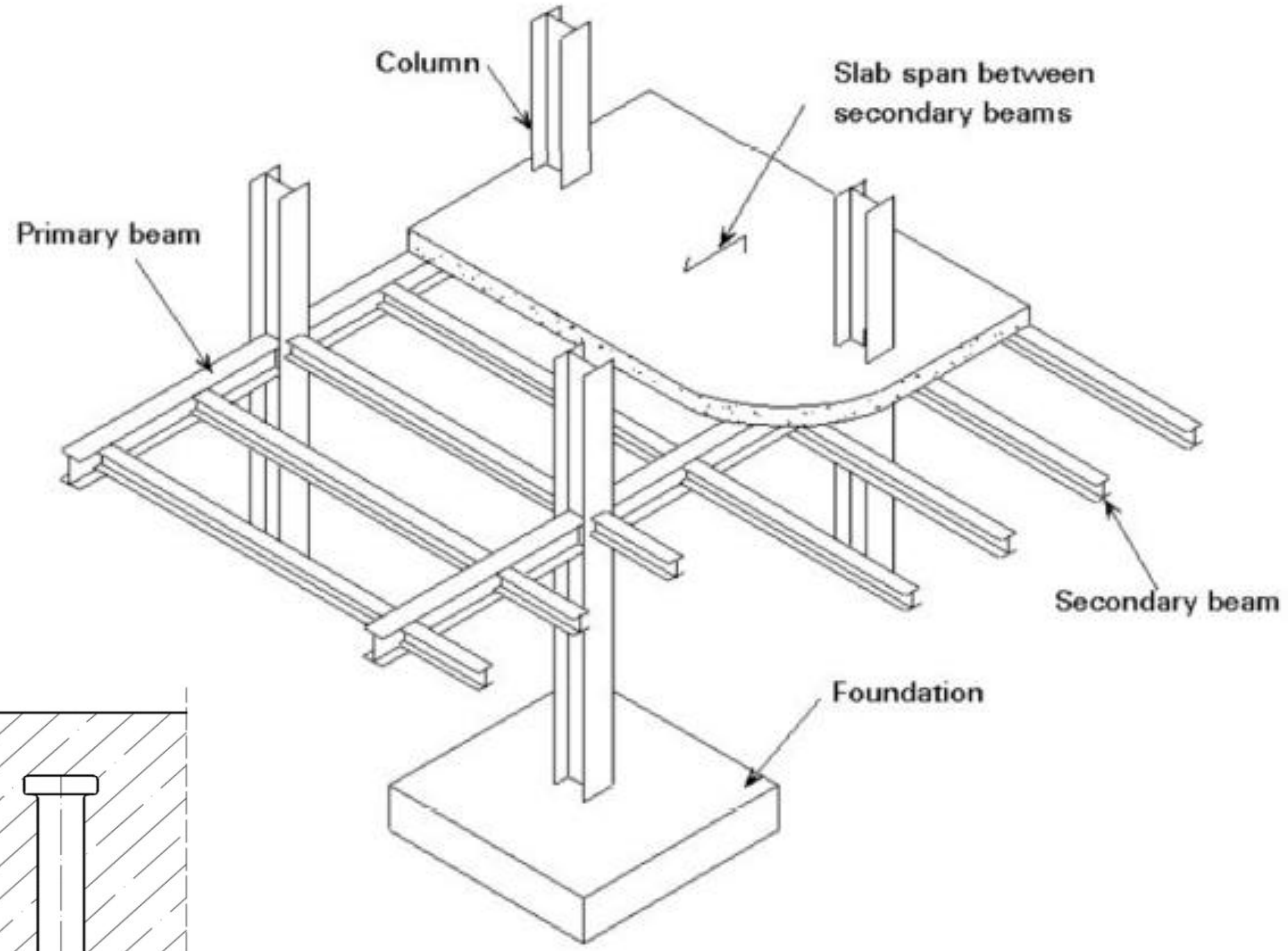
WP	Leader
WP1	HAMK
WP2	JUPA
WP3	UPT
WP4	HAMK
WP5	UC
WP6	HAMK
WP7	ROBO
WP8	FER

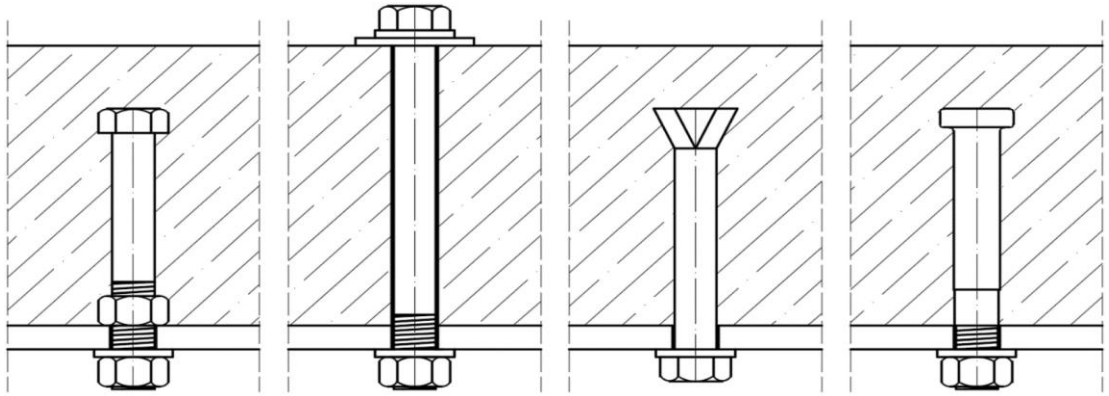
WP1. Project coordination and dissemination

- Project coordination and management
- Organization of workshops
- Scientific publications and presentations
- Design rules and guidelines

WP2. Reference buildings and structures

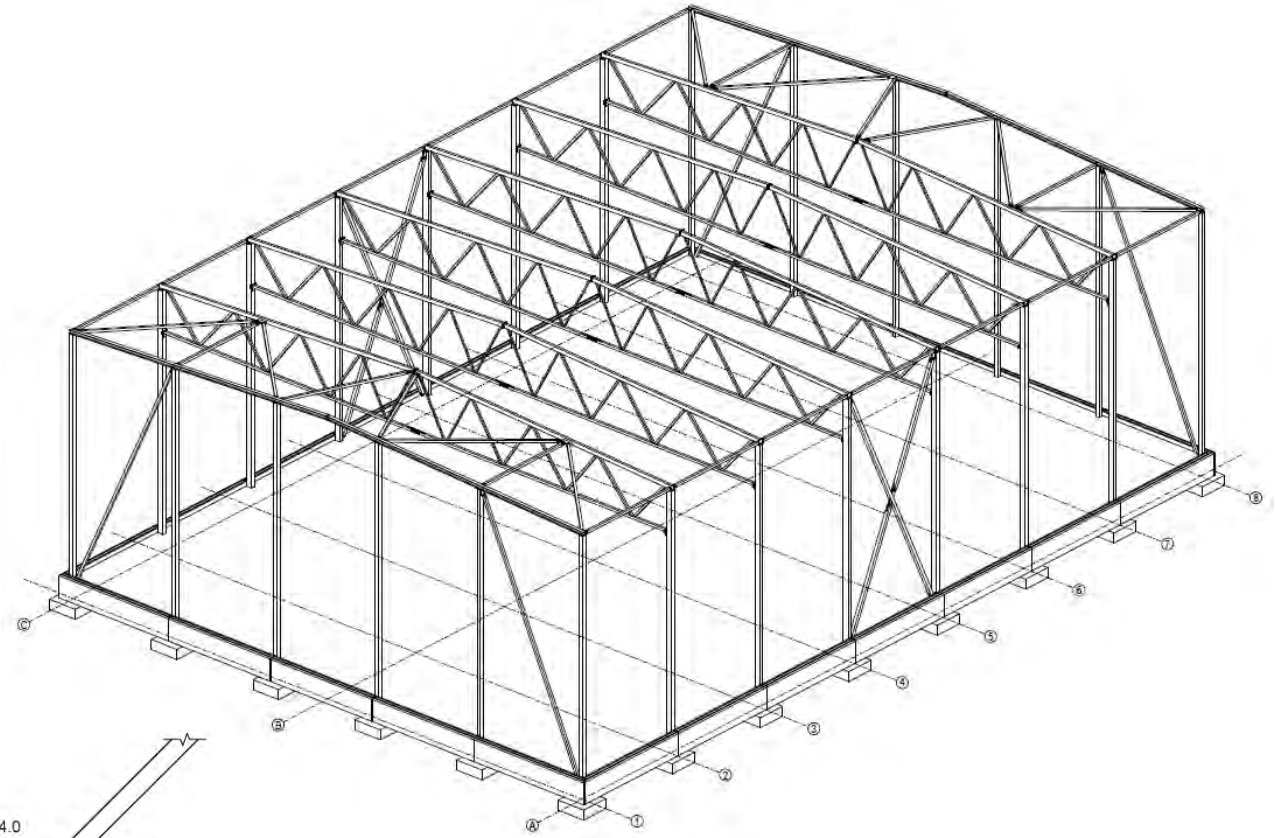
- Design of a multi-storey composite building
- Deconstruction options for composite buildings

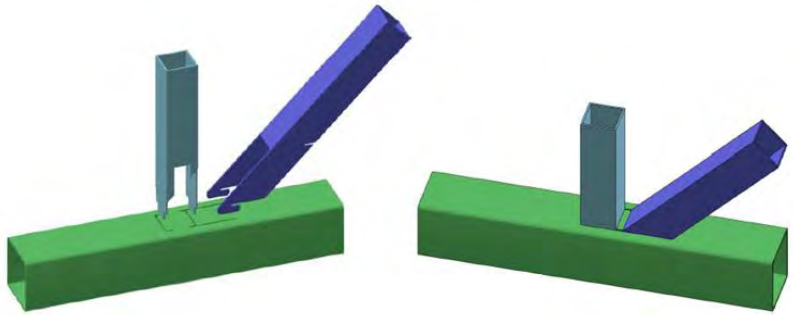


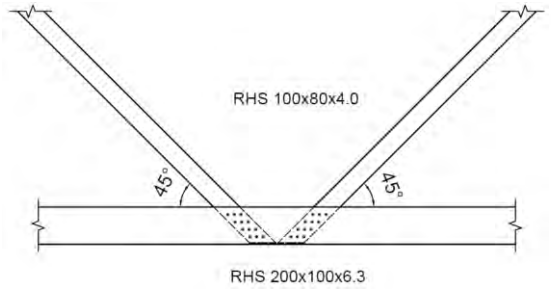


WP2. Reference buildings and structures

- Design of a single-story industrial hall with tubular roof truss
- Deconstruction options for tubular truss structures

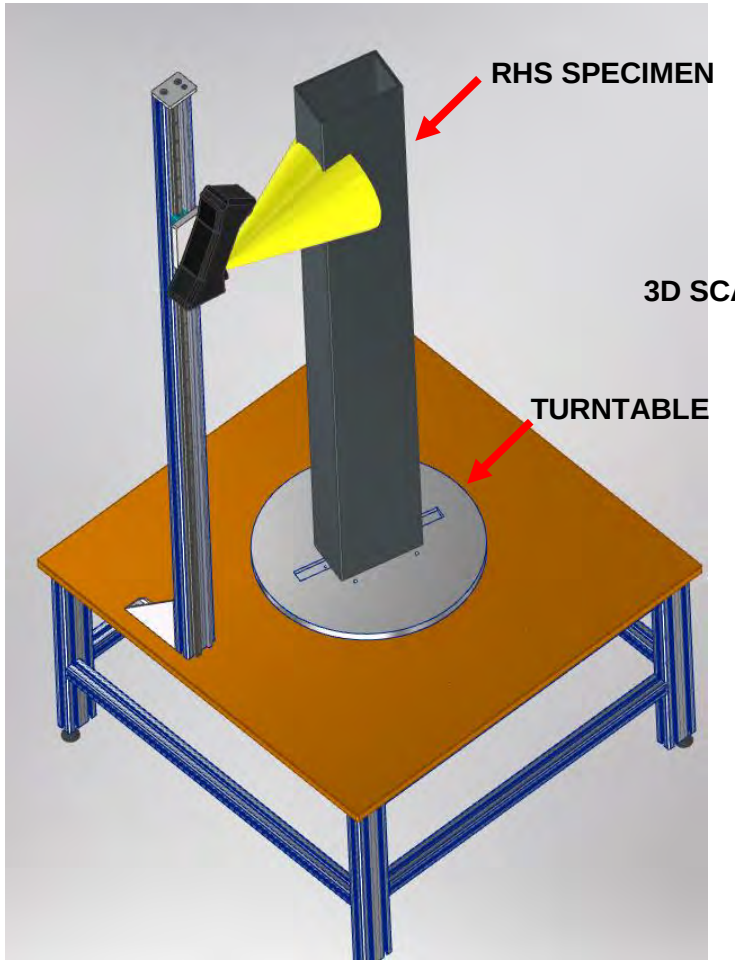


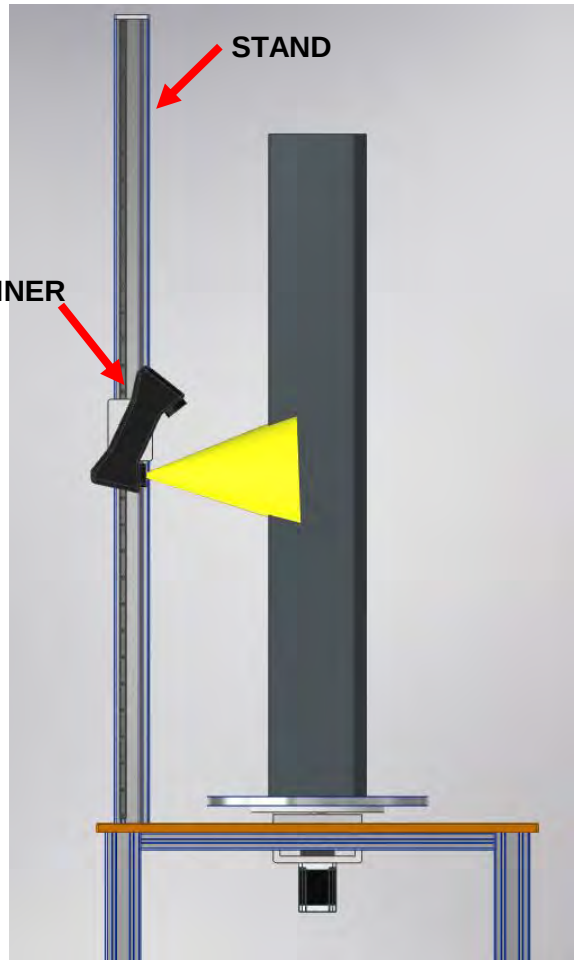




WP3. Increased imperfections

- Design and execution of a robotized scanner for imperfections

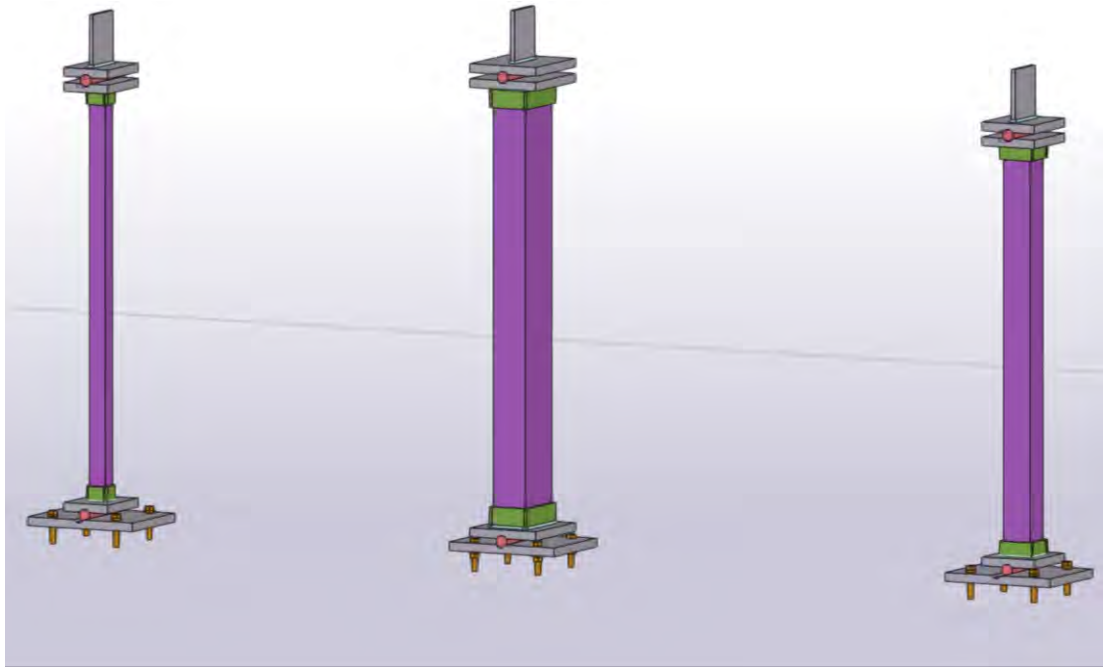


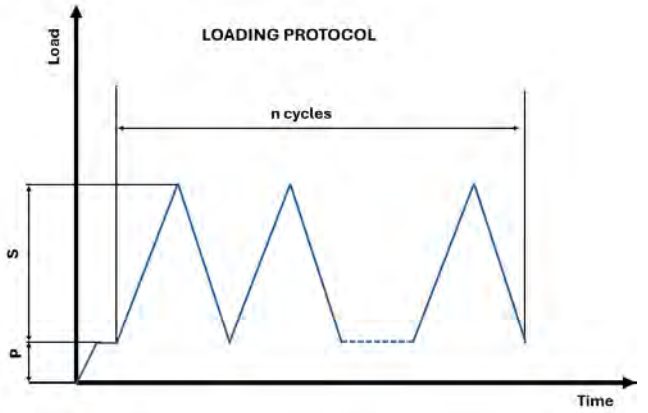


CREAFORM HANDYSCAN BLACK SERIES

WP3. Increased imperfections

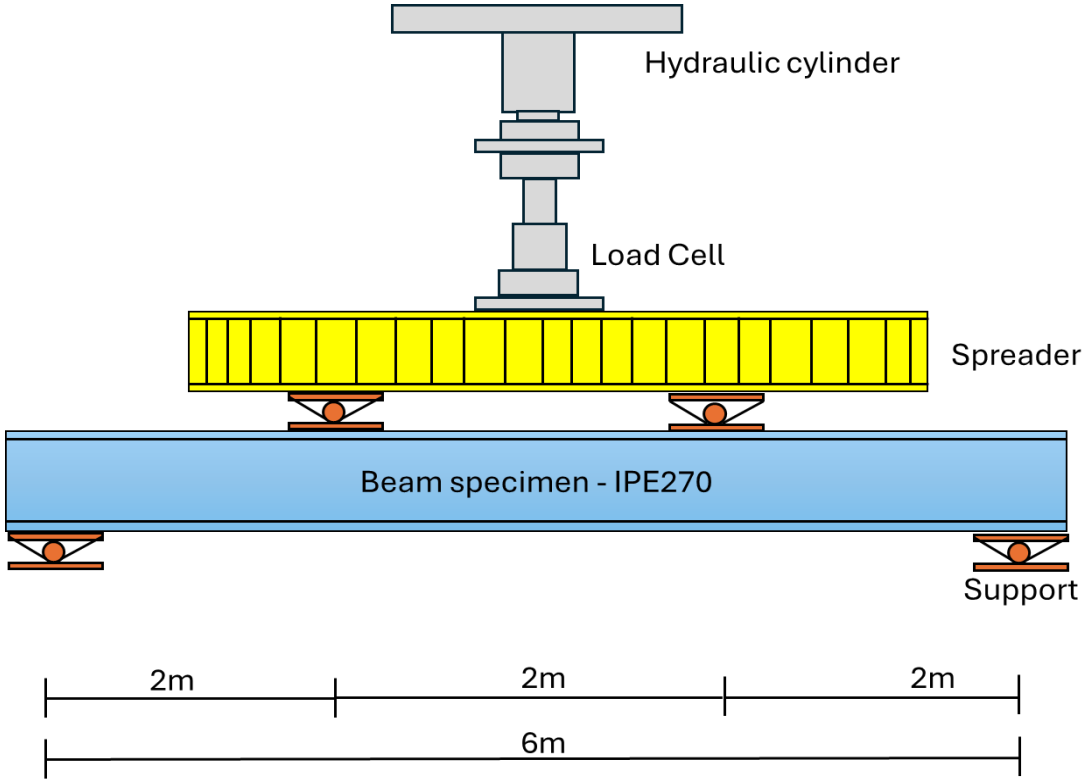
- Deriving geometric imperfections on existing structural elements: Measurements on compressed RHS sections

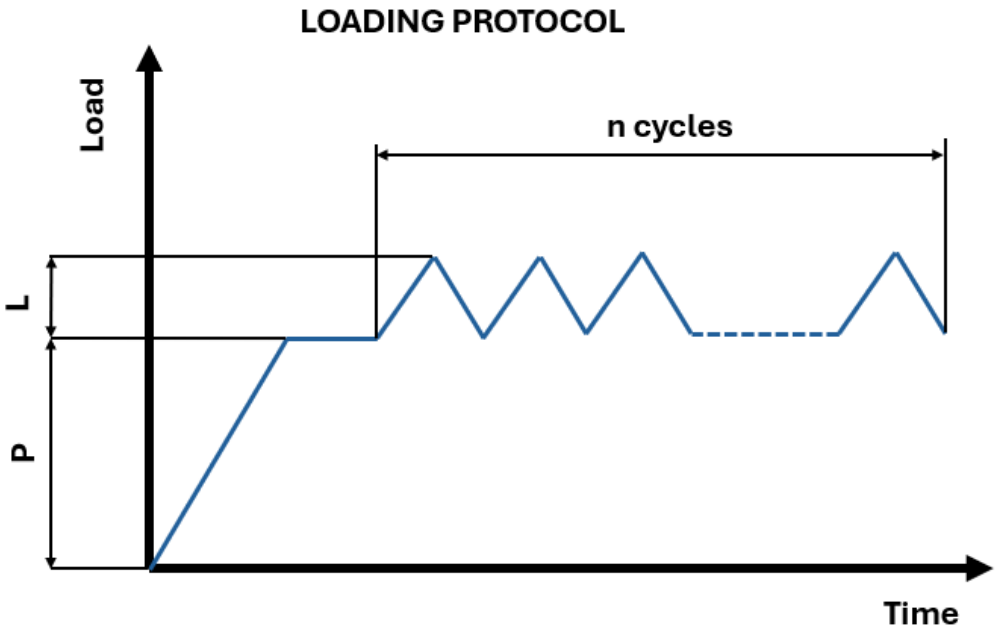




WP3. Increased imperfections

- Deriving geometric imperfections on existing structural elements: Measurements on steel elements loaded in bending





WP3. Increased imperfections

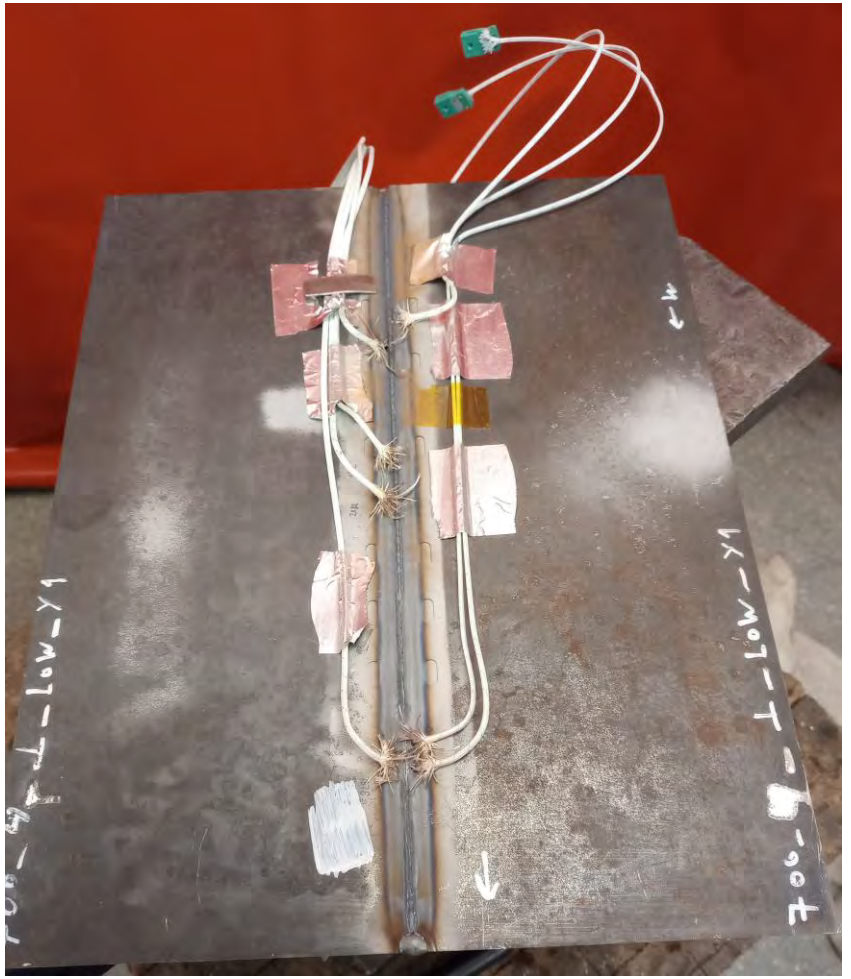
- Deriving geometric imperfections on existing structural elements: Measurements on deconstructed elements

WP3. Increased imperfections

- Deriving geometric imperfections on re-fabricated structural elements

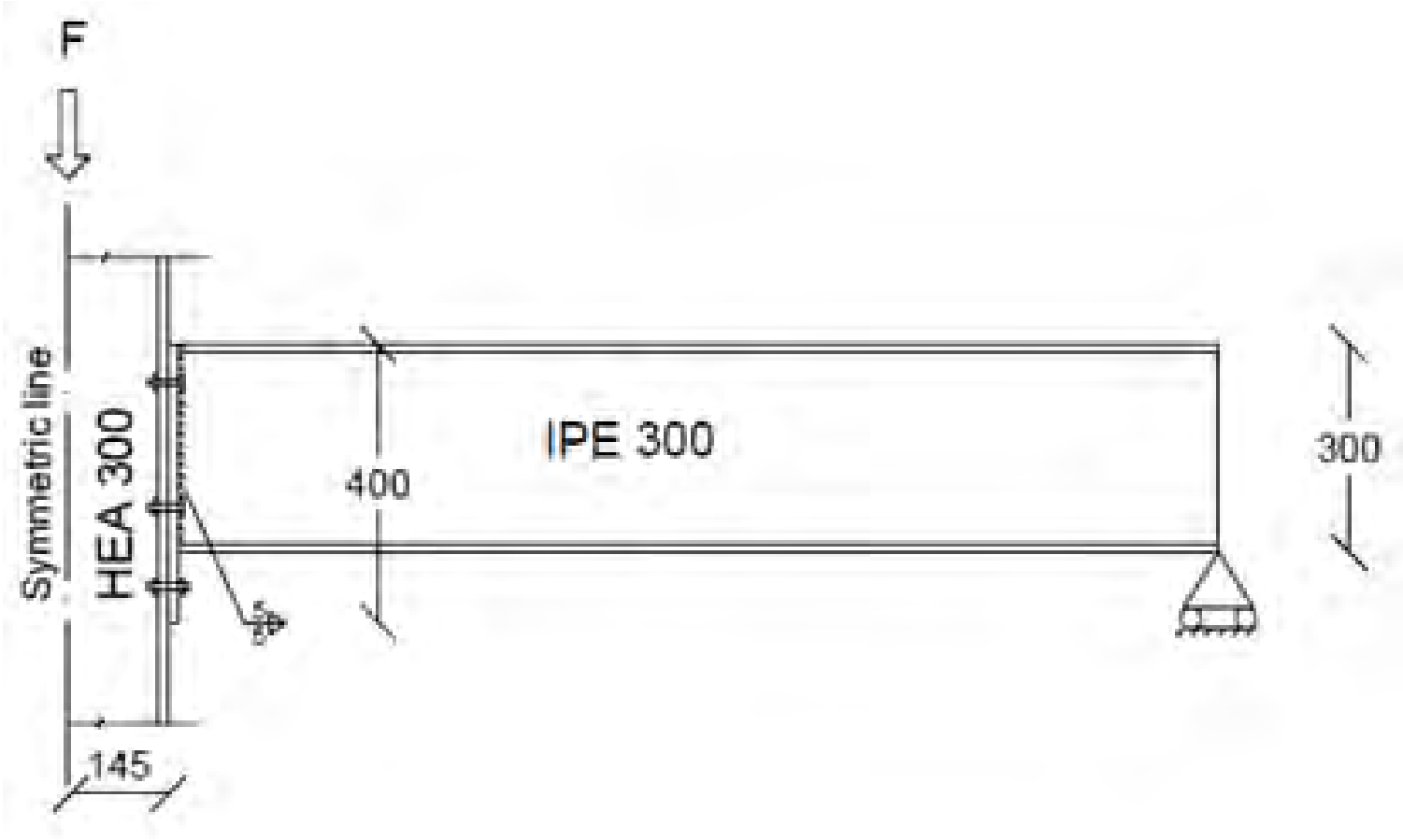
WP4. Re-fabrication methods

- Effect of welding execution parameters on microstructure and mechanical properties
- Effect of multiple welding – thermal cutting – welding thermal cycles



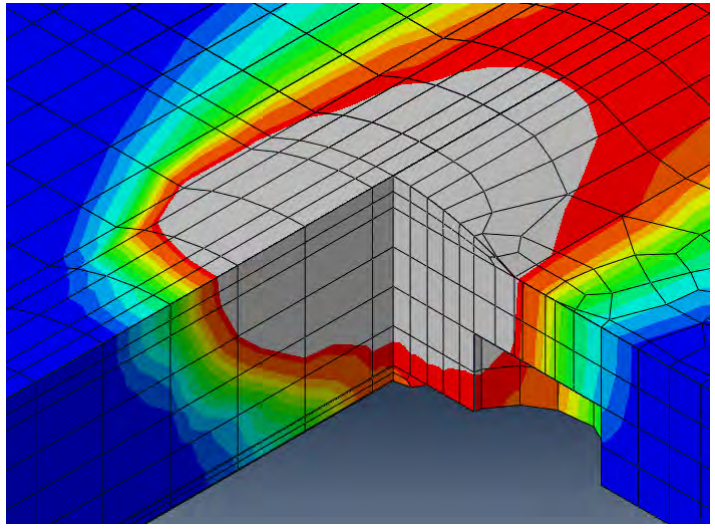
WP4. Re-fabrication methods

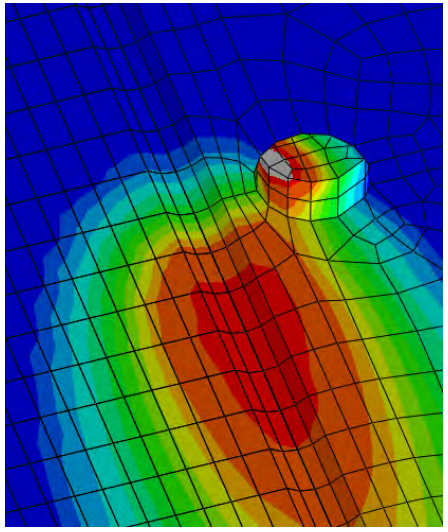
- Effect of rewelding on mechanical properties of HAZ (tests on beams)

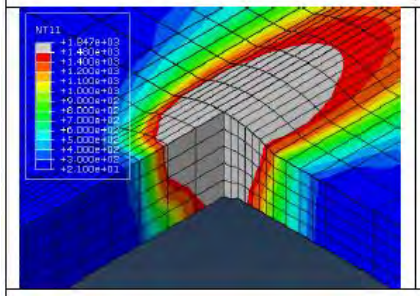
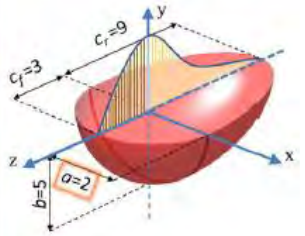
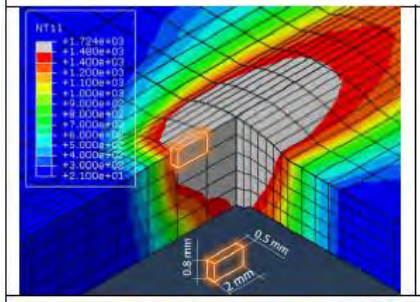
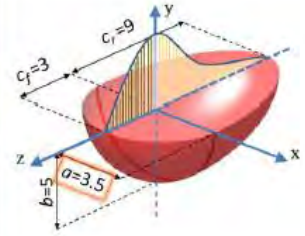
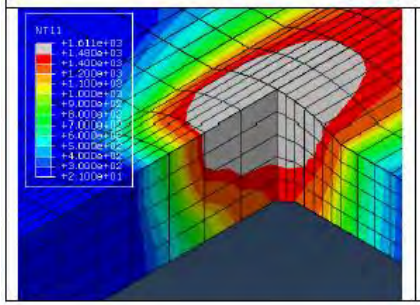
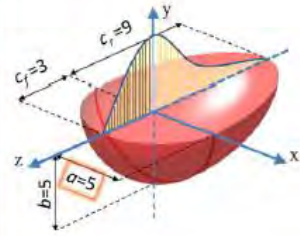


WP4. Re-fabrication methods

- FE simulations of welding temperatures, residual stresses and tensile test of weld joint under repeated welding-cutting cycles

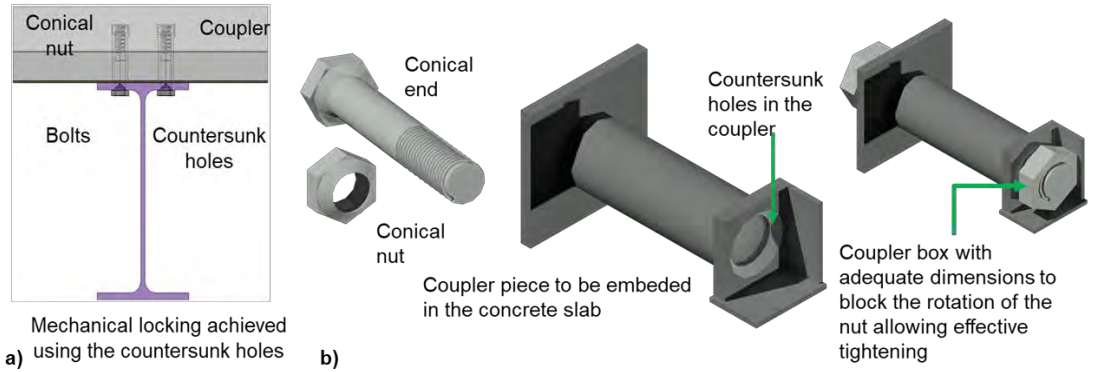




Outcome	Input for Goldak's heat source parameters (units in mm)	Remarks
		- Max. temperature equal to 1847 °C. - Weld pool too large. - Weld root too large.
		- Max. temperature equal to 1724 °C. - Weld pool sufficient. - Weld root sufficient.
		- Max. temperature equal to 1611 °C. - Weld pool too small. - Insufficient penetration.

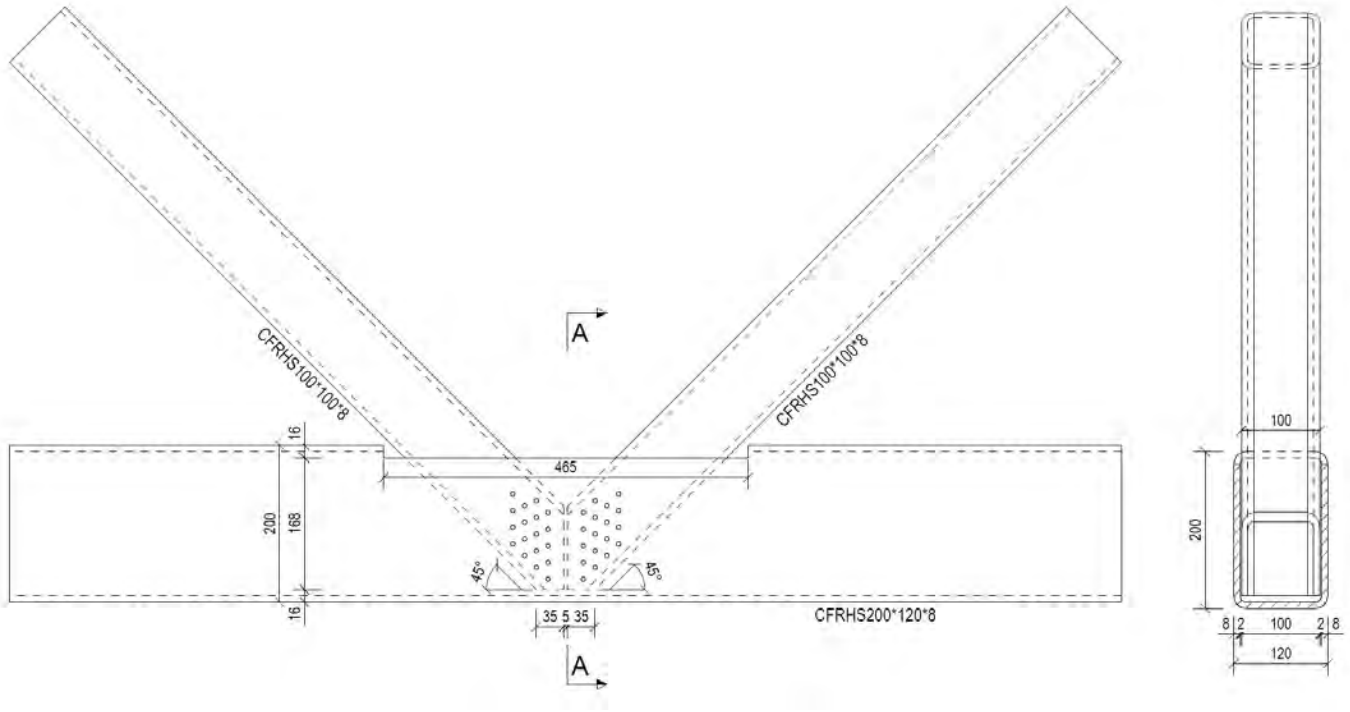
WP5. Demountable composite construction

- Conceptual development of innovative demountable shear connectors
- Experimental characterization of the behaviour of the demountable shear connectors
- Full scale testing of composite beams
- Design guidelines



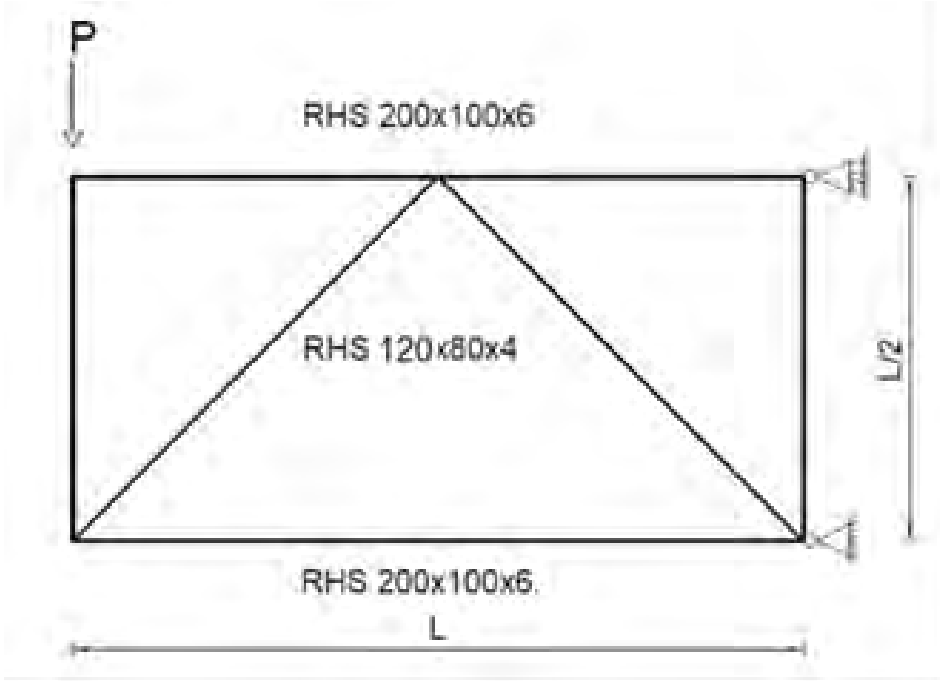
WP6. Mechanical truss joints

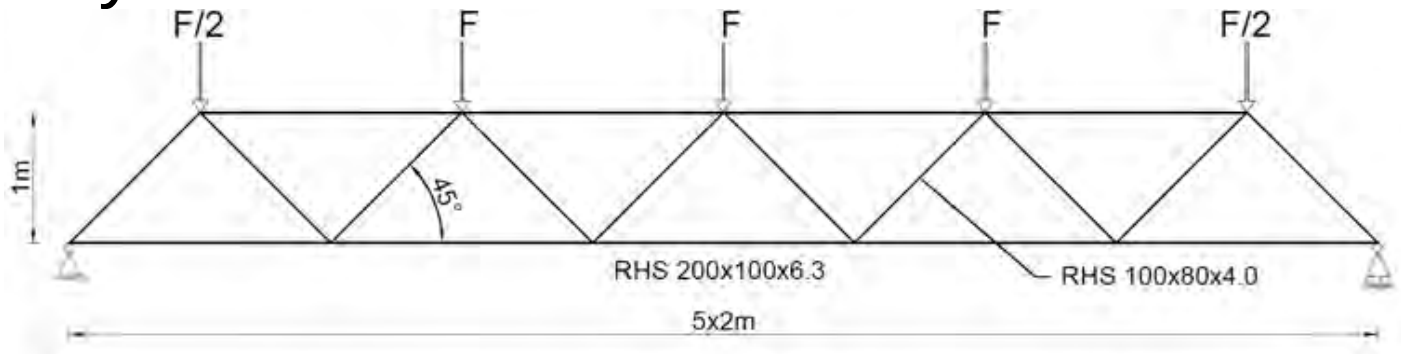
- Solution development for demountable mechanical truss joint



WP6. Mechanical truss joints

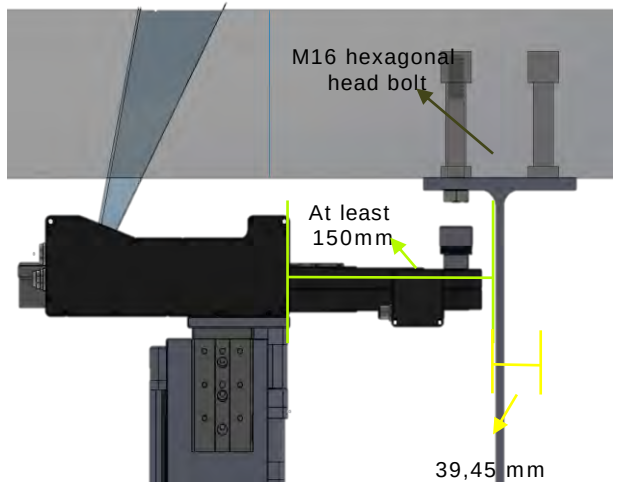
- Structural behaviour of T-joints and K-joints with mechanical solution
- Full truss structures with demountable non-welding joint solution
- Design rules and manufacturing guidelines, design and assembly process automation

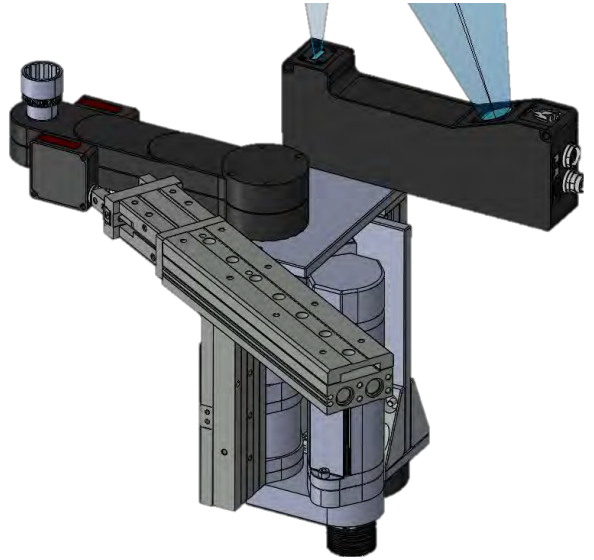




WP7. Automated and robot-assisted deconstruction

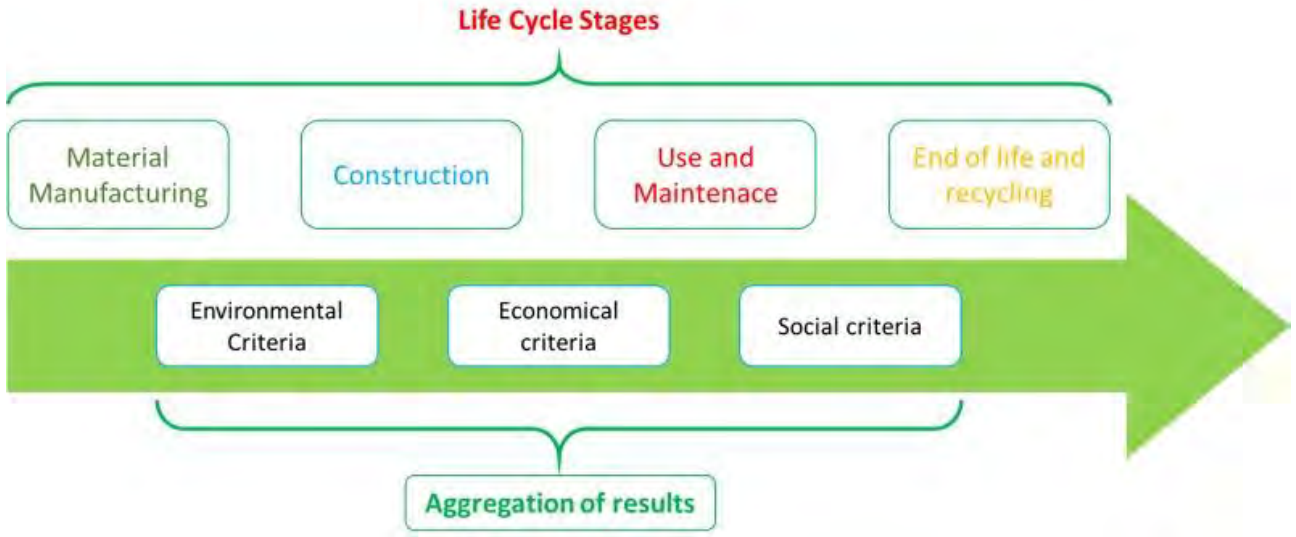
- Framework for robot assisted construction and deconstruction (FRACD)
- Simulation of scenarios, system specification and requirements
- General system architecture and Digital Twin
- Data management, Artificial Intelligence (AI) & Mixed Reality (MR) integration
- Steel-concrete composite construction: robot assisted construction and deconstruction process
- Non-welded tubular roof truss: the deconstruction of roof truss
- Transporting FRACD to standard rules of robot-assisted construction and deconstruction





WP8. Re-fabrication design and LCA, technical rules and standardization

- Improved strategies for deconstruction
- Information management and BIM tool
- Life-cycle assessment
- Pre-normative guidance for reuse of steel and steel-concrete composite structures

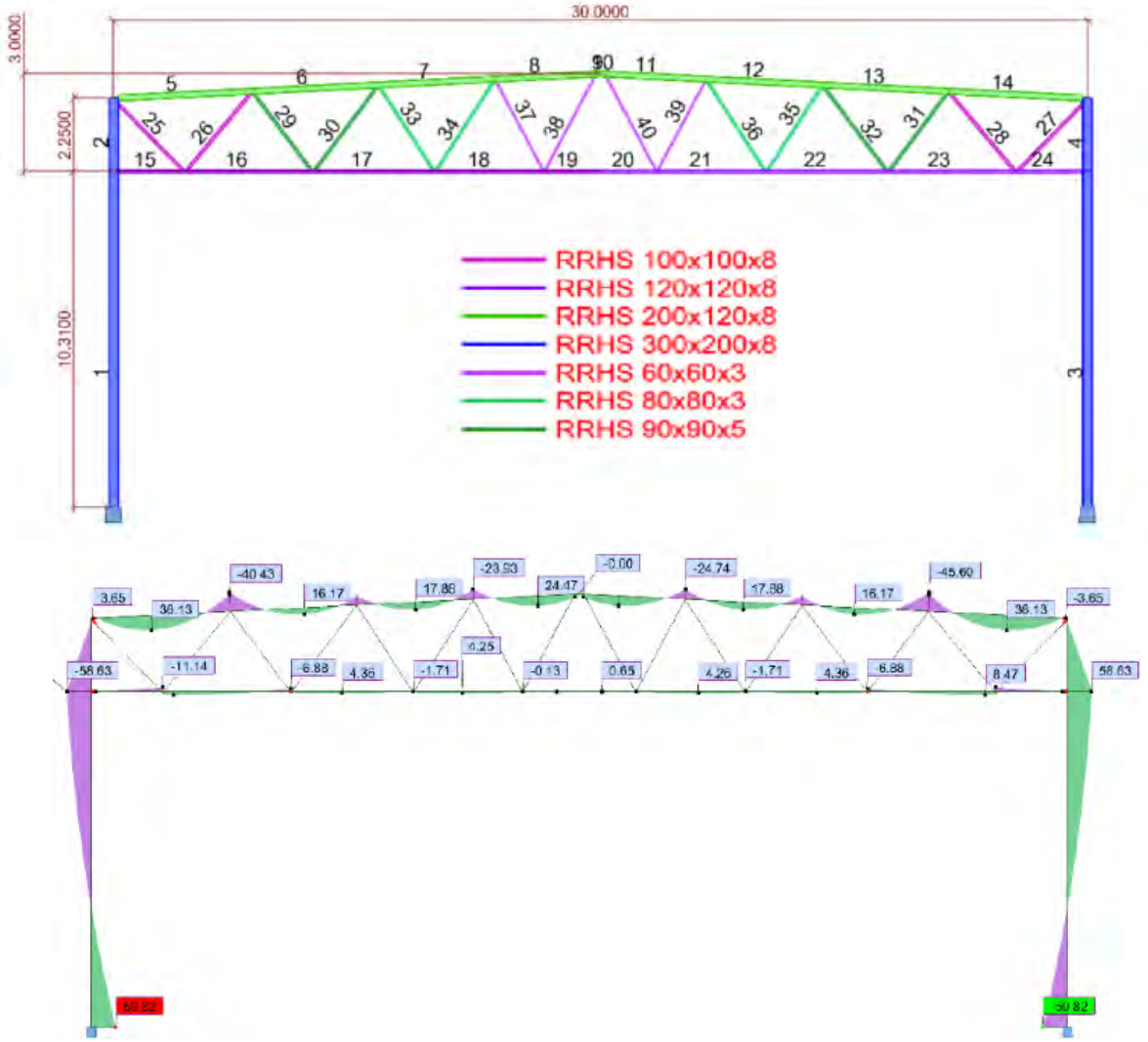


WP3 Increased imperfections

Assessment of increased imperfections of tubular truss members under service conditions

Reference structure and test specimens

- Industrial structure with truss girder typical for Finnish practice.
- Design to Eurocode 3 and Finnish codes.
- Investigated members:
  - Top chord: N+M,
  - Lower chord: N,
  - Web: N.



Specimen scaling

- Buckling resistance ratio $(N_{Ed}/N_{b,Rd})$
- Width-to thickness (c/t)
- Non-dimensional slenderness $(\bar{\lambda})$

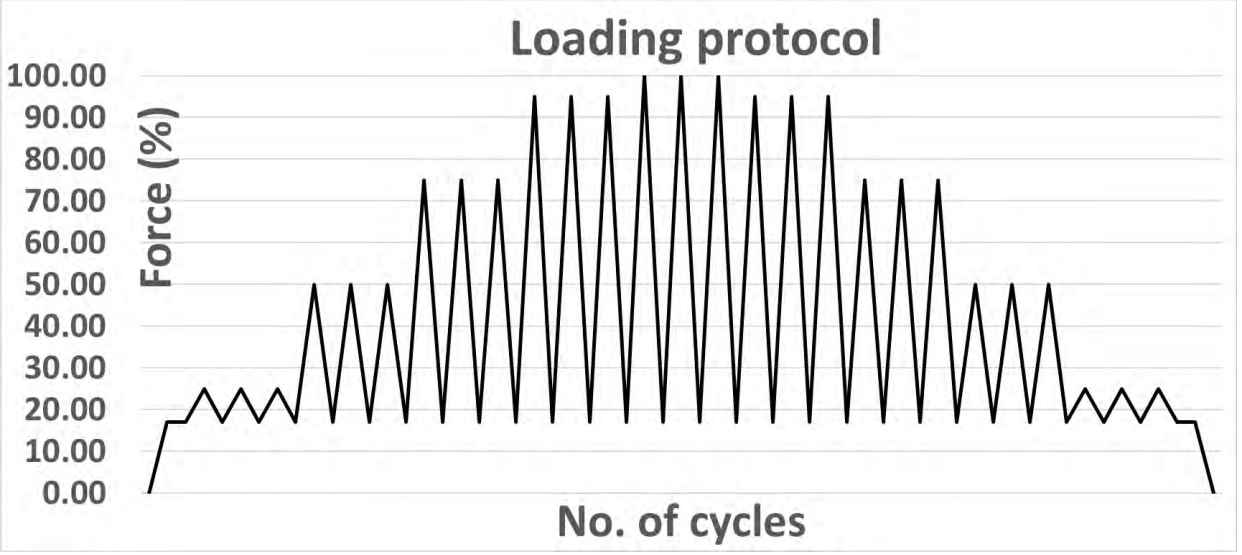
Parameters	Original section RHS200x120x8	Scaled section RHS100x60x4
$N_{Ed}/N_{b,Rd}$	0.54	0.54
c/t	20.00	21.00
$\bar{\lambda}$	1.31	0.88
e (mm)	58.22	22.68
Length (m)	4.00	1.50
Steel grade	S500	S420
$N_{Ed,ULS}$ (kN)	783.17	215.02
$N_{Ed,SLS}$ (kN)	531.00	145.80

Specimen	Cross-section original	Cross-section scaled	Element type	Eccentricity
MC-A-SLS	RHS 200x120x8	RHS 100x60x4	Top chord	22,7 mm
MC-B-SLS	SHS 100x100x8	SHS 50x50x4	Lower chord	-
MC-C-SLS	SHS 80x80x3	SHS 50x50x2	Diagonal	-

Loading protocol

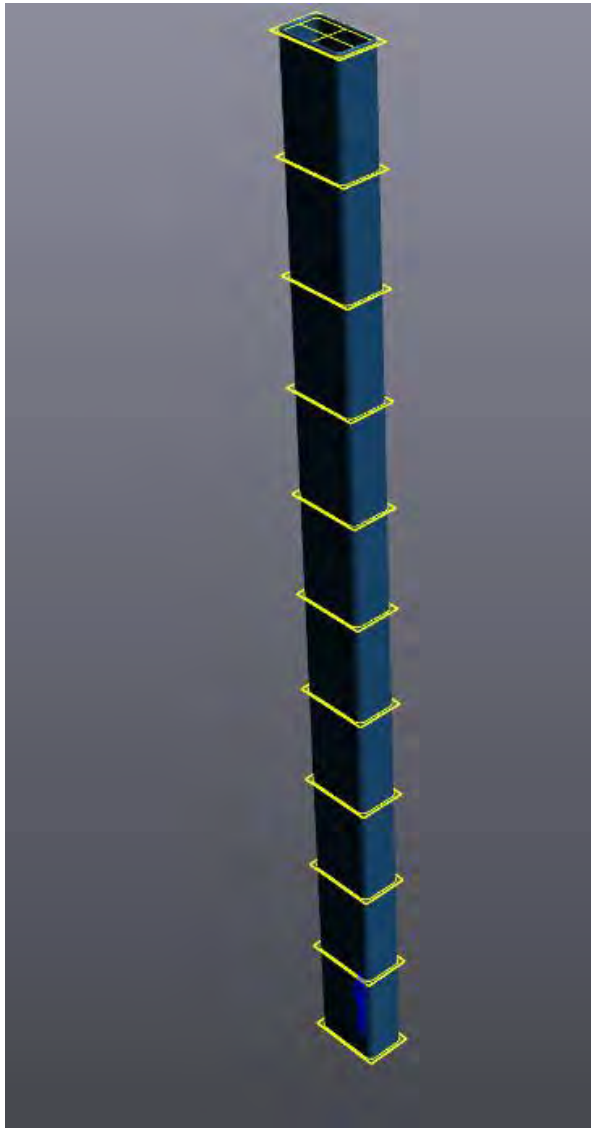
- Loading corresponding to serviceability limit state $P_{SLS} = G_k + S_k$
  - G_k - permanent load;
  - S_k = snow load.
- Tests operated under force control.
- Baseline loading: G_k
- Cyclic loading: groups of 3 cycles at 25%, 50%, 75%, 95%, 100% of P_{SLS}

Specimen	P_{SLS} (kN)
MC-A-SLS	145.80
MC-B-SLS	87.80
MC-C-SLS	47.80



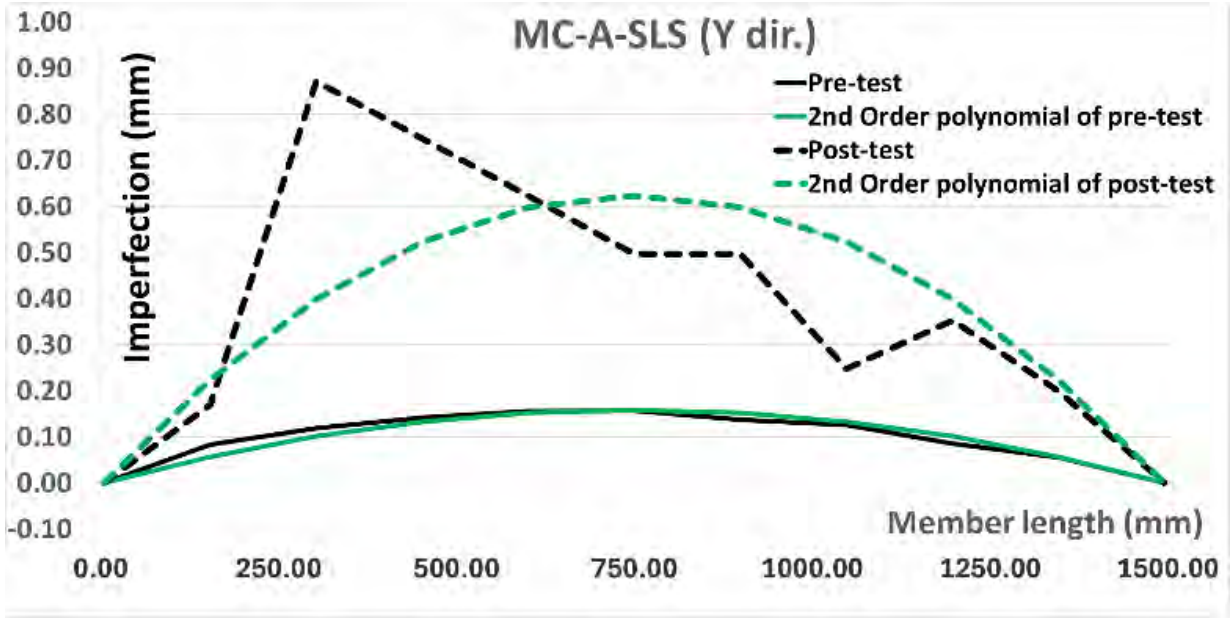
Measurement of geometric imperfections

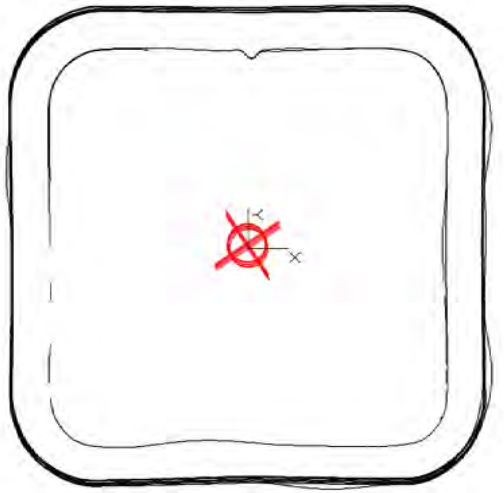
- Handheld 3D scanner
  - blue laser
  - accuracy of 0,04 mm
  - maximum possible scanning volume of 4 m^3.
- Each specimen scanned before and after testing.



Geometric imperfections

- Magnitude of local imperfections (thickness deviations, or cross-section waviness) is comparable to member imperfection.
- To separate local imperfections from member imperfections, a second-order polynomial was fitted to the measured data, constrained to pass through the end points.





Experimental results

Maximum permitted deviations from straightness for bracing components in lattice structures to EN 1090-2:2008 is the larger of L/750 or 6 mm.

Measurement	MC-A-SLS (mm)	MC-B-SLS (mm)	MC-C-SLS (mm)
Pre-test (X)	0.01	-0.06	0.02
Pre-test (Y)	0.16	-0.16	0.41
Post-test (X)	0.48	-0.22	-0.12
Post-test (Y)	0.62	0.52	**0.72**

Measurement	MC-A-SLS (ratio)	MC-B-SLS (ratio)	MC-C-SLS (ratio)
Pre-test (X)	L/25000	L/150000	L/75000
Pre-test (Y)	L/9375	L/9375	L/3659
Post-test (X)	L/6818	L/3125	L/12500
Post-test (Y)	L/2885	L/2419	**L/2083**

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