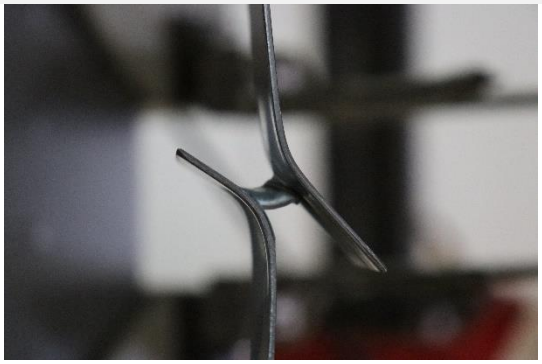
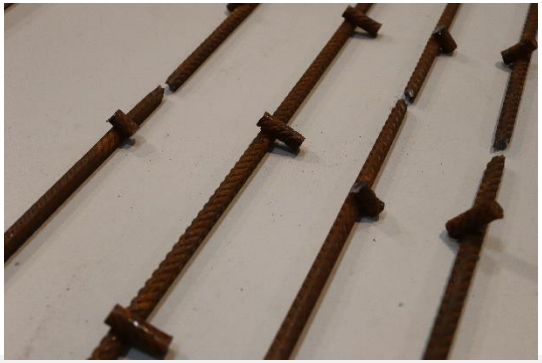
Project title: **Innovative lightweight cold-formed steel-concrete composite floor system**
Acronym: **LWT-FLOOR** Project ID: **UIP-2020-02-2964**
3rd LWT-FLOOR Project Workshop

Laboratory Tests of Lightweight Composite Floor System LWT-FLOOR





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http://www.grad.unizg.hr/lwtfloor


I. LWT-FLOOR project
II. Laboratory tests
III.Results and discussion
IV.Conclusions

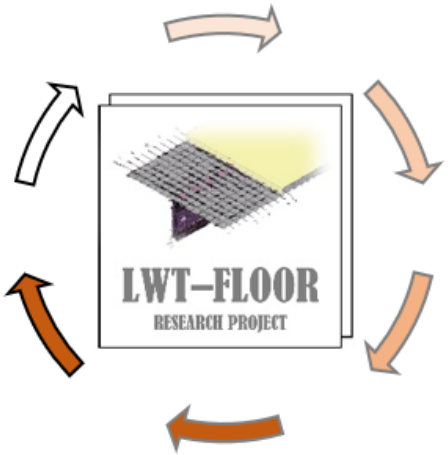
PROJECT OBJECTIVES

O1 …to establish research group

ER1: Research group equipped with knowledge and instrumentation for specimen's preparation, experimental, numerical and probabilistic testing, understanding components and overall behaviour of the proposed system through the entire life cycle.

O2 …to investigate and validate, experimentally, numerically and probabilistically components of proposed system

ER2: Technical report with test results on materials and optimal welded and shear connections solutions.



O3 …to investigate and validate, experimentally, numerically and probabilistically proposed system

ER3: Technical report with results for the proposed system

O4 …to validate proposed floor system through on numerical parametric studies, probabilistic methods and life cycle analyses

ER4: Report with validation of FE models for different floor system typologies and results of numerical, probabilistic and life cycle studies of specimens with larger spans.

O5 …to establish an analytical proposal for design recommendations for this new type of floor system

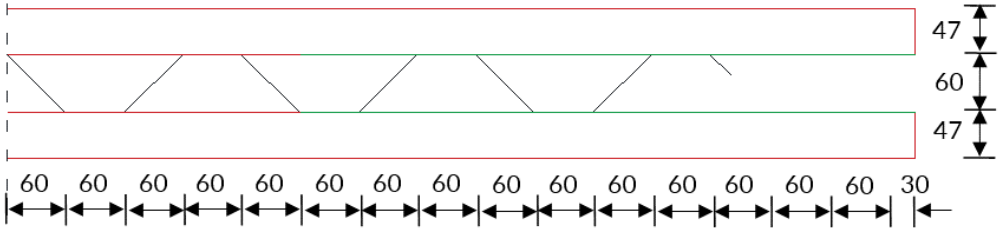
ER5: Technical recommendations for design and fabrication will be proposed

O6 …to prepare project proposals and applying to other sources of funding

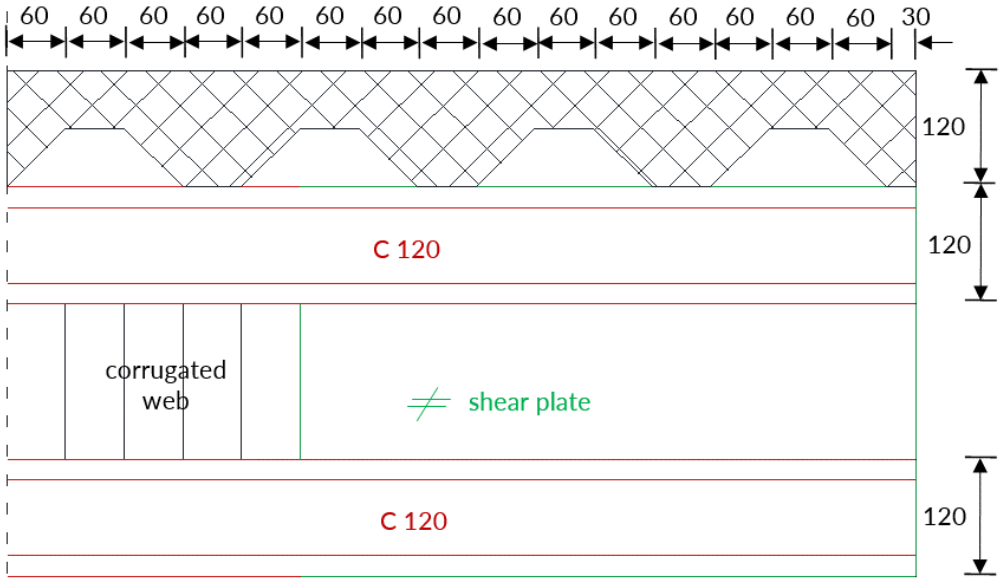
ER6: Research group as a centre of expertise self-sustained through other national and international funding sources.

SYSTEM OVERVIEW

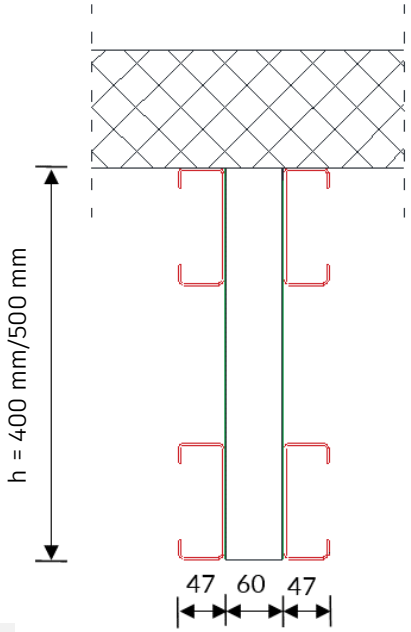
plan view of steel girder



longitudinal view of the whole system



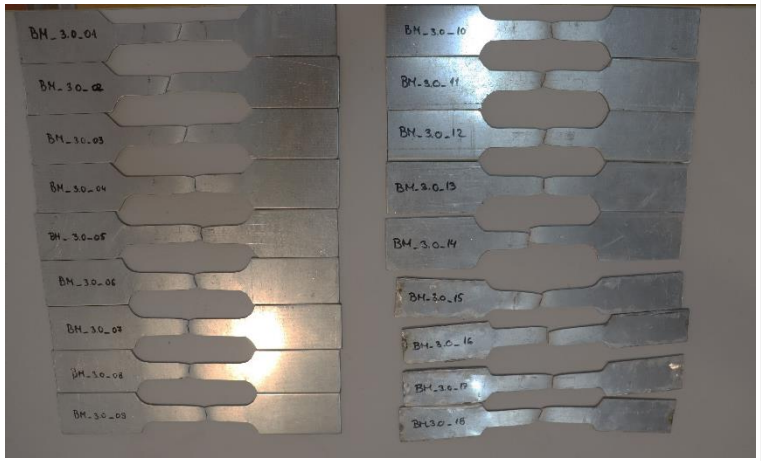
cross section of the whole system



BASE MATERIALS

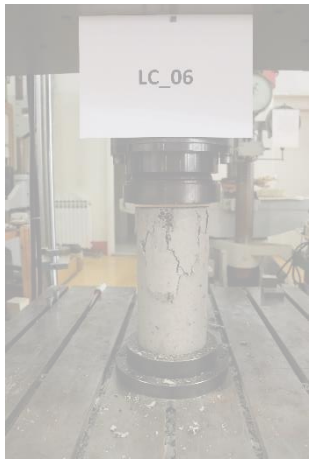
STEEL SHEETS

(all the elements, all the used thicknesses)



CONCRETE CYLINDERS

(NC20/25, LC20/22)



BASE MATERIALS

STEEL SHEETS

(all the elements, all the used thicknesses)

CONCRETE CYLINDERS

(NC20/25, LC20/22)

BASE MATERIALS

BOLTS

(M12, M16, grade 8.8)

REINFORCEMENT – BARS AND MESHES

(Ø8 mm bars, Q-525 mesh)

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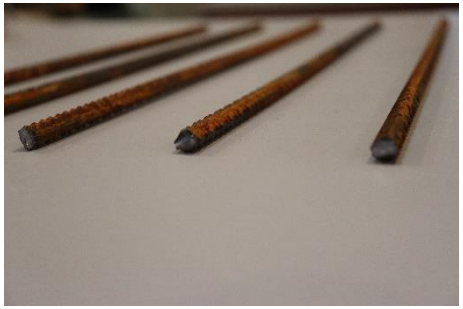
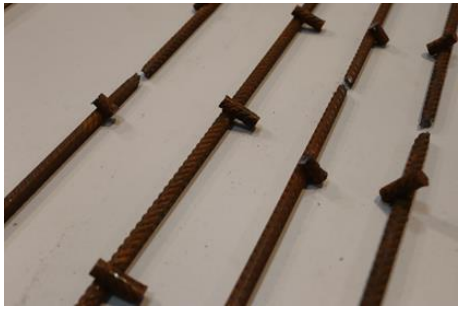
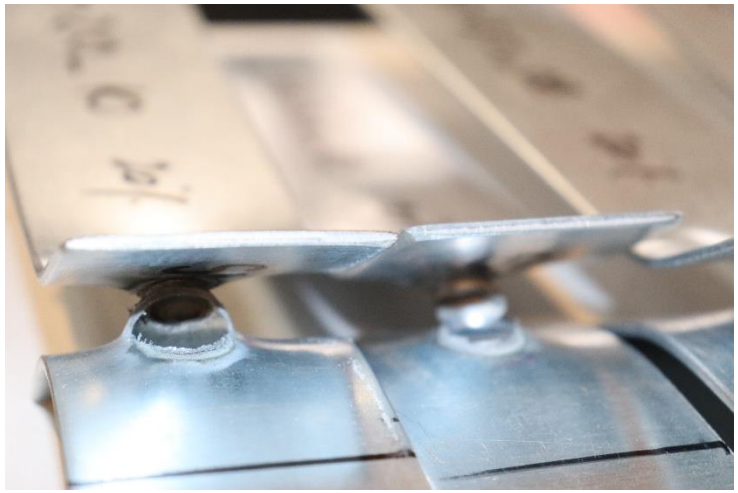




SPOT WELDS

0.8-0.8	1.0-1.0	1.25-1.25	1.5-1.5	2.0-2.0	2.5-2.5	3.0-3.0
0.8-1.0	1.0-1.25	1.25-1.5	1.5-2.0	2.0-2.5	2.5-3.0	
0.8-1.25	1.0-1.5	1.25-2.0	1.5-2.5	2.0-3.0		
0.8-1.5	1.0-2.0	1.25-2.5	1.5-3.0			
0.8-2.0	1.0-2.5	1.25-3.0				
0.8-2.5	1.0-3.0					
0.8-3.0						

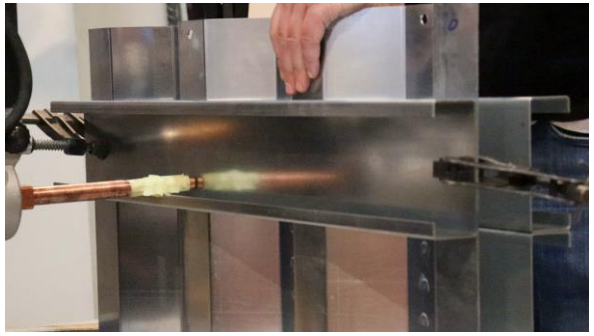
all the combinations from the experiments



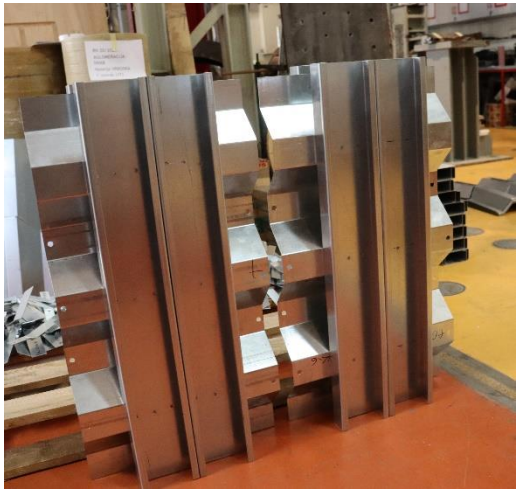
SHEAR CONNECTION

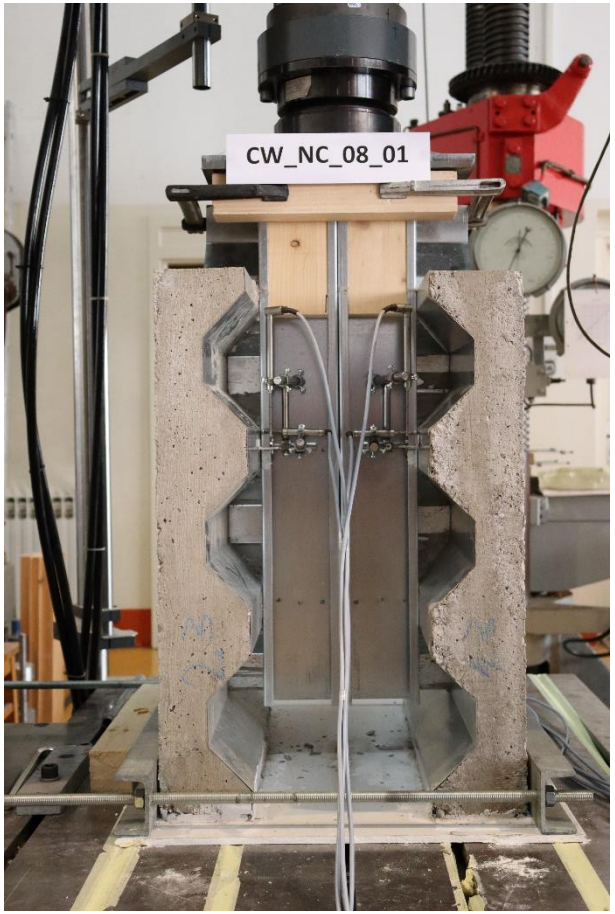
Push-out specimens with concrete dowels:

- Thickness of corrugated web - 0.8 and 1.5 mm
- Normalweight and Lightweight concrete



- Top layer steel sheet - 1 mm
- C profile 2 mm





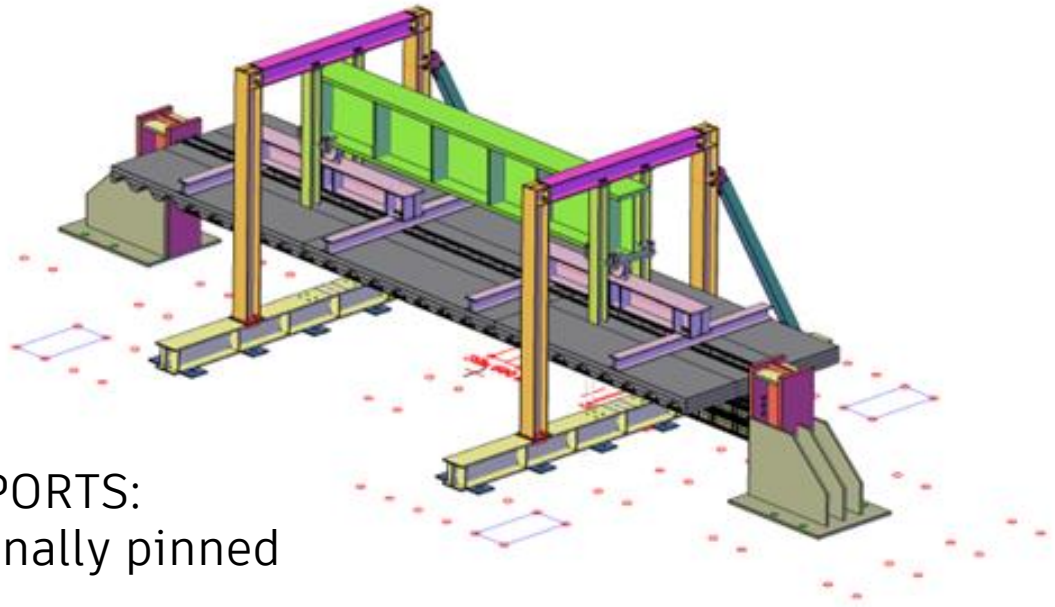
SHEAR CONNECTION

Push-out specimens with demountable bolted shear connection:

- Two systems configurations (BB_xx and BCWB_xx)
- Steel grade – DX51D and S350GD (only 3 mm C profiles)
- C profile thickness – 2.5 and 3 mm
- M12 & M16 bolts, grade 8.8

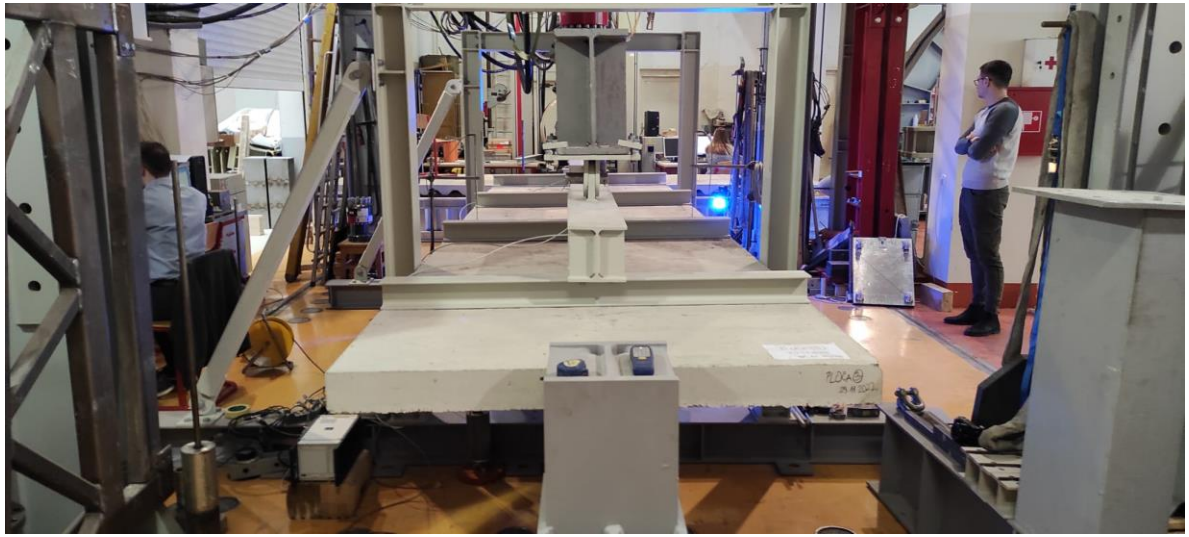
FULL-SCALE SYSTEM

Steel girder	Thickness of the C profile [mm]	Shear plates		Corrugated web	
		Height [mm]	Thickness [mm]	Height [mm]	Thickness [mm]
SB1	3.0	400	1.5	400	1.5
SB2	2.5	400	1.0	400	1.0
SB3	2.0	500	1.0	500	1.0



SUPPORTS:
nominally pinned

FULL-SCALE SYSTEM

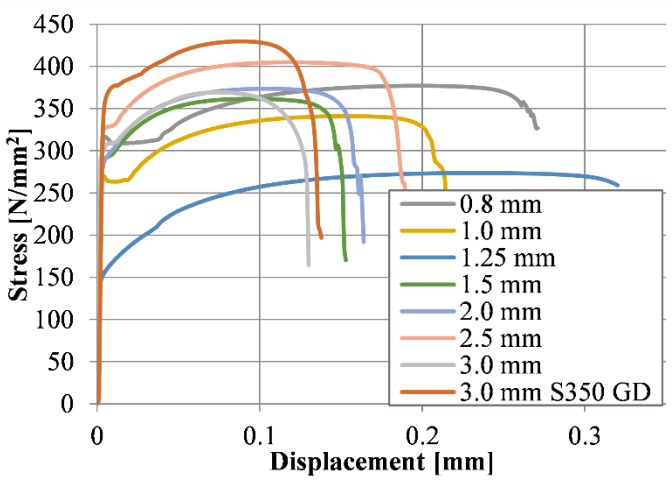


steel girders

with and without web openings

composite girders (only LC)

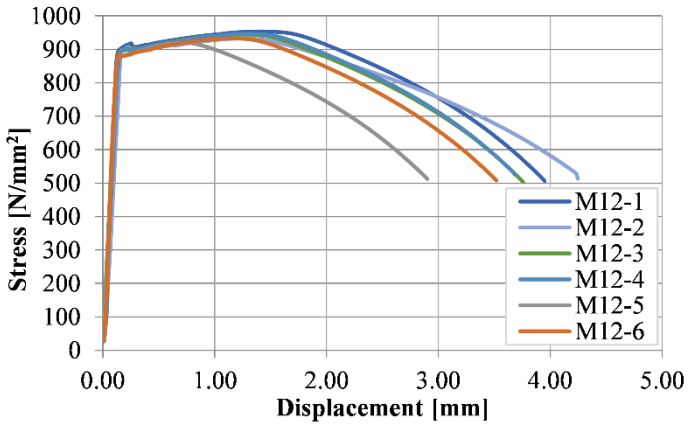
STEEL SHEETS

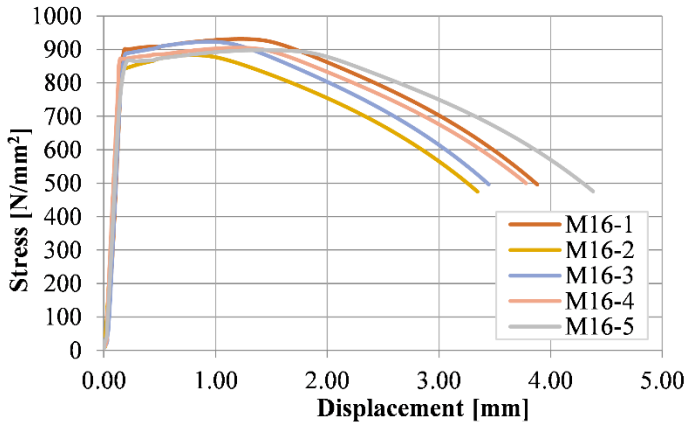


CONCRETE CYLINDERS (NC)

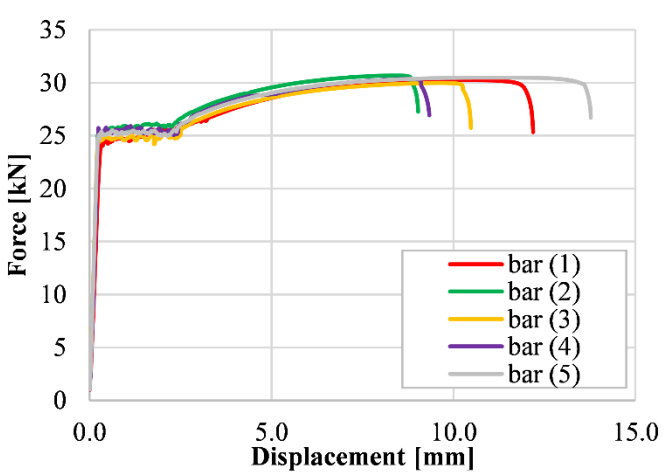
	Compressive strength [MPa]	Modulus of elasticity [MPa]
Mean value	28.09	29562
St. dev. [%]	2.429	0.281
Coefficient of variation [%]	8.64	0.95

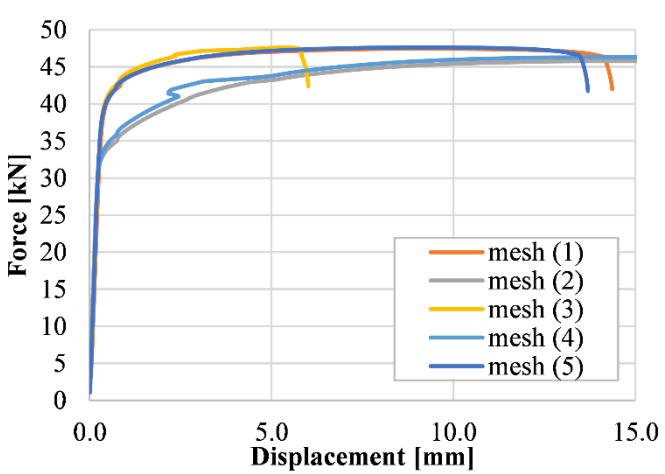
BOLTS





REINFORCEMENT - BARS AND MESHES





SPOT WELDS

0.8-1.0

1.5-2.5

2.5-3.0

full button pull-out

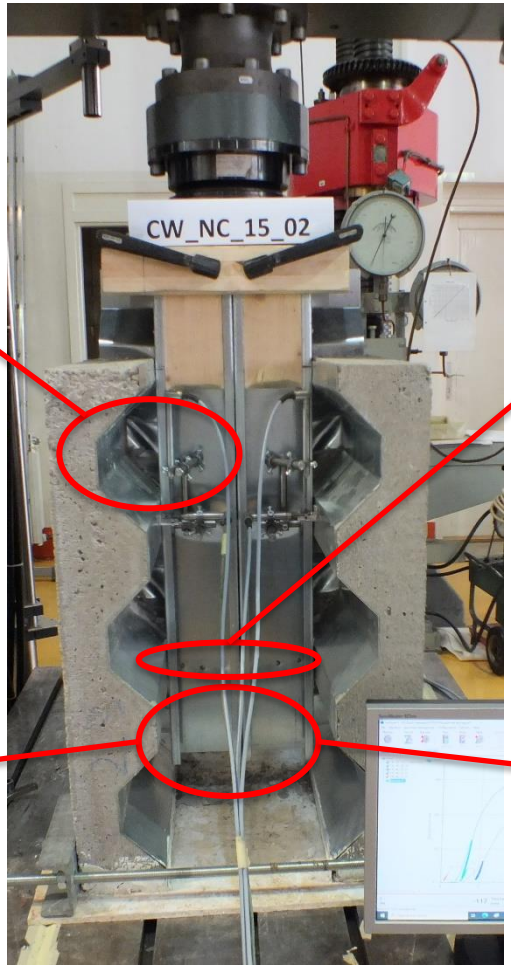
combination of modes

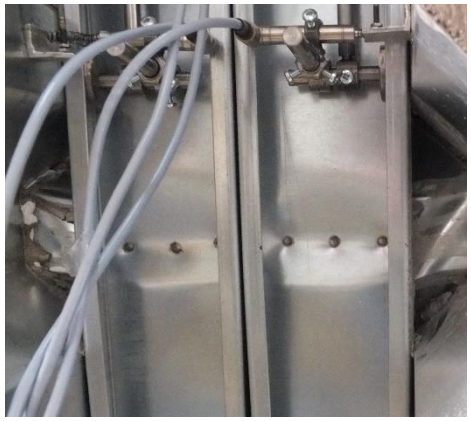
interfacial fracture

Push-out specimens with concrete dowels

SHEAR CONNECTION

- corrugated web failure
- C profile instability

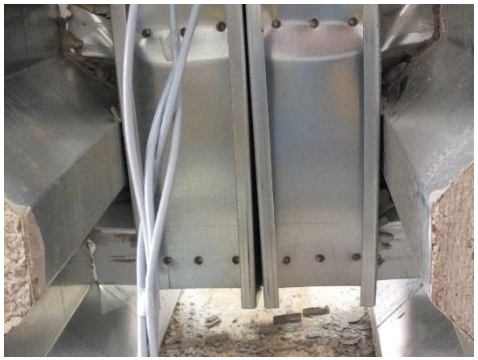




- corrugated web failure
- C profile instability

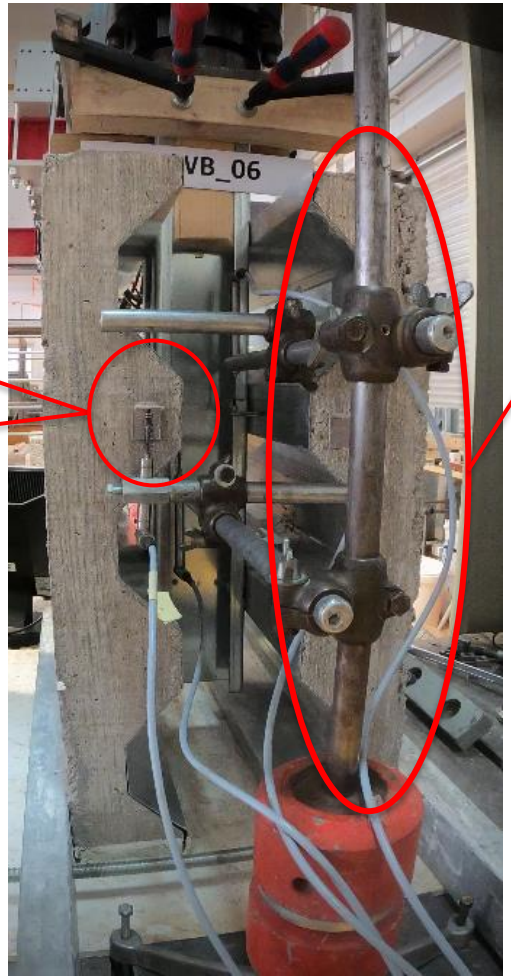
Front view

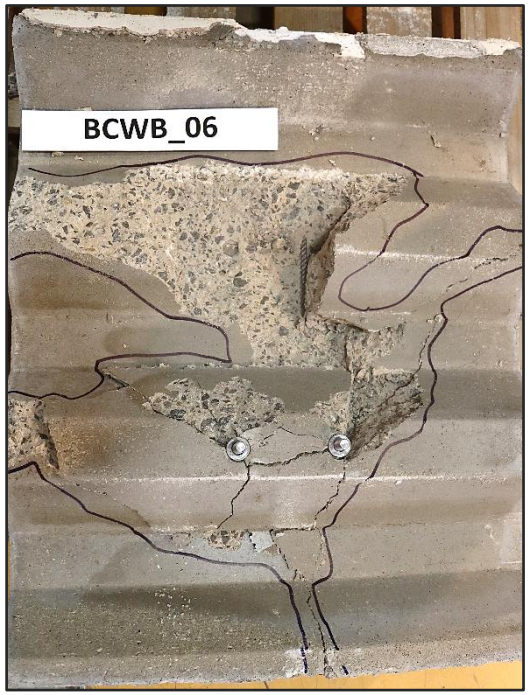
Back view



Push-out specimens with demountable bolted shear connection

SHEAR CONNECTION

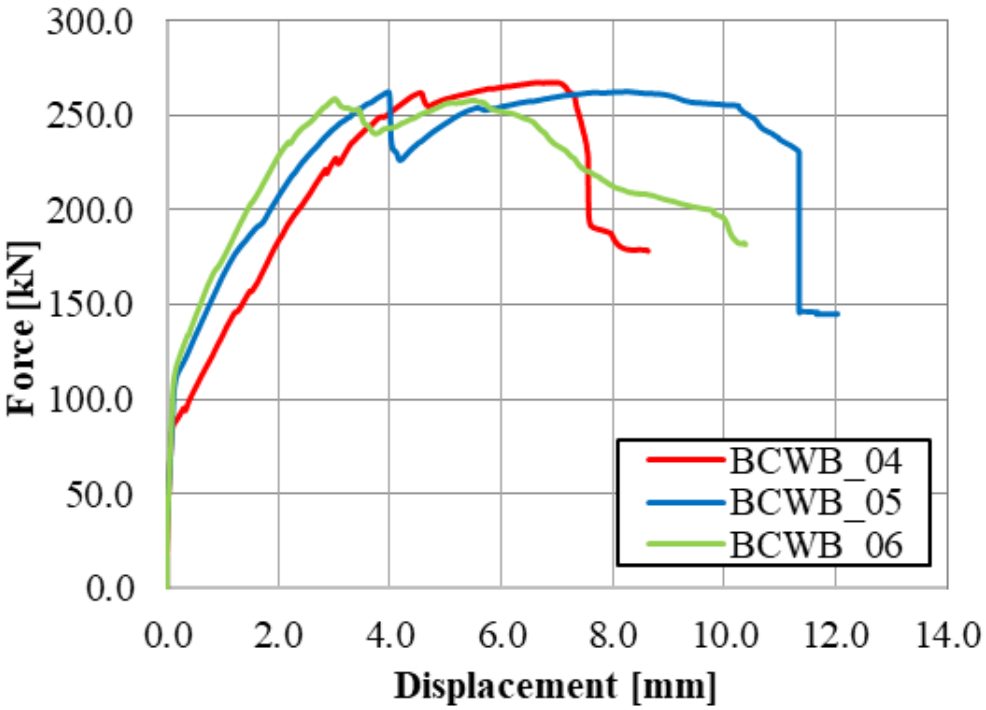




- C profile flange bearing failure
- Bolt deformation
- Concrete damage

Push-out specimens with demountable bolted shear connection

SHEAR CONNECTION



- The LWT-FLOOR project aims to develop an effective floor system by integrating spot-welding technology and cold-formed steel-concrete composite solutions.
- Investigations through experimental and numerical research with the support of probabilistic methods and life cycle analyses.
- Calibrated numerical models will be the base for parametric studies to find the optimal solution for larger spans and different configurations of web openings.
- The analytical proposal will be evaluated based on probabilistic and life cycle analyses for analyzed types of shear connections, steel girders with and without web openings, and composite LWT-FLOOR systems with and without web openings.

Laboratory Tests of Lightweight Composite Floor System LWT-FLOOR

THANK YOU FOR YOUR ATTENTION!

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Andrea Rajić
Vlaho Žuvelek

HrZZ Croatian Science Foundation