Component behaviour of reverse channel connections

Ambient and elevated temperatures

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COST Action TU0904

Outline

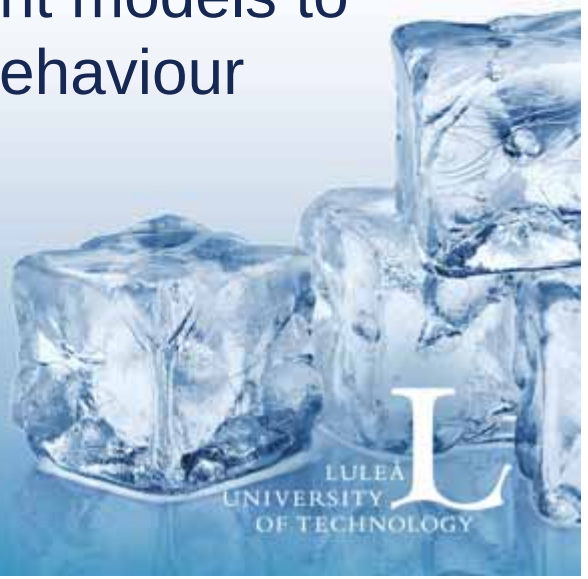
- Introduction
- Finite Element modelling
  - Reverse channel joints
  - Reverse channel sections
- Results
- Parametric study
- Outlook

Introduction

- "**COMPFIRE** – Design of composite joints for improved fire robustness" (RFCS)
- Objective
  - Development of a comprehensive component-based design methodology for composite joints against fire

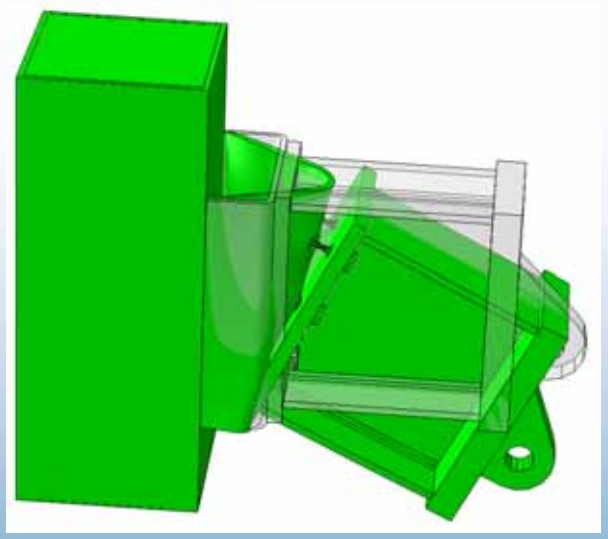
Introduction

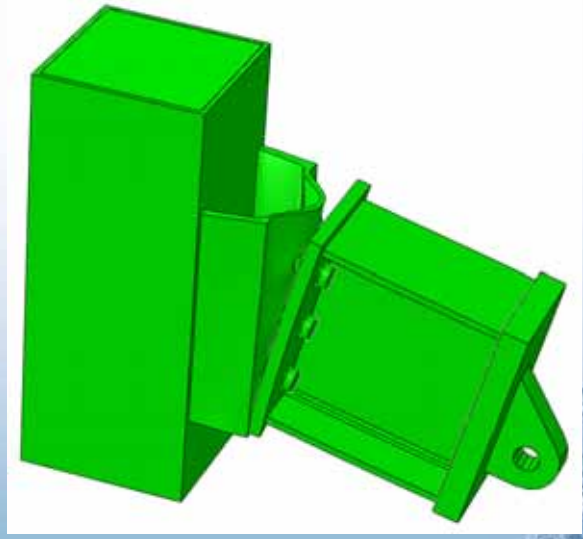
- Work package on “Component behaviour”
- Main objectives
  - Provide additional experimental data
  - Characterize behaviour of composite joint components
  - Develop simple temperature dependent models to predict temperature-force-deflection behaviour



Introduction

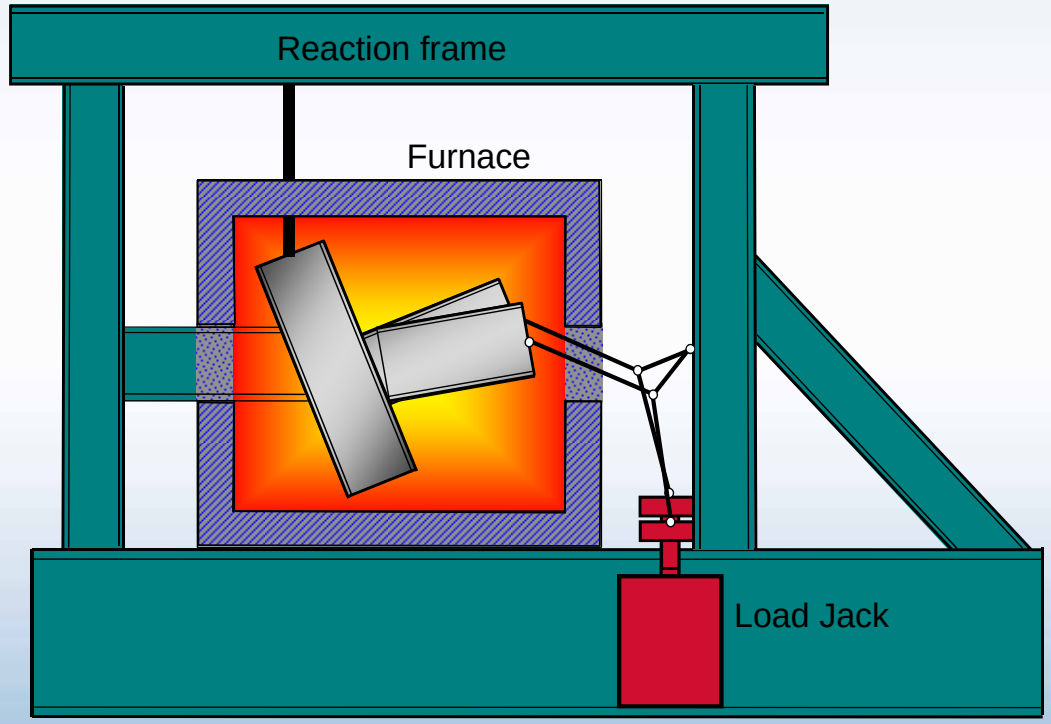
- Reverse channel connections
  - Possibility to develop catenary action
  - Deformation of web channel
    - high ductility





Introduction

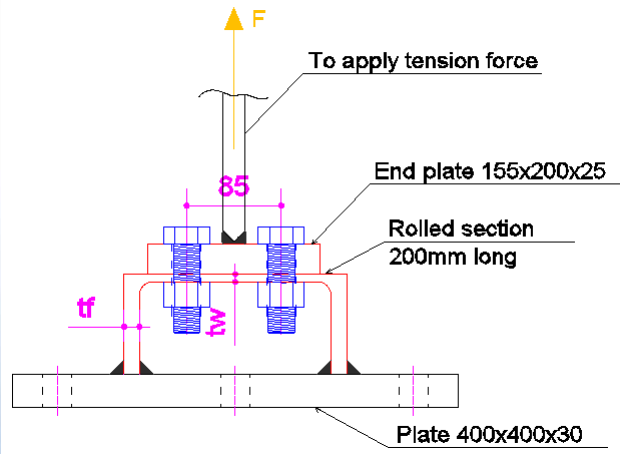
- Constant temperature tests of isolated joints



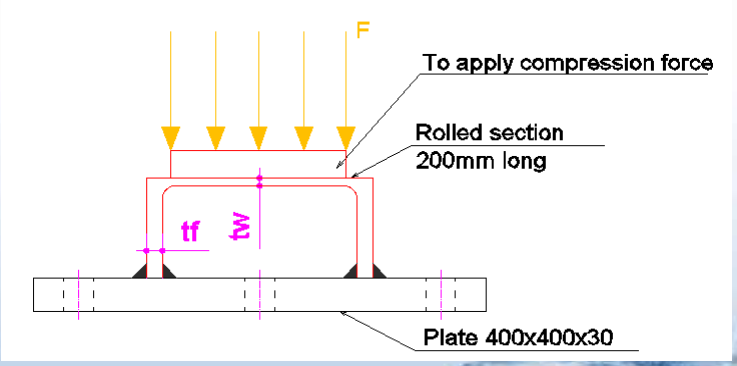
Introduction

- Constant temperature tests of reverse channel sections

Tensile tests

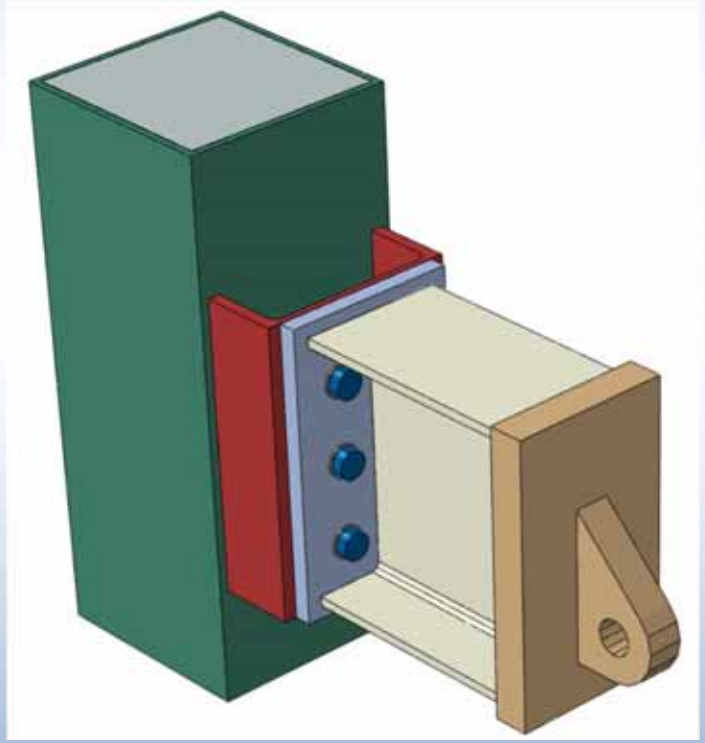


Compressive tests



Finite Element modelling

- Reverse channel joints



Interactions:

- surface-to-surface contact between:
  - reverse channel and endplate
  - bolts and endplate/reverse channel
- tie constrain between:
  - endplates and beam
  - column and reverse channel

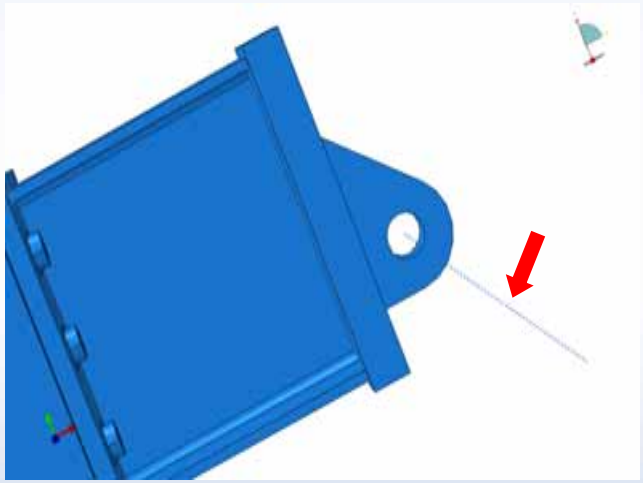
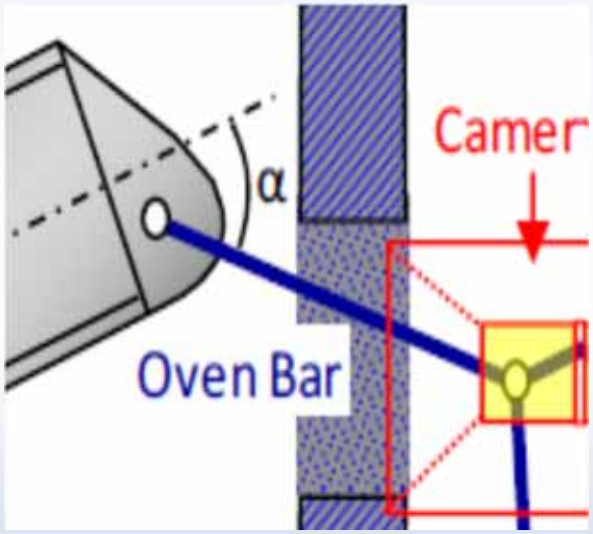
Finite Element modelling

General procedure:

- Initial step
  - Ambient temperature (20 ºC) application (predefined field)
- First step
  - Small pre-tensioning of bolts
    - Initialise contact
- Second step
  - Applying temperature (predefined field)
- Third step
  - Applying mechanical load through loading device

Finite Element modelling

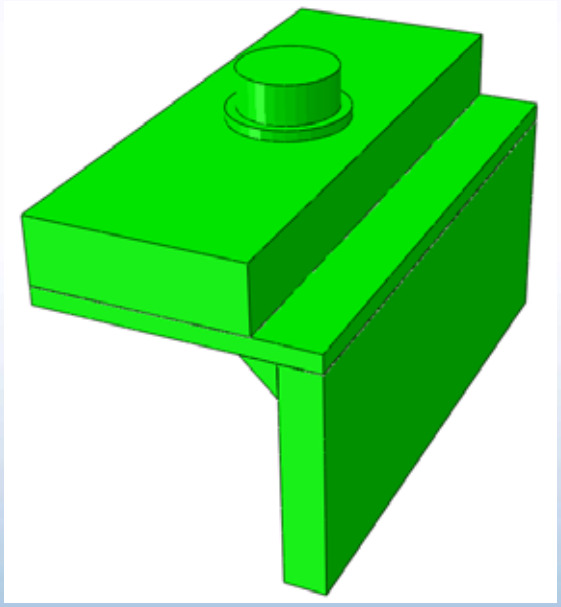
Loading mechanism

	
Connector wires used to model the loading mechanism	Schematic diagram of the loading mechanism

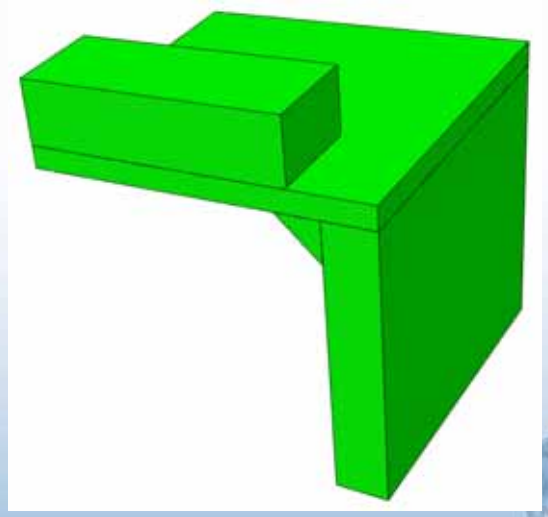
Finite Element modelling

- Reverse channel sections

Tensile tests

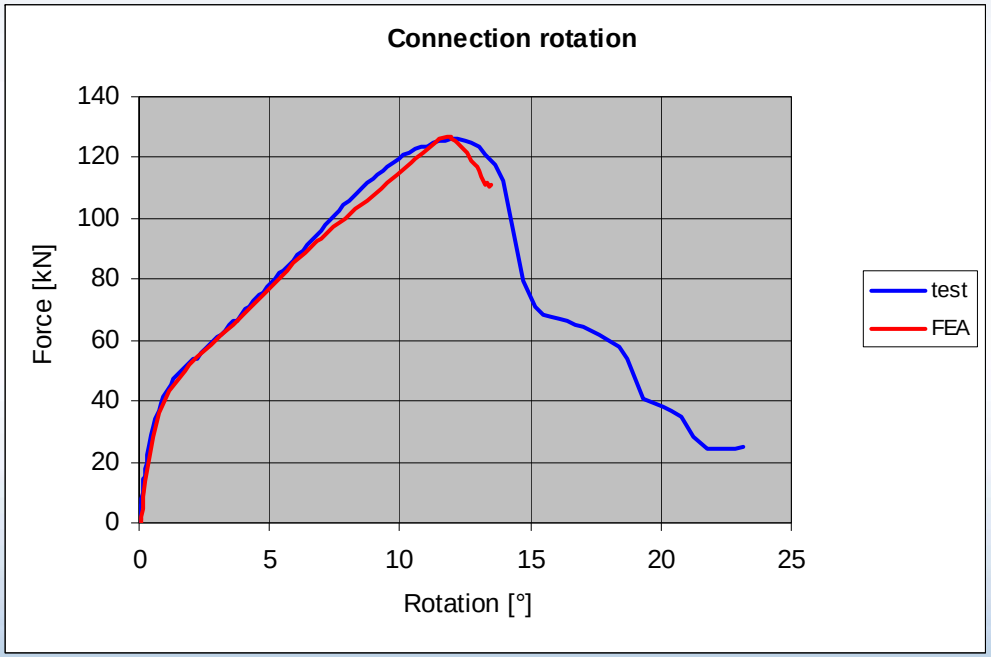


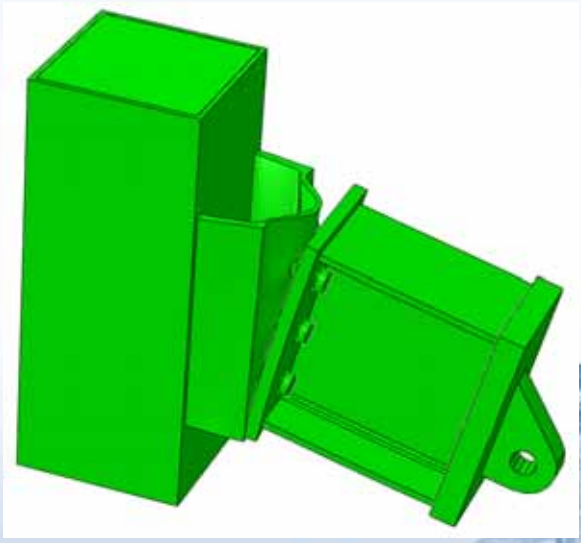
Compressive tests



Results

- Reverse channel joints

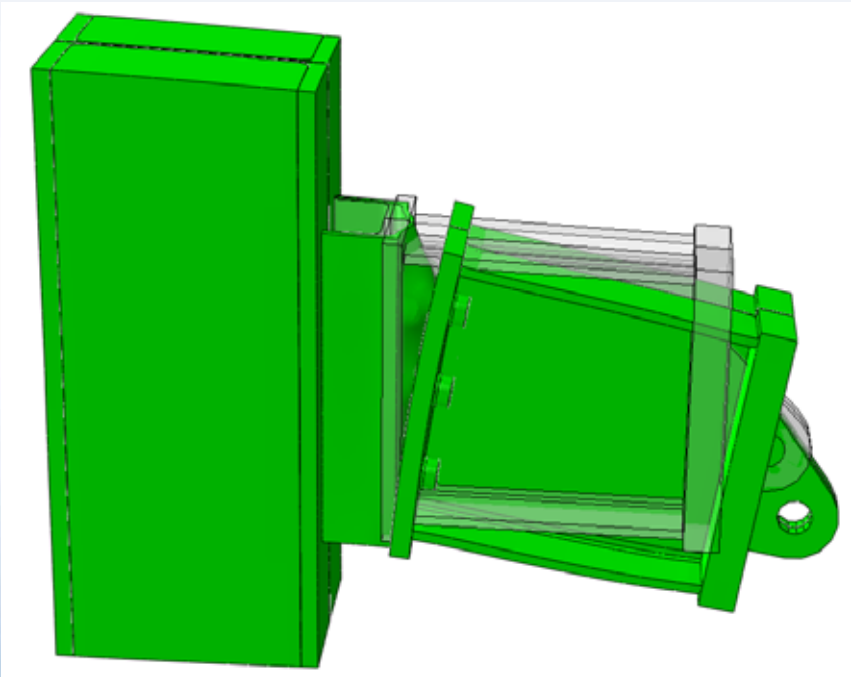




550 ºC, failure mode: bolt rupture

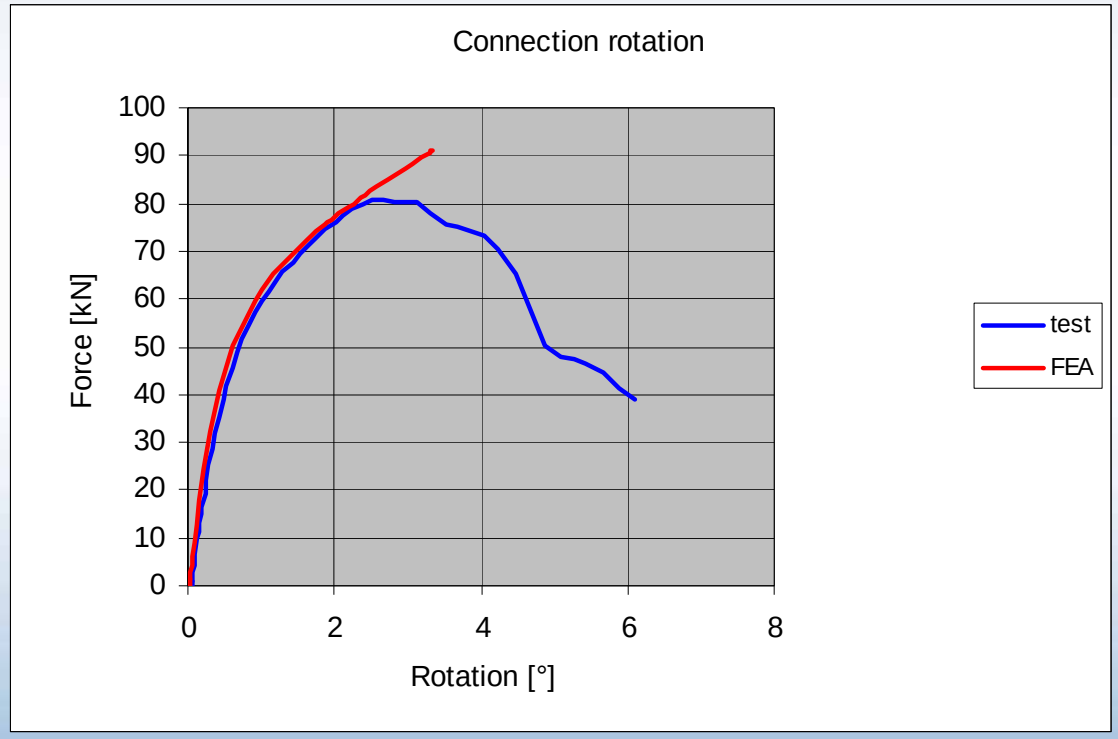
Results

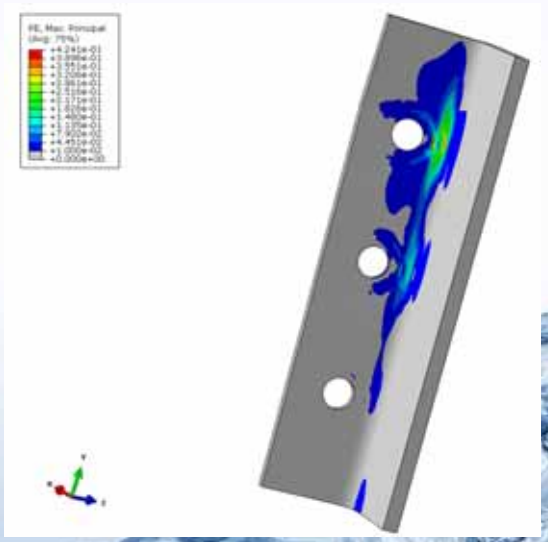
- Reverse channel joints



Results

- Reverse channel joints

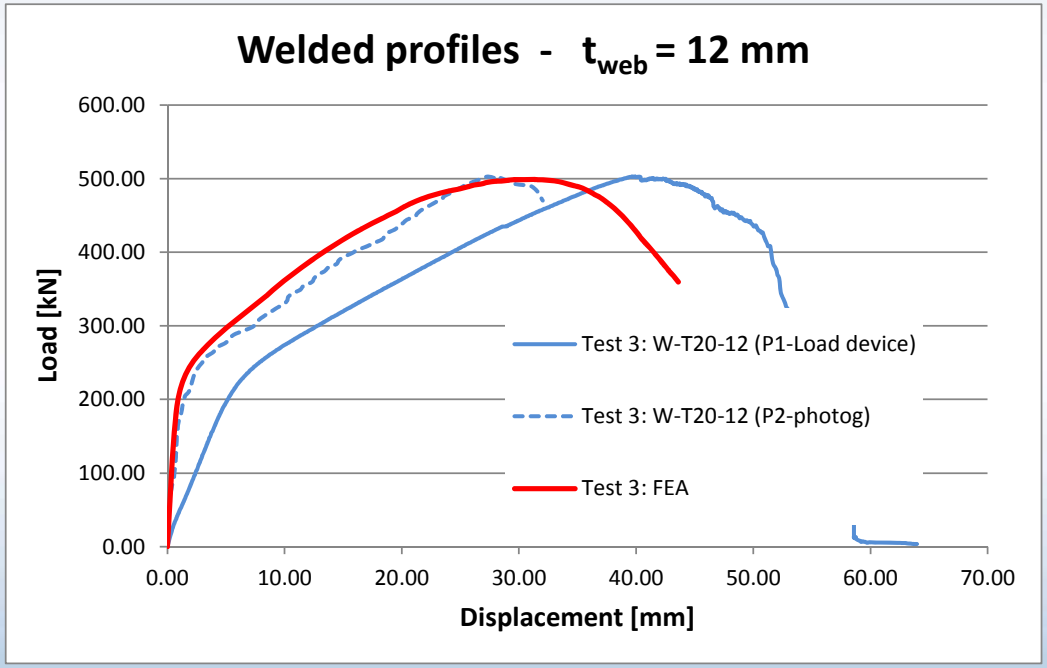


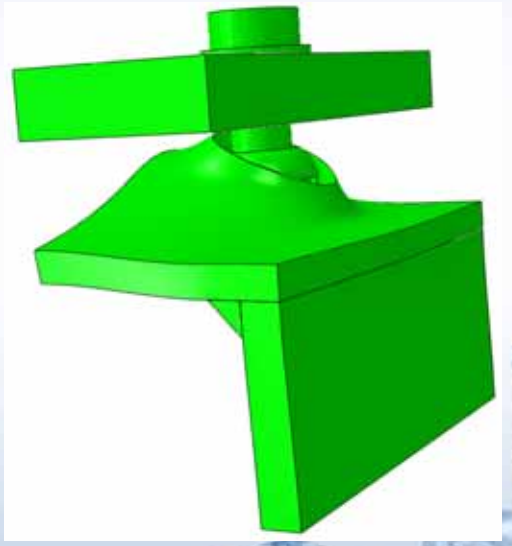


550 ºC, failure mode: fracture of reverse channel web

Results

- Reverse channel sections – tensile tests

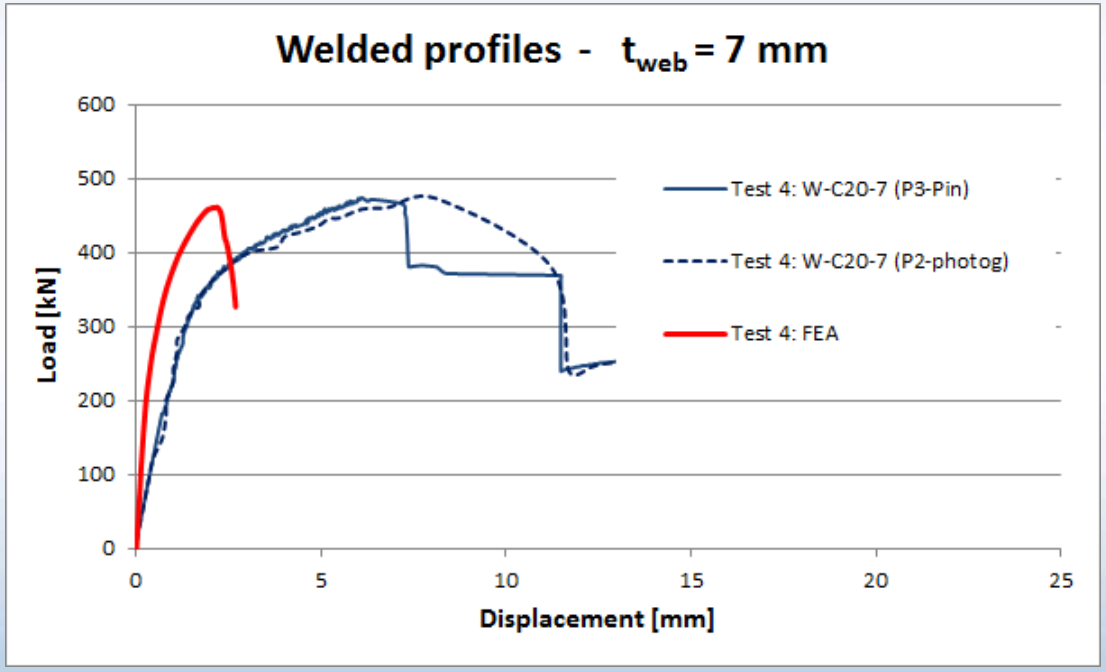


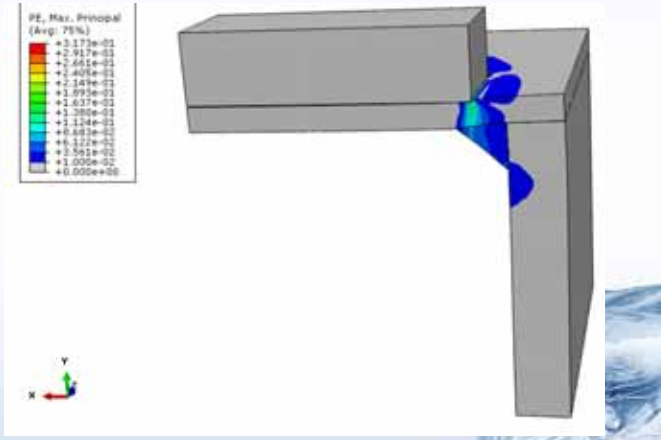


20 ºC, failure mode: excessive yielding around hole

Results

- Reverse channel sections – compression tests





20 ºC, failure mode: shear of web channel

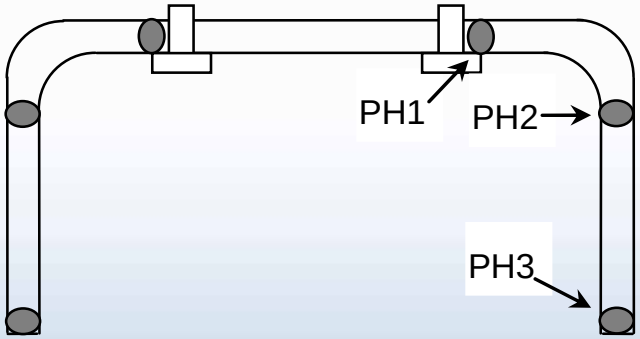
Parametric study

170 simulations (compression/tension)

- Bolt row effect
- Bolt spacing
- Endplate thickness effect
- Reverse channel thickness
- Use of UKPFC profiles vs. channels cut from tube
- Temperature

Outlook

- Simplified models
  - Based on plastic theory of structures
  - Reverse channel as portal frame



Acknowledgements

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Investing in your future

EUROPEAN UNION
European Regional Development Fund

NSS – Nordic Safety and Security


Thank you for
your attention!
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