Current research of Division of Metal Structures at Poznan University of Technology

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Institute of Structural Engineering

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Institute of Structural Engineering
Division of Metal Structures

Research Team

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The scope of research

**AIM**
- Understanding and describing the phenomenon of mechanical, kinematical and stability response of steel structural elements

**RESEARCH**
- **Experimental tests:**
  - material tests
  - full scale
- **Numerical simulations Abaqus/CEA**
  - verification and validation
  - convergence analysis of the FE models
Stability of thin-walled structures with clearances and initial imperfections

(K. RZESZUT)

FEM model

Buckling mode

Real structure with clearances

Z-purlins:

Trapezoidal sheet

Double sigma

Nonlinear FEM analysis
Stability of thin-walled structures with clearances and initial imperfections (K. RZESZUT)

Model structure

Elastic support with clearances

Virtual deformations, variation of a) $u_1$, b) of $u_2$

Virtual work equations

- $M_1 \delta \phi_1 + M_2 \delta \phi_2 = P \delta^x u_2 - R_1 \delta^y u_1$
- $M_1 \delta \phi_1 + M_2 \delta \phi_2 + M_3 \delta \phi_3 = P \delta^x u_3 - R_2 \delta^y u_2$
- $M_2 \delta \phi_2 + M_3 \delta \phi_3 = P \delta^x u_4 - R_3 \delta^y u_3$

Numerical example
FEM analysis of resistance of pre-stressed bolted connections
Optimization and sensitivity analysis of sandwich panels

(P. STUDZINSKI)

Pareto optimization of:
- support model
- geometric and material parameters

FEA and laboratory tests
Stability of thin-walled elements interacting with sandwich panels

(K. CIESIELCZYK, R. STUDZINSKI)

AIM
Understanding and describing the phenomenon of global and local loss of stability of thin-walled beams interacting with sandwich panels

Experimental tests:
• material tests
• full scale (Fig. 1)
• double lap shear test

Numerical simulations (Fig. 2)
• Abaqus/CEA
• verification and validation
• convergence analysis of the FE models
Experimental and numerical analysis of sandwich panels with hybrid core

(R. STUDZINSKI, Z. POZORSKI)

AIM
Understanding and describing the mechanical and kinematical response of the sandwich panels with hybrid cores

Experimental tests:
• material tests
• four point bending test
(Fig. 1)

Numerical simulations (Fig. 2)
• Abaqus/CEA
• verification and validation
• convergence analysis of the FE models
Laboratory and FEM tests of welded girders with orthogonal and diagonal ribs

(M. CHYBINSKI)

FEA and laboratory full scale tests

Stress in web
Aluminum - concrete composite elements subjected to bending

**AIM**
An analysis of load bearing capacity and stiffness

Test of the shear connectors

Test of the composite beams

FEA and laboratory full scale tests
Fire Design of Steel Structures (Ł. POLUS, K. RZESZUT)

Fire Dynamics Symulator
Fire in the shopping arcade

FEM and EC 3 1-2 Analysis

Bus fire

Yeld stresses
Critical temperature: 450 °C
AIM

- Formulation of interdisciplinary problem regarding analysis of state and response of structures in fire
- Modelling and numerical analysis of fire course with respect to dynamics of fire actions and mechanical response of structure locally affected by high temperature
- Mechanical analyses of the real buildings subjected to localized fire

Research objectives

- Fire modelling (CFD)
- Structural analysis (FEM)

Thermal exposure of elements in the vicinity of fire can be significant

Other parts of structure can be barely affected by temperature
Fire Design of Steel Structures
Localized Fires

Experimental programe

Tests 4-5:
- Thermocouple axis
- Sand burners
- IPE 300
- HEA 200
- HEA 300
- HEA 340

Horizontal specimens placement
Vertical specimens placement
Validation of Heat Transfer Model
Thank you for your attention

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REFERENCES


