

2.18 Recent Fire Safety Research at the Technische Universität München (short version)

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Chair for Metal Structures

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Recent Fire Safety Research at the Technische Universität München

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Non-Fire Research at the Chair for Metal Structures

- Hinged connections of composite- and steel beams
- Composite columns under blast loading
- Optimization of thinwalled sections by applying genetic algorithms
- Fatigue behaviour of new short span composite railway bridges
- Laminated glass - Temperature dependent stiffness and fatigue behaviour
- Sustainable composite floor system
- Sustainability of bridges (including external costs)
- Predesign tools for sustainable office buildings

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Patch Loading of Steel Plates at Elevated Temperatures

In case of fire, both yield stresses and elasticity modulus fall depending on the steel temperature. Thus higher limited strains (2% instead of 0,2%) are permitted by construction design. The lateral buckling of the web of girders under patch loading is also influenced by the fire. The practicable approach to the above described phenomenon is the yield line theory which is extended with the consideration of the higher deformations.

Numerical Simulation [SOFISTIK]

Fig. 1. Types of patch loading: (a) flexion patch loading, (b) flat patch loading, (c) opposing trapezoid patch loading.

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Numerical Investigations by SOFISTIK -Parametric Study-

Theoretical Background

DIN 18800-1

$$l = c + 5(t + r)$$

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Comparison between FEM & Theoretical Solutions

Ratio of $P_{Theoretical} / P_{FEEM}$ at $t = 10 \text{ min.}$

Ratio of $P_{Theoretical} / P_{FEEM}$ at $t = 20 \text{ min.}$

Ratio of $P_{Theoretical} / P_{FEEM}$ at $t = 30 \text{ min.}$

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Intumescent coating systems on steel columns in interaction with industry claddings

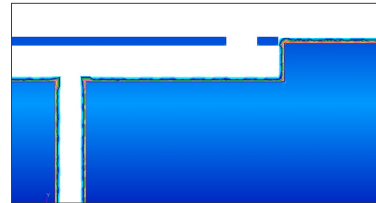


Test specimen no 2 after the fire test.

- The intumescent coating foamed up very well.
- The standard coating on the metal sheet cladding (very thin polyester resin) burnt away (brown)
- The local gaps between column and metal sheet cladding are very good filled out with intumescent foam.

Intumescent coating systems on steel columns in interaction with industry claddings

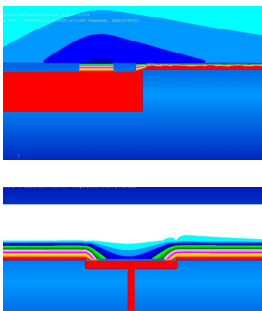
Numerical simulation with Patran



Temperature arrangement after 5 minutes standard ISO fire.

The assumptions of conductivity and radiation are quite good, but the numerical simulation of the behavior of the foam during the fire is not perfect. A following research project should resolve this.

Intumescent coating systems on steel columns in interaction with industry claddings

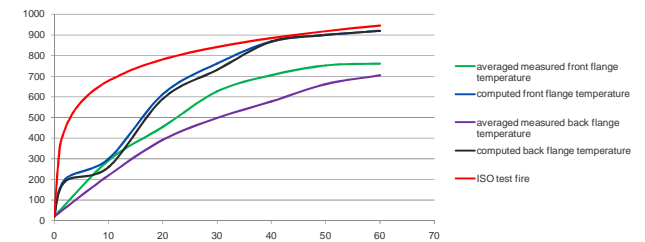


Temperature arrangement on the upper edge (contact column - metal sheet) after 22.5 minutes standard ISO fire

Temperature arrangement after 25 minutes standard ISO fire

Intumescent coating systems on steel columns in interaction with industry claddings

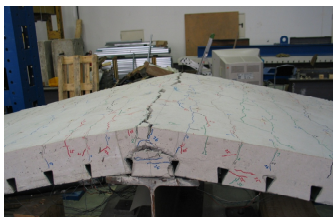
Comparison between measured and computed temperature behavior



To find out the reason of the divergence between the measured and the computed results is the task for the next research project.

Utilisation of Membrane action for Fire Design of Composite-Beam-Slab-Systems

- National Project together with Leibniz University Hannover, Prof. Peter Schaumann
- Founded by the German Government (AiF No. 16142) and Industry
- Aim of the Project:
Enable the use of membrane action in Germany
Clarify details e.g. the behaviour of the edge-beams between two slab panels



Fire Tests

Two large scale tests on two-bay-slabs with different slab systems

