

WG PLENARY MEETING TO WP4 BENCHMARK STUDIES

# Charring of fire protected and unprotected timber

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- Fire Tests
- Numerical Modelling
- Goals of Project and Outputs



Behaviour of Protected and Unprotected Timber Elements under Fire Conditions

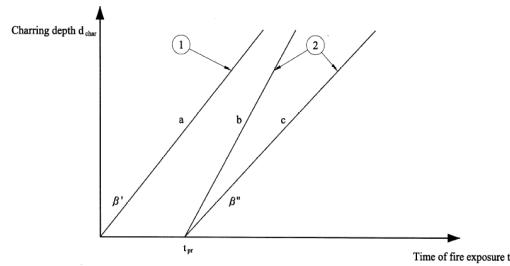
Fire Tests

Numerical Modelling

Goals of Project and Outputs

## Behaviour of Protected and Unprotected Timber Elements under Fire Conditions

- Charring rate and contribution to the fire resistance
- Contribution according to Eurocode 5 is simple but applicable to only limited amount of materials
- Very difficult to determine the starting time of charring of the timber element of the fire protection and the failure time of the cladding



Key  
1 Unprotected member  
2 Protected member

Behaviour of Protected and Unprotected Timber Elements under Fire Conditions

Fire Tests

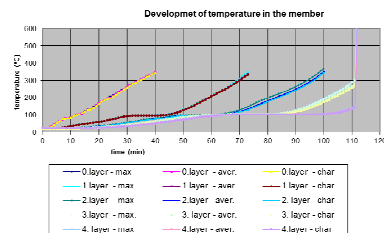
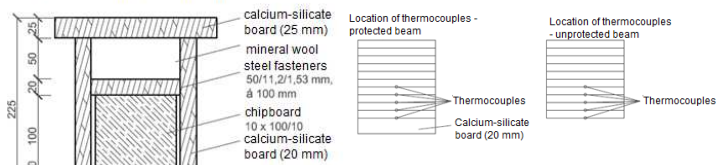
Numerical Modelling

Goals of Project and Outputs

## Fire Test of Calcium-Silicate Board

- Specimens with a calcium-silicate board and without cladding
- Thickness of the fire protected board was 20 mm

Cross-section of test specimen



Behaviour of Protected and Unprotected Timber Elements under Fire Conditions

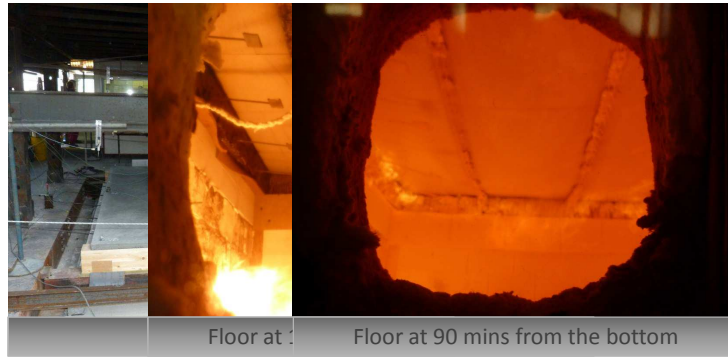
**Fire Tests**

Numerical Modelling

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### Fire Test of Timber-Concrete Floor

- Full-size floor specimen performed at the Fire testing laboratory
- Specimen was 4,5 m long and 3 m wide, consisting of two secondary beams with the cross section 120/160 mm and a 60 mm thick floor slab connected to glue laminated floor joists
- It was subjected the standard fire for over 150 mins



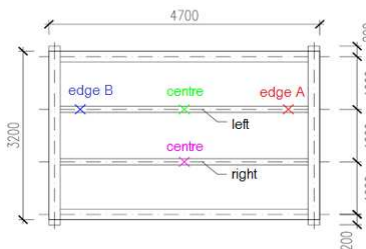
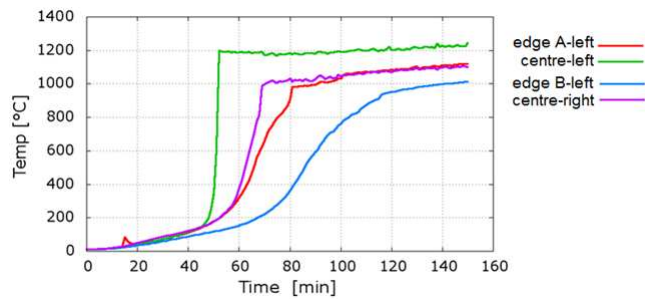
Behaviour of Protected and Unprotected Timber Elements under Fire Conditions

**Fire Tests**

Numerical Modelling

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### Fire Test of Timber-Concrete Floor



Behaviour of Protected and Unprotected Timber Elements under Fire Conditions

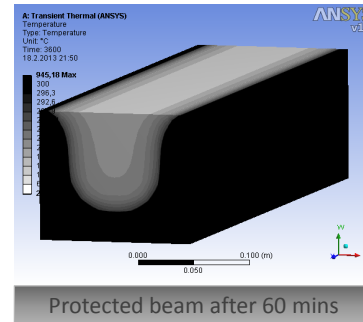
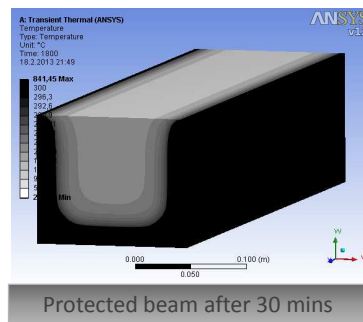
Fire Tests

Numerical Modelling

Goals of Project and Outputs

## Numerical Modelling

- 3D model was performed using the ANSYS Workbench
- Material properties → for timber at elevated temperatures from the Eurocode (EN 1995-1-2)
- for the calcium-silicate board from the producer based on testing



Behaviour of Protected and Unprotected Timber Elements under Fire Conditions

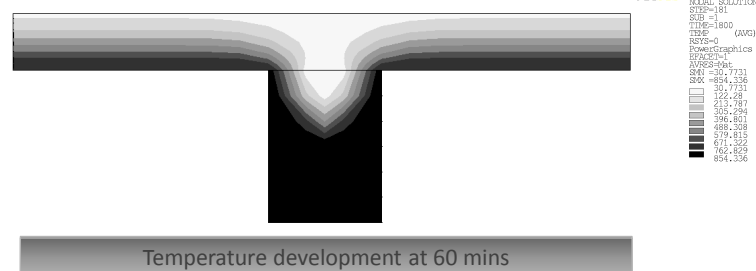
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## Numerical Modelling

- 2D and 3D finite element models
- Ansys software package to simulate the experimental tests and to analyse the thermal and structural performance of protected and unprotected timber sections
- Temperature-dependent relationships for timber properties proposed by the European code were adopted
- Timber was assumed as a non-linear isotropic material



Department of Steel and Timber Structures Prague 18<sup>th</sup> April, 2013

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**Goals of Project and Outputs**

## Goals of Project and Outputs

**Goals**

- To test of validity of currently accepted charring rates
  - solid protected/unprotected (Fire test of Calcium-Silicate Board)
  - glue- laminated (Fire Test of Timber-Concrete Floor)
- Charring rates of protected and unprotected timber elements
- The contribution to the fire resistance of timber structures boards

↓

**Outputs**

- Model of fire protected and unprotected timber structures, to be used for comparison when using or validating fire engineering software

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COST TU0904 Integrated Fire Engineering and Response  
PRAGUE MEETING 18-19 April, 2013

# THANK YOU FOR YOUR ATTENTION

URL: [www.ocel-drevo.fsv.cvut.cz](http://www.ocel-drevo.fsv.cvut.cz)

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