EXPERIMENTAL AND NUMERICAL STUDY OF HIGH PERFORMANCE CONCRETE COLUMNS SUBJECTED TO FIRE LOADING

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INTRODUCTION

For modelling concrete columns under fire condition knowledge about material properties at high temperatures is necessary. Additionally, elementary tests for controlling the numerical results and validating the model are required. In this presentation two elementary tests as well as first results of the numerical simulations are presented.
Identification of material properties is actually under development.

1. EXPERIMENTAL STUDIES (s. Fig. 1)

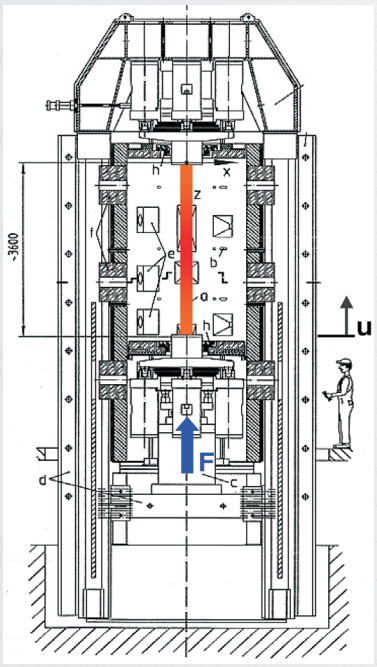

Fig. 1: BAM Column Furnace

- Realization of fire tests through BAM column furnace.
- Axial load capacity 6300 kN.
- Four-sided fire loading in accordance to EN 1363-1 and EN1365-4 as well as ISO 834.

2. TEST SPECIMENS AND CONDITIONS (s. Fig. 2)

- Column I: Compressive strength 132 Mpa
  Polypropylenfibres 2 kg/m^3
  Steelfibres 80 kg/m^3
- Column II: Compressive strength 124 Mpa
  Polypropylenfibres 2 kg/m^3

- Cross section: 30 cm x 30 cm
- Longitudinal reinforcement: 4 x Ø 25 mm (axis distance 50 mm)
- Lateral reinforcement: Ø 10 mm (distance 300 mm)
- 40 thermocouples of type K at 6 measuring stations

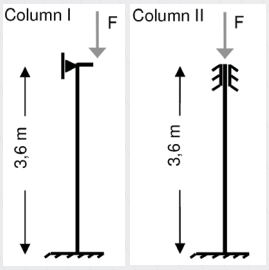

Fig. 2: Top and Bottom Boundary Conditions

3. EXPERIMENTAL RESULTS (s. Fig. 3 and 4)

3.1 Failure

- Column I: Failure after 94 minutes
- Column II: Failure after 116 minutes

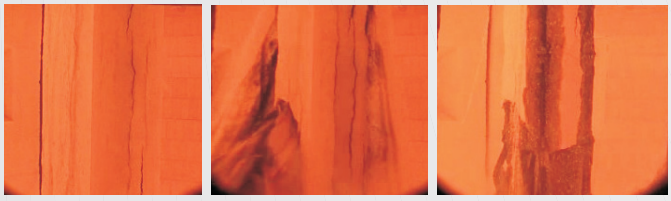

Fig. 3: Failure mode of column II

3.2 Deformations

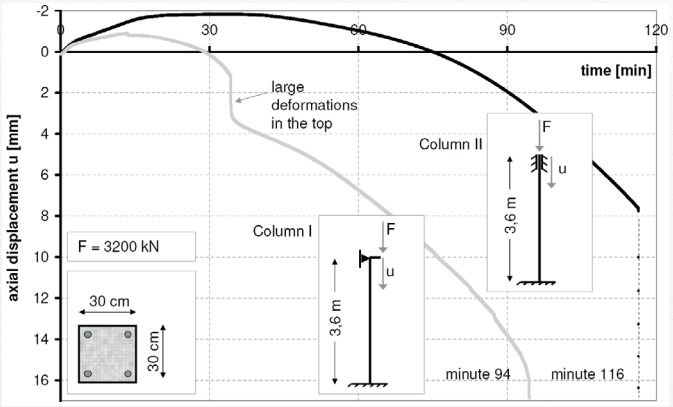

Fig. 4: Axial Displacement

- Failure of column I was due to a concentrated load, which resulted in local failure at the top of the column. Therefore no consideration with respect to the evaluation of the numerical analysis.

4. NUMERICAL STUDIES (s. Fig. 5)

4.1 Numerical Model

- Finite element program DIANA (3-dimensional)
- Thermal properties according to Eurocode 2, adjusted to experiments at high temperatures
- Mechanical properties according to Eurocode 2 (properties for high strength concrete not included in Eurocode 2)

4.2 Numerical Results

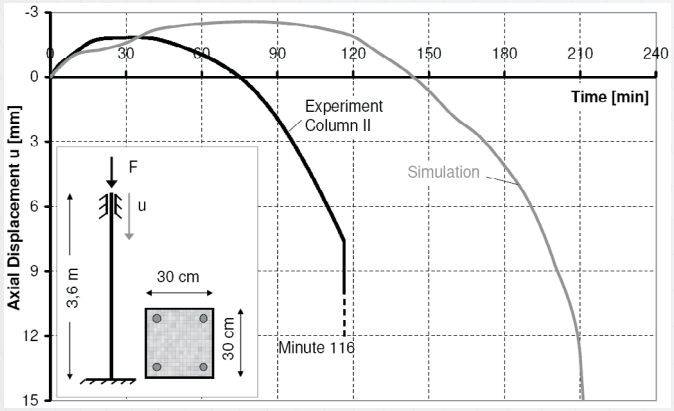

Fig. 5: Comparison of Calculated and Measured Axial Displacements

- Satisfying results of thermal analysis and good agreement to measured temperatures
- Minor agreement of mechanical analysis with experimental results
- Problem: No data for high strength concrete properties available
- Material property data for high strength concrete nessecary

5. OUTLOOK

- Investigations of material properties of used high strength concrete are in process.
- Based on these identified parameters further numerical simulations will be performed.

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