System approach on structural fire safety

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Abstract

The actual structural fire safety level of a building, using the current statutory component approach on the calculation of the fire resistance with regard to collapse, is unknown. The structural fire safety level is unknown because the connection and mutual interaction between the structural components is not taken into account and the standardised fire curve doesn't describe real time-temperature development in case of fire.

To improve insight into the structural fire safety level of buildings through application of a system approach. In the system approach natural fire, thermal response and mechanical FEM models are coupled.

In a literature investigation the component and system approaches are presented and compared. Furthermore an overview of system behaviour in real fires and an investigation on the support to the system approach is presented. In a case study the fire resistance with regard to collapse of the 25th storey of building Delftse Poort is examined using both the component and the system approaches.

The FEM results are understandable and provide insight into the real behaviour of the structure in case of fire.

The 25th storey of Delftse Poort will not collapse during a fire however; the structure will be highly damaged by a fire. In general the outer five centimetres of the heated concrete is crushed and the heated columns and beams are cracked. Furthermore the columns of the 24th and 26th storeys are damaged even though they remain cold. The deformations of the structure are small.

By use of the system approach weak structural spots can be identified. Weak structural spots of Delftse Poort are the columns and the beams. This identification leads to opportunities for both insurers and owners to assess risks and to optimise investments. Structural engineers can improve the structural fire safety of their designs.