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Detailing of modern concrete constructions for improved fire resistance.

This project was conceived to study the response of hollow core and prestressed concrete construction exposed to fire. It was prepared following a fire which occurred in 2010 in the warehouse of the Hong Kong department store in Vantaa, Finland. The building was concrete framed with a hollow core slab deck. In the space above the fire seat, cracks were found by fire fighters along with deformation of the floor surface. Response crews reported a strong jolt within the building approximately 1 hr after ignition and were given the order to evacuate. Approximately 10 to 15 minutes after this, failure of the hollow-core slab systems started. The first collapse was followed by several more collapses of the hollow core slabs.

The project is divided into three distinct sections:

- **a numerical modelling part;**
- **an analytical part,**
- **a short study of parameters influencing the response of hollow core and prestressed concrete construction to fire**

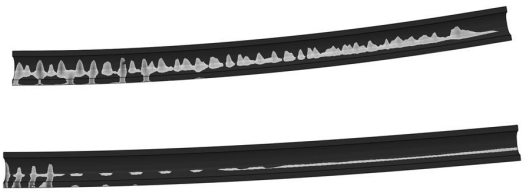
Results

It is shown through numerical modelling that an explicit formulation of transient strain in concrete has a significant impact compared with an implicit formulation of transient strain, in the overall behaviour of the hollow core slab and also in the response of, e.g. the prestessing tendons.

Based on the results of the analytical modelling, it is shown that hollow core concrete construction experiences a far higher thermal gradient and resulting thermal moment than monolithic concrete construction.

This is a result of the geometry of the cross section which effectively traps heat in the lower flange. This in turn leads to a faster loss of prestressing force on the cross section than in a monolithic concrete section. This contributes to a faster reduction in the ultimate moment of hollow core slabs compared with monolithic concrete construction.

Changing the prestressing tendon depth is shown to have a significant effect on the evolution of the ultimate moment under fire exposure. A shallow tendon with little cover has higher capacity at ambient and under fire exposure for a short duration, whereas a tendon with a large amount of cover has a lower ambient capacity, but is shown to retain more of this capacity for longer under fire exposure.



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