Kamila Horova

Travelling Fire in Multi-storey Buildings

Abstract

Project ***Travelling Fire in Multi-storey Buildings*** proposes a methodology to define the design fire environment for structural analysis of high-rise buildings that are outside the range of applicability and validity of nominal methods given by the standards. The objective aim is to investigate travelling fire in horizontal direction by the methodology of computational fluid dynamics and apply to a bearing structure to stress the safety, the design economy and the global performance. The results, expressed in simple terms without loss of generality, will have direct engineering applicability. During the work it is expected to study applicability of design fire load and heat release for CFD (Computional Fluid Dynamics) modelling, develop an analytical model of travelling fire and apply to solution to the global analysis of floor slab of multi-storey buildings.

Traditionally, structural fire analysis has been based on the standard temperature-time curve (ISO 834) or parametric temperature-time curve (EN 1991-1-2: 2002: Eurocode 1. Action on structures, Action on structures exposed to fire). While both of these methods have great merits, they have also many limitations. The standard temperature-time curve has slow grow period, never reduces in temperature due to fire decay and is independent of building geometry, ventilation and fuel load. The Eurocode parametric temperature-time curve is valid only for compartments with floor area up to 500 m^2, height up to 4 m, with no opening in the ceiling and limited thermal properties of the compartment linings. Therefore, it is beneficial to use a new methodology that can describe dynamics of a travelling fire more realistic even in modern constructions such as large open spaces, high ceilings, atria or glass facades that are outside the range of applicability of traditional design methods.

During the first year of work State of the art was described by the aid of collecting of contemporary literature. An exemplary fire compartment was designed by CFD simulation of travelling fire. The simulation allowed prediction of spreading fire in non-standard fire compartments that are outside the range of applicability of nominal methods. Proposed simulation described the fire environment also in small compartment better. In September 2011 travelling fire test was carried out in Veseli nad Luznici, Czech Republic. Two floor experimental full scale specimens represented a part of an administrative building of dimension of 10.4 x 13.4 m, with a height of 9 m. According to simulation fire travelled from one side to the other of the compartment. The temperature measurements from the fire test are used to validate the dynamic simulation approach in FDS (Fire Dynamics Simulator) developed in the study. Presently work on improvements of FDS simulations including the implementation of adiabatic surface temperature from fire test is in progress.

The work should go on to parametrical study of FDS simulation, modifying limits of traditional design models and analytical model of travelling fire which should complete the family of traditional design models of fire. Finally analytical model of travelling fire based on Rein´s model will be applied on composite floor slab with membrane behaviour to compare the difference with structure response to uniform fire. Data from fire test executed in Veseli n. L. should also serve to evaluate theory of Rein´s model.