Analysis of steel–concrete composite beam with interlayer slip in fire conditions

Tomaž Hozjan

The work presents the behaviour of steel–concrete composite beam with interlayer slip subjected to fire conditions. The moisture and heat transfer is assumed to be governed by a coupled problem, while the mechanical behaviour accounting for slip between layers is described by strain-based beam finite elements. Hence the fire analysis is performed in two separate steps, of which the moisture and heat transfer analysis is performed first, followed by the mechanical analysis. In order to determine the temperature field we used advanced model which also considers the moisture effect. Composite beam is build of lower steel beam and a top concrete deck. Due to the fact that the steel is not porous media, to determine the temperature field over the steel part of composite beam we consider only heat transfer in steel with generally known Fourier's law of heat conduction. On the interface between steel and concrete the heat conduction (heat transfer) is permitted while mass transfer is not possible. In the second part of fire analysis we considered mechanical behaviour of steel-concrete composite beam. In order to analyse such a composite structure with sufficient accuracy, a new strain based finite element was developed. Model considers the exact kinematical equations of the beam where axial and flexural deformations are considered while neglecting the shear deformation. Interlayer slip between concrete deck and steel beam is allowed while uplift is not possible. The non-linear stress-strain relations for steel and concrete at elevated temperatures and the rules for the reduction of material parameters due to an increased temperature are taken from European standard EC2 and EC 3.