Abstract

Numerical modelling was conducted with ABAQUS to investigate the performance of the headed shear studs in solid and composite slabs at normal temperatures. In addition, a thermo-mechanical analysis was carried out to study the behaviour of the stud at elevated temperatures in the solid slab. For the composite slab, a three-dimensional FE model was developed to study the behaviour of the headed studs with the corrugated metal sheeting with ribs oriented parallel to the beam to resemble main beams supporting a typical slab of a building. The typical push-out tests were simulated using the ABAQUS/Explicit solver which is convenient for this type of analysis, as complex interactions between different elements and damage problems are encountered. The material of concrete was modelled using the concrete damaged plasticity available in the ABAQUS library and a perfect plastic stress-strain curve was used for the steel material of the headed stud. The capacity of the studs as well as the load-slip curves were established from the results of the model. The numerical capacity of the studs was compared with the strength predictions of Eurocode 4. The numerical model was validated using the numerical results obtained by Lam and El lobody (2005), Chen et al. (2016) and Mirza and Uy (2009). It was found that the failure mode in the slab is dominated by the steel stud failure rather than the concrete cone failure. Also, the predicted capacities from Eurocode 4 appeared to be conservative if the recommended value for the partial factor was used. At elevated temperatures, the stud reached 25 % of its strength at ambient temperature. Furthermore, the results were proven to be very sensitive to the parameters used in the model as well as the loading rate applied in the explicit solver.