Congreso de Métodos Numéricos en Ingeniería CMN2017
Valencia, 3-5 julio, 2017

Finite element analysis and experimental fire test of lightweight composite slabs.

Juan Enrique Martínez-Martínez[1]*, Mar Alonso-Martínez[2] and Felipe Pedro Álvarez Rabanal[3].

Department of Construction and Manufacturing Engineering, University of Oviedo

1: GICONSIME Research Group. University of Oviedo. e-mail: quique@constru.uniovi.es

2: GICONSIME Research Group. University of Oviedo. e-mail: mar@constru.uniovi.es

3: GICONSIME Research Group. University of Oviedo. e-mail: felipe@constru.uniovi.es

Abstract

In this work lightweight composite slabs are studied using numerical simulations and experimental tests. These slabs are very efficient in terms of energy saving and sustainability due to their low values of thermal transmittance and lightweight.

Eight experimental fire tests are carried out using specimens of 160 mm. thick, 1120 mm. wide and 2030 mm. long with four different lightweight concrete compositions. Samples are tested in a furnace following the time-temperature curve while a constant force is applied following the fire resistance Standard UNE-EN 1363-1.

A nonlinear finite element model (FEM) is developed using shell elements for the steel plate and solid elements for the lightweight concrete. The numerical analysis combines thermal and structural study in order to evaluate the behavior of the composite slab under fire conditions. The interaction between the concrete and the steel sheet is modelled through a nonlinear model using frictional contact. The steel plate is simulated by a multilinear material model including plasticity. A combined constitutive model for the lightweight concrete is adopted. Next, the nonlinear analysis is done. Then, the design of experiments methodology (DOE) is used to optimize the numerical model.

Finally, the numerical simulation and the experimental results are compared to validate the numerical models. In this way, Hybrid Engineering methodology is used to reach the results of this research work. These validated numerical models can be applied to other composite slabs in order to study their structural behavior under fire conditions.