

FINITE ELEMENT BASED MICRO MODELLING OF MASONRY STRUCTURES SUBJECTED TO FIRE

P. Ravi Prakash¹, João M. Pereira¹, Miguel Azenha¹ and Paulo B. Lourenço¹

1: Institute for Sustainability and Innovation in Structural Engineering (ISISE)
Department of Civil Engineering, University of Minho
e-mail: {patnayakuni.prakash, jpereira, miguel.azenha, pbl }@civil.uminho.pt

Keywords: Masonry, Finite Element, Fire, Thermo-mechanical analysis, Parametric analysis

Abstract. *The response of masonry structures is well studied in the context of static and dynamic mechanical loading. However, studies pertaining to thermo-mechanical response characterization of masonry structures subjected to fire are very limited. Moreover, within the limited investigations pertaining to the numerical response of masonry structures subjected to fire, most of them depict the global thermo-mechanical response without much emphasis on unit level thermo-mechanics. This study presents a comprehensive numerical investigation on the thermo-mechanical response history of a masonry structure subjected to fire, utilizing a 2D finite element (FE) based micro model. The 2D FE model accounts for material nonlinearity, cracking and crushing in unit and mortar in conjunction with the temperature-dependent thermal and mechanical properties. The FE model is validated against the cross-sectional temperature histories given in the EN 1992-1-2 and the experimental results available in the literature, respectively. Utilizing the validated FE model, thermo-mechanical analysis is performed on a masonry wall subjected to a one-sided fire exposure and the fire induced critical physical phenomena which include thermal bowing, heat diffusion, unit-mortar thermo-mechanical interaction, and cracking and stress profiles within the masonry structure are studied intricately. Furthermore, fire ratings are quantified for the masonry structure subjected to fire in accordance with the failure limit states give in the EN 1996-1-2.*

Acknowledgement: The first author gratefully acknowledges the financial support provided by the University of Minho (ISISE).