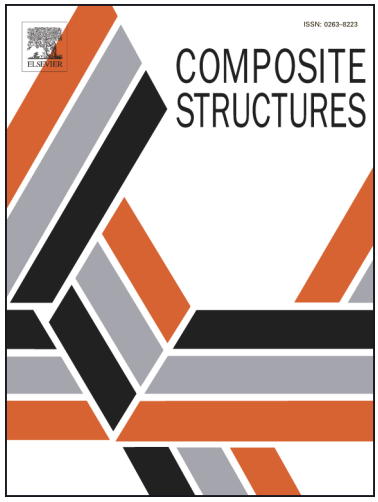

Durability of sandwich composites under extreme conditions: Towards the prediction of fire resistance properties based on thermo–mechanical measurements

Georgio Rizk, Vincent Legrand, Khaled Khalil, Pascal Casari, Frédéric Jacquemin

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Durability of sandwich composites under extreme conditions: Towards the prediction of fire resistance properties based on thermo-mechanical measurements

Georgio Rizk[1,2], Vincent Legrand[1,*], Khaled Khalil[2],
Pascal Casari[1] and Frédéric Jacquemin[1]

[1] Université de Nantes - Ecole Centrale Nantes
Institut de Recherche en Génie Civil et Mécanique (GeM) UMR CNRS 6183
Equipe Etat Mécanique et Microstructure des Matériaux (E3M)
58 rue Michel Ange, BP 420, 44606 Saint-Nazaire cedex, France

[2] Université Libanaise, Faculté de Génie,
CRSI, Unité MGC, Campus Hadath, Beyrouth, Liban

* Corresponding author: vincent.legrand@univ-nantes.fr

ABSTRACT

The main objective of the present study was to develop a fire thermal model able to predict the evolution of the temperature gradient across a sandwich composite structure when exposed to fire. Thermal response of sandwich panels, with glass/polyester skins and balsa core, was investigated under severe temperature conditions as samples were exposed to high temperatures up to 570°C. Based on experimental measurements, an accurate three-dimensional thermal model was developed using finite element analysis. The obtained predictions of the temperature field are in excellent agreement with the experimental data, showing the importance of combined numerical-experimental analyses. This allowed us to propose a new approach that can be used for the prediction of thermo-mechanical post-combustion properties in a very large number of fire and material scenarios according to its simplicity and robustness.

Keywords: Sandwich composites, Fire resistance, numerical modeling, properties prediction, extreme environment.

1. Introduction

Analyses under extreme conditions make it possible to put a material in non-ambient conditions. The properties of that material are often drastically modified and new properties can then be studied. This occurs when the material is subject to a severe environment of low or high temperature [1-2], generally coupled to a second stress such as an intense magnetic field, a light irradiation [3-4], a mechanical stress [5-6] or a high pressure [7-8]. Under these extreme conditions, the material undergoes important physical and/or chemical modifications, often leading to the appearance of metastable states or phase transitions [9-10]. It is then very interesting to understand the behavior of materials under extreme conditions in order to predict and optimize their properties under normal