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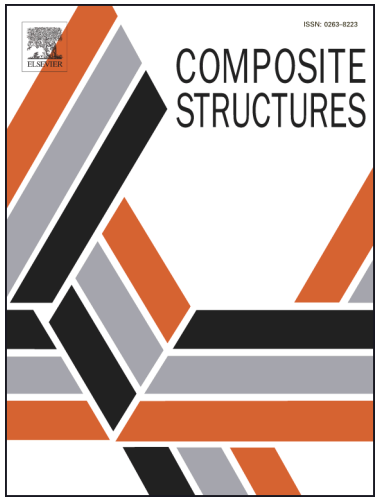

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Thermo-mechanical Behaviour of Smart Composite Beam under Quasi-Static Loading

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Abstract:

Experimental and numerical studies on a hybrid composite smart beam under quasi-static loading were carried out. The composite beam is consisted of two layers; carbon fibre/epoxy and SMA wire/epoxy layer. Carbon fibres as well as SMA wires were embedded in the host epoxy unidirectionally. SMA wires were programmed before being embedded in the composite beam. All thermo-mechanical properties associated with SMA wires were experimentally determined. A constant flexural load was initially applied to the middle of a simply-supported beam and temperature of the beam was then increased. The beam was heated using a thermal-chamber. During the heating process the deflection of the beam at midpoint was measured and the behaviour of the hybrid beam under incremental load was investigated. It was observed that, the presence of embedded SMA wires in the beam can effectively reduce deflection. Furthermore, using high volume fraction of fibres can cause buckling in the opposite direction of lateral force. Experimental results were compared against FE method and a perfect fit was obtained.

Keywords: SMA wire, Smart composite beam, Thermo-mechanical behaviour, Quasi-static loading.

Introduction

The advent of smart materials which are so appropriate in designing modern applications has opened a new horizon ahead of researchers. Shape memory alloy as a material with shape memorising capability can be applied in the common structures to change them into the smart ones. Shape memory alloys in the form of wire are used in different structures to investigate various requirements [1-4]. In the experimental study implemented by Garafolo et al. [5] the flutter vibration was mitigated using shape memory alloys. It is shown that SMA can potentially reduce the tip displacement amplitude and increase the natural frequencies. Design, fabrication and experimental evaluation of functionally graded shape memory alloy were investigated by Shariat et

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