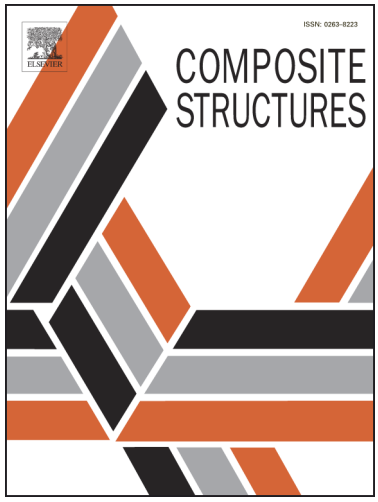
Journal Pre-proofs



Localization simulation of a representative volume element with prescribed displacement boundary for investigating the thermal residual stresses of composite forming

Qi Wu, Hongzhou Zhai, Nobuhiro Yoshikawa, Tomotaka Ogasawara

PII: S0263-8223(19)32638-8
DOI: https://doi.org/10.1016/j.compstruct.2019.111723
Reference: COST 111723

To appear in: *Composite Structures*

Received Date: 13 August 2019
Revised Date: 19 October 2019
Accepted Date: 21 November 2019

Please cite this article as: Wu, Q., Zhai, H., Yoshikawa, N., Ogasawara, T., Localization simulation of a representative volume element with prescribed displacement boundary for investigating the thermal residual stresses of composite forming, *Composite Structures* (2019), doi: https://doi.org/10.1016/j.compstruct.2019.111723

Localization simulation of a representative volume element with prescribed displacement boundary for investigating the thermal residual stresses of composite forming

Qi Wu[1,2], Hongzhou Zhai[2], Nobuhiro Yoshikawa[1*], and Tomotaka Ogasawara[1]

1. Institute of Industrial Science, the University of Tokyo, 4-6-1 Komaba, Meguro-Ku, Tokyo 153-8505, Japan

2. State Key Laboratory of Mechanics and Control of Mechanical Structures, Nanjing University of Aeronautics and Astronautics, Yudao Street 29, Nanjing 210016, China

*Correspondence: nobyoshi@iis.u-tokyo.ac.jp; Tel: +81-03-5452-6103

Abstract

In this research, a methodology of localization simulation that not only discriminately described fiber and resin but also considered the global influence like external temperature loading was introduced. The newly proposed representative volume element with a prescribed displacement boundary that was deduced from a generalized viscoelastic shear lag model can link the macro and micro models if the edge effect was ignored. After the material models and software platform were demonstrated through a composite warpage experiment, the proposed localization simulation was investigated by comparing to a large-scale fully microscale benchmark model in an ideal cooling phase. The results show that the temperature and residual stresses evaluated from the new technique not only presented details fine to the scale of the representative volume element but also included the macroscopic temperature gradient, indicating a promising way to understand the composite forming process in a comprehensive format.

Keywords: localization simulation; residual stresses; finite element analysis; composite forming; multiscale.