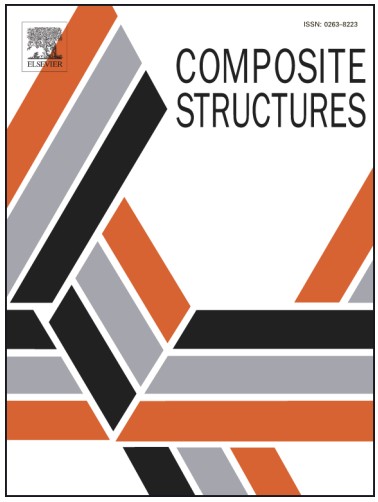

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PII: S0263-8223(17)32038-X
DOI: http://dx.doi.org/10.1016/j.compstruct.2017.08.061
Reference: COST 8819

To appear in: *Composite Structures*

Received Date: 2 July 2017
Revised Date: 11 August 2017
Accepted Date: 16 August 2017

Please cite this article as: Li, Z., Haigh, A., Soutis, C., Gibson, A., Sloan, R., Dielectric constant of a three-dimensional woven glass fibre composite: analysis and measurement, *Composite Structures* (2017), doi: http://dx.doi.org/10.1016/j.compstruct.2017.08.061

Dielectric constant of a three-dimensional woven glass fibre composite: analysis and measurement

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Abstract

This paper presents a novel methodology for predicting the dielectric constant of three-dimensional woven glass fibre-reinforced composites. A well-established approach of deriving the effective dielectric constant is the dielectric mixing formulae (rule of mixtures based), which either provide a single value or offer upper and lower bounds. For composites with three-dimensional fibre architecture, an accurate model considering the three-dimensional effect is needed. Here, the anisotropic effect is revealed using electromagnetic simulation to extract the effective dielectric constant of a model material with unidirectional fibres, which are aligned or orthogonal to the electric field. The rule of mixtures based formulae are evaluated. The most suitable formula selected for each case is then extended to a general case with arbitrary fibre orientation and is further used to characterise the capacitor element of an electromagnetic model for 3D woven composites. The proposed method is compared to measurements to demonstrate the improved accuracy.

Keywords: Dielectric constant; glass fibre; 3D woven composites; simulation; modelling.