

Accepted Manuscript

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PII: S0263-8223(16)32784-2

DOI: <http://dx.doi.org/10.1016/j.compstruct.2017.05.060>

Reference: COST 8569

To appear in: *Composite Structures*

Received Date: 6 December 2016

Revised Date: 18 March 2017

Accepted Date: 23 May 2017



Please cite this article as: Garcia, R., Prabhakar, P., Bond Interface Design for Single Lap Joints using Polymeric Additive Manufacturing, *Composite Structures* (2017), doi: <http://dx.doi.org/10.1016/j.compstruct.2017.05.060>

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Bond Interface Design for Single Lap Joints using Polymeric Additive Manufacturing

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Abstract

In this paper, the use of polymer additive manufacturing technology, also called 3D printing, for imparting texture to bond regions in adhesively bonded joints is explored. An improvement in the apparent shear strength values of adhesively bonded single lap joints is achieved by fusing structural reinforcements to the adherents through fused deposition modeling (FDM) additive technique. Towards that, computational models were first developed to simulate stress distribution along the overlap region of single lap shear joints, and four models that performed the best were chosen for physical testing. Pure adhesive (PA) joints were manufactured first, followed by the fabrication of 3D-printed adhesive (3D-PA) joints. Peak loads, shear stresses, and failure types were compared between these models. PA joints failed mainly adhesively, resulting in low peak loads and shear strength, whereas, 3D-PA joints registered higher average peak loads and shear strengths (increased by up to $\approx 832\%$) with predominantly cohesive failure. 3D printed reinforcements appear to have imparted higher shear resistance against failure at the bond regions. Overall, using a combined computational and experimental approach, it is established that the 3D printed reinforcements have the potential to drastically improve the apparent shear strength of adhesively bonded single

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