TIME-TO-FAILURE OF STEEL/CFRP DOUBLE STRAP JOINTS UNDER COMBINED THERMAL AND MECHANICAL LOADING

Tien-Cuong Nguyen *, Yu Bai *, Xiao-ling Zhao *, and Riadh Al-Mahaidi †

* Department of Civil Engineering, Monash University, Melbourne, Australia
e-mail: Yu.Bai@monash.edu.

† Faculty of Engineering and Industrial Sciences, Swinburne University of Technology Melbourne, Australia.

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Abstract: Degradation of structural adhesives at elevated temperatures makes the time-to-failure of adhesively-bonded steel/CFRP joints subjected to combined thermal and mechanical loading a critical issue for structural safety considerations. In this paper, the time-to-failure of steel/CFRP double strap joints was examined under two scenarios: 1) mechanical loading at constant temperature levels until the final failure, and 2) varied or cyclic thermal loading at constant load levels until the final failure or the specified time duration. Experimental results from Scenario 1 indicated that the decrease of joint stiffness and strength is largely dominated by the temperature dependence of the structural adhesive and the most significant reduction was observed around the adhesive’s glass transition temperature. Experimental results from Scenario 2 revealed that thermal loading history has noticeable effects on the time-to-failure of joints at different load levels. Incorporating a joint strength degradation model, the time-to-failure of adhesively-bonded steel/CFRP joint was predicted for different thermal loading regimes and compared with available experimental measurements. In addition, the residual strength of the joints that survived exposure to certain thermal loading regimes was examined and the potential stiffness and strength recovery was evaluated based on reference specimens.