



Pin-bearing Strengths for the Design of Bolted Connections with Pultruded Material

Behrouz Zafari (PhD student)¹ and J. Toby Mottram (Reader)¹

¹*Civil Research Group, School of Engineering, University of Warwick, CV4 7AL. United Kingdom.*

Abstract

Presented in this paper are test results for the determination of the pin-bearing strength of pultruded fibre reinforced polymer material required to calculate the bearing resistance of bolted connections under factored loading. It is well-known [1] that single-bolted and multi-bolted connections of pultruded material fail ultimately in a number of distinct failure modes (e.g. bearing, shear-out, cleavage, net-tension and block shear). Bearing is the only one of the mechanisms that does not give a brittle failure response, and can provide the connection with a degree of damage tolerance, which is desirable. The design calculation for bearing resistance is given by the projected area of bearing bolt times the specified bearing strength ($F_{br,\theta}$) in the direction of the connection force, which is then multiplied by the number of bolts. In [2] a historical review on the determination of $F_{br,\theta}$ is reported, and evaluated to show that there is a lack of consistency in how this strength has been measured, and much uncertainty on what values are to be taken in the resistance calculations. A comparison in [2] of pin-bearing strength measurements, based on the two test methodologies given in ASTM D5764 [3] and BS EN ISO 13706 [4], showed that the ‘timber’ approach is suitable when there is a restriction on the size of coupon specimen that can be cut from a pultruded section. Presented are new test results for pin-bearing strengths when θ is equal to 0, 45 or 90 degrees, using the ‘timber’ approach. An evaluation of the data (with varying pin diameter-to-thickness ratio) is made with the aim of establishing how we establish a specified strength for the safe and reliable design of bolted connections.

References

1. Mottram, J. T. and Turvey G. J., ‘Physical test data for the appraisal of design procedures for bolted joints in pultruded FRP structural shapes and systems,’ *Progress in Structural Engineering and Materials*, 5 4, 2003, 195-222.
2. Mottram, J. T., ‘Determination of pin-bearing strength for the design of bolted connections with standard pultruded profiles,’ in *Proc. 4th International Conference on Advanced Composites in Construction (ACIC 2009)*, 1st–3rd September 2009.
3. ASTM D5764 - 97a, ‘Standard Test Method for Evaluating Dowel-Bearing Strength of Wood and Wood-Based Products,’ ASTM, West Conshohocken, Pa, 2007
4. BS EN ISO 13706-1:2002. ‘Reinforced plastic composites - Specification for pultruded profiles - Part 2: Methods of test and general requirements,’ British Standards Institution, 2002.

Corresponding author: E-mail: b.zafari@warwick.ac.uk tel: 0044 2476 522528