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Influence of surface structure of composite on adhesive joint shear strength

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This paper is focused on the experimental investigation of the shear strength of the adhesive joint of composites depending on the surface structure. The composite material was manufactured from carbon fibers and epoxy resin. VAP© technology was used. Two types of the surface structure were obtained. The joint shear strengths were determined by means of the lap-shear test according to the ASTM standard.

The composite plate was made in autoclave. Carbon fibers TENAX J IMS60 E13 24K and epoxy resin (L285+hardener 287) were used. Composite plate was consistered of 8 layers ($[0°, 90°, 45°, -45°]_s$).

Two types of the surface structure were created. The smooth surface was created by lamination to a smooth mold (aluminum plate). The rough surface was created by contact with the peel-ply fabric. Prismatic tapes were cut using water jet from the composite plate. The top layer of the tape had a 90° orientation relative to its longest side. Width of the tapes was w = 25 mm, thickness of the tapes was T = 2.3 mm and length of the tapes was l = 100 mm. The tapes were glued together in combinations of different surface structures (smooth-smooth, rough-rough and smooth-rough). Length of glued part was a_{lep} = 12,5 mm (Fig. 1). To ensure an even thickness of the adhesive, a special preparation tool was used [2]. An adhesive Scotch-Weld DP490 was used in this work.

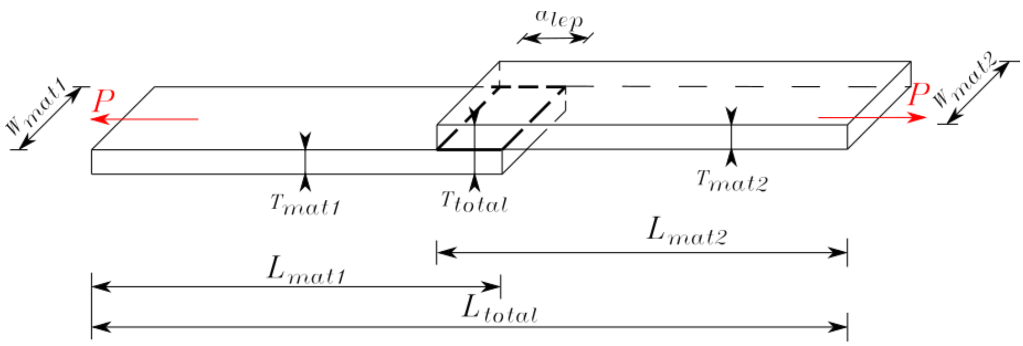

Fig. 1. Geometric parameters of specimen

A universal testing machine *Zwick/Roell Z050* was used. Specimens were loaded in the tension in the longitudinal direction according to standard ASTM D5868 [1]. The initial distance between the jaws of the machine was L_j = 112.5 mm. A uniaxial extensometer was used for measuring the elongation (gage length was L_0 = 80 mm). Self-locking jaws were used to clamp the sample, which allow mutual offset so that the loading takes place in the axis of the adhesive. The loading velocity of crosshead was v = 1 mm/min.

The force–displacement dependencies (Fig. 2) were obtained from the tensile test complying with ASTM D5868 [1]. The shear strength was calculated using

$$\tau = \frac{P_{\max}}{W \cdot a_{lep}}, \tag{1}$$

where $P_{\max}$ is maximum force, W is width of the specimen and a_{lep} is length of the glued part.

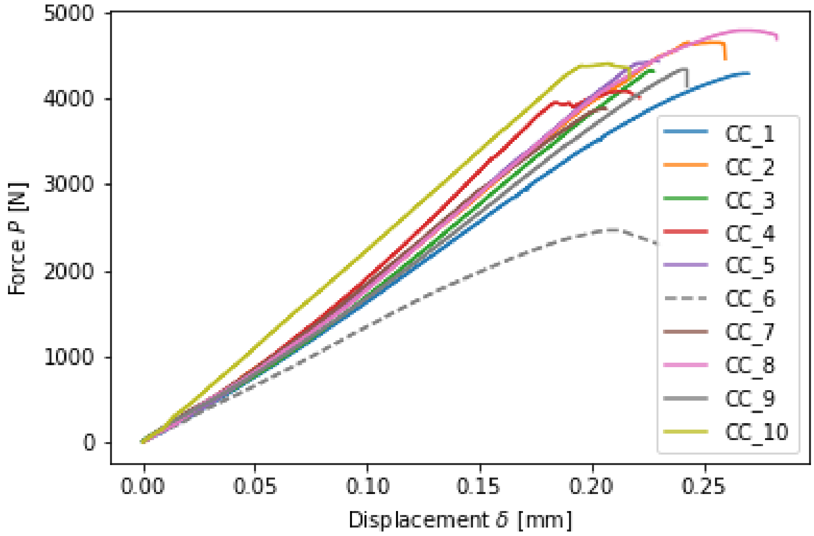

Fig. 2. Force–displacement dependencies

The shear strength was not affected by the surface structure. The influence of the surface structure on cohesive failure was found.

Acknowledgements

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References

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[2] Kalina T., Sedláček, F., Krystek, J., Determination of the influence of adherent surface on the adhesive bond strength, MATEC Web Conf. 157 (2018) 05012. https://doi.org/10.1051/matecconf/201815705012