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PROCEEDINGS

Mechanical Properties and Failure Modes of 3D-Printed Continuous Fiber-Reinforced Single-Bolt Composite Joints with Curved Paths and Variable Hatch Spaces

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ABSTRACT

Composite joints are widely used in machinery industries such as aviation, aerospace, and marine, where they transfer main loads as lightweight connectors. Recently, 3D printing with continuous fibers has relieved the required molds in composite manufacturing process and given flexibility to the design of robust composite joints. However, how the curved paths and variable hatch spaces affect the mechanical properties and failure modes of 3D-printed single-bolt composite joints with continuous fibers remains undisclosed. In this study, 3D printing has been introduced to fabricate three types of continuous fiber-reinforced single-bolt composite joints with different paths, including the straight path joints (SPJs), the curved path joints (CPJs), and the CPJs with variable hatch spaces (VHSs). Tensile tests were carried out to investigate the mechanical properties of these joints, and their failure modes were also compared experimentally. The results indicate that the adoption of curved paths changed the failure modes from inter-column debonding to transverse cracking. Moreover, the variation of hatch space altered the failure modes from transverse cracking to a mixed mode of extrusion, front cracking, and transverse cracking. Compared with SPJs, the maximum load of CPJs with VHSs increased by 2.58 times, while tensile stiffness increased by 51.61% due to the improved failure modes.

KEYWORDS

3D-printed; continuous fiber; composite joints; curve paths; variable hatch spaces

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