

PROCEEDINGS

Characterization of 3D fracture evolution In Inorganic-Bonded Bamboo Composite Material Using X-Ray Computed Tomography Testing

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ABSTRACT

A new composite material of inorganic-bonded bamboo with a magnesium-based inorganic adhesive was investigated at the meso-scale using X-Ray computed tomography (CT) scanning technology. Twenty-four specimens with dimensions of 70 mm×70 mm×70 mm were used. To investigate the fracture evolution process under the pressure, the specimens were subjected to different pressure levels: zero (initial state), 20 MPa and 32 MPa, peak pressure (P_{max}), and $0.8P_{max}$, $0.65P_{max}$, $0.5P_{max}$, $0.12P_{max}$ after peak pressure, respectively. Additionally, a continuous loading-scanning-reloading case was also considered for comparison. Three specimens were scanned by CT at each load level. Analysis of the CT images revealed that the initial volume fractions of the inorganic adhesive, bamboo strips, and voids were 55.06%, 44.40%, and 0.74%, respectively. Cracks initiated primarily within the bamboo bundles, subsequently propagated along the bamboo-adhesive interfaces, and ultimately formed within the inorganic adhesive. Furthermore, significant differences were also observed in the fracture evolution behavior between the single loading case and loading-reloading case at the same stress level. The repeated loading case exhibited earlier crack initiation, with broader and longer cracks developing. A clear, abrupt increase in the porosity ratio was observed at the load level of $0.5P_{max}$, where the average porosity increased from 2.55% into 42.3% at the load level of $0.12P_{max}$. These observations indicate that the fracture evolution is a steady and progressive process, beginning with initial cracks from the bamboo bundles and culminating in failure within the adhesive. This demonstrates that the adhesive functions not only as a binder but also as a load-bearing component. In summary, InorgBam exhibits stable post-peak bearing capacity and good collaborative behavior among its constituent components.

KEYWORDS

Inorganic-bonded bamboo composite (InorgBam); uniaxial compression; CT scanning; fracture evolution

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