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Damage Propagation Analyses of CFRP Laminate with Impact Damage under Compressive Load by Quasi-three-dimensional XFEM

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Extended Abstract

Due to high specific strength and stiffness, carbon fiber-reinforced plastics (CFRP) have been widely used in aviation industries in recent years. However, CFRP laminate is susceptible to out-of-plane load, leading to complex damage such as delamination, matrix crack, and fiber breakage. Because the damage may cause a decrease in compressive strength, CAI (Compression After Impact) strength is important in designing CFRP laminate structures.

This study applies a quasi-three-dimensional extend finite element method (XFEM) to damage propagation analyses of CFRP laminate. An eight-node quadrilateral interface element and an eight-node hexahedral continuum element enriched with only the Heaviside function are used to model delamination and matrix cracks, respectively. In addition, the zig-zag cohesive zone model is employed for delamination and matrix cracks to perform the implicit analysis successfully.

In this presentation, the implicit method is used to perform damage propagation analyses of CFRP laminates subjected to out-of-plane load and, subsequently, to compressive load. The results including the size of damage in the impact test analysis and CAI strength in the CAI test analysis are compared with those of experiments and the proposed method is validated.

References

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