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含缺陷复合材料T型接头失效数值分析

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Numerical Simulation of the Failure of Composite T-joints with Defects

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摘要 针对复合材料T型接头优化设计问题,利用粘聚区模型(CZM)建立了可预测复合材料接头拉伸破坏过程的分析方法.将填充物缺陷加入该模型,填充区裂纹的起始是随机的,重点分析填充物缺陷的位置、尺寸大小以及填充物刚度对接头承载能力的影响.计算结果表明:模拟结果与实验结果吻合较好;无论缺陷位置如何,缺陷尺寸越大,结构承载能力越弱;结构承载能力对上角缺陷最为敏感;填充物刚度在3～50 MPa时,填充物刚度较大的接头损伤容限特性更好;不同的缺陷位置,破坏模式差异较大,但起裂点或最终失效处都在缺陷附近的基体中.

关键词: 粘聚区模型 随机裂纹 复合材料 T型接头 缺陷

Abstract： This paper focuses on the influence of defects in the filler and filler stiffness on the tensile strength of composite T-joints for their optimal design. A numerical model is developed to simulate the debonding and delamination of the composite structure by utilizing a cohesive zone model (CZM). The random crack path in the filler is also involved, and different sizes and locations of defects of the filler are taken into consideration. The present model is validated by experimental results. The load capacity of the structure is found to decrease with increasing defect size, and it is very sensitive to defects at the top of the filler. The damage tolerance performance of the composite T-joint is improved when filler stiffness increases from 3 MPa to 50 MPa. Failure modes are quite different for different forms of defects, but the random crack initiation or the final failure mode is always at the adhesive near the defect.

Keywords： cohesive zone model random crack composite materials T-joint defects

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