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Z-pin点阵分布对层合板面内压缩性能的影响

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Influence of Z-pins Insertion Pattern on In-plane Compression Properties of Laminates

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摘要

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摘要

Z-pin三维增强技术能显著提高层合板层间性能, 但会一定程度上引起层合板面内性能劣化。本文着重研究Z-pin植入点阵分布对层合板的面内性能的影响, 设计加工了在层合板中植入一定体积分数不同点阵分布的Z-pin增强层合板试样, 并进行了面内压缩性能测试, 获得了Z-pin的点阵分布对层合板面内压缩强度的影响规律, 并利用有限元软件分析了Z-pin点阵分布对面内压缩强度的影响机制。研究表明, Z-pin的植入降低面内压缩强度的原因是其破坏了层合板中的部分承载纤维, 层合板的压缩强度与垂直于加载方向截面上的Z-pin分布数量成反比; 在层间增强要求允许条件下, Z-pin应尽量平行于面内载荷的承载方向植入。

关键词: Z-pin增强层合板 点阵分布 压缩强度 劣化 影响规律

Abstract:

Z-pin technology is a notable method for laminated composites to improve the resistance to delamination. However, the presence of the Z-pins unavoidably leads to a degradation of the in-plane strength of the composite. This paper mainly explores the influence of the Z-pin insertion pattern on the in-plane compression performance of laminates by testing the compression properties of laminates with Z-pins inserted in different patterns. Meanwhile, the influencing mechanism is researched by means of finite element analysis. The results show that the through-thickness reinforcing pins decreases the compressive strength by vitiating several bunches of load-bearing fiber. The compression strength of Z-pinned laminates is inversely proportional to the fraction of the Z-pins inserted in the cross-section vertical to the compression loading direction. If permitted by the demands of inter-layer reinforcement, Z-pins should be distributed along the compressive loading direction.

Keywords: Z-pin reinforced laminates insertion pattern compression strength degradation influence law

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