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复合材料机身壁板的纵向连接设计与失效分析

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Longitudinal Panel Splice Design and Failure Analysis of Composite Fuselage Structures

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摘要 按照连接设计准则及机身压差载荷水平,开展了复合材料机身壁板的纵向连接设计研究。为提高壁板多钉连接结构分析精度及设计效率,发展了一种基于Fastener单元的钉群载荷计算方法,在此基础上结合单钉失效分析模型,提出了一种壁板多钉连接区的失效评估方法。首先,通过与试验数据对比,验证了采用Fastener单元求解钉群载荷的可行性;然后运用Fastener单元分析壁板连接结构的钉载分配;最后基于钉载分析结果,对局部危险区域采用单钉模型进行失效载荷计算并进而评估壁板连接区的失效载荷。本方法特别适用于快速、有效地校核多钉连接区的连接强度。

关键词： 复合材料 机身 壁板纵向连接 多钉连接 失效分析

Abstract： A study on the longitudinal panel splice design of composite fuselage structures is carried out in accordance with the design criteria of mechanical joints and pressure differential level. In order to improve the analysis precision and design efficiency for multiple-bolted joints of panel splice, a novel method for calculating the load distribution of multiple-bolted joints is developed by using fastener elements. Combined with failure analysis of single-bolted joints, an evaluation method is presented to predict the failure strength of panel splice joints. Firstly, the feasibility of using fastener elements to determine the load distribution of multiple-bolted joints is confirmed via comparing the FEM result with experimental data. Then the fastener load distribution of panel splice joints is studied by applying fastener elements. Finally, based on the previous analysis of fastener loads, the failure strength of panel splice joints is assessed by failure analysis on single-bolted joints at critical locations. The study provides a very simple and effective approach for strength calibration of multiple-bolted joints.

Keywords： composite fuselage longitudinal panel splice multiple-bolted joint failure analysis

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