

论文

复合材料圆柱壳中心受横向集中载荷作用的渐进破坏非线性有限元分析

(飞行器结构力学与控制教育部重点实验室, 南京航空航天大学结构与强度研究所, 南京 210016)

摘要:

旨在建立能够正确预计复合材料圆柱壳的屈曲和后屈曲渐进破坏行为的模拟策略。采用有限元方法和Hashin失效准则进行模拟, 基于该失效准则编写了用户材料子程序, 然后插入到商用有限元软件ABAQUS中。分析了中心受横向集中载荷作用复合材料圆柱壳板, 壳板的2条直边弹性支持, 2条曲边自由。为了探讨弹性边界条件和集中载荷作用点应力集中的影响, 将有限元分析结果与文献中的试验结果进行了比较, 提出了一种合理的弹性边界选取依据。研究表明, 在建模中考虑了弹性边界和集中载荷作用点处存在的应力集中后, 本文中模拟的结果与文献中的试验结果比较接近, 模拟精度明显高于文献中报道的结果。这也验证了本文中建立的模拟策略的合理性。

关键词: 复合材料圆柱壳 非线性有限元; 弹性边界条件 渐进破坏 应力集中

Progressive failure nonlinear finite element analysis of cylindrical composite shells under a transversely centre concentrated load

(Ministry of Education Key Lab of Structure Mechanics and Control for Aircraft, Institute of Structures and Strength, Nanjing University of Aeronautics and Astronautics, Nanjing 210016, China)

Abstract:

The purpose of this investigation is to establish a modeling strategy for accurately predicting the buckling and the progressive failure in the post-buckling of cylindrical composite shells. Finite element method was employed and Hashin failure criterion was used. A user material subroutine based on the failure criterion was developed and inserted into the commercial finite element software ABAQUS. Cylindrical composite shell panels subjected to a transversely concentrated load at its centre were analyzed. Two straight edges of the panel were elastic support and two curved edges were free. Finite element results were compared with the existing experimental data in the literature to investigate the effect of the elastic support conditions and the stress concentration caused by the concentrated load. A reasonable criterion for simulating the correct elastic boundary condition was proposed. It is found that if the elastic support and the stress concentration at the small area of the concentrated load point are considered in the modeling, the simulated results are fairly close to the experimental data and are much better than the existing predictions. Therefore, the rationality of the established modeling strategy is validated.

Keywords: cylindrical composite shell nonlinear finite element elastic boundary condition progressive failure stress concentration

收稿日期 2009-09-14 修回日期 2009-11-10 网络版发布日期

DOI:

基金项目:

国家自然科学基金(50675100)

通讯作者: 王鑫伟, 教授, 主要从事复合材料力学、 计算力学等方面的研究工作

作者简介:

作者Email: wangx@nuaa.edu.cn

参考文献:

扩展功能

本文信息

- ▶ Supporting info
- ▶ PDF(925KB)
- ▶ [HTML全文]
- ▶ 参考文献[PDF]
- ▶ 参考文献

服务与反馈

- ▶ 把本文推荐给朋友
- ▶ 加入我的书架
- ▶ 加入引用管理器
- ▶ 引用本文
- ▶ Email Alert
- ▶ 文章反馈
- ▶ 浏览反馈信息

本文关键词相关文章

- ▶ 复合材料圆柱壳
- ▶ 非线性有限元; 弹性边界条件
- ▶ 渐进破坏
- ▶ 应力集中

本文作者相关文章

PubMed

本刊中的类似文章

1. 王志勇,王磊,郭伟.搭接区端部细观结构对受拉复合材料单搭接头力学响应的影响[J]. 复合材料学报, 2009,26(3): 182-187
2. 韩小平,郭章新,朱西平,曹效昂.含孔复合材料层合板孔边的应力集中[J]. 复合材料学报, 2009,26(01): 168-173
3. 肖俊华, 谢新亮, 徐耀玲, 蒋持平.双周期涂层纤维增强复合材料反平面剪切问题[J]. 复合材料学报, 2008,25(3): 168-173
4. 陈伟, 许希武.复合材料双曲率壳屈曲和后屈曲的非线性有限元研究[J]. 复合材料学报, 2008,25(2): 178-187

文章评论

反馈人	<input type="text"/>	邮箱地址	<input type="text"/>
反馈标题	<input type="text"/>	验证码	<input type="text" value="8798"/>
反馈内容	<input type="text"/>		