

平板編織複合材料結構等效機械性質之研究

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摘要

本研究開發一平板編織複合材料之機械性質預測模型並採用數位影像相關 (Digital Image Correlation, DIC) 法檢測結構機械性質。近年來複合材料已在各產業廣泛使用, 不論是碳纖維或玻璃纖維複合材料。為了大量製造的方便性、結構件外表美觀, 或長纖維複合材料的材料方向性而使用編織複合材料。但編織結構減弱了長纖維複合材料原有之強度與剛性, 因此本研究開發一平板編織複合材料通解模型預測編織複合材料之材料機械性質。本研究使用有限元素法之電腦輔助工程 (Computer Aided Engineering, CAE) 軟體ANSYS分析編織複合材料結構最小單元 (Unit Cell) 之等效機械性質與表面應變。根據ASTM D3039/D3039M-08規範下使用數位影像相關 (Digital Image Correlation, DIC) 法、應變規之拉伸實驗檢測編織複合材料剛性與表面應變, 並將實驗結果與CAE分析結果進行差異之比較。研究分析結果顯示DIC法檢測技術克服了編織纖維結構剛性會隨應變規檢測區域不同而不同的問題。從實驗結果與CAE分析結果得到編織樣式、纖維束寬度、編織結構厚度與編織結構剛性之關係。從CAE分析結果中之等效剛性與實驗差異在0.05%至3.02%, 此結果證明了CAE編織複合材料模型建構與模擬能廣泛的分析不同平板編織複合材料結構機械性質。

關鍵詞: 有限元素法分析、材料檢測、等效材料性質、編織複合材料、數位影像相關法

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