複合材料型樑之熱回彈行為探討

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摘 要

本研究針對碳纖維複合材料疊層型樑由固化至成形時，因溫度效應所造成之變形現象進行探討，並藉由疊層順序來降低應用在複合材料L型樑上所產生之熱回彈量。因此，本研究之主要目的開發一解析解預測模型，該預測模型以2D型態計算出包含疊層順序、疊層厚度、折彎半徑與設計角度之影響因素所產生熱回彈角，並應用有限元素法（Finite Element Method）之商業套裝軟體ANSYS以3D模型來模擬長度與疊層偏差，探討造成熱回彈角與具反對稱（Antisymmetric）、擬向性（Quasi-isotropic）等疊層角度所產生扭曲量。 本文也應用ANSYS來模擬驗證解析解之熱回彈角，以驗證數學模型具一折彎半徑之複合材料L型樑、U型樑固化成形後產生之熱回彈角（Spring-in）及其疊層順序之影響，並探討其疊層厚度、疊層偏差、折彎半徑以及長度等製造參數與熱回彈角、扭曲（Twist）及翹曲（Warpage）關係，以期能提供操作人員了解各種加工參數對於熱回彈角的影響程度，並作為一修正加工參數的參考依據。進一步將所得之結果與解析解模型、實驗結果比較，以驗證此解析解模型之可行性與準確性。利用連續回彈，尋找模具最佳補償角，製造工程師以此製造符合欲成形角度之複合材料L型樑，以降低修整模具比例，進而減少成本與時間的浪費，最後使用MATLAB開發一介面系統整合全部流程，提供預測成形角度更有效率。

關鍵詞 : 複合材料型樑、固化翹曲、熱回彈角、有限元素法

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