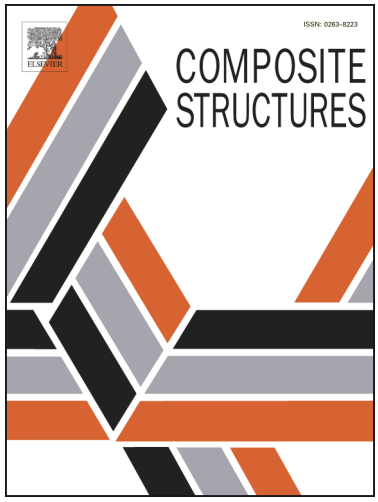

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Design of Filament-wound Composite Elbows Based on Non-geodesic Trajectories

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Abstract: In this paper two winding methods were applied to produce filament-wound composite elbows, which are the whole application of non-geodesics, and the application of geodesics for the torus section and non-geodesics for cylindrical end sections. The resulting winding patterns were numerically simulated for various numbers of partitions. Tsai-Wu failure indices of the composite elbows obtained using various initial winding angles were calculated and the burst pressure of the elbow was predicted using finite element method. The results reveal that the whole application of non-geodesics leads to better structural performance of the composite elbows than the partial application of non-geodesics for cylindrical end sections. The present non-geodesics-based method provides a useful reference tool for design and production of filament-wound composite elbows.

Keywords: Composite materials; Filament winding; Elbow; Non-geodesic; Winding pattern

1. Introduction

Filament winding is a primary manufacturing technique for producing fiber-reinforced composite structures, by which impregnated fibers are precisely positioned onto the rotating mandrel in a predetermined pattern to form the composite shell. Filament-wound composite products have been extensively applied in many industries, such as aerospace, marine, transportation, automotive and nuclear engineering. More recently, filament-wound elbows have emerged as an attractive alternative as a joint part of piping, cylinders, pressure vessels, etc., where the connection between two unparallel composite parts is required.

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