Buckling of Open Cross-Section Composite Thin Shells

Prof. Sergio Pellegrino
Booth-Kresa Department of Aerospace
California Institute of Technology

Abstract

Thin-shell deployable composite structures, with high stiffness to mass ratio, efficient packaging and potentially very low cost, are key components of large, future space solar arrays. A particular structural architecture that is being considered in the Caltech Space Solar Power Project uses long, slender cylindrical shells (longerons) with open cross-section consisting of two circular arc flanges bonded along one edge as the main load-bearing elements. To achieve extreme lightness and tight packaging, thin-ply composite laminates less than 0.1 mm thick are used, and hence the overall structural response of these shells, mainly loaded in bending, is dominated by localized geometric imperfections. A detailed study of the effects of these imperfections has explained the nonlinear moment-rotation behavior that is measured in prototype shells, allowing a close correlation between the magnitude, shape and distribution of the imperfections and the overall bending stiffness of these structures.

Biography

Sergio Pellegrino is Director of the Booth-Kresa Department of Aerospace, Joyce and Kent Kresa Professor of Aerospace and Civil Engineering at Caltech, JPL Senior Research Scientist and Co-Director of the Caltech Space Solar Power Project. He is an editor of the International Journal of Solids and Structures, a Fellow of the Royal Academy of Engineering and a Fellow of AIAA. Among other awards, he has received a Pioneers' Award in 2002 from the Space Structures Research Center, University of Surrey, NASA Robert H. Goddard Exceptional Achievement Team Awards in 2009 and 2016, and the IASS Torroja Medal in 2022.