NASA TECH BRIEF

Analysis of Stability-Critical Orthotropic Cylinders Subjected to Axial Compression

An analytical procedure, for determining critical buckling loads of orthotropic cylinders subjected to axial compression loading, has been defined. Three modes of instability have been considered: general instability (a failure mode in which the total cylindrical structure collapses as a shell); local instability caused by panel and interframe buckling; and local instability caused by yielding and crippling in areas of stress concentration.

An analytical approach employing the strain energy solution has been developed to analyze the general instability mode for determination of the load carrying capability of a stability-critical stiffened cylindrical shell structure under axial compression. The hoop extensional and flexural rigidities are expressed in terms of an equivalent isotropic cylinder thickness. This approach facilitates the derivation of the strain energy equations and the development of a theoretical buckling stress equation for stiffened cylinders critical in general instability.

Local instability including interframe buckling and edge crippling failure modes which may be evaluated by means of the established column or shell theory as applicable to the specific structural configurations have been appraised. Application of the theoretical buckling stress equation for general instability and the resulting buckling coefficients for the ring-reinforced corrugated Saturn V/S-IC intertank models has shown good correlation with test results. Correlation with test results from other sources for integrally milled waffle-stiffened cylinders; honeycomb sandwich cylinders; mechanically attached Zee-stiffened, ring reinforced cylinders; and integrally milled, externally stiffened, ring reinforced cylinders have also been investigated.

Notes:

Inquiries concerning this innovation may be directed to:

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No patent action is contemplated by NASA.

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