NASA TECH BRIEF

NASA Pasadena Office

Structural Design and Stress Analysis Program for Advanced Composite Filament-Wound Axisymmetric Pressure Vessels (COMTANK)

The problem:

To develop a detailed vessel design and perform a complex stress analysis of the design in an efficient and cost-effective manner.

The solution:

A computer program, COMTANK, has been developed to design and analyze advance composite filament-wound axisymmetric pressure vessels.

How it's done:

The program has been specifically developed to handle planar-wound pressure vessels fabricated of either boron/epoxy or graphite/epoxy advanced composite material. The vessel may or may not contain a cylindrical mid-section; i.e., the tank configuration may be that of a cylinder with dome closures or an oblate spheroid. In the former case, provision has been made to accept unequal boss openings in the forward and aft domes.

In general, input to the program must be provided in three basic categories:

(1) tank description, consisting of geometry and material property data;
(2) design loading condition; and
(3) analysis loading conditions.

The tank description consists of a definition of overall tank geometry and component geometry relating to the liner, bosses, and skirt attachments. The design loading condition consists of internal pressure only. The analysis loading conditions consist of internal pressure, boss line loadings, and temperature gradients through the tank wall.

Items (2) and (3) above indicate that it is possible to analyze a pressure vessel design for loading conditions other than those for which it was designed.

Given the proper input, COMTANK will perform computations to provide output that describes a detailed pressure vessel design and stress analysis. The vessel design consists of midsurface coordinates defining the entire tank and skirt-support element geometry, element wall thicknesses throughout the structure, ply construction, enclosed volumes, weight breakdowns, and material property details relating to filament tape wrap angles and coefficients of thermal expansion. The stress analysis consists of the entire displacement field of the structure, element nodal forces, stress resultants and couples, and point stress analysis; giving a detailed breakdown of the longitudinal, transverse, and shear stress in each layer of the composite at the point of consideration.

The program makes a call for subroutine TICK which calculates the CPU time of a particular run. The user will have to supply his own TICK subroutine or remove the small amount of logic that utilizes the CPU time.

Notes:

1. This program is written in FORTRAN V to be utilized on the UNIVAC-1108, EXEC-8 computer system.

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