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NASA TECH BRIEF

Langley Research Center

Computer Program for Stress, Vibration, and Buckling Characteristics of General Shells of Revolution

The problem:

A system was needed to analyze the response, under various loadings, of axisymmetric shell structures.

The solution:

The Structures Research Associates (SRA) system of programs is composed of six compatible computer programs for structural analyses of axisymmetric shell structures. The theories and methods upon which these programs are based are presented in the documentation. They apply to a common structural model but analyze different modes of structural response.

How it's done:

The structures may be classified, according to their functions, into three groups, designated here as the 100, 200, and 300 series. In particular, they are:

- SRA 100 - Linear static response under asymmetric loads;
- SRA 101 - Buckling of linear states under asymmetric loads;
- SRA 200 - Nonlinear static response under axisymmetric loads;
- SRA 201 - Buckling of nonlinear states under axisymmetric loads;
- SRA 202 - Imperfection sensitivity of buckling modes under axisymmetric loads; and
- SRA 300 - Vibrations about nonlinear states under axisymmetric loads.

Each of these programs treats branched shells of revolution with an arbitrary arrangement of a large number of open branches but with, at most, one closed branch. Current dimensioning allows for seven branch points, each of which may have as many as five branches emanating from it. Branches which close at the axis of revolution, i.e., dome closures, are not considered to be closed branches. A maximum of 23 dome closures or other shell edges is allowed. At each meridional station, the shell wall may consist of as many as five orthotropic layers, in each of which elastic properties may vary only in the meridional direction. At each material point, the shell is assumed to posses orthotropic principal axes in meridional and circumferential directions. All geometric and mechanical properties of the structure are assumed to be axisymmetric but may have arbitrary meridional variation. A continuous reference surface, arbitrarily located within or near the shell wall, is treated. The shell may be stiffened by:

1. Up to 34 discrete isotropic rings;
2. Stringers, whose stiffness is circumferentially distributed; and
3. An elastic foundation attached to the shell wall.

The effects of thermal loads and live pressure fields are included.

Notes:

1. This program is written in FORTRAN II for the CDC 6000 series computer.
2. Inquiries concerning this program should be directed to:

   COSMIC
   112 Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: LAR-11369

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