NASA TECH BRIEF

Computer Program Determines Vibration in Three-Dimensional Space of Hydraulic Lines Excited by Forced Displacements

A computer program has been developed which determines the forced vibration in three-dimensional space of a multiple degree of freedom beam type structural system. Provision is made for the longitudinal axis of the analytical model to change orientation at any point along its length. In addition, either support or forcing input in any direction, or combination of directions, at any such point may also be provided for. Readout may be either tabular or CRT plotted.

The program is written in four subroutines: (1) three-dimensional modal beam; (2) beam response; (3) three-dimensional static beam; and (4) vibration of lines excited by forced displacements.

The three-dimensional modal beam subroutine has been developed to determine the natural frequencies and the associated three-dimensional modal vectors of a system of beam segments, concentrated masses, and springs. The beam segments are joined at points, called stations, so that the system has two ends and no more than two segments are joined at each station. The stations are numbered in consecutive order with the end points being considered stations. At each station there may be concentrated mass and mass moments of inertia and linear translational and rotational springs. The springs at station "i" are parallel to the beam axis and the two principal planes of bending of the beam segment between station "i" and "i + 1". At the ends of the beam system each displacement may be free elastically constrained, or rigidly constrained. A reference x,y,z coordinate system is set up and the coordinates of the stations are designated. A secondary ξ, η, ζ, coordinate system is set up for each beam segment. The axes of the secondary system coincide with the beam axis and the principal planes of bending.

The beam response subroutine has been developed to determine the steady-state response to sinusoidal forcing functions of structures whose natural frequencies and modal vectors are determined by the three-dimensional modal beam subroutine. The method used is the so-called generalized coordinate method.

The three-dimensional static beam subroutine has been developed to determine the three-dimensional static deflections of a system of beam segments and springs acted upon by concentrated forces and bending moments. The coordinates and vectors are set up as is the modal beam subroutine.

In the vibration of lines excited by forced displacements subroutine, as a portion of the analysis performed on the Saturn S-11 it is necessary to determine the vibration response of various lines. It is assumed that each line may be treated as a separate component deriving its vibration input through its supporting bracketry from the primary structure.

Notes:

1. This program is written in Fortran IV and MAP for use on the IBM 7090/94 computer.
2. This program may be of use to those industries in which structural design dynamic analyses are performed.
3. Inquiries concerning this program may be made to:
   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10159

(continued overleaf)

Patent status:

No patent action is contemplated by NASA.

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