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THE STABILITY OF THIN-WALLED AXIAL SYMMETRIC STRUCTURES MADE UP TWO COAXIAL SHELLS CONTAINING LIQUID UNDER THE MULTIFACTOR STATIC LOADING

Abstract

Nowadays space rocket designs are becoming thinner and lighter. For this, stability concerns should be solved. At this time the stability problems with two or more independent variables cannot be solved by Euler's standard formula. To determine critical values for static stability assessment the most common dynamic method is used. The dynamic approach is based on mathematical stability theories, including proven theories and research methods based on mathematics. To analyze dynamic characteristics of thin-walled structures containing liquids, such as liquid rocket fuel tanks, some programs based on finite element method have been developed for decades. To calculate more complicated structures with high accuracy, it was necessary to use mathematical models with higher dimensions. The developed algorithms expand the possibilities and calculate sophisticated computing programs. The calculations of this study were performed in Visual Basic for Applications (VBA) system on Excel spreadsheet processor. In this paper, it is assumed that the structure made up two coaxial shells filled with liquid is under the external pressure and internal pressure. An internal distributed pressure is applied to the inner cylindrical shell and an external pressure is applied to the outer shell. These pressures are independent variables. The distance between the outer and inner cylinders also can change. When the distance between the cylinder walls decreases, the volume and mass of the liquid contained in the structure also decreases and the hydroelastic frequencies are changed. Each of these variables affect the natural frequency and structure stability. Static stability graphs can be plotted with the external pressure and the internal pressure as the axis. On the coordinate plane of the two parameters, the boundary of the stability area is defined, which separates the area in which the loaded structure retains stability from the area in which the structure loses stability.