FORCE DISTRIBUTION AT INDETERMINATE STRUCTURAL INTERFACES OF LARGE ELEMENTS OF SPACECRAFT

K. Renji
Advanced Technology Development Group
ISRO Satellite Centre (ISAC)
HAL Airport Road, Kodihalli
Bangalore-560 017, India
Email : renji@isac.gov.in

Vivek Prabhakar, K. Divya
Structures Group
ISRO Satellite Centre (ISAC)
HAL Airport Road, Kodihalli
Bangalore-560 017, India

Abstract

Spacecraft is an assemblage of several elements and many of these elements have statically indeterminate interfaces. The distribution of forces at their interfaces depends on the stiffness at these interfaces. It is expected that the forces at the interface of a subsystem are significant in regions that are relatively stiff. It is shown here that this behavior is true when the force acts only on the specific subsystem and no forces act on the rest of the elements. If the forces act on the entire system the force distribution at the interface of a subsystem is significantly modified by the deformation at these interfaces which are caused due to the forces acting on the rest of the elements. The forces can be significant even at locations where the stiffness is low. These characteristics are concluded using a spring-mass model. Using the results of finite element model these findings are then demonstrated for the forces at the interfaces of a propellant tank mounted in a spacecraft. Similar characteristics of force distribution are seen in the natural modes of vibration. Experimental results are obtained and they show good agreement with the above findings.

Keywords: Indeterminate Structure, Finite Element Method, Propellant Tank, Static Load, Dynamic Load