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# DESIGN OF INTERSTAGE STRUCTURES TRANSFERRING THRUST FROM BOOSTER TO CORE STAGE OF ISRO MISSIONS - A PARADIGM SHIFT

**Abstract**

Interstage structures transferring thrust load from strap-on (booster) stages to the core stages are usually subjected to eccentric highly concentrated thrust loads in addition to radial and shear loads.

For the ASLV missions of ISRO, design was carried out in the 1980s relying more on design checks, and, idealisation of the circumferentially varying sections of the rings as beam elements with loads appropriately applied to ensure adequate margins before qualification and flight.

As for the PSLV mission, the interface joint between the Strap-On Motor ( SOM ) and the strap-on a structure in a launch vehicle is a bolted joint with a tapped hole on the motor flange. In the initially designed structure, the interface bolts at the interface were found to be bent near the thrust transfer location subsequent to structural qualification level test. This called for modifying the structure and assembly in 1990s. For this an analysis methodology was established first proving the bolt bending of the primary design configuration, and subsequently design modifications to the assembly were carried out based on this methodology before the structural qualification level test on the modified assembly which was successful.

The LVM3-X/CARE mission was the experimental mission of ISRO. The thrust transfer structure of the solid booster stage is designed to transfer primarily concentrated load of nearly 5 times the PSLV missions. The design was required to be done in a tight time schedule with several fabrication, design and functional constraints. This was for NCA structure of LVM3 mission, wherein a combination of aerospace materials like Al.Alloy,15CDV6,maraging steel and later on EN24 were made use of for the assembly. The design and analysis procedure was quite involved with respect to the earlier thrust transfer structures, with more detailed analysis of almost all interface joints with adjoining structures, as well as major structural component joints in the assembly. The estimation of margins was very crucial since the time left for the structural qualification test of the assembly was very little and the structure and assembly was envisaged to be later used for GAGAYAAN (Human Space Flight ) flights too.

This paper briefly summarises the paradigm shift in the design and analysis procedures of interstage structures transferring thrust loads from booster stage to the core stage over three of ISRO missions spanning over a period of two decades.