DESIGN AND ANALYSIS OF A TYPICAL INTER-TANK STRUCTURE OF A LAUNCH VEHICLE USING INTEGRALLY STIFFENED CONSTRUCTION

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ABSTRACT

In launch vehicle structures design, importance is given to lightweight with high load bearing capacity design, so the factor of safety is kept low compared with ground-based structures and at the same time maintaining high reliability. This demands very accurate analysis of structural elements for launch vehicle. The main criteria are lightweight, ease of fabrication, lower cost and at the same time meeting the strength and stiffness requirements. The commonly used launch vehicle structure is the closely stiffened structure in which the structure consists of 90 or 120 no's of stringers riveted onto a 1.2mm thick skin and a few number of bulkheads. In this type of structures, thin shell can buckle or cripple at a load much lower than the buckling strength of stringers. In order to overcome this, integrally stiffened structures such as isogrid structures is chosen. Isogrid is the name given to integrally, grid stiffened shell and structures in which the grids form an equilateral triangle pattern. The isogrid structure can withstand both compressive and bending loads and also offers lower weight and higher structural efficiency. A typical inter tank structure that was preliminary designed using closely stiffened shell structure has been identified for study. This is a cylindrical structure having a diameter of 4.0m and a height of 2.75m which should safely withstand the loads expected on it during different phases of flight. It should safely carry the accessories needed for the next stage separation. A detailed design analysis of this particular launch vehicle structure using integrally stiffened construction is done both theoretically and also the results are verified by using FEA packages. The scope of study is to make a detailed design through FE analysis.

General Terms

Finite element analysis, tank structure, shell element, integrally stiffened construction

KEYWORDS: Inter-Tank Structure, Isogrid, Integrally Stiffened, Buckling Analysis