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Joints in Deployable Space Truss Structures

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Since the response of deployable structural concepts being considered for the LDR backup structure will be dominated by the response of joints, the joint characteristics are significant. This presentation is an overview of the research activities at LaRC on the static behavior of joints for deployable space truss structures.

Since a pin-clevis-type joint will be utilized in deployable structures, an experimental research program to characterize the joint parameters which affect stiffness was conducted. Some of the parameters evaluated were the effects of the pin and joint material properties, the tolerance between the pin diameter and the hole, and the effect of pin diameter on joint stiffness. Based upon the experimental studies, the design recommendations for pin-clevis joints were established. FIGURE 1 shows the joint stiffness efficiency for tensile and compressive loads for various joint materials.

An experimental research program was conducted on a second type of joint, referred to as a near-center latch joint. It was used in the center of members on the deployable truss structure for the Control of Flexible Structures (COFS) flight experiment. The design features of the joint are (1) the parent joint material is titanium and the pin material is steel, (2) the linkage members in the load path take only axial loading, (3) all pins and holes have light interference fits, (4) critical pin holes are drilled on assembly fixture, and (5) an interior preload of 80 pounds was applied. The test results of the near-center latch joint and the member with the joints indicated that the stiffness of the near-center joint is linear and stiffer than the stiffness of the total member, and that non-linearities in the stiffness characteristics of the total member were due to bending introduced at the ends of the member. The resulting data indicates that stiff linear folding joints can be designed and that bending load paths should be avoided whenever possible. In summary, for deployable structures, special attention to the joint and the structure design is required to minimize the undesirable structural non-linearities.

$$\text{Efficiency} = \frac{\text{Maximum measured stiffness}}{(E\ A\ /\ L)_{\text{Test section}}}$$

Joint Material	Efficiency	
	Tension	Compression
Steel	30%	38%
Titanium	43%	59%
Aluminum	50%	76%

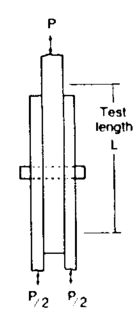

FIGURE 1. Joint Section Efficiency

F. Special Session on Ballooning