

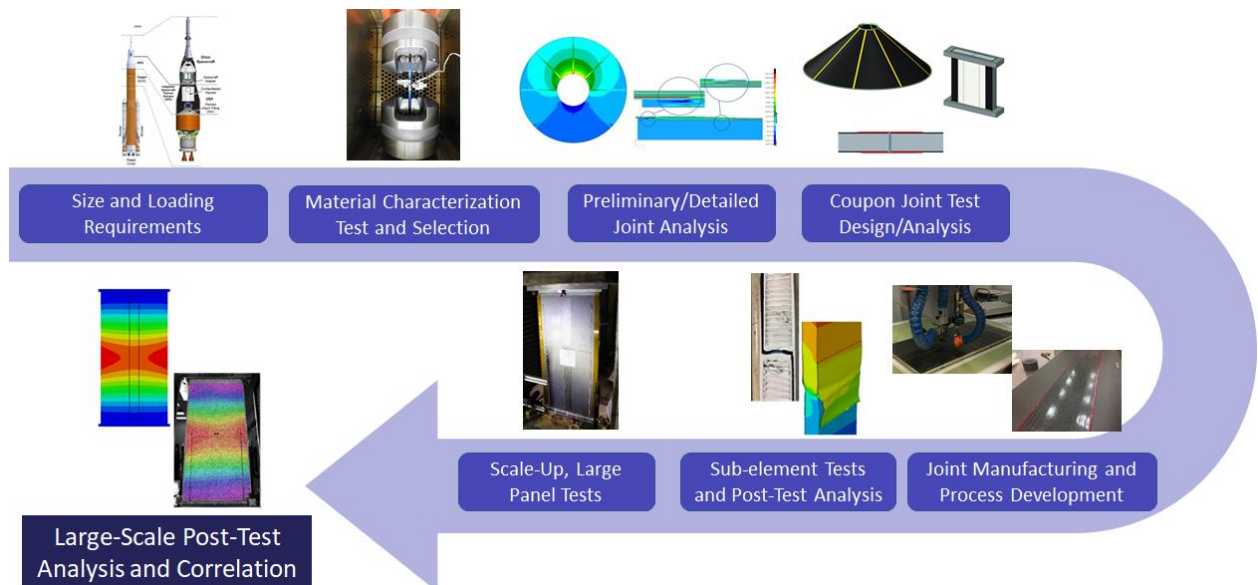
Exploring New Composite Bonded Joint Technology Through Design, Manufacturing, Testing, and Analysis

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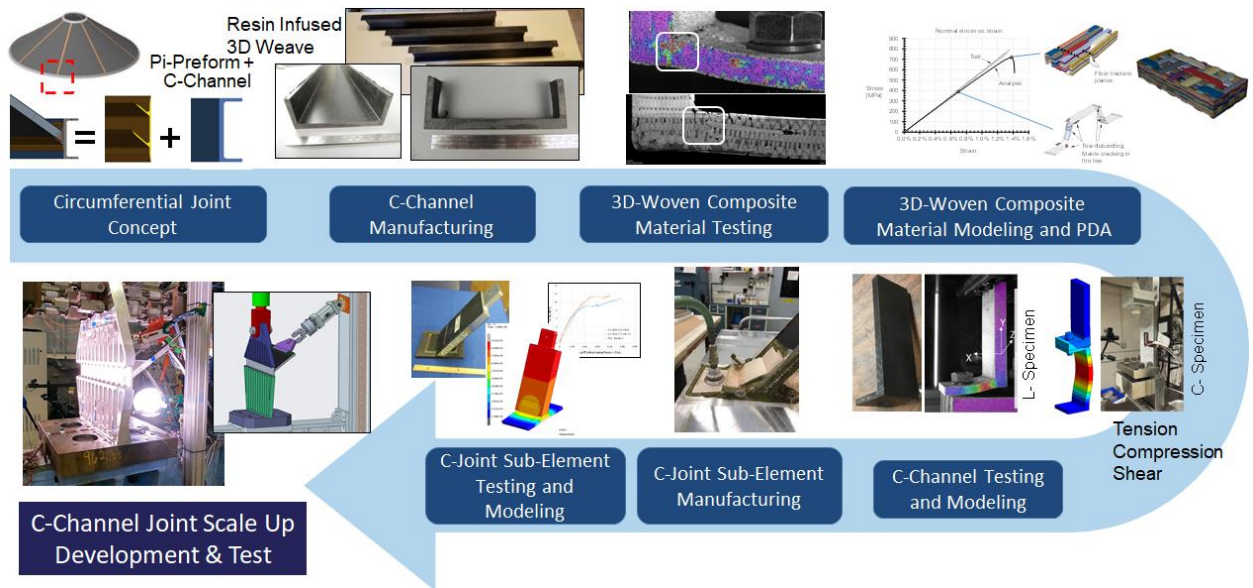
As composite materials have become the “gold standard” for modern aerospace structures, more lightweight, durable, rapid, and inexpensive joining techniques are desired. Among these classes of joints are bonded joints, which use adhesion or cohesion to join the composite parts. Aerospace structure designs require higher knockdown factors (KDFs) for the joints than the acreage. The material and process variability, widely varying geometric configurations, and concentrated loads due to discontinuities motivate these KDFs in bonded joint designs. In response, NASA is actively expanding the application of bonded joints through flight programs and technology development.

The objective of NASA’s recent, Composites Technologies for Exploration (CTE) project, under the Game Changing Development (GCD) program, within the Space Technology Mission Directorate (STMD), is to advance bonded joint technology and improve the customer confidence through design, manufacturing, testing and analysis. This agency-wide effort, which includes NASA Goddard Spaceflight Center, NASA Langley Research Center, NASA Glenn Research Center, and NASA Marshall Space Flight Center, utilized a building block approach to investigate the behavior and demonstrate the capabilities of both longitudinal (L-) joints and circumferential end ring (C-) joints in Space Launch System (SLS) scale structures. The material utilized for the circumferential end ring is an advanced 3D woven composite developed and manufactured by Bally Ribbon Mills and Cornerstone Research Group. The L-joint and C-joint test articles achieved greater than two times the design limit load, demonstrating the robustness of the bonded joint technology. The CTE project concluded in September, 2021, and the AIAA Materials Technical Committee (MAT-TC) and Structures Technical Committee (STR-TC) co-organized a special session on the CTE project work at the SciTech2022 Forum in San Diego, CA in January, 2022.

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Building block approach for testing of longitudinal L-Joint including design, manufacturing, analysis and testing.



Building block approach for testing of 3D woven circumferential C-Joint including design, manufacturing, analysis and testing.