STEPHEN TSAI-STANFORD UNIVERSITY

MASTER LAMINATES

MASTER LAMINATES TO SIMPLIFY DESIGN, MANUFACTURING, AND TESTING OF COMPOSITES

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ABSTRACT

Composite materials and structures have traditionally been viewed as more complicated than metals. With master stiffness and failure envelopes composites are as simple as metals. Stiffness of laminates can be split into two part: one for trace that represents the total stiffness capacity; one for the partitioning of trace for each laminate. Thus only one material constant, not four, is needed to define the master stiffness. One uniaxial test will suffice. As a simplification, the complicated, unreliable shear test is not needed. For failure envelopes that defines strength, a similar master envelope for each laminate can be defined also in two analogous parts: one materials related strength capacity by the size of the envelope; one related to the shape of the envelope. Just like metals the controlling strength is determined by uniaxial tensile and compressive tests. The same combined-stress strength from coupons with holes or defects can be covered by a master envelope with stress concentration. Design allowable generation, a huge undertaking, can be simplified by uniaxial tests and master envelopes to be on par with metals. Presentation will cover how the master stiffness and strength envelopes are derived, validated, and used with unmatched simplicity and common sense. Many self-inflicted complications can be a thing of the past leading composites to a new level of competitiveness. Also to be offered from our webpage: compositesdesign.stanford.edu free download of our book on double-double, and free participation in Composites Design Workshop for graduate students. Next workshop: January 22-27, 2023.

STEPHEN TSAI

Professor Research Emeritus, Dept. of Aeronautics and Astronautics,
Stanford University

B I O

Stephen W. Tsai, BE and D.Eng in mechnical engineering from Yale University in 1952 and 1961, respectively. He started his work in composite materials at Aeronutronic, Newport Beach, CA, in 1961. He was professor at Washington University in 1966, chief scientist, Air Force Materials Laboratory in 1968, and research professor at Stanford University in 1990. He is known for his work in failure criterion in Tsai-Wu, micro mechanics in Helping-Tsai, trace known as Tsai's modulus, omni envelopes and unit circle criterion with Melo, glueless assembly using negative thermal expansion of [±60], and his latest master envelopes that will be foundation of his presentation. His latest book on double-double can be downloaded without charge from compositesdesign.stanford.edu. He has been life member of American Society of Mechanical Engineers, International Conference of Composite Materials, and US Academy of Engineering.