Experimental Techniques

Experimentally Speaking

THE CHALLENGE OF COMPOSITES

Composites are not new. They have been present in nature for millenia and were made by the Israelites in Biblical times. Yet it is only within the past quarter century that they have come under extensive and intensive research and development. Applications range from consumer products such as golf-club shafts, automotive-suspension springs and driveshaft, to fossil-powerplant smokestacks, helicopter rotor blades, aircraft structural components, filament-wound rocket-motor casings, and the 65-ft payload baydoors for the space shuttle.

Due to their inherent complexity, composites present a particular challenge to experimental mechanicians on a variety of scales: the micmscale, the laminate scale and the structural-component scale. The challenge is being accepted and an increasing number of articles on composites are appearing in the pages of both EXPERIMENTAL MECHANICS and EXPERIMENTAL TECHNIQUES. These include such aspects as photoelasticity, moire, strain-gage technology, fracture and damage mechanics, residual stresses, impact, wave propagation, fatigue, creep, plasticity, testing techniques and adhesive and mechanical joints.

As with most rapidly growing research fields, the field of composites has its own specialized terminology. It is hoped that newcomers to the field will comply with the established terminology. For instance, an individual layer may be called a lamina but not a laminate, since the latter is an assemblage of individual layers. Another term that is often confused is that of symmetrical lamination versus balanced lamination. A symmetrical laminate is one in which all of the layers are configured symmetrically with respect to the midplane of the laminate, while a balanced laminate is one having its layers oriented at $+\alpha$ with respect to a reference direction balanced by an equal number oriented at $-\alpha$.

It is emphasized that in many instances composites are saving cost as well as weight relative to the homogeneous materials which they are replacing. In a few instances composites are making possible new technological advances which would not even be possible without composites. A case in point is the forward-swept-wing technology now being flight tested on the Grumman X-29 research aircraft.

Before closing, I would like to offer two 'laws' of research. These are laws in the sense of the well-known Murphy's law of human endeavors in general and Parkinson's and Augustine's laws of management.

— One experiment is worth at least 500 tests. (This is an extension of a testing-machine builder's axiom that 'one test is worth 1,000 expert opinions'.)

— The maximum advance in the frontiers of knowledge is made by directing research attention to the lesser developed of these two aspects: analytical (including numerical) and experiments.

With the combined help of experimentalists and theoreticians both using today's computer power to the fullest, the future is indeed bright for the continuing expansion of composite products into new areas now only being envisioned, such as a hypersonic passenger aerospacecraft.

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