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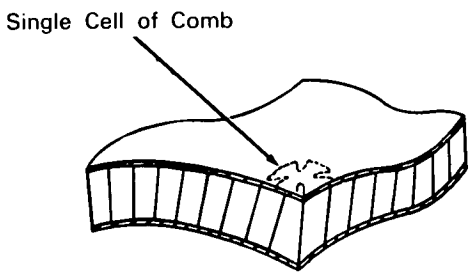
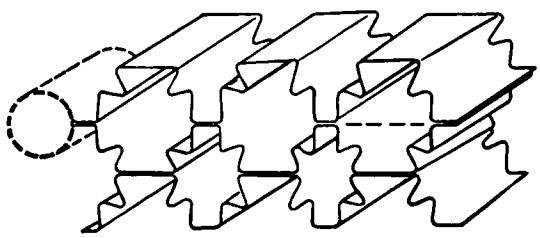
NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the NASA space program.

Flexible Honeycomb Structure Can Bend to Fit Compound Curves



PANEL OF FLEXIBLE HONEYCOMB



HONEYCOMB CORE

The problem: Honeycomb structure is often specified for lightweight panels requiring high strength; but for curved panels the standard honeycomb materials have limited flexibility. If, in forming a curved panel, the bonds between the foils are destroyed, the structural strength of the panel is reduced. A lightweight honeycomb structure is needed that will bend to fit compound curves.

The solution: A new configuration of honeycomb utilizing multiple pleats that has superior flexibility to other honeycomb cores currently available.

How it's done: The configuration of the cellular structure resembles a Maltese cross, as shown in the illustration. The four partial pleats formed in the individual cell walls permit these walls to move toward or away from the central axis without causing tearing or cell wall collapse. As each cell is deformed in the process of fitting the honeycomb structure to a curved surface, a multiplicity of important functional angles are involved in allowing the expansion or compression of upper or lower cross sections. Since each pleat consists of four angles, each individual angle is required to flex only to a limited extent, thereby avoiding the development of large localized stresses and resultant buckling even when the cell is subjected to extreme flexing.

The honeycomb structure may be fabricated from aluminum, stainless steel, plastic, paper, or fiberglass, depending upon requirements for the finished panel. Practical fabrication may be accomplished by cutting strips of material in the desired width (1/4 inch to several inches) and forming them to a pattern representing the upper half of a series of side-by-side Maltese crosses. Two such formed strips then assembled in mirror-image fashion constitute a single series (or line) of cells. Assembled strips may then be secured with appropriate soldering, welding, blazing, or adhesive techniques.

(continued overleaf)

A completed honeycomb core can be fitted to a compound surface by placing the core over the curved surface and applying a downward force. Flexibility results from the partial pleats in each wall of the cell. These pleats may be opened or closed along either their X- or their Y-axis. Tests have shown that cores with 3/16-inch cells could be bent successfully over a compound curve having a 2-inch radius.

Notes:

1. Flexible honeycomb panels would find use in compound-curve structures such as aircraft parts where strength with minimum weight are essential.
2. Potential large uses of flexible honeycomb panels are seen in the roof and body section of automobiles, building construction, and particularly tank trucks or railroad cars which must have insulation with low weight.

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