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EML 4230 Introduction to Composite Materials

Chapter 4 Macromechanical Analysis of a Laminate Objectives and Laminate Code

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Courtesy of the Textbook Mechanics of Composite Materials by Kaw

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 Find the coefficients of thermal and moisture expansion of a laminate based on elastic moduli, coefficients of thermal and moisture expansion of individual laminas, and stacking sequence





Laminate Code

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Laminate Code $\begin{array}{c} 0 \\ -45 \\ -45 \\ 0 \\ \end{array}$ $\begin{array}{c} [0/-45/\overline{60}]_S \\ -45 \\ 0 \\ \end{array}$



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Laminate CodeGraphite/Epoxy0Boron/Epoxy45Boron/Epoxy-45Boron/Epoxy-45Boron/Epoxy45Graphite/Epoxy0

Special Types of Laminates

- Symmetric Laminate: For every ply above the laminate midplane, there is an identical ply (material and orientation) an equal distance below the midplane.
- **Balanced Laminate:** For every ply at a $+\theta$ orientation, there is another ply at the $-\theta$ orientation somewhere in the laminate.

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Laminate Behavior

- Elastic Moduli
- Stacking Position
- Thickness
- Angles of Orientation
- Coefficients of Thermal Expansion
- Coefficients of Moisture Expansion

Special Types of Laminates

- Cross-ply Laminate: Composted of plies of either 0° or 90° (no other ply orientation).
- Quasi-isotropic Laminate: Produced using at least three different ply orientations, all with equal angles between them. Exhibits isotropic extensional stiffness properties.

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