MODELING THE PROGRESSIVE DAMAGE IN 2D AND 3D WOVEN FABRIC COMPOSITES
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BACKGROUND

- Advantages of 3D Fabric Composites:
  - High Fracture Toughness (GIC, GIIIC, GIIIIC)
  - Damage Tolerance
  - Easy Handling & Infusion
- Prediction of the Properties of 2D/3D Woven Composites
  - Micro- or Meso-scale Levels through Theoretical and Finite Element (FE) Analysis
  - Non-linear Responses and Softening Behaviors after Damages Have Been Hardly Studied

RESEARCH GOAL AND SCOPE

- Research Goal:
- Research Scope:
  - Single Element (SE) Analysis (SEA) of Uni-Directional (UD) S-2 Glass/SC15 Composites & Pure SC15 Resin
  - Mechanical Response Simulation of 3D S-2 Glass/SC15 OWF Composite using the Meso-Mechanical UCM
  - Homogenization of 3D S-2Glass/SC15 OWF Composite Properties

PROGRESSIVE DAMAGE MODEL FOR UD S-2 GLASS/SC15

- Progressive Composite Damage Model MAT162 in LS-Dyna
- Stress-Based Failure Criteria (Hashin, J Appl Mech, 1980), and Matzenmiller’s Damage Model (Compos Struc, 1995)
- Damage Modes for UD Composite
  - Fiber Tension/Shear
  - Fiber Compression
  - Fiber Crush
  - Transverse Compression
  - Perpendicular Matrix Crack
  - Parallel Matrix (Delamination)

SINGLE ELEMENT ANALYSIS OF UD S-2 GLASS/SC15

SINGLE ELEMENT ANALYSIS OF UD S-2 GLASS/SC15

SUMMARY OF UD S-2 GLASS/SC15 MODEL

SUMMARY OF SC15 INTERSTITIAL RESIN MODEL

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(Continued)

UNIT CELL MODEL (UCM) OF 3D OWF COMPOSITE
- Composite Density: 1720.30 kg/m³
- Aerial Density: 9.271 kg/m² (1.9 psf)

X-TENSION
- Homogenized Properties
  \[ E_x = 30.2 \text{GPa} \]
  \[ v_{12} = 0.0961 \]
  \[ S_{XT} = 517.5 \text{MPa} \]
  \[ S_{XC} = 299.8 \text{MPa} \]
  \[ m_1 = 30 \]
  \[ m_2 = 30 \]
  \[ SFFC = 0.15 \]

X-COMPRESSION

XY-IN-PLANE SHEAR
- Stress-Strain Curve and Deformed Shape

XZ-INTER-LAMINAR SHEAR
- Stress-Strain Curve and Deformed Shape

APPLICATION
- Prediction of Effective Property For Different 3D OWF Composites

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