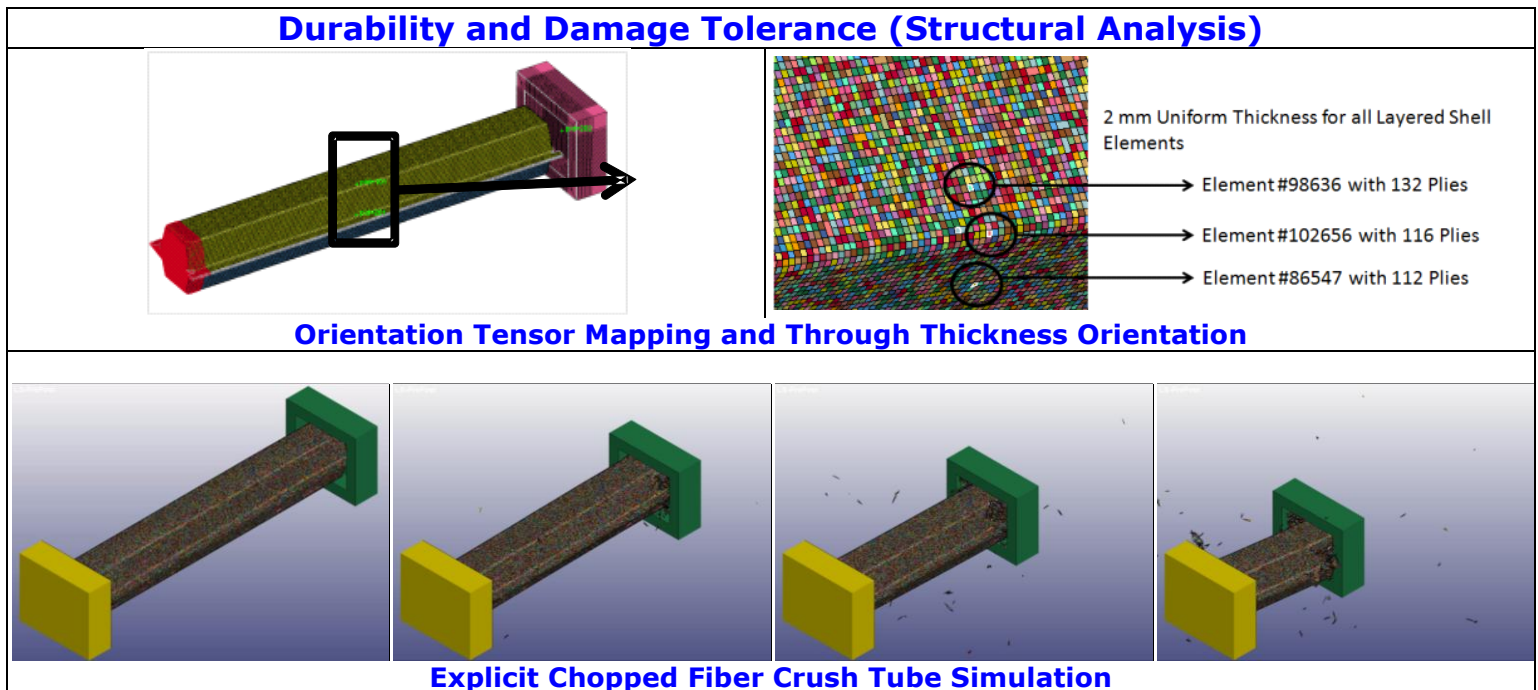


**MCQ Chopped** is a software toolset designed to assist in predicting chopped properties based on effective particles and matrix material properties. The software allows engineers to characterize chopped fiber reinforced composite material properties as a function of several manufacturing, geometric, and material variables. Using a de-homogenized, multi-scale material modeling approach, MCQ Chopped is ideal for the end-user that wants to accurately predict strength, stiffness in response to manufacturing anomalies, effect of defects, and environmental conditions.



**Highlights**

- ✓ Predicts aligned, in-plane random and 3D random material properties;
- ✓ Reverse engineers effective constituent material properties
- ✓ Determines Orientation Tensor and Predict effective orientation distribution of plies through-thickness
- ✓ Identify variation in aligned properties with variation in constituent material properties and manufacturing variables
- ✓ Predict aligned layer, 2D random, 3D random and user defined layup stress-strain curve
- ✓ Reverse engineer aligned layer stress-strain curve from flow or cross-flow test
- ✓ Predict damage evolution, growth and final failure for chosen orientation
- ✓ Predict damage initiation and final failure of coupons subjected to biaxial loading
- ✓ Predict average material properties directions considering material uncertainty, orientation, and thickness effect

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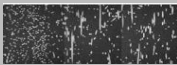
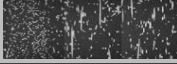
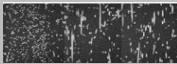






## Key Benefits

- ✓ Generates de-homogenized material model including ply orientation through thickness and the effect of defect
- Effective and efficient calibration of material properties of constituents using ASTM Tests
- ✓ Accurately predict strength in addition to stiffness
- ✓ Material database for several validated classes of Thermoplastic, Elastomer and Thermoset

## Modules

• <b>GUI</b>	Base GUI for project management, setup and post-processing results
• <b>Aligned Layer Non-Linearity</b>	Reverse engineer aligned layer stress-strain curve from flow or cross-flow direction test stress strain curve
• <b>Chopped Characterization</b>	Graphically verify the variation in aligned layer properties with variation in constituent material properties and manufacturing variables
• <b>Chopped Mechanics</b>	Predict aligned, in-plane random and 3D random material properties and reverse engineer effective constituent material properties
• <b>Design Failure Envelope</b>	Predict damage initiation and final failure of coupons subjected to biaxial loading
• <b>Material Non-Linearity</b>	Predict aligned layer, 2D random, 3D random and user defined layup stress-strain curve using matrix stress-strain curve as input
• <b>Material Uncertainty</b>	Predict average material properties (flow, cross-flow, user defined) directions considering material uncertainty, orientation, and thickness effect
• <b>Orientation Distribution Determination</b>	Predict effective % orientation distribution of the fillers through-thickness
• <b>Progressive Failure</b>	Predict damage evolution, damage growth and final failure for chosen orientation (e.g., user defined, flow or cross-flow direction un-notched coupons)
• <b>Orientation Tensor Distribution</b>	Predict effective layup and properties from 5 component orientation tensors

## Validated Material Database

Thermoset/Thermoplastic/Elastomers Chopped Fiber Composites			
Material	Fiber/Polymer	Specimen View	Manufacturing
1. CR-GF15	Fiberglass + Neoprene (Elastomer)	 Short Fiber Distribution	Two Roll Mill
2. PP-GF40/PP-LGF30/PP-SGF40	Fiberglass + Polypropylene (Thermoplastic)	 Long/Short Fiber Distribution	Injection Molding
3. PBT-GF20/PBT-SGF30	Fiberglass + PolyButylene Terephthalate (Thermoplastic)	 Short Fiber Distribution	Injection Molding
4. Urethane 420 IMR-T300	Carbon + Urethane (Thermoset)	 Discontinuous Long Fiber	Prepreg
5. AS4-8852-HexMC	Carbon + Epoxy (Thermoset)	 Discontinuous Long Fiber	Prepreg (SMC)
6. TR-50S-Nylon-6	Carbon + Polycaprolactam (Thermoplastic)	 Discontinuous Long Fiber	Compression Molding
7. MuCell (PA-6)	None + Poly Amide-6 (Thermoplastic)	 Discontinuous Long Fiber	Injection Molding
8. ABS-CF13	Carbon + ABS (Thermoplastic)	 Short Fiber Distribution	FDM BAAM
9. GNP-Inclusion	Graphene + Epoxy (Thermoset)		
10. Filled ULTEM 1010	Carbon + ULTEM 1010 Resin (Thermoplastic)	 Short Fiber Distribution	FDM

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