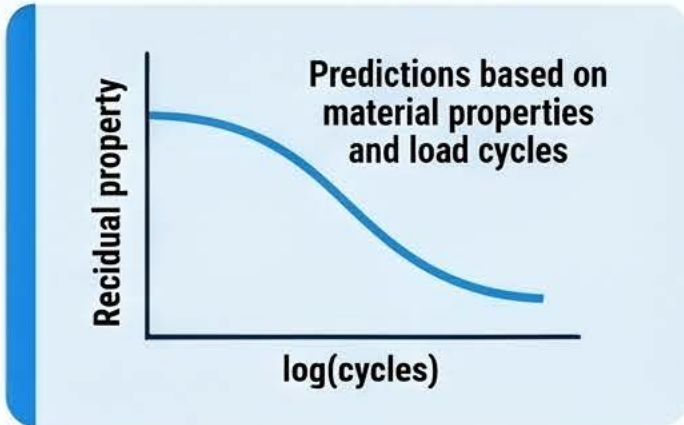


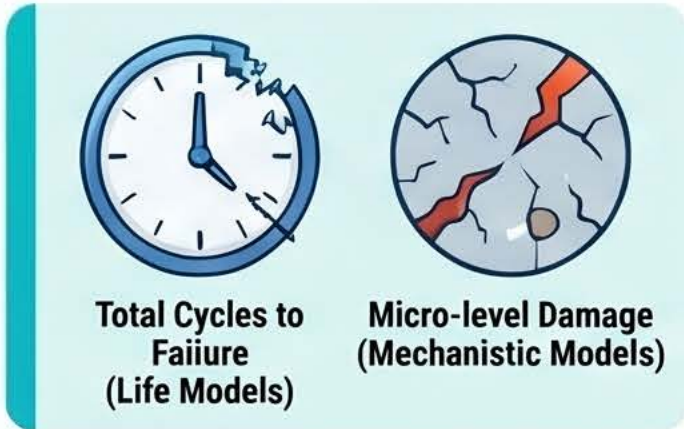
Modelling the Decay: Fatigue Damage in Polymer Composites

Categories of Fatigue Models



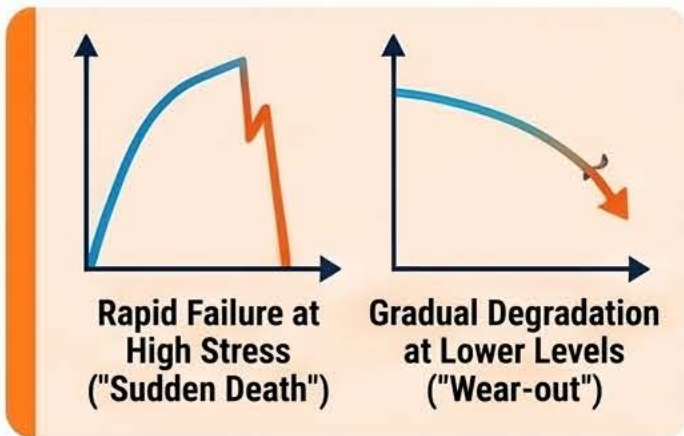
Phenomenological Models (Strength & Stiffness)

These link material properties directly to the number of loading cycles for structural predictions.



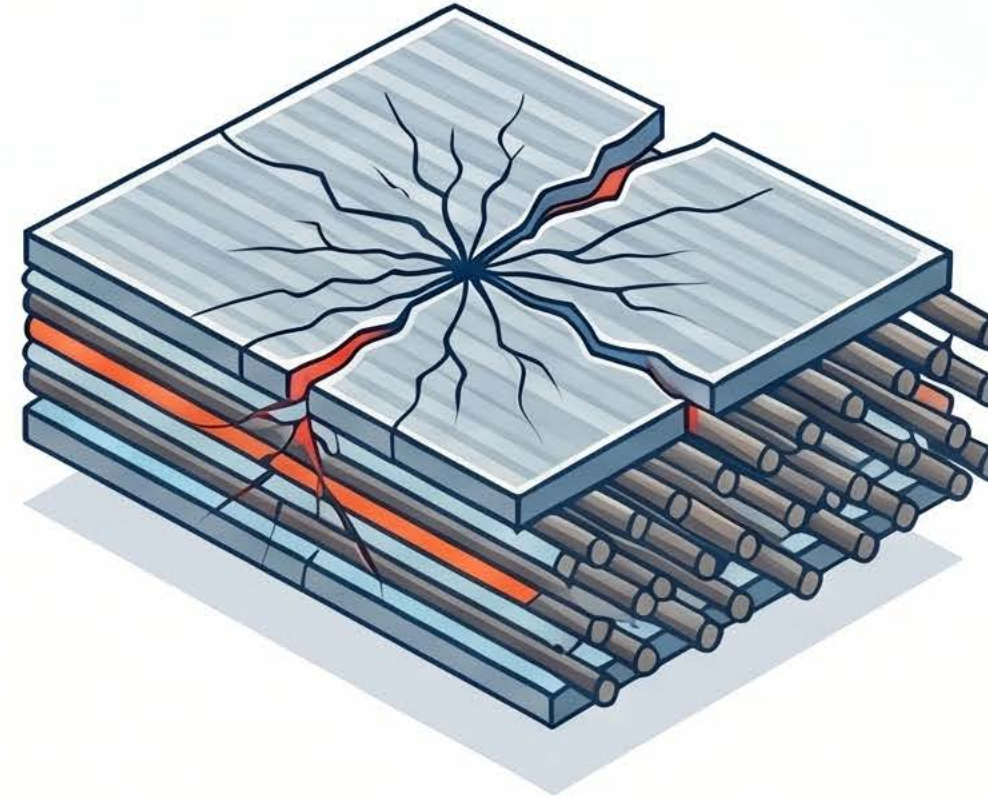
Fatigue Life vs Mechanistic Models

Life models predict total cycles to failure, while mechanistic models track micro-level damage.

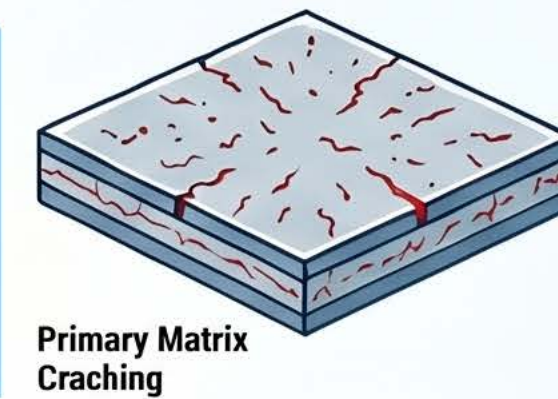


Strength "Sudden Death" vs "Wear-out"

Models distinguish between rapid failure at high stress and gradual degradation at lower levels.



The Three Stages of Degradation

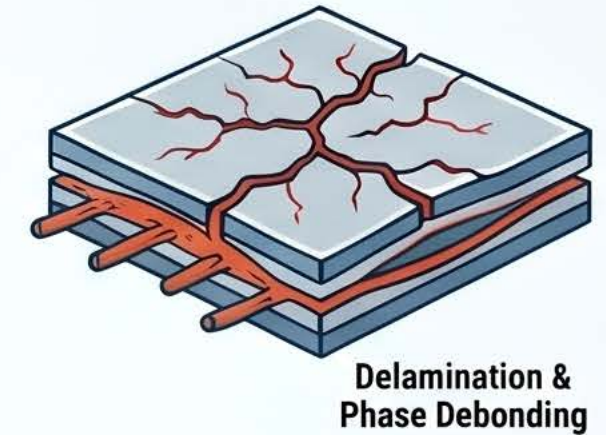


Stage 1: Initial Rapid Decay

A sharp decrease in properties occurs early due to primary matrix cracking processes.

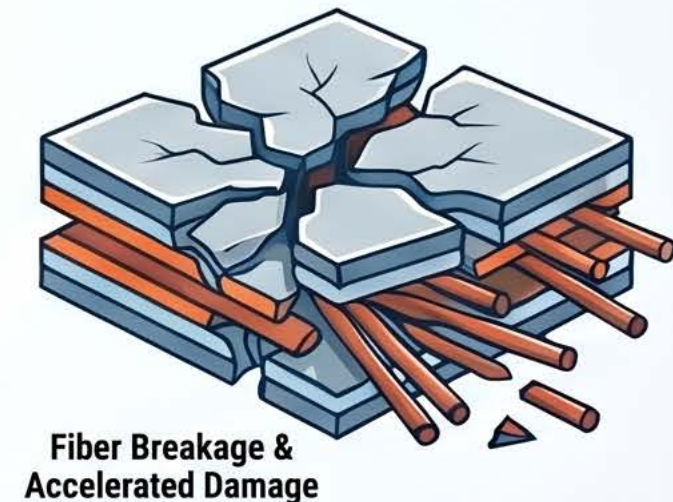
Stage 2: Gradual Accumulation

A slow, linear decrease as delamination and phase debonding develop over time.



Stage 3: Final Macro-Failure

Accelerated damage accumulation and fiber breakage leading to final structural collapse.



Data Table: Mathematical Damage Functions

Function Type	Typical Application	Descriptive Ability
Polynomial / Power Law	General degradation	Best for 2-stage (accelerated or decelerated) curves
Exponential	Stiffness / Strength	Excellent for decelerated damage and endurance limits
Advanced Combinations	Multi-stage analysis	Capable of describing complex 3-stage "fast-slow-fast" patterns