

# Optimising 3D-Printed Hybrid Composites: The Role of Fibre Architecture

Continuous carbon fibre (CCF) layup angles and matrix materials determine the tensile strength and stiffness of FDM printed parts.

## Fibre Alignment & Layup Strategy

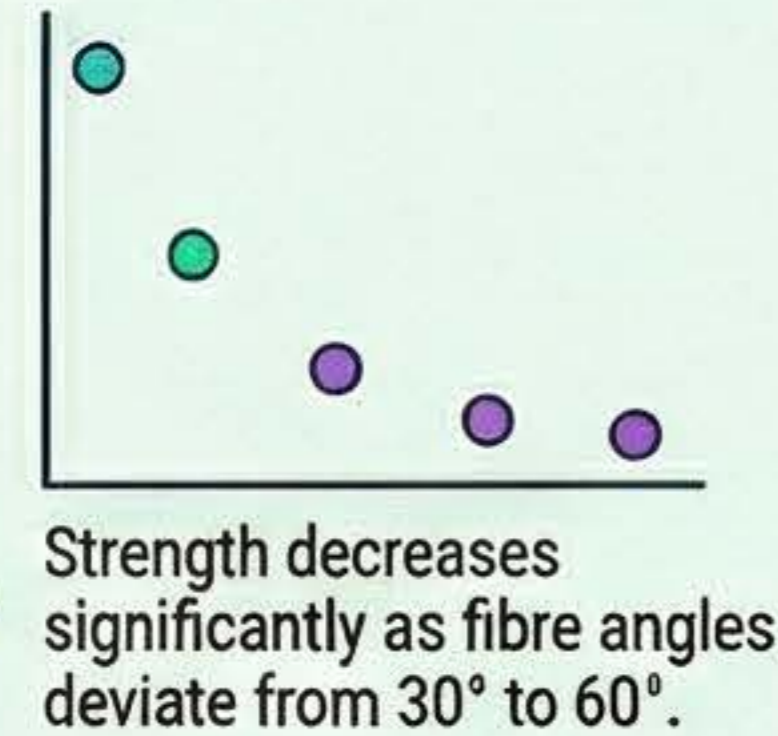
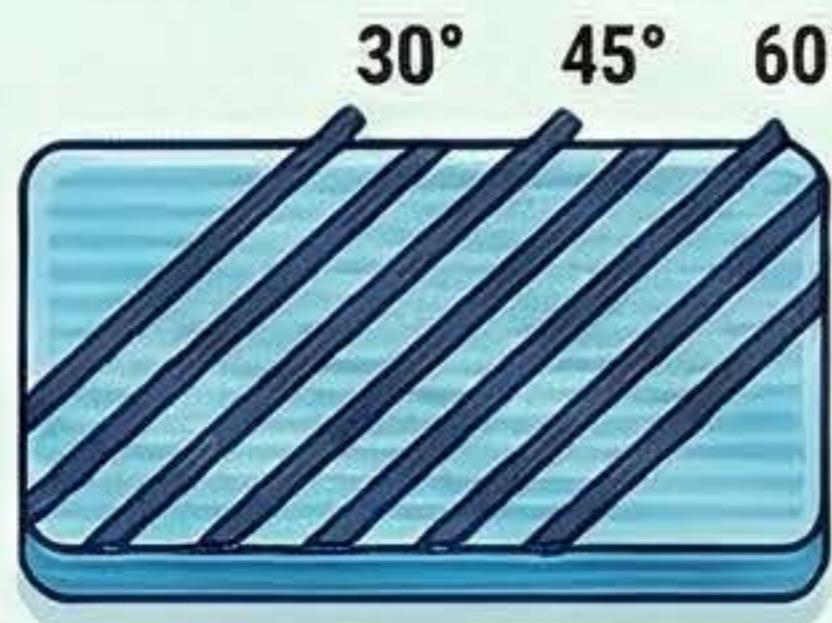
### Axial Alignment is Critical

Continuous carbon fibres

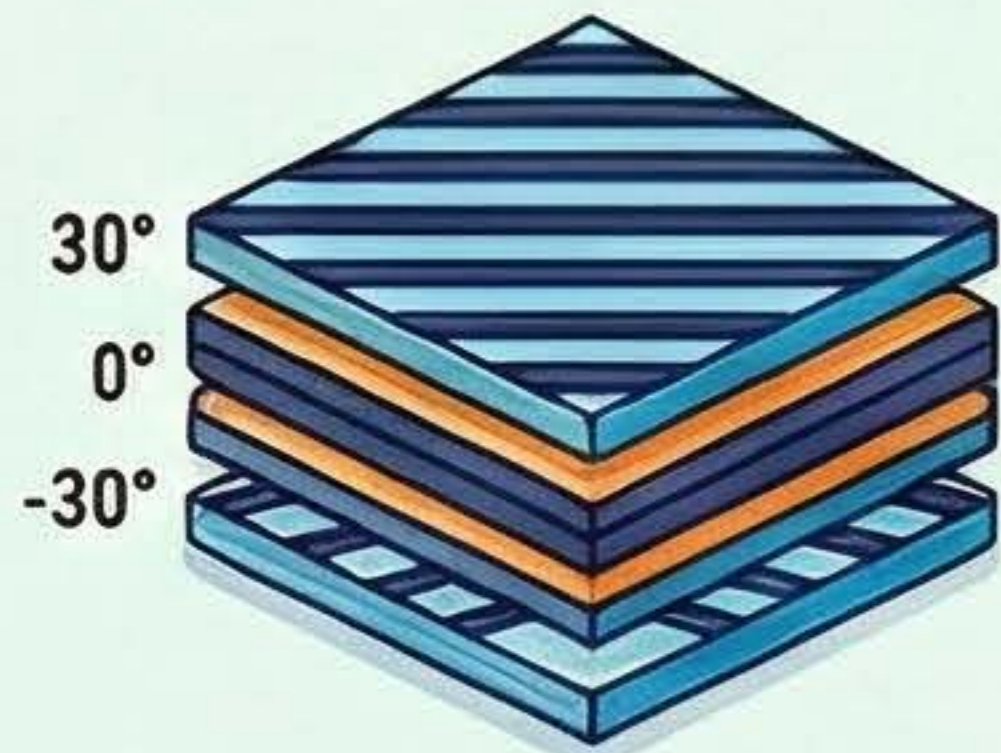


Fibres aligned at 0° to the load direction maximise stiffness and tensile strength.

### Dramatic Drop in Off-Axis Strength

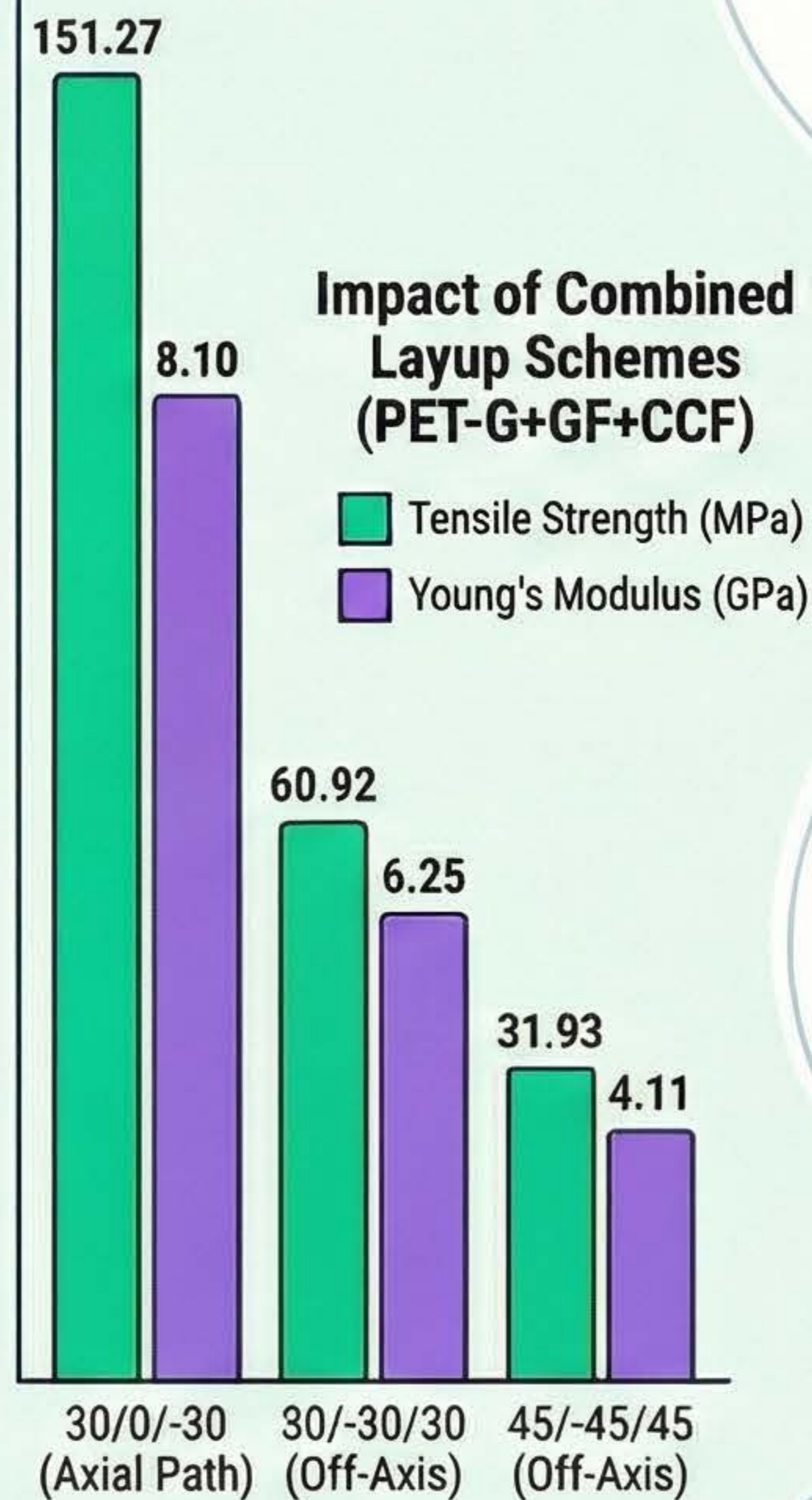


### The Superior 30/0/-30 Scheme



Combined layups with a 0° axial layer consistently outperform all off-axis configurations.

### Impact of Combined Layup Schemes (PET-G+GF+CCF)



## Material Selection & Failure Mechanics

### Matrix Controls Ductility

PA12 (Highest Ductility)



PA12 offers the highest ductility.

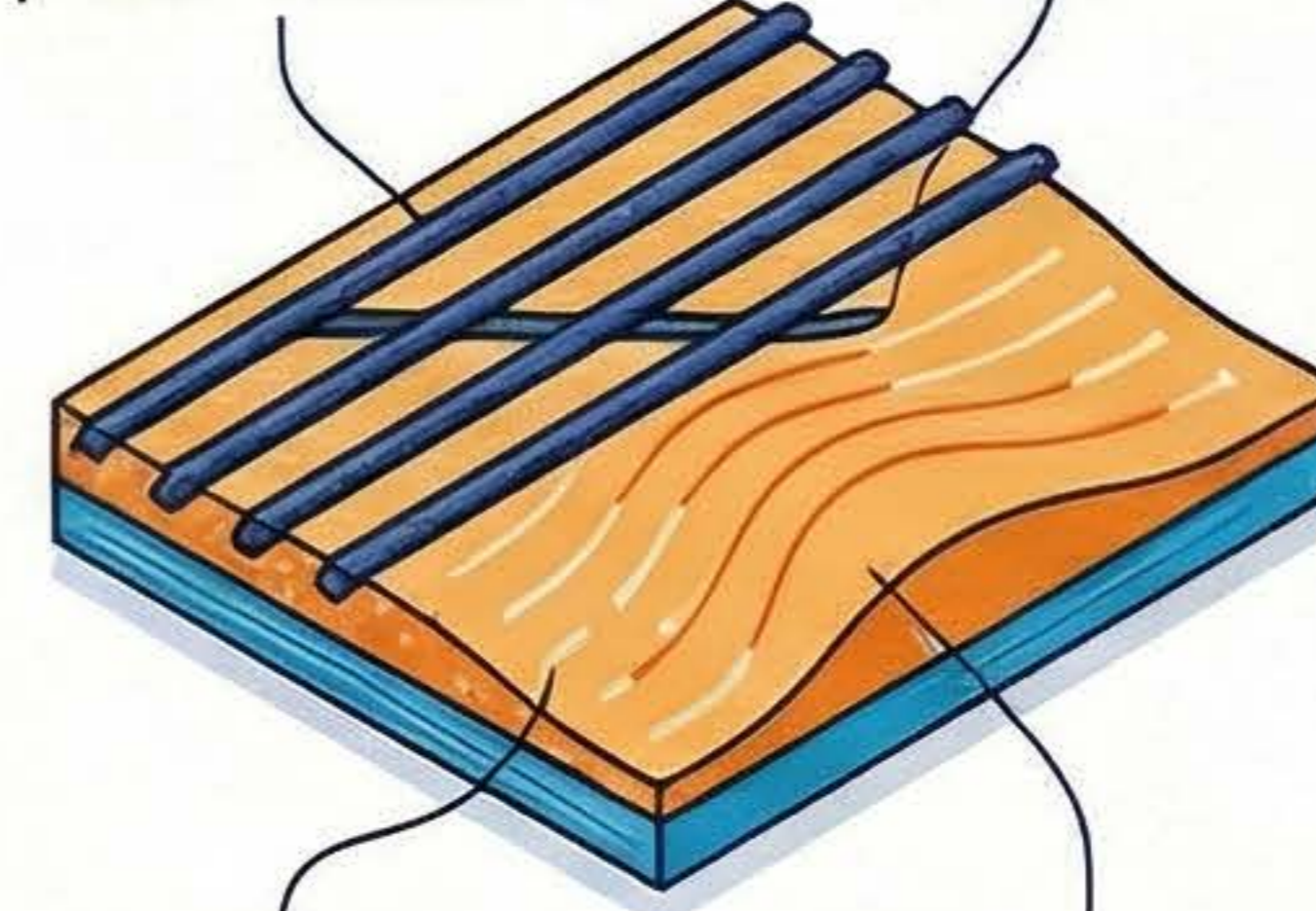
ABS (Brittle)



ABS results in brittle, sudden failure.

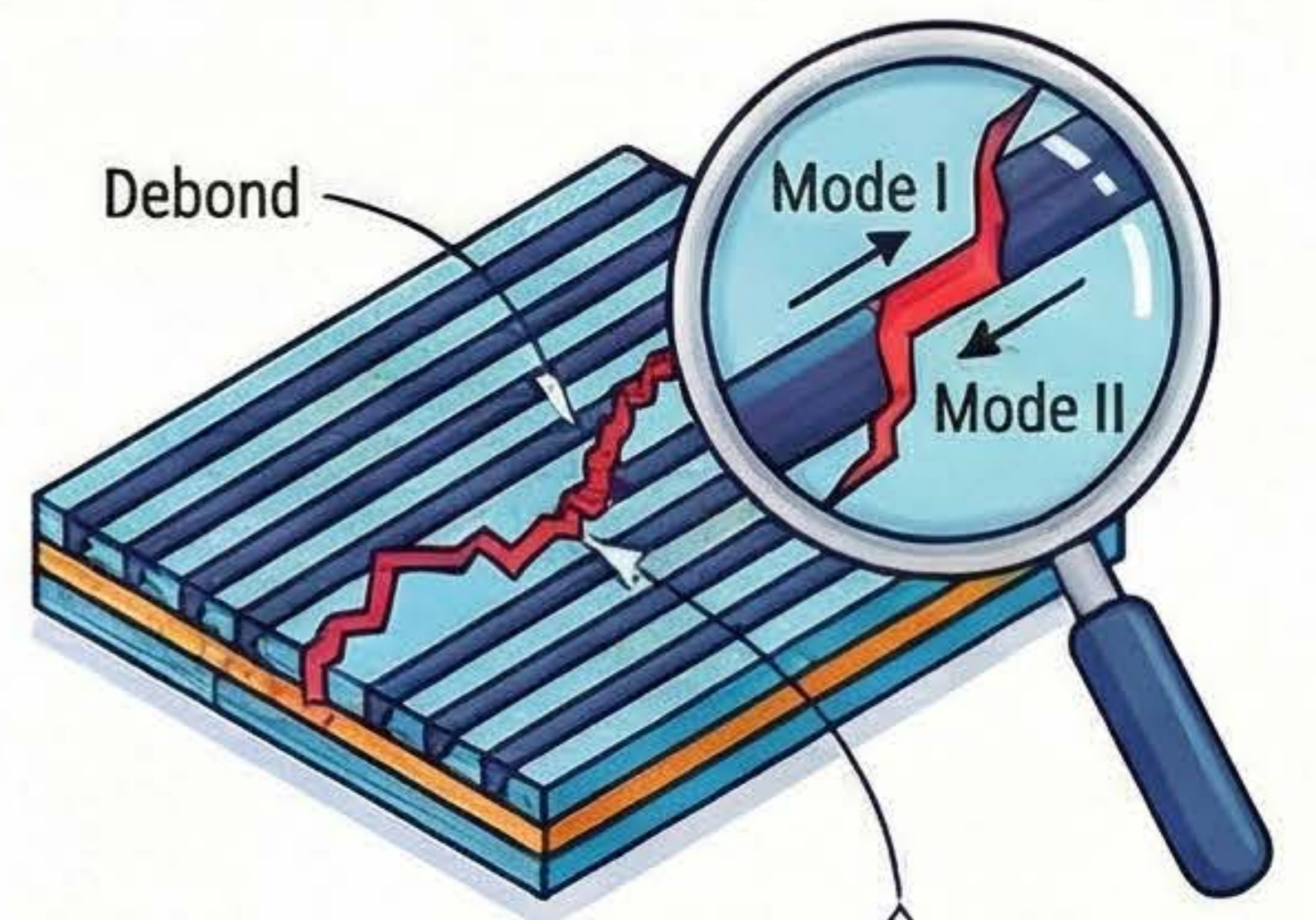
### Hybrid Framework Dynamics

Continuous fibres provide stiffness. Matrix governs final strain-at-failure.



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### Mixed-Mode Fracture Trajectory



Cracks follow fibre paths, resulting in combined Mode I and Mode II failure.