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Static and Fatigue Behavior of Composite Hybrid Joints

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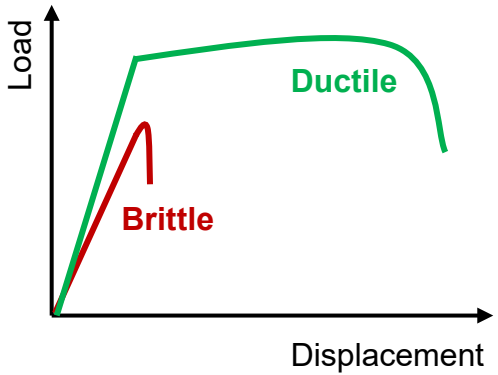
Outline

- Background and motivation
- Static behavior
- Fatigue behavior
- Conclusions

Background and motivation

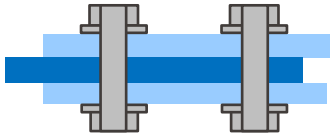
- Higher joint efficiency can improve utilization of composite materials
- Ductile joints can provide system ductility for composite structures
- Resistance (100% capacity) and ductility improvement is required in composite joints



Bonded joint

Nonuniform shear stress

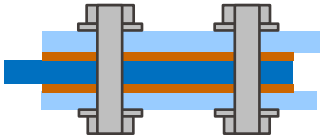
Flexible adhesive



Bolted joint

UD-dominated fiber architecture

MD fiber architecture



Hybrid joint

No load sharing

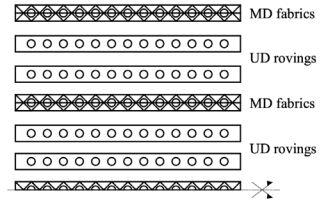
Deformation consistency

Investigation of static and fatigue behavior of ductile hybrid joints is relevant

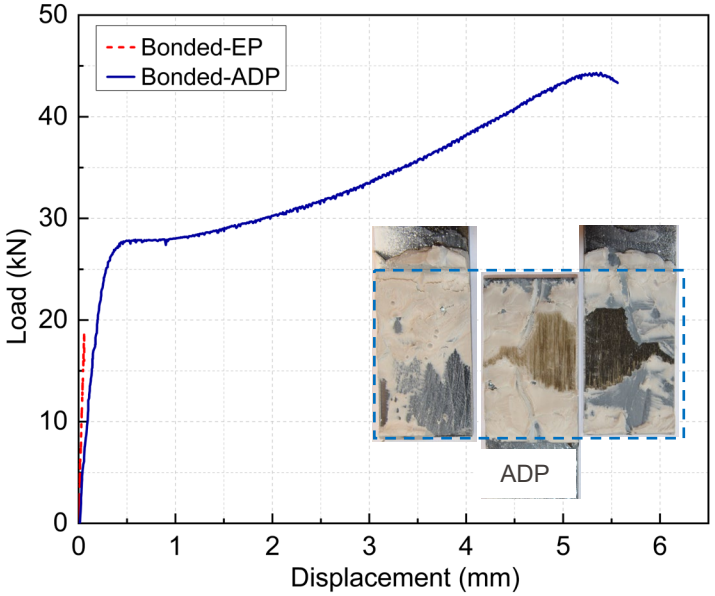
Static behavior

Materials

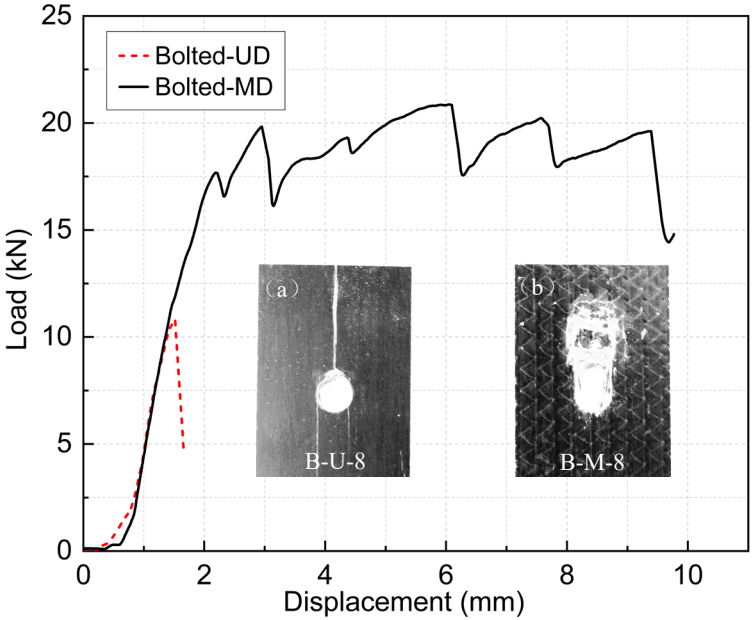
- Adherends: Pultruded unidirectional (UD) and multidirectional (MD) laminates
- Adhesives: Ductile acrylic (ADP) & brittle epoxy (EP)



MD fiber architecture



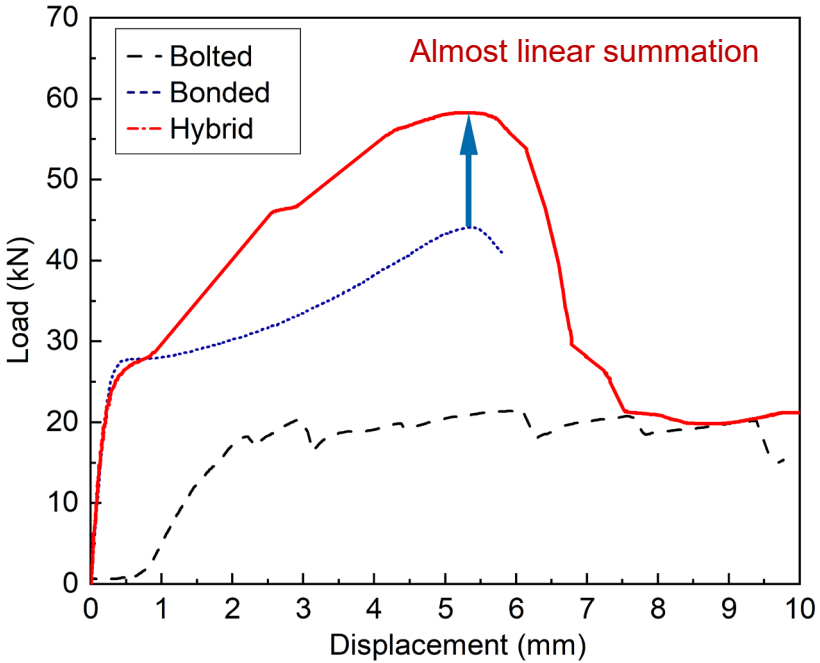
Load vs. displacement of EP and ADP **bonded** joints

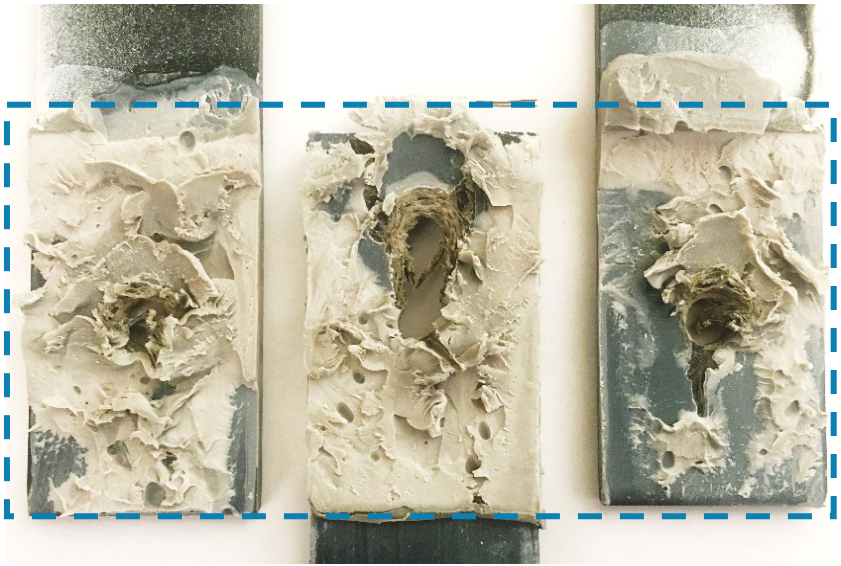


Load vs. displacement of UD and MD **bolted** joints

Static behavior

Hybrid joints

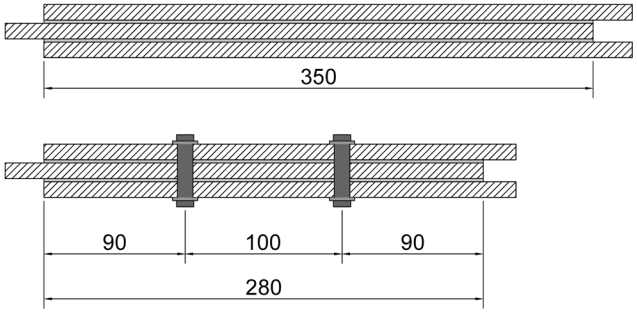




Failure mode of hybrid joint

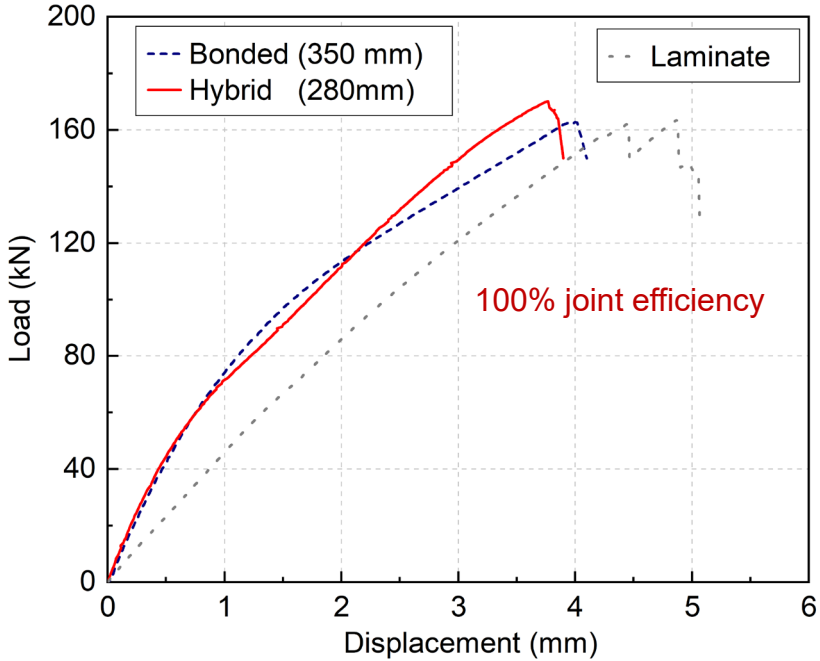
Load vs. displacement of bolted, ductile bonded and hybrid joints

Static behavior



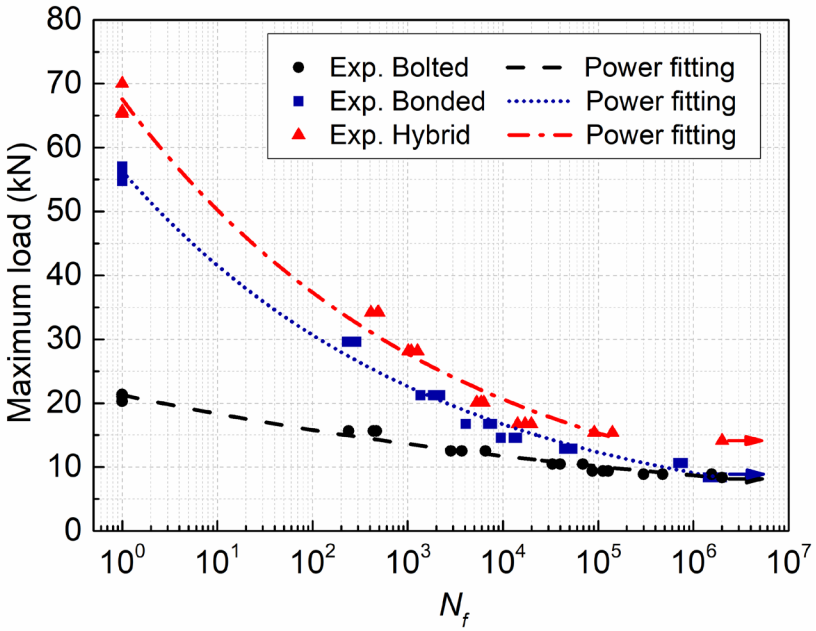
Dimensions of bonded and hybrid joints

Failure modes of (a) bonded and (b) hybrid joints

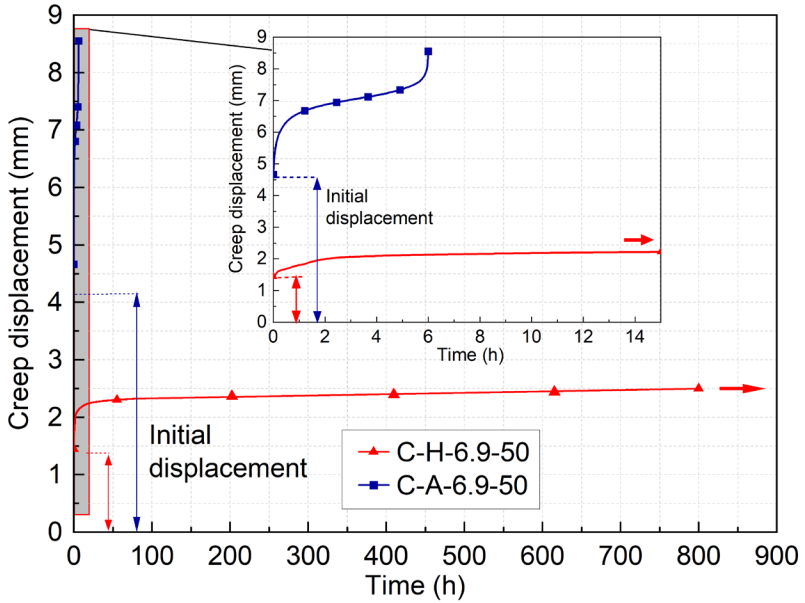


Load vs. displacement of bonded, hybrid joints and laminates

Fatigue and creep behavior



Fatigue life of bonded, bolted and hybrid joints



Creep behavior of bonded and hybrid joints

Conclusions

- MD bolted joints significantly increased the joint resistance and deformation capacity compared to the unidirectional cases; ADP bonded joints exhibited a highly ductile response compared to EP cases.
- The static resistance of ductile hybrid joints corresponded to almost the full summation of the resistances of the bonded and bolted connection parts, and showed high ductility.
- The 100% joint efficiency was reached both in bonded and hybrid joints with the failure occurring in laminates.
- The fatigue resistance of hybrid joints was much improved compared to that of bonded and bolted joints due to the load sharing behavior. The creep in adhesive was hindered by bolts in the hybrid joints.

Many thanks for your attention !

Any questions?

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