Strength Evaluations for Stitched CFRP Laminates

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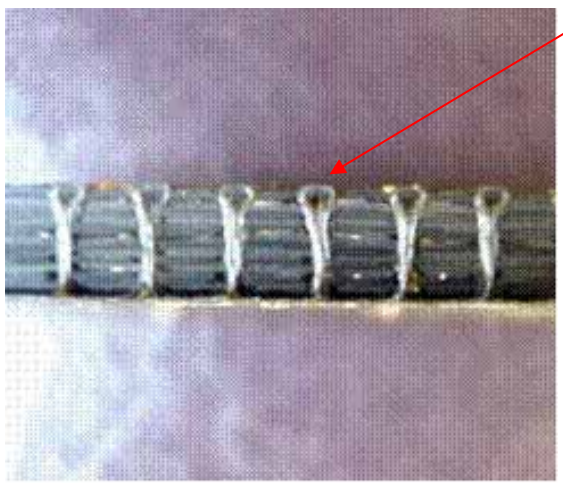
Introduction

- **Stitching is one of the interlaminar strength improvement technique.**
- **Reinforcement of through-the-thickness direction**

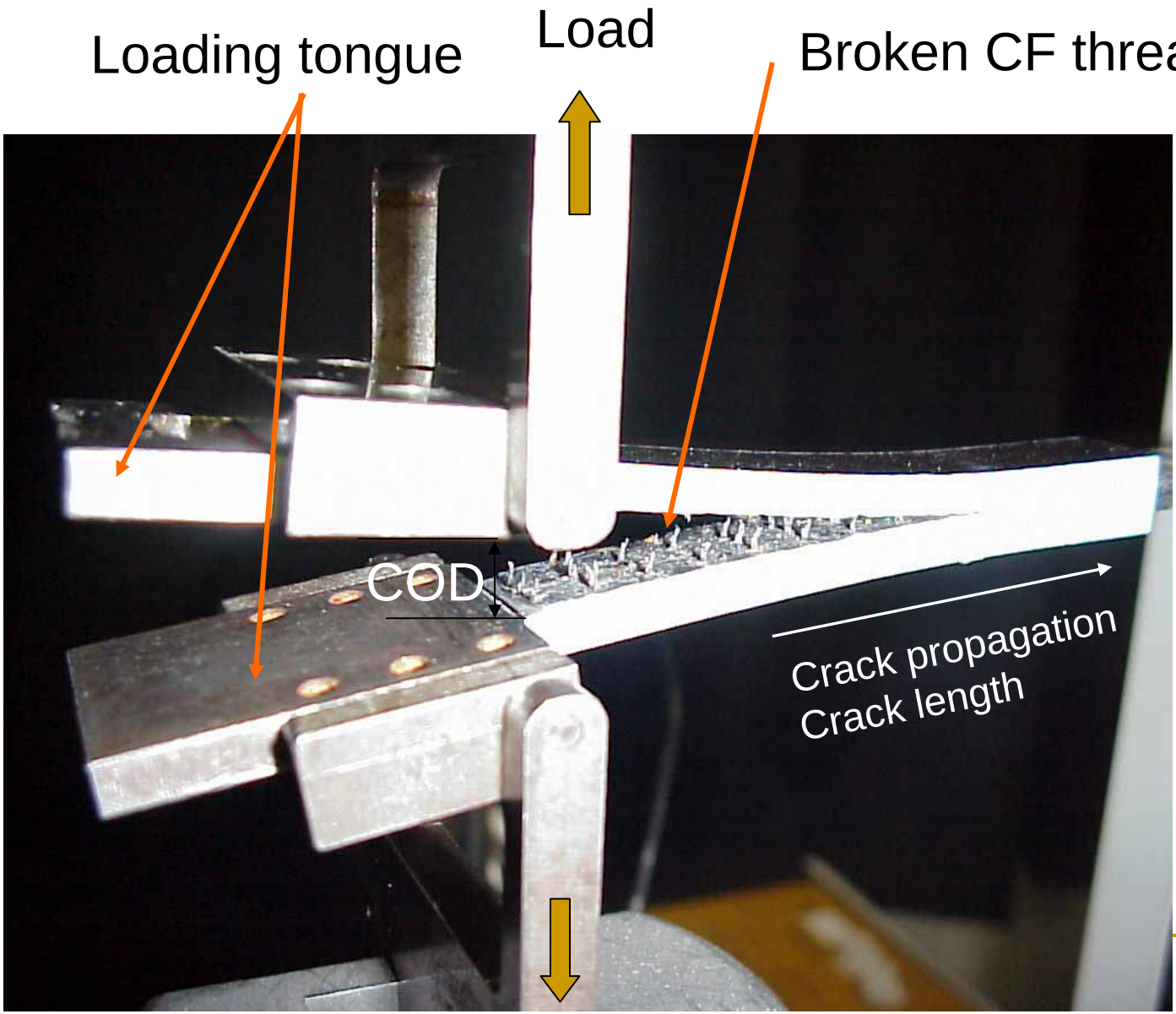


Sectional cut of the CFRP
On the stitch line

Interlaminar strength UP
+
Low cost consolidation
*RTM (resin transfer molding)
*RFI (resin film infusion)
+
Near net shape dry preform tech.

Carbon fiber stitched : DCB,CAI, OHC,DNS

DCB test



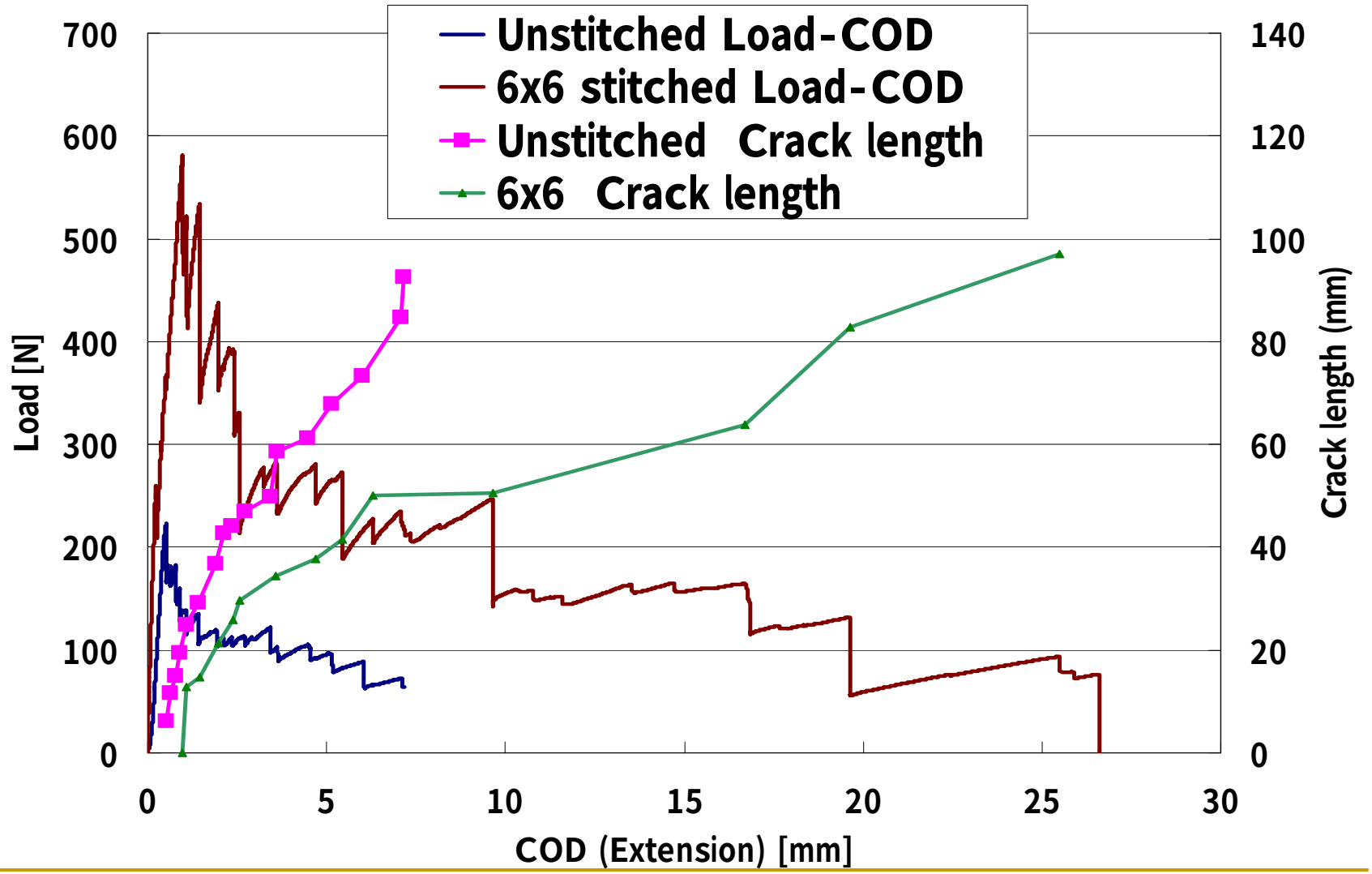
INSTRON 5500R

Displacement
Control mode

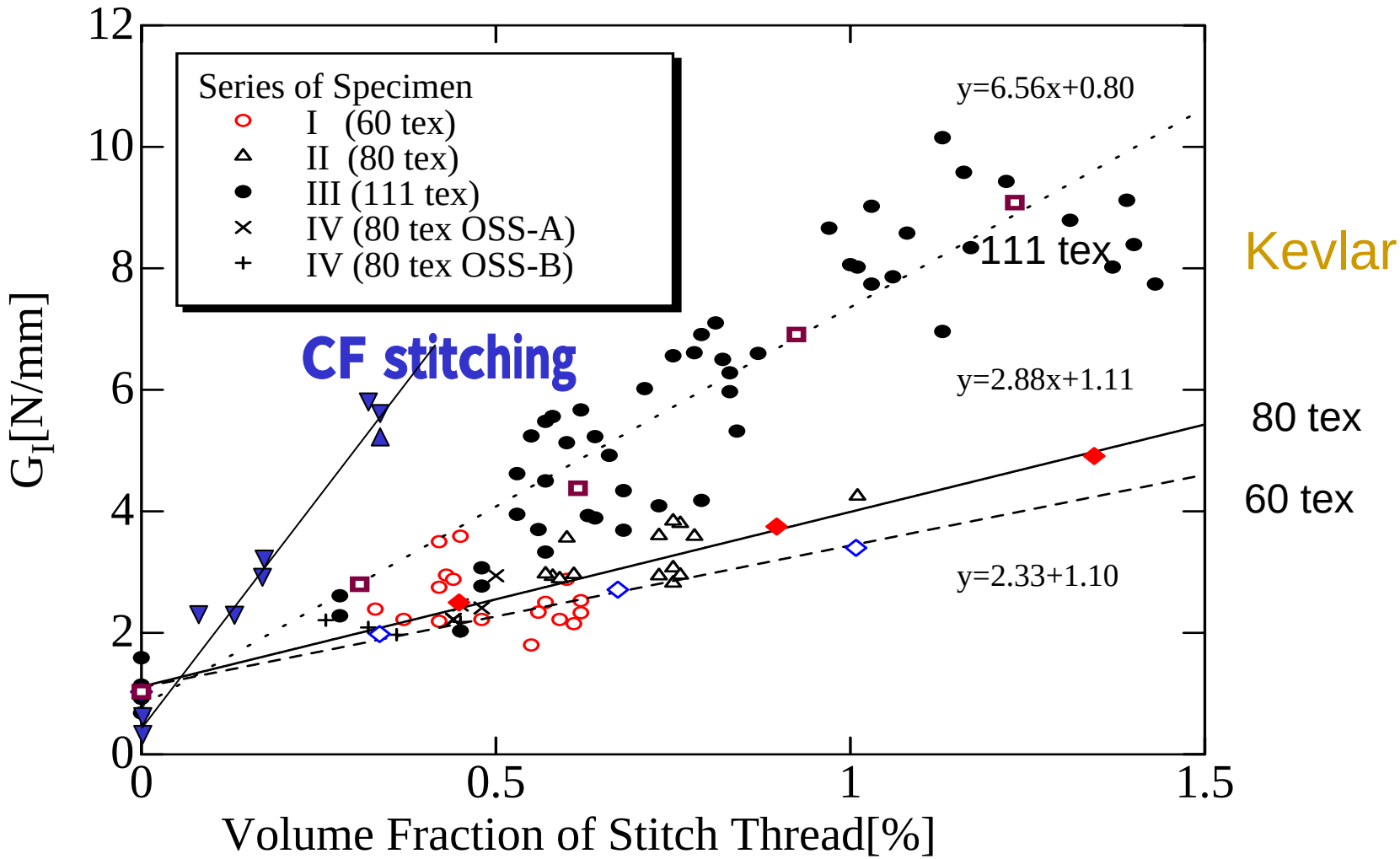
Test speed
0.25 mm/min

Load-COD
Crack length

Typical Load-COD curve

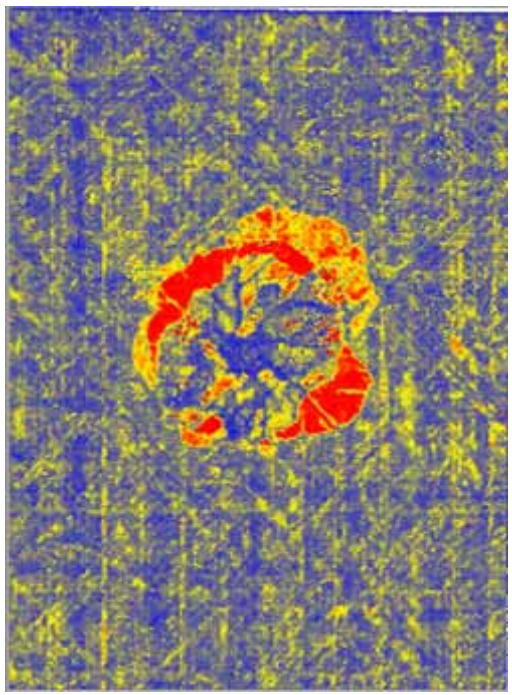


Relationships between G_I and Vft

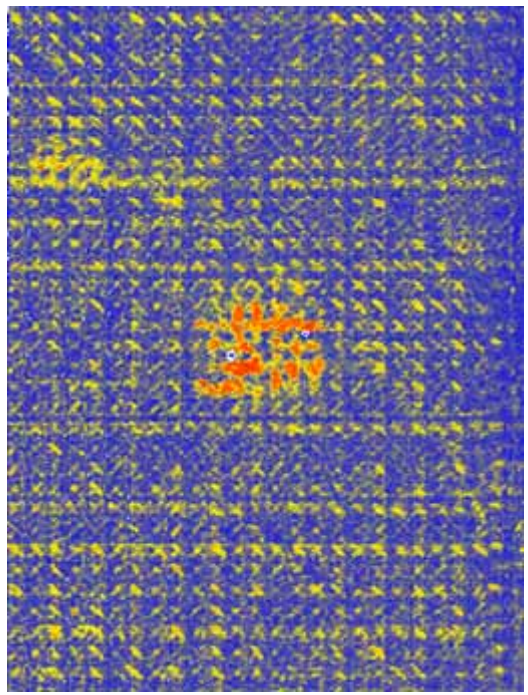


Experimental data

C-Scanning images of Half-SACMA specimen after impact (typical)



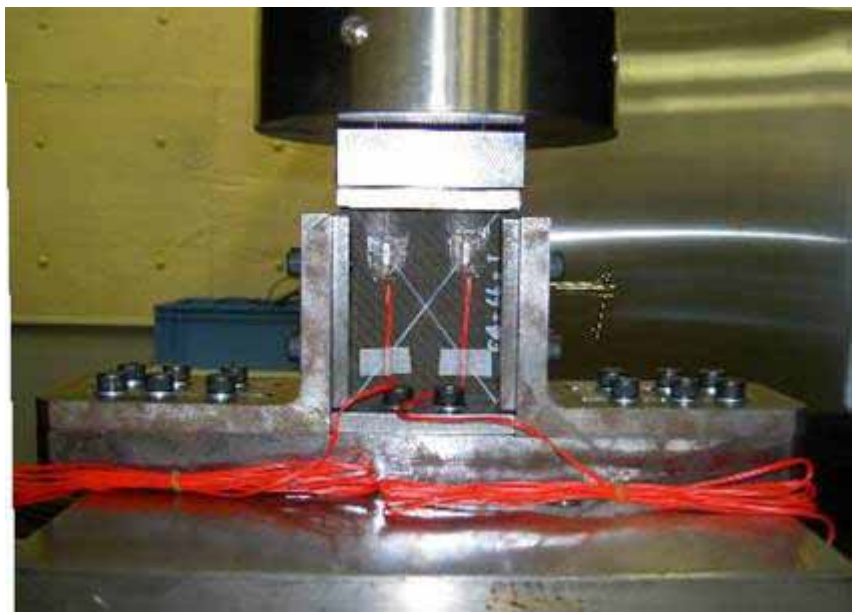
(a) Unstitched



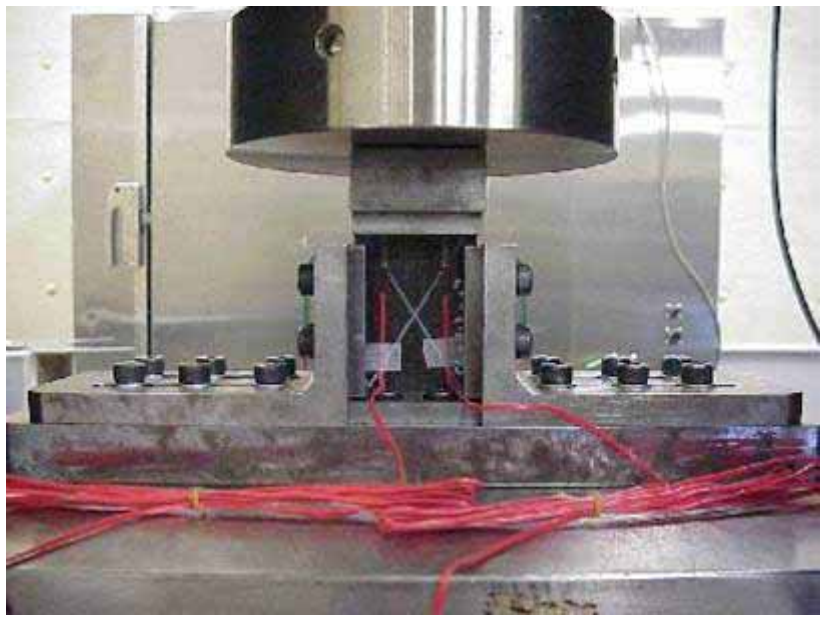
(b) 3x3 stitched

After impact of 10.7 J

CAI Strength test



H-SACMA CAI test

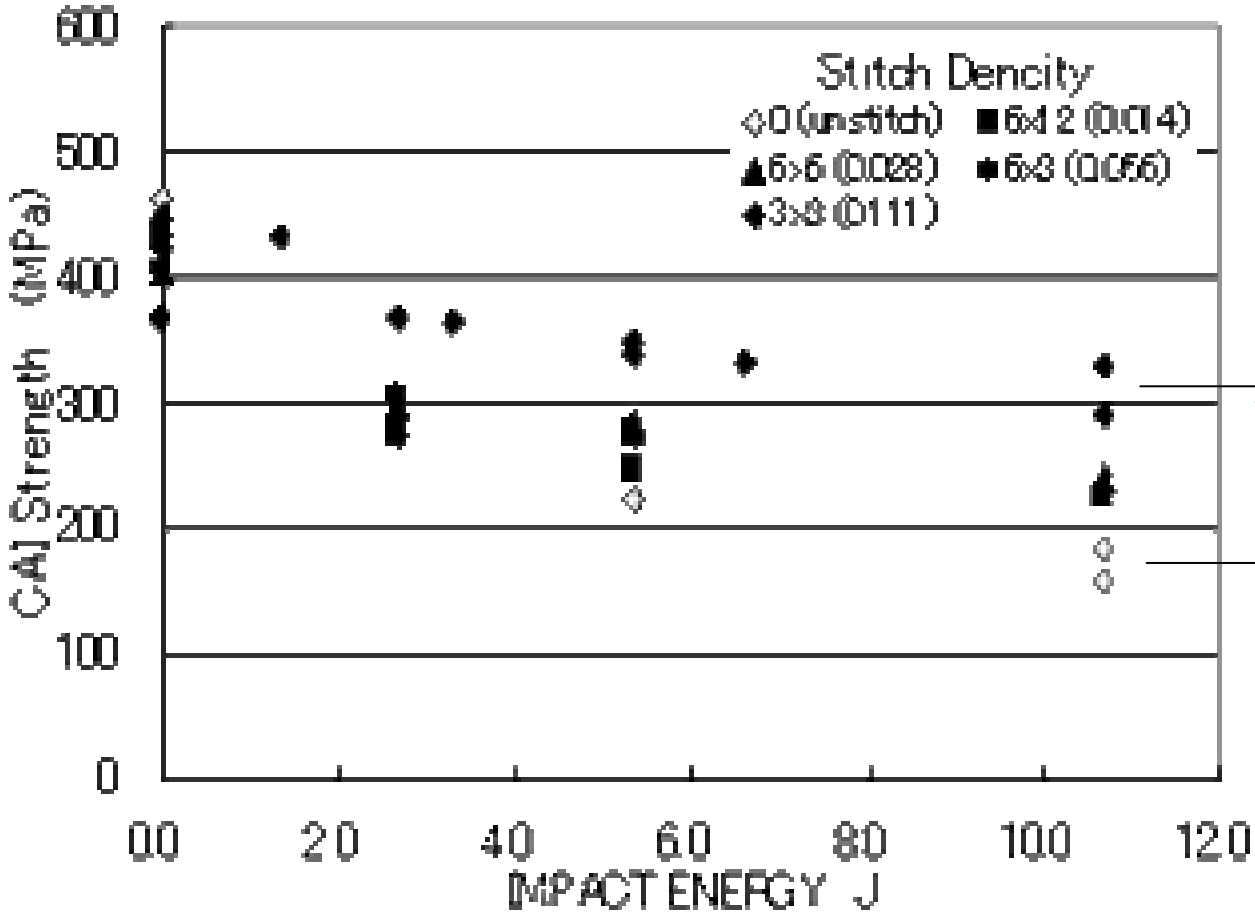


JIS R CAI test

INSTRON 4500R/1128 screw driven testing machine
Test speed : 1.0 mm/min

After strength test ➡ C-Scanning

Relationships between CAI strength and Impact energy levels



3x3

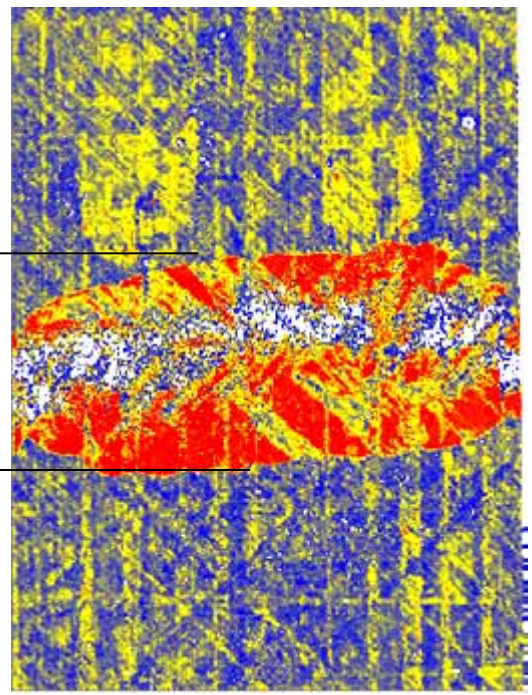
improved

Unstitched

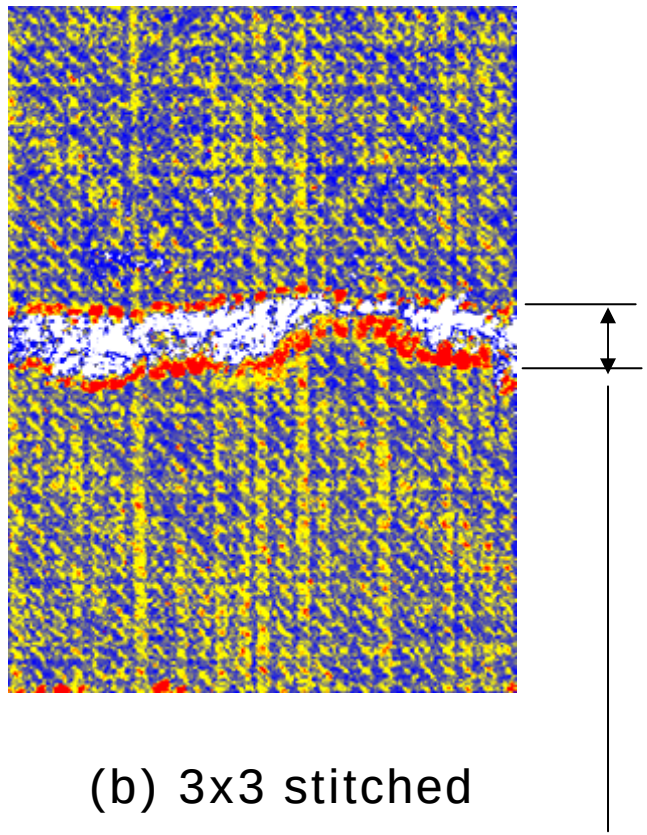
L series

CAI strengths are improved when stitch densities are increased.

Fracture damage in H-SACMA after CAI strength test (5.34 J)



(a) unstitched



(b) 3x3 stitched

Fracture damage area is small and arrested to the loading direction by CF stitching.

CONCLUSION

1) CF stitching causes on G_{IR} improvement more so than V_{ft} Kevlar stitching.

2) CF stitching affect to prevent dynamic impact damage propagation of CFRP laminates.

3) CF stitching affect to improve compression after impact strength of CFRP laminates.

4) Fracture damage propagation after CAI test is arrested by CF stitching, and the final fracture mode in a CAI strength test specimen is changed by CF stitching.

5) CF stitching does not affect shear strength improvement.

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