ADDITIVE EDGE BINDING LAYERS TO SUPPRESS FREE-EDGE DELAMINATION UNDER TENSILE LOAD

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An additive laminate applied to the free-edges of cured composite laminates was used for stopping delamination in laminates under tension. The solution was examined on an angle-ply substrate laminate (AP laminate) susceptible to delamination with a layup of $[(20_2/-20_2)]_s$. Numerical analyses were conducted to determine the effectiveness of this technique and the experimental results proved that the free-edge delamination was successfully suppressed.
A Python code for Abaqus 2019 was developed for calculating the interlaminar energy release rate (G) values for a range of pre-crack lengths at different interfaces of the AP laminate, when no binding was applied. The slice model technique proposed in [1], and represented in Figure 1, was used to achieve high accuracy while reducing computation weight. The interface with higher G values was determined to be the most probable to delaminate (critical interface).
The additive binding layup selected was $[\pm 45]_s$. Figure 2 shows a comparison of the G values at the critical interface for both cases with and without binding. The G was reduced by 70%. Experimentally, the tensile failure strain and load of the laminate were increased by about 50%. Thus, this technique suppresses delamination successfully.

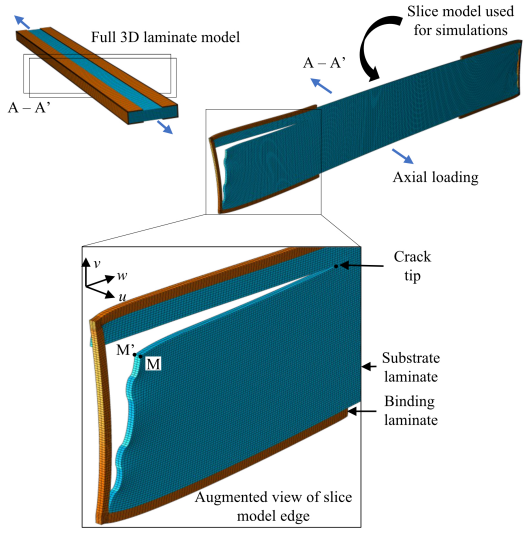

Figure 1: Slice model used with binding applied.

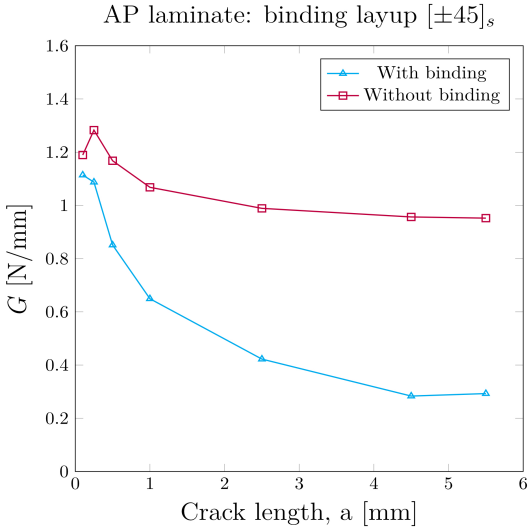

Figure 2: G versus crack length for AP laminate at the critical interface.

References

[1] W.G. Jiang, J.L. Henshall (2006) Analysis of composite laminate beams using coupling cross-section finite element method. *Applied Mathematics and Mechanics*, **27**, 1709–1718.