Is there a ply thickness effect on the mode I intralaminar fracture toughness?

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The problem

No effect

Increase of $G_{1+}$ with the ply thickness
The methods

Materials

T700/M21 UD tape

Experimental Methods

Test cross-plied geometrically similar notched specimens

Numerical methods

Complementary numerical analysis

Catalanotti et al. 2014

Size effect law

R-curve
The apparent intralaminar fracture toughness scales linearly with the ply thickness

- The fracture toughness associated with longitudinal failure was determined for 3 different ply grades.

- The apparent intralaminar fracture toughness scales linearly with the ply thickness;

- This increase is related to the appearance of split cracks near the notches;
Simulation of the notched samples shows that the fracture toughness is constant.

**H1:** The intralaminar fracture toughness is not thickness dependent

**H2:** The intralaminar fracture toughness is thickness dependent

**Thin (75 gsm):**
- Accurate (~ 7% error)

**Thick (268 gsm):**
- Accurate (~ 10% error)
- Overestimation (~35% error)
Simulation of the notched samples shows that the fracture toughness is constant

**H1**: The intralaminar fracture toughness is not thickness dependent

Thin (75 gsm)

- $G_{14} = 83 \text{N/mm}$
- $\sim 7\%$ error

Thick (268 gsm)

- $G_{14} = 83 \text{N/mm}$
- $\sim 10\%$ error
Conclusions

• The apparent intralaminar fracture toughness scales linearly with the ply thickness.
• This increase is related to the appearance of split cracks near the notches.
• The intralaminar fracture toughness used in mesomodels should not be scaled with the ply thickness.