INTRODUCTION

Usually, no difference between tensile and compressive modulus is considered in the analysis of bending of unidirectional composites, in spite of tensile and compressive tests bring different values of modulus.

In the present work, considering the difference between modulus, an experimental method in order to obtain tensile, compressive and flexure modulus using bending tests is proposed.

$E_t$: Tensile modulus  
$E_c$: Compressive modulus  
$E_f$: Flexure modulus

According to Classical Beam Theory:

Provided that resultant force is 0

$$\int \sigma dA = 0 \Rightarrow \begin{cases} h_1 = \frac{h}{1 + \sqrt{\lambda}} \\ h_2 = \frac{h}{1 + \sqrt{\lambda}} \end{cases}$$

Provided that resultant moment is $M$

$$\int \sigma y dA = M \Rightarrow \begin{cases} E_t \lambda \rho \varepsilon_t = \frac{P}{2} \\ E_c \rho \varepsilon_c = \frac{P}{2} \end{cases}$$

Where:

- $\varepsilon_t$: Strain in the outer face (tensile)
- $\varepsilon_c$: Strain in the inner face (compressive)
- $\rho$: curvature radius
- $P$: resultant force
- $M$: resultant moment

Experimental Procedure

As long as for the same load $P$ the curvature radius is the same, $\lambda$ and $\beta$ are obtained.

Flexure modulus $E_f$ is determined in the same specimen from the slope of load-displacement curve of a 3-point or 4-point bending test.

Having determined $E_f$ and knowing $\beta$, $E_t$ is calculated.

Finally, knowing $E_t$ and $\lambda$, $E_c$ is calculated.

<table>
<thead>
<tr>
<th>Material</th>
<th>Strain gage position</th>
<th>$P/N$</th>
<th>$E_t$ (MPa)</th>
<th>$E_c$ (MPa)</th>
<th>$E_f$ (MPa)</th>
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<tr>
<td>AS4/3501-6</td>
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REFERENCES