Intricate Multiscale Mechanical Behaviors of Natural Fish-Scale Composites

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25.2 The Hierarchical Structure of Fish Scales

25.3 Tensile Testing of Individual Scales

Morone saxatilis

$$E_S = - \; E_C + E_B$$

E_C E_B

$$E_B = \; E_S - E_C$$

Figure 25.5

Figure 25.6

25.5 Analytical Model

σ_Y =

f_n^L

f^L

φ

$$U = EI\frac{\partial}{\partial s}\ \varphi - \varphi\ + g\ s\ =$$

E I φ s g

$$g\ s\ = w \blacklozenge F + \alpha F \cdot P\ - m$$

$\blacklozenge$ $w \blacklozenge F = w_x F_y - w_y F_x$

w $P =$ $-$ φ φ φ φ

F f^L f^R m s

$$m\ = m^D \quad m = \quad x$$

α G E A

$$\alpha = - \frac{}{EA} - \frac{}{GA}$$

$\varphi = \varphi\ s$ $x = x\ s\ , y\ s$

$$x\ s\ = x\ + \int^{s} q\ \varphi\ \xi\ d\xi$$

q φ

$$q \quad \varphi \quad = w + P \quad \cdot F$$

$P \quad = \quad \beta + \alpha \quad \varphi \ \alpha \quad \varphi \quad \alpha \quad \varphi \quad \beta + \alpha \quad \varphi \quad \beta \quad = \quad -$

$\overline{EA} + \overline{kGA}$

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m^D

$$m^D = K^D \left(\theta^S - \theta^D\right) = K^D \theta^S$$

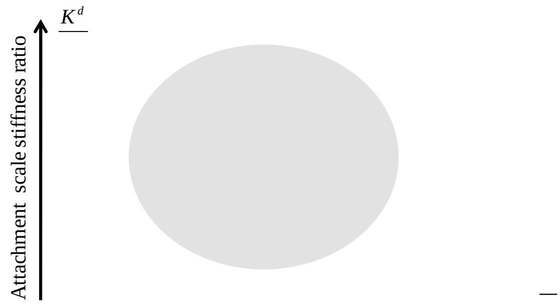
θ^D θ^S K^D θ^D

25.6.2 *Results*

$\kappa/l \approx$ t GA/EI $/t$

Figure 25.9 $\kappa/l \approx$

25.7 Conclusions


Attachment scale stiffness ratio
K^d

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