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

[illegible] *Morone saxatilis* [illegible]

$$E_S = - \ E_C + E_B$$

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

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

E I φ s g

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

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

w $P = \; - \; \varphi \; \varphi \; \varphi \; \varphi$

F f^L f^R m s

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

α G E A

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

$\varphi = \varphi \quad s$

$x = \quad x \quad s \quad , y \quad s$

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

q φ

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

P = $\beta + \alpha$ φ α φ / α φ $\beta + \alpha$ φ β = –

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

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m^D

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

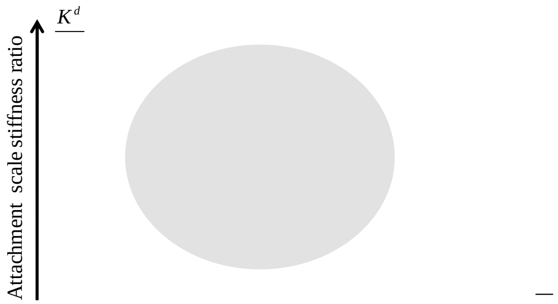
θ^D θ^S K^D θ^D

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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