

Some Answers to Energy Methods Problems:

4.5.3

$$(u_y)_{Center} = \frac{5qL^4}{768EI}$$

$$(\theta)_{Center} = \frac{7qL^3}{5760EI}$$

4.5.4

(a)

$$(u_x)_A = \frac{5QL^3}{3EI}$$

$$(u_y)_A = \frac{QL^3}{EI}$$

$$(u_z)_A = 0$$

(b)

$$(u_x)_A = 0$$

$$(u_y)_A = 0$$

$$(u_z)_A = \frac{4FL^3}{3EI} + \frac{2FL^3}{GJ}$$

4.6.5

$$(u_x)_A = \frac{\pi F_x R^3}{2EI}$$

$$(u_y)_A = \frac{\pi F_y R^3}{2EI}$$

$$\frac{(u_x)_A}{(u_y)_A} = \frac{F_x}{F_y}, \text{ so force and displacement are parallel}$$

$$k = \frac{F_{total}}{\Delta_{total}} = \frac{2EI}{\pi R^3}$$

4.7.7

$$T = \frac{F}{2 + \frac{6I}{5AL^2}}$$

4,7.12

$$M_{ends} = \frac{FL}{8} - \frac{2\beta EI}{L}$$
$$(u_y)_{center} = \frac{FL^3}{192EI} + \frac{\beta L}{4} \quad (down)$$

4.7.16

(a) axial force and bending moment at F are

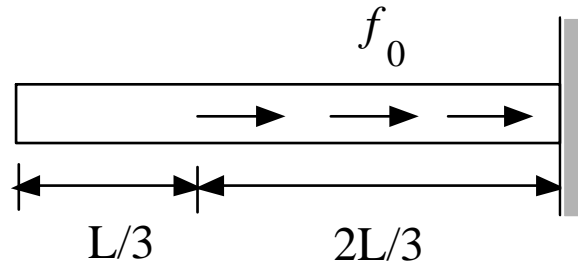
$$N = .2453 F$$
$$M = ,3073 FR$$

(b)

$$(u_y)_{at F} = 0.0704 \frac{FR^3}{EI} \quad (down)$$

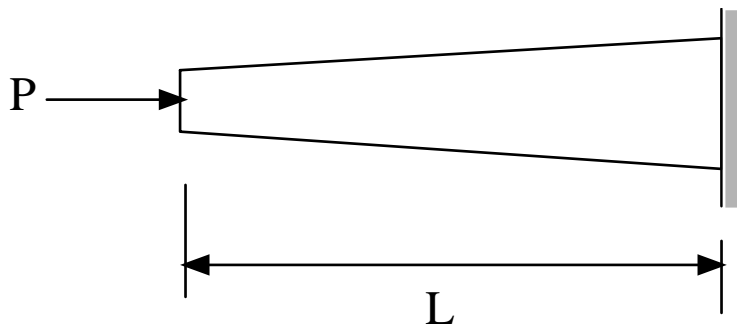
Finite Element Problems

1. The bar shown (cross sectional area A and Young's modulus E) is rigidly fixed at its right end and is loaded by a uniform body force f_0 (dimensions are force/unit volume) over two thirds of its length.



- Using three equal length constant strain finite elements, determine the displacement and stress throughout the bar
- Compare your results of (a) with the exact solution

2. The bar shown has a cross sectional area that varies linearly from A_0 at $x = 0$ to $2A_0$ at $x = L$.



- Using three equal length finite elements, determine the displacement and stress throughout the bar
- Compare your results of (a) to the exact solution