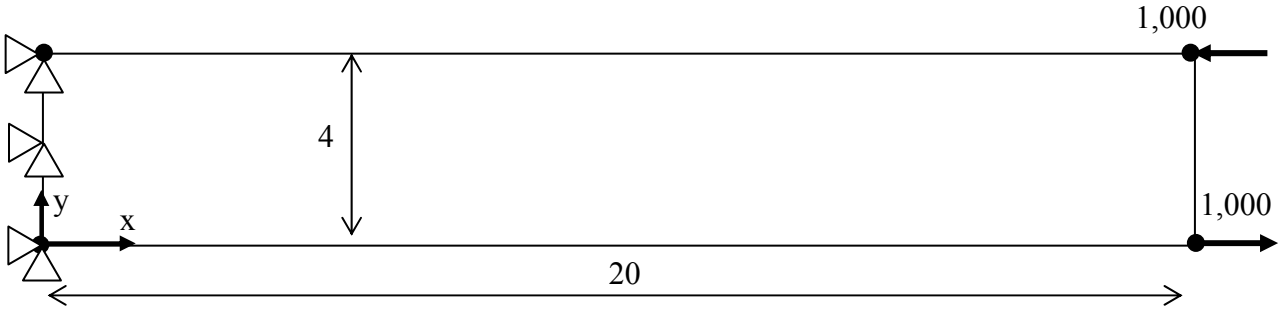
Mini-FEA Assignment 4.1.1

Comparison of FEA and Predictions of Bending Stress and Curvature

Geometry: Length = 20, Height = 4 (Diagram of modeled configuration on final page)
Material: E =30.0E6, ν = 0.3.
Mesh: 20 x 4 Quadratic Elements.
Loads:
Left end: All nodes at left end x = 0 (not just those shown in Figure) do not displace horizontally or vertically (U_x = 0, Uy = 0).
Right end: Fx = 1000 at (x,y) = (20,0); Fx = -1000 at (x,y) = (20,4)



FEA Results to Extract
- σ_x at (x,y) = (10,0), (10,1), (10,2), (10,3), and (10,4).
- Uy at (x,y) = (9,2), (10,2), and (11,2).

Analyses and Comparison with FEA Results

(i) Stress Comparison
- Enter FEA stress σ_x at points (10,0), (10,1), (10,2), (10,3), and (10,4) into tables.
- Use simple bending to predict stresses at these points, and enter into tables. Remember how y is defined in the bending stress formula $\sigma = -My/I$.

(ii) Curvature Comparison
- Enter FEA deflections at points (9,2), (10,2), and (11,2) into Table.
- Estimate the slope at x = 9.5 using [Uy(10,2) - Uy(9,2)]/(10 – 9). Enter into table.
- Estimate the slope at x = 10.5 using [Uy(11,2) - Uy(10,2)]/(11 – 10). Enter into table.
- Estimate the curvature at x = 10 using [Slope(10.5,2) - Slope(9.5,2)]/(10.5-9.5). Enter into Table.
- Predict the curvature from M/EI and enter into Table.

Results

(i) Stress Comparison

	(10,0)	(10,1)	(10,2)	(10,3)	(10,4)
σ_x (FEA)					
σ_x (-My/I)					

Show the individual terms for evaluating σ_x = -My/I

(i) Curvature Comparison

	(9,2)	(10,2)	(11,2)
Uy			

	(9.5,2)	(10.5,2)
Slope ($\Delta U_y/\Delta x$)		

	$\kappa = \Delta(\text{Slope})/\Delta x$	$\kappa = M/EI$
At x = 10		

Show the individual terms for evaluating κ = M/EI

The FEA analysis in this assignment models the following problem.