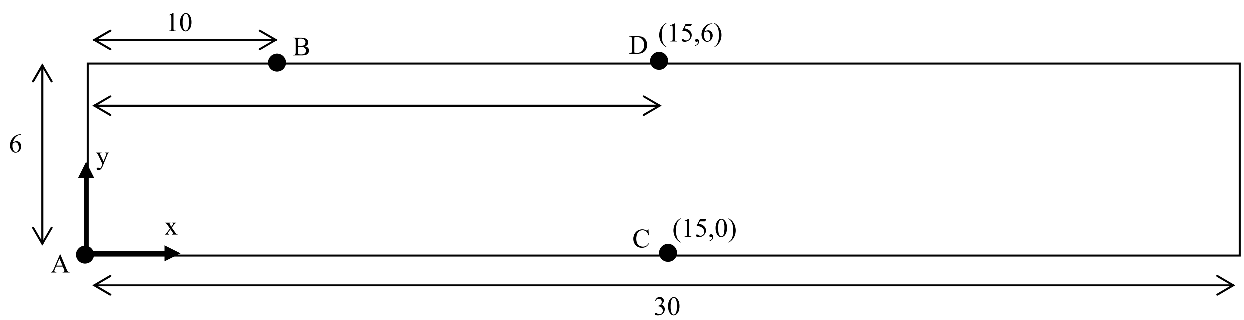
Comparison of FEA and Predictions Using Equations of SimpleAxial Loading

Geometry: Length = 30, Height = 6 (Diagram of modeled configuration on final page)
Material: E =20000, ν = 0.4.
Mesh: 30 x 6 Linear Elements.
Loads:
Left end: all nodes do not displace horizontally ($U_x = 0$); zero vertical force ($F_y = 0$) at all nodes, except center node (x,y) = (0,3), where vertical displacement is zero ($U_y = 0$).
Right end: two cases.

Case I. Fx = -6000 and Fy = 0 at the center node (x,y) = (30,3).

Case II. Net negative x-force of 6000, but distributed over the right end. Namely, Fx = -500 at (30,0) and (30,6), and Fx = -1000 at (30,1), (30,2), (30,3), (30,4), and (30,5); Fy = 0 on all nodes.



FEA Results to Extract
- σ_x at (x,y) = (15,1), (15,3), (29,1), and (29,3) for two Cases.
- Ux , Uy at points B, C and D in the figure above for Case II.

Analyses to Compare with FEA Results
(i) Stress Comparison
- Enter FEA stresses at points (15,1), (15,3), (29,1), and (29,3) for two Cases into tables.
- Use simple axial loading to predict stresses at these points, and enter into tables.
- At which points would you expect the FEA stresses σ_x for Cases I and II to agree reasonably well with each other and which not? Why? At which points should the uniaxial loading prediction agree reasonably well with Cases I and/or II? Why?

(ii) Elongation/Contraction Comparison
- Draw the deformed and undeformed shapes of the domains for both Cases.
- Enter FEA displacements Ux and Uy at points B, C and D for **Case II** into table.
- From these displacements determine the change in length of segments BD and CD, and enter into table.
- Use simple axial loading to predict the changes in the length BD (δ_{BD}) and CD (δ_{CD}), and enter into table.
- Explain why the changes of length of BD and CD based on axial loading should or should not agree reasonably well with FEA prediction.

Numerical Results

Your analyses and discussion should be given on the following page.

(i) Stress Comparison

Case I: Stress component σ_x on four points (x,y); Compare FEA results and predictions based on simple uniaxial compression				
	(15,1)	(15,3)	(29,1)	(29,3)
σ_x (FEA)				
σ_x (Axial)				

Case II: Stress components σ_x on four points (x,y); Compare FEA results and predictions based on simple uniaxial compression				
	(15,1)	(15,3)	(29,1)	(29,3)
σ_x (FEA)				
σ_x (Axial)				

(ii) Elongation/Contraction Comparison

Draw the original rectangular boundary. On top of it, drawn the deformed boundary predicted by FEA. Do this for both Case I and Case II.

Case I Case II

(ii) Elongation/Contraction Comparison

Displacements from FEA at three points (Case II)			
	B	C	D
U_x			
U_y			

Change in lengths of segments BD and CD; compare FEA and axial loading prediction		
	FEA	Axial Loading Prediction
δ_{BD}		
δ_{CD}		

Results (discussion and analysis)

(i) Stress Comparison

Derive here the uniaxial prediction for stress here:

At which points would you expect the FEA stresses σ_x for Cases I and II to agree reasonably well with each other and which not? Why? At which points should the uniaxial loading prediction agree reasonably well with Cases I and II? Why?

(ii) Elongation/Contraction Comparison

Show here your analysis of changes of length of BD and CD based on axial loading

Explain here why the changes of length of BD and CD based on axial loading should or should not agree reasonably well with FEA prediction.

The FEA analysis in this assignment models the following problem. The single applied force corresponds to Case I. Case II models a uniformly distributed force at the end.