Comparison of FEA and Predictions For a Block in Shear

A block 3 m by 0.3 m (by 1 m into paper) is bonded to two rigid plates.
(Additional diagrams of modeled configuration on final page.)
- Block properties: E = $2x10^6$ (2E6) and ν = 0.4.
- Vertical displacement of plates = 0.
- Horizontal displacements on plates are shown in Figure.
- Plates are rigid, so displacements are uniform in each plate.
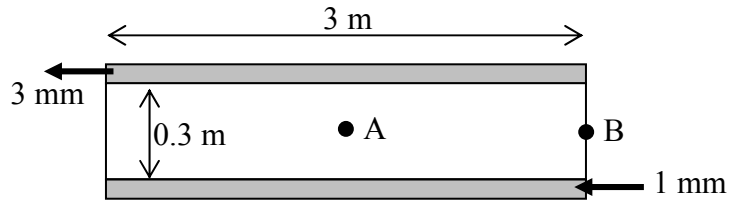
(a) Analyze with methods from class and textbook. Assume block has uniform shear strain. G = E/(2(1+ν)).
- Determine the shear stress in block.
- Determine the external horizontal force that must be applied to each rigid plate.

(b) Analyze this configuration with the Mini-FEA program.

Geometry: Length = 3, Height = 0.3
Material: E =2E6, ν = 0.4.
Mesh: 10 x 4 Linear Elements.
Loads:
Apply Ux = -0.003 and Uy = 0 (from top plate) on all nodes at y = 0.3
Apply Ux = -0.001 and Uy = 0 (from bottom plate) on all nodes at y = 0

Analyses to Compare with FEA Results
(i) Draw Shape
- Draw the original rectangular body and the deformed shape on top of each other.

(ii) Stress Comparison
- Enter FEA stress τ_{xy} at points A and B (each is at center line of block) into tables.
- Use analysis of part (a) to predict stress τ_{xy} at points A and B into tables.

(iii) Comparison of forces applied by plates
- Extract Fx at all nodes at y = 0 and sum to get net force. Do same for forces on nodes at y = 0.3. Enter net forces into Table.
- Use analysis of part (a) to predict net force applied by each of the plates. Enter into table.

(ii) Stress Comparison

Stress τ_{xy} at points A and B. Compare FEA results and predictions based on simple shearing.		
	A	B
τ_{xy} (FEA)		
τ_{xy} (Simple Shear)		

Give your simple shear analysis of the block and two rigid plates below.

Then, list the points (A and/or B) at which the predictions of the stress τ_{xy} agree reasonably well. Discuss why the agreement is good at these points and not at others points.

(iii) Comparison of forces applied by plates

Net force on plates. Compare FEA results and predictions based on simple shearing.		
	Bottom plate	Top plate
Net Fx (FEA)		
Net Fx (Simple Shear)		

Show here how the simple shear analysis leads to your prediction of the forces on the plates.

The FEA analysis in this assignment models the following problem.

Initial configuration of
block and plates

Configuration of block and plates
after top and bottom plates have
been displaced to the left by
different distances

3 mm

1 mm