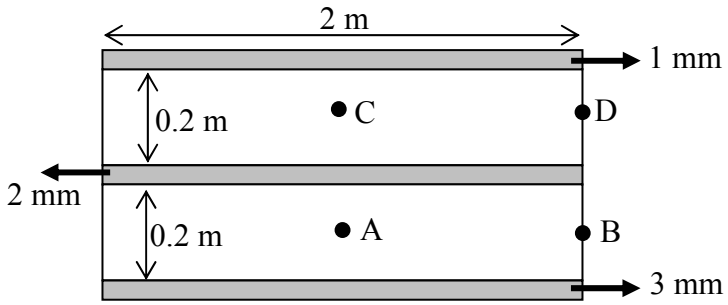
Comparison of FEA and Predictions For Two Bonded Blocks in Shear

Two blocks, each 2 m by 0.2 m (by 1 m into paper), are bonded to three rigid plates.

- Block properties: $E = 2.8 \times 10^9$ (2.8E9) and $\nu = 0.4$.
- 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 blocks have uniform shear strain. $G = E/(2(1+\nu))$.

- Determine the shear stress in each block.
- Determine the external horizontal force that must be applied to each rigid plate.

(b) Analyze this configuration with the Mini-FEA program as a single block.

Geometry: Length = 2, Height = 0.4
Material: E =2.8E9, $\nu = 0.4$.
Mesh: 10 x 4 Linear Elements.
Loads:
Apply Ux = 0.001 and Uy = 0 (from top plate) on all nodes at y = 0.4
Apply Ux = -0.002 and Uy = 0 (from middle plate) on all nodes at y = 0.2
Apply Ux = 0.003 and Uy = 0 (from bottom plate) on all nodes at y = 0

Analyses to Compare with FEA Results

(i) Stress Comparison

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

(ii) 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 = 0.2 and y = 0.4. Enter net forces into Table.
- Use analysis of part (a) to predict net force applied by each of the three plates. Enter into table.

(i) Stress Comparison

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

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

Then, list the points (A,B,C,D) 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.

(ii) Comparison of forces applied by plates

Net force on three plates. Compare FEA results and predictions based on simple shearing.			
	Bottom plate	Middle 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.