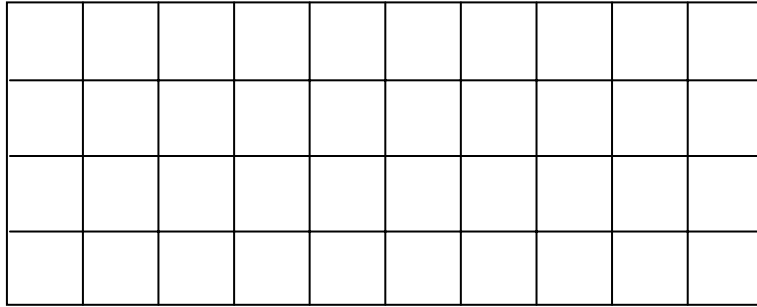


Definition of Displacements – Useful for FEA (Finite Element Analysis)

The original body is a rectangular sheet. We draw lines on it to track its deformation.



Say we apply tension to the body in the horizontal direction. The body gets longer horizontally, and shorter vertically.

The displacements U_x and U_y quantify how each point moves, as follows:

U_x (or u_x) quantifies horizontal motion ($U_x > 0$: moves to right, $U_x < 0$: moves to the left)

U_y (or u_y) quantifies vertical motion ($U_y > 0$: moves up, $U_y < 0$: moves down)

Think of superimposing two drawings: (1) the original body and mesh (now shown as dashed lines) and (2) the body and mesh while the tension is applied (shown as solid lines). Let the two bodies be located as shown below.

Each point on the original body corresponds to a point on the deformed body. One can describe how much each point moves, left and right and up and down, when deformed.

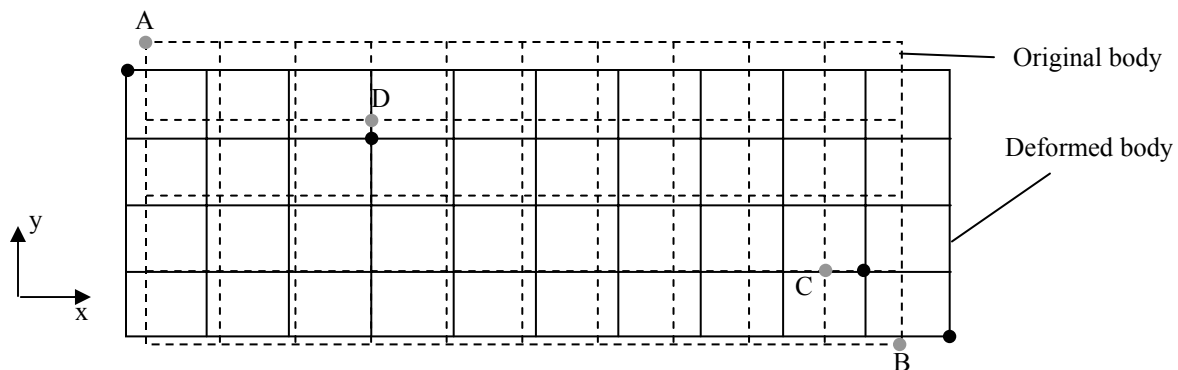
Points A, B, C and D are points on the original body (dashed). The light dot is the position in the original body. The black dot shows the position in the deformed body.

Point A: Moves left and down: $U_x < 0, U_y < 0$.

Point B: Moves right and up: $U_x > 0, U_y > 0$.

Point C: Moves right and doesn't move up or down: $U_x > 0, U_y = 0$.

Point D: Doesn't move left or right and moves down: $U_x = 0, U_y < 0$.



Introductory Assignment using CMU Mini-FEA Program

Geometry: Length = 10, Height = 4

Material: $E = 1.5E5$, $\nu = 0.3$

Mesh: 10 x 4 Linear Elements.

Loads: See diagrams below for Problems 1 and 2.

After specifying loads for a problem, click on Solve button to solve.

FEA Results to Extract for each of the two problems

- Move slider so mesh is maximally deformed. Click on Mesh at bottom so that original mesh is shown. Type Print Screen, copy the image into a image program (like Microsoft Photo Editor), and crop all but the deformed and undeformed mesh. Print out the image so it occupies the upper half of a page.
- Extract U_x and U_y at point where force is specified.
- Extract F_x and F_y at points where displacement is specified (supports).

Tasks and Analyses for each of the two problems

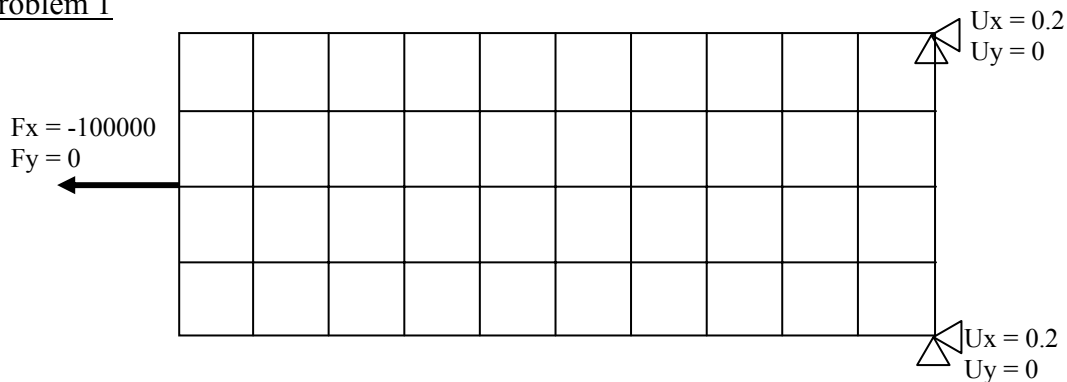
(i) Definitions of Displacement

- On the printout of the deformed mesh, label the distances corresponding to the displacements at the point where force is applied.

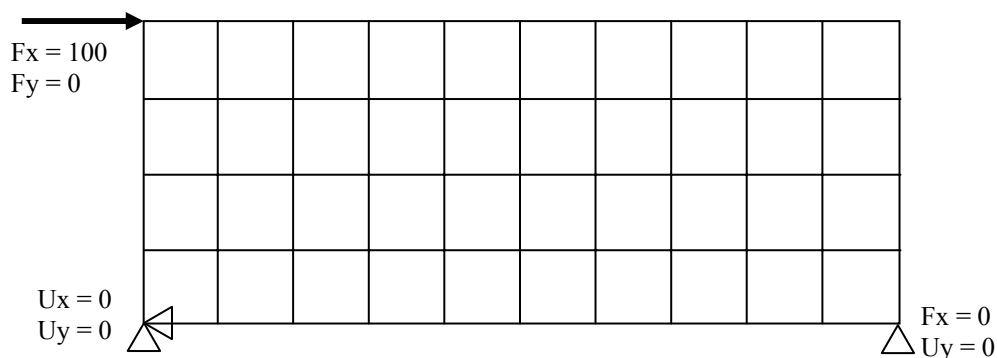
(ii) Equilibrium (put your work on next page)

- On drawings of the original rectangular body, draw the prescribed force, and the support forces.
- Show that all three equations of the equilibrium are satisfied.

Problem 1



Problem 2



Results

Problem 1

Draw all forces on body



Write down equations of equilibrium and show they are satisfied.

Problem 2

Draw all forces on body



Write down equations of equilibrium and show they are satisfied.