Computational Structural Mechanics and Dynamics

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Assignment 2

<u>Assignment 2.1:</u>

1)

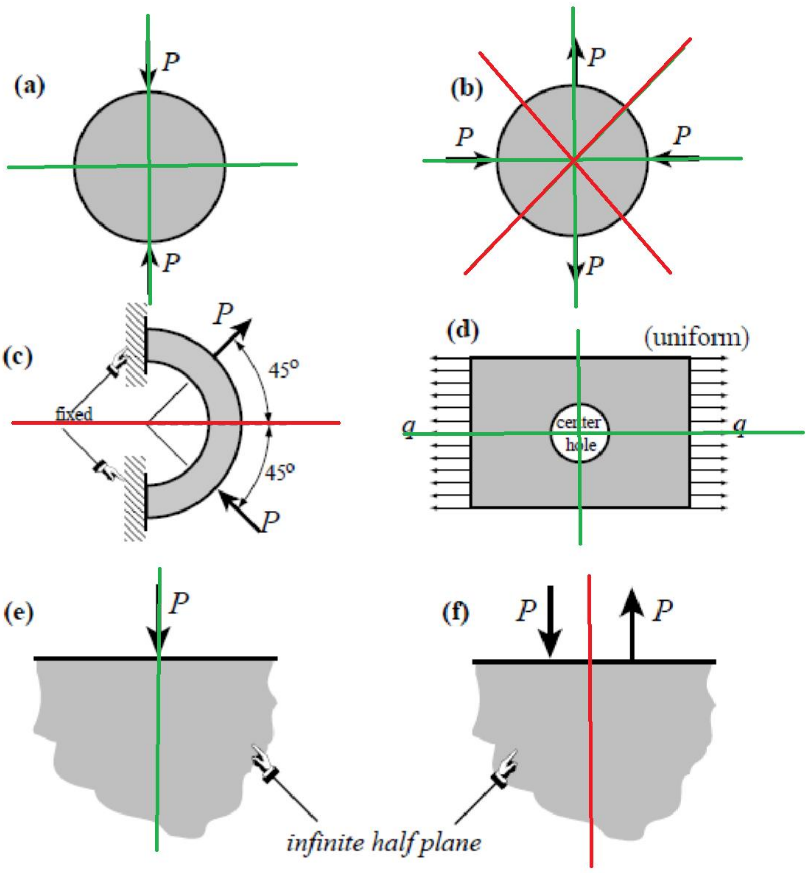


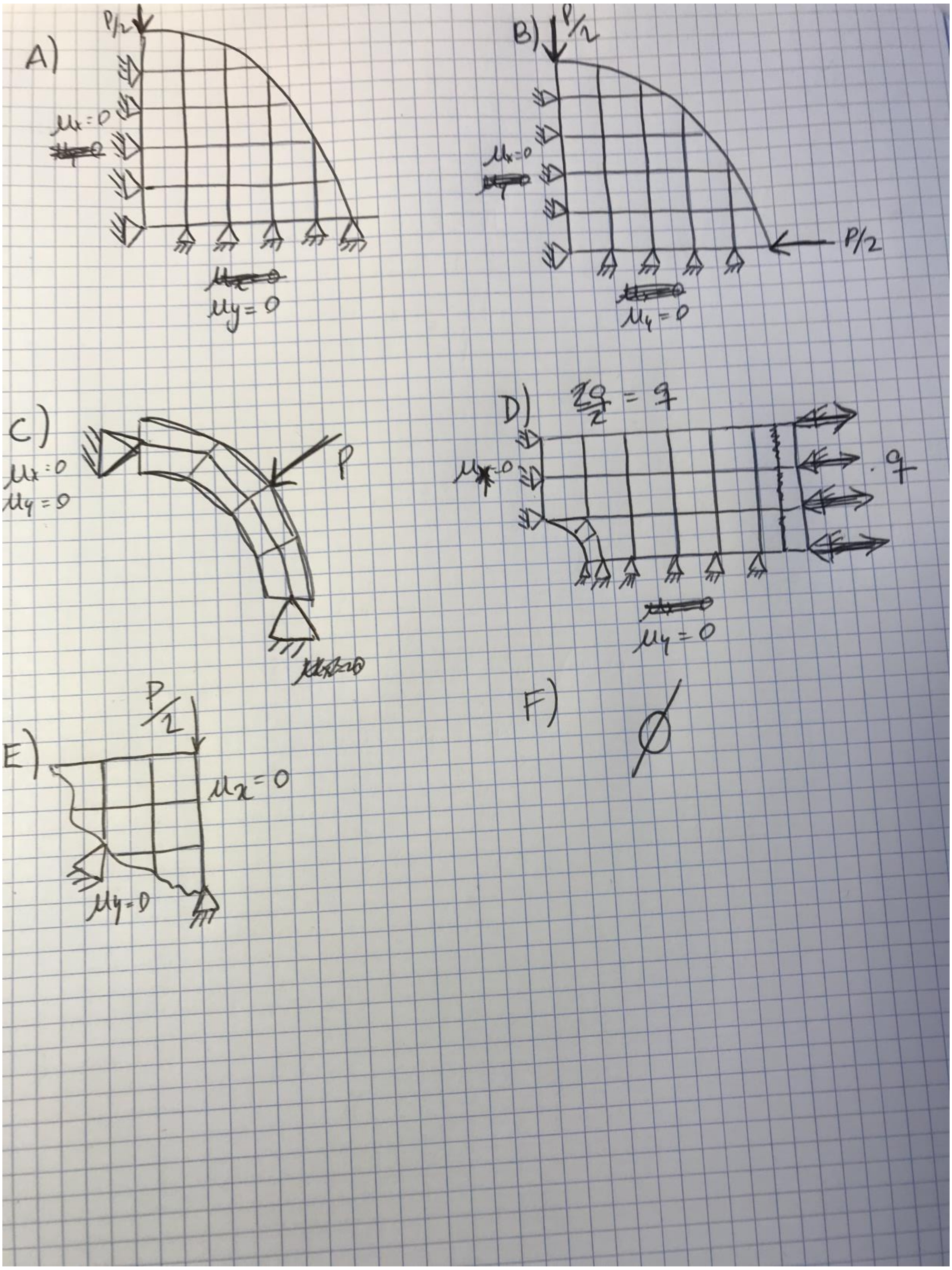
Figure 2.1.- Problems for assignment 2.1

Green stands for symmetry plane

Red stands for anti-symmetry plane.

2)

As seen in the picture, we can divide the geometries in quarters/half and apply B.C so we can apply a smaller mesh and reduce by half or more the computation cost. I'm aware the drawings show hyperstaticity but it was the way I thought I had to represent them. Normally, we would have to have an isostatic system so it can behave as expected when loaded.



Assignment 2.2:

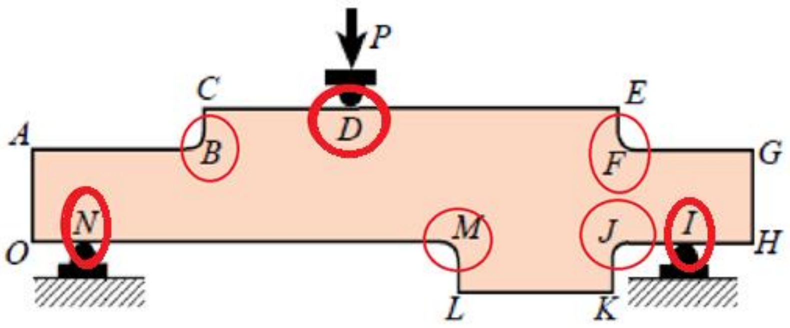


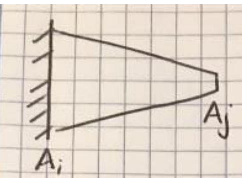
Figure 2.2.- Inplane bent plate

D: The effort is applied in this spot.

B,F,M,J,: Due the angle and proximity to the effort, this part will bend with ease.

I,N: The effort reaction.

Assignment 2.3:



$$A = A_i(1-\xi) + A_j \xi$$

The consistency nodal force vector is defined as:

$$F_{ext} = \int_0^1 q \begin{bmatrix} 1-\xi \\ \xi \end{bmatrix} \ell \, d\xi$$

$$q = \rho A \omega^2 x = \rho A \omega^2 \xi \ell = \rho \omega^2 \xi \ell (A_i(1-\xi) + A_j \xi)$$

We can now proceed to substitute into the "F_{ext}" expression:

$$F_{ext} = \int_0^1 \rho \ell^2 \omega^2 \xi (A_i(1-\xi) + A_j \xi) \begin{bmatrix} 1-\xi \\ \xi \end{bmatrix} d\xi$$

After a few computations we get:

$$F_{ext} = \begin{bmatrix} A_i(\xi^4/4 - 2/3\,\xi^3 + \xi^2/2) + A_j(\xi^3/3 - \xi^4/4) \\ A_i(\xi^3/3 - \xi^4/4) + A_j \xi^4/4 \end{bmatrix}_0^1 \cdot \rho \ell^2 \omega^2$$

$$\Rightarrow F_{ext} = \rho \ell^2 \omega^2 \begin{bmatrix} A_i\left(\frac{1}{4} - \frac{2}{3} + \frac{1}{2}\right) + A_j\left(\frac{1}{3} - \frac{1}{4}\right) \\ A_i\left(\frac{1}{3} - \frac{1}{4}\right) + A_j \frac{1}{4} \end{bmatrix}$$

$$\boxed{F_{ext} = \rho \ell^2 \omega^2 \begin{bmatrix} \frac{A}{6} \\ \frac{A}{3} \end{bmatrix}}$$