COMPUTATIONAL STRUCTURAL MECHANICS AND DYNAMICHS

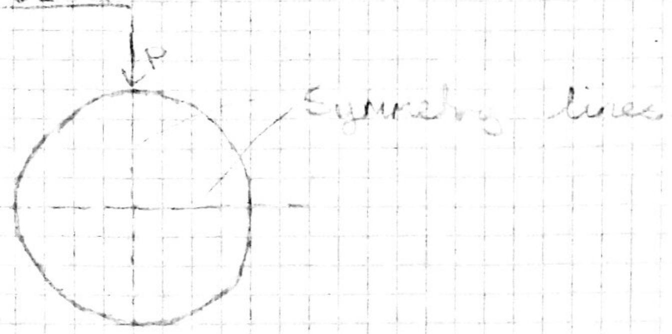
ASSIGNMENT 2.1

MARTIN VEE AKSELSEN
ERASMUS

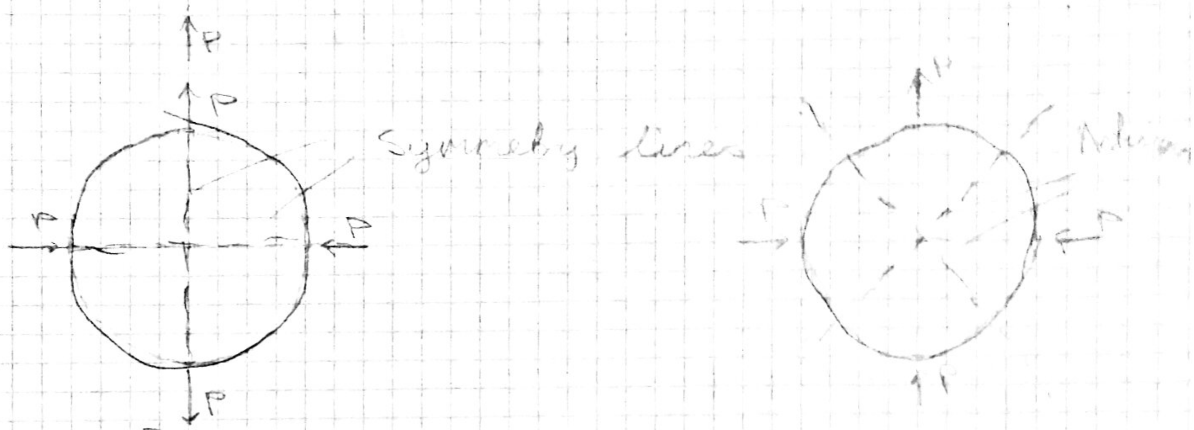
EXERCISE 1

1

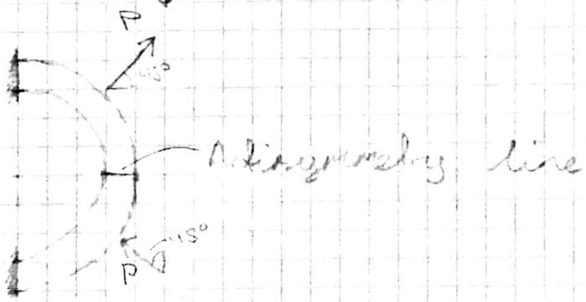
a)



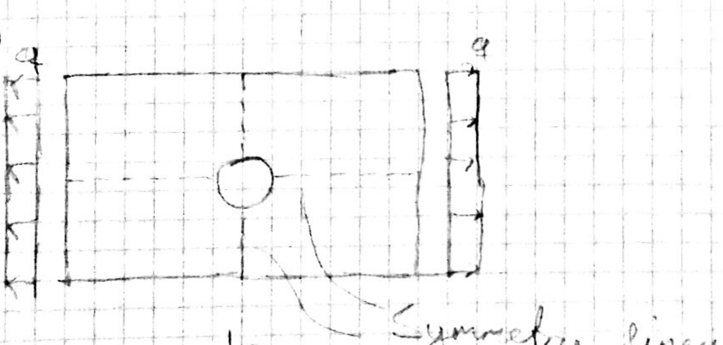
b)



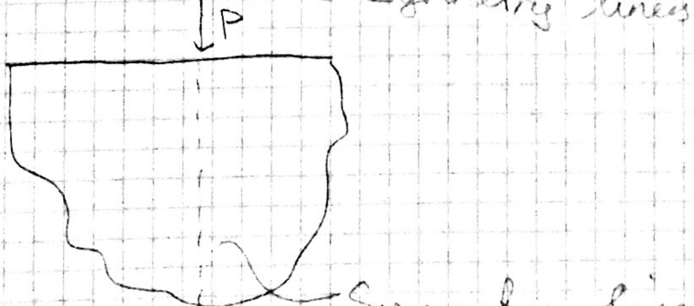
c)



d)



e)



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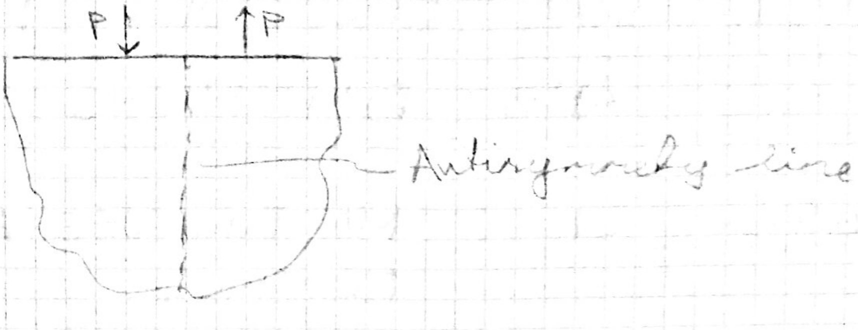
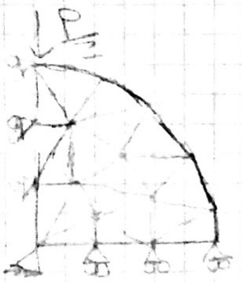


②

a)

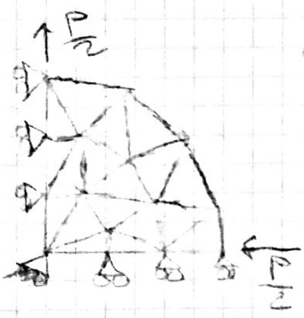


We don't have any rotations on the symmetry lines

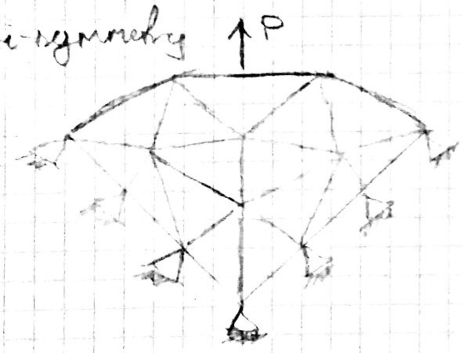
We don't have any displacement on the anti-symmetry lines

b)

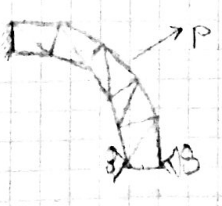
Symmetry



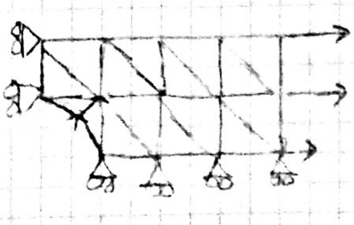
Anti-symmetry



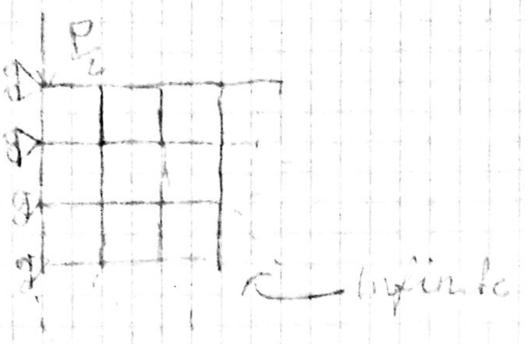
c)



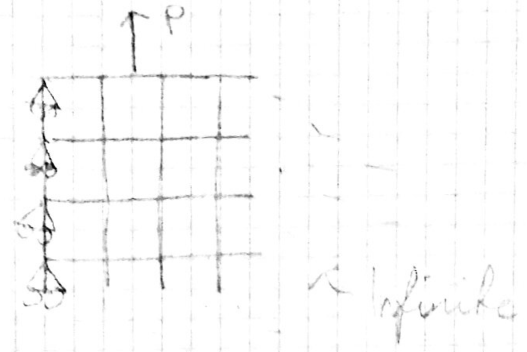
d)



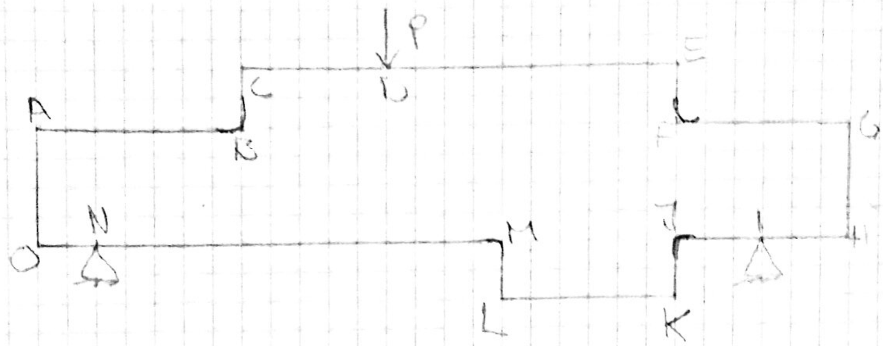
c)



d)



EXERCISE 2



We use a finer mesh on entrants corners.
That means on this structure we would use a finer mesh at the spots:
B, F, J and M

We would also use a finer mesh close to spots with concentrated load, meaning in this exercise the spots
N, D and F

EXERCISE 3

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

The consistent nodal force vector

$$W^e = \int_{x_1}^{x_2} q u \, dx = \int_0^1 q N^T u^e l \, d\xi = u^{eT} \underbrace{\int_0^1 q \begin{bmatrix} 1-\xi \\ \xi \end{bmatrix} l \, d\xi}_{} = (u^e)^T f^e$$

$$\Rightarrow f = \int_0^1 q \begin{bmatrix} 1-\xi \\ \xi \end{bmatrix} l \, d\xi \qquad x = \xi l$$

$$f = \rho\omega^2 \int_0^1 (A_i(1-\xi) + A_j\xi)\,\xi l^2 \begin{bmatrix} 1-\xi \\ \xi \end{bmatrix} d\xi$$

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

$$f = \rho\omega^2 l^2 \int_0^1 \begin{bmatrix} A_i\xi^3 - 2A_i\xi^2 + A_i\xi - A_j\xi^3 + A_j\xi^2 \\ -A_i\xi^3 + A_i\xi^2 + A_j\xi^3 \end{bmatrix} d\xi$$

$$f = \rho\omega^2 l^2 \begin{bmatrix} A_i \frac{1}{4}\xi^4 - \frac{2}{3}A_i\xi^3 + \frac{1}{2}A_i\xi^2 - \frac{1}{4}A_j\xi^4 + \frac{1}{3}A_j\xi^3 \\ -\frac{1}{4}A_i\xi^4 + \frac{1}{3}\xi^3 A_i + \frac{1}{4}A_j\xi^4 \end{bmatrix}_0^1$$

$$f = \rho\omega^2 l^2 \begin{bmatrix} \frac{A_i + A_j}{12} \\ \frac{1}{12}(A_i + 3A_j) \end{bmatrix}$$

For the prismatic bar $A = A_i = A_j$

$$\Rightarrow f = \rho\omega^2 l^2 A \begin{bmatrix} 1/6 \\ 1/6 \end{bmatrix}$$ Constant node forces