Computational Structural Mechanics and Dynamics

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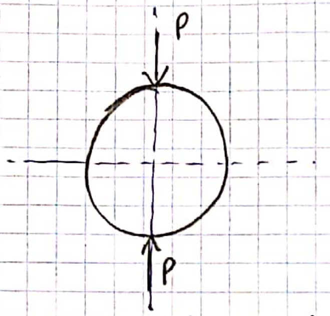
Computational Mechanics

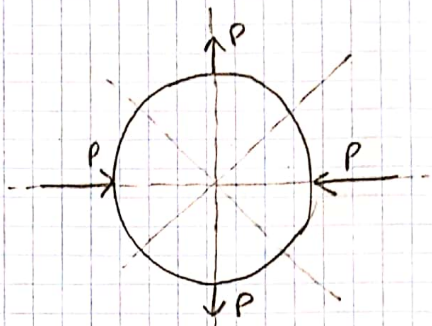
Assignment 2.1

1. (a)



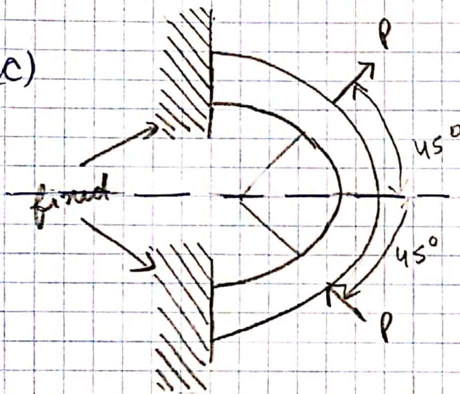
2-symmetry lines

(b)



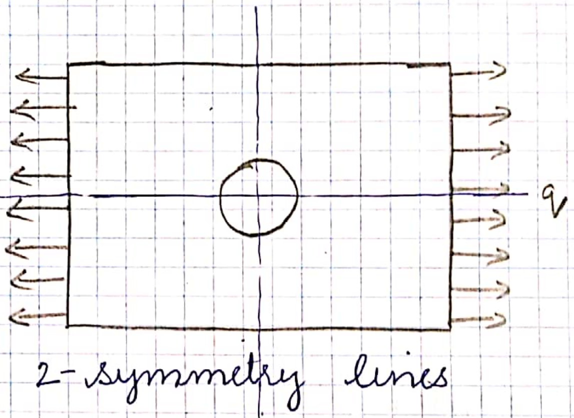
2-symmetry and 2-antisymmetry lines.

(c)



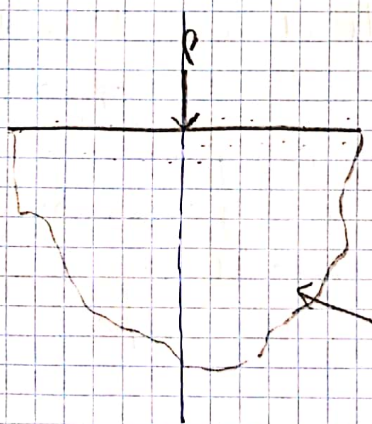
1-antisymmetry line

(d)

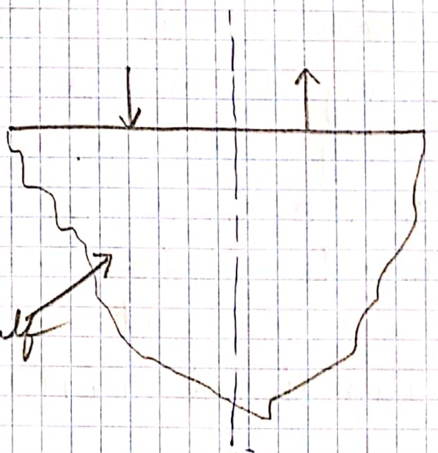


2-symmetry lines

(e)



(f)

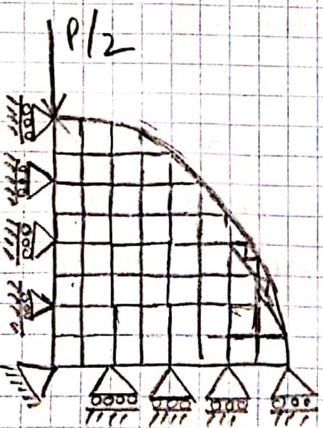


infinite half plane

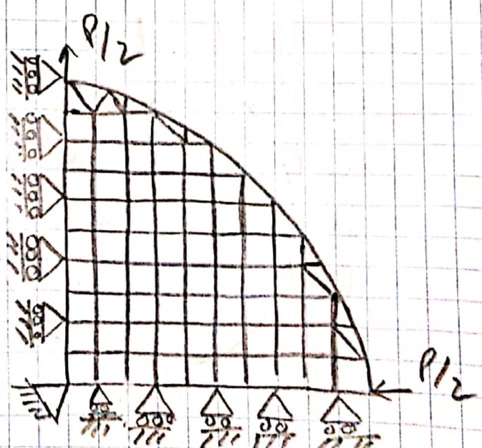
1-symmetry line

1-antisymmetry line.

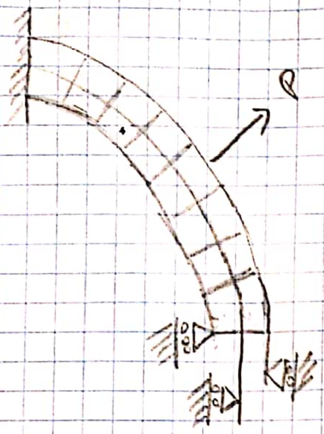
2. (a)



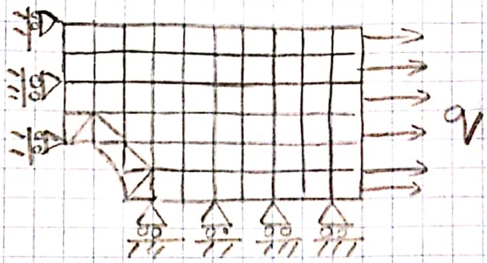
(b)



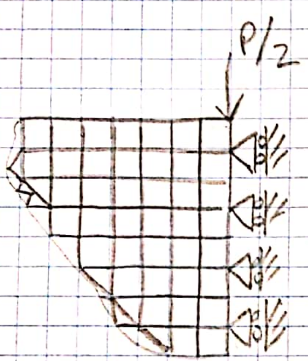
(c)



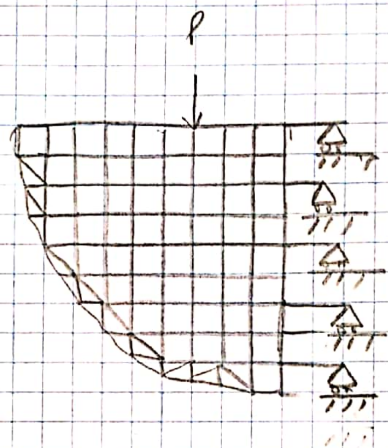
(d)



(e)



(f)



Assignment 2.2

<u>Verification</u> deals with mathematical aspect and identifying error to ensure that code developed is correctly incorporated into FE. program. In other words, verification is done by replacing the discrete solution into discrete model to obtain solution error. But, solution error is important in Mathematical FEM.

Validation deals with physical aspects, i.e., to ensure that the numerical model is capable of simulating real-time model. Validation compares discrete solution with physical observation and compute simulation error. Validation is important in Physical FEM.

Assignment-2.3

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

$$q(x) = \rho A \omega^2 x$$

$$f^{(e)} = \int_0^1 q \begin{pmatrix} 1-\varepsilon \\ \varepsilon \end{pmatrix} l \, d\varepsilon$$

$$\varepsilon = \frac{x - x_1}{l} \Rightarrow x = x_1 + \varepsilon l$$

$$f = \int_0^1 \rho A \omega^2 (x_1 + \varepsilon l) \, l \begin{pmatrix} 1-\varepsilon \\ \varepsilon \end{pmatrix} d\varepsilon$$

$$= \int_0^1 \rho [A_i(1-\varepsilon) + A_j\varepsilon] \omega^2 (x_1^{0} + \varepsilon l) \, l \begin{pmatrix} 1-\varepsilon \\ \varepsilon \end{pmatrix} d\varepsilon$$

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

$$= \rho\omega^2 l^2 \int_0^1 \begin{pmatrix} A_i(1-\varepsilon)^2\varepsilon + A_j\varepsilon^2(1-\varepsilon) \\ A_i(1-\varepsilon)\varepsilon^2 + A_j\varepsilon^3 \end{pmatrix} d\varepsilon$$

$$= \rho\omega^2 l^2 \int_0^1 \begin{pmatrix} A_i(\varepsilon^3 + \varepsilon - 2\varepsilon^2) + A_j(\varepsilon^2 - \varepsilon^3) \\ A_i(\varepsilon^2 - \varepsilon^3) + A_j\varepsilon^3 \end{pmatrix} d\varepsilon$$

$$= \rho\omega^2 l^2 \begin{pmatrix} A_i\left(\frac{\varepsilon^4}{4} + \frac{\varepsilon^2}{2} - \frac{2\varepsilon^3}{3}\right) + A_j\left(\frac{\varepsilon^3}{3} - \frac{\varepsilon^4}{4}\right) \\ A_i\left(\frac{\varepsilon^3}{3} - \frac{\varepsilon^4}{4}\right) + A_j\left(\frac{\varepsilon^4}{4}\right) \end{pmatrix}_0^1$$

$$f = \rho\omega^2 l^2 \begin{pmatrix} \frac{A_i + A_j}{12} \\ \frac{A_i}{12} + \frac{A_j}{4} \end{pmatrix}$$

when $A_i = A_j = A$

$$f = \rho\omega^2 l^2 \begin{pmatrix} A/6 \\ A/3 \end{pmatrix} = \frac{\rho\omega^2 l^2}{6} \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$