



SNS COLLEGE OF TECHNOLOGY

**Coimbatore-35
An Autonomous Institution**

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DEPARTMENT OF AUTOMOBILE ENGINEERING

19AUB303 – Finite Element Methods and Analysis

III YEAR / VI SEM

UNIT – 2 General Procedures of FEM

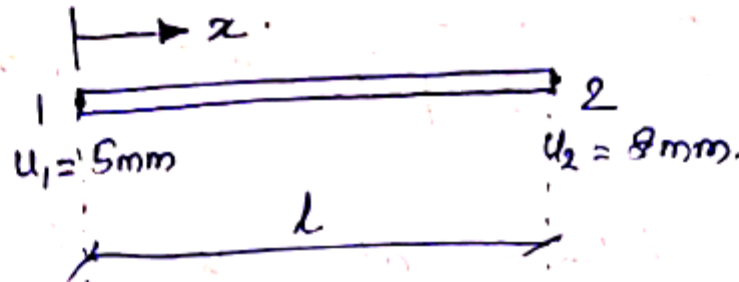
Topic – 4 – Problems on Finding Displacement



Displacement Function - Problem



A two noded truss element is shown below. The nodal displacements are $u_1 = 5\text{mm}$, & $u_2 = 8\text{mm}$. Calculate displacement at $x = \frac{l}{4}$, $\frac{l}{3}$ & $\frac{l}{2}$.





To Find

To find: -

Displacement u at $x = l/4, l/3$ & $l/2$.



Solution, at $x = l/4$

Soln!-

displacement function for two noded bar element is

$$u = N_1 u_1 + N_2 u_2 \rightarrow \textcircled{A} \quad N_1 = \frac{l-x}{l}$$

Sub $x = l/4$, $u_1 = 5$ & $u_2 = 8 \rightarrow \textcircled{1}$

$$u = \left(\frac{l-x}{l}\right) u_1 + \left(\frac{x}{l}\right) u_2 \rightarrow \textcircled{1} \quad N_2 = \frac{x}{l}$$

$$\Rightarrow u = \left[\frac{l - l/4}{l}\right] 5 + \left[\frac{l/4}{l}\right] \times 8$$

$$= \left[1 - \frac{1}{4}\right] 5 + \left[\frac{1}{4}\right] 8$$

$$\boxed{u = 5.75 \text{ mm}} \quad \text{at } x = l/4$$



$$x = l/3$$

* Substituting $x = l/3$, $u_1 = 5 \text{ mm}$ & $u_2 = 8 \text{ mm}$ in eqn. (1)

$$u = \left[\frac{l - \frac{l}{3}}{l} \right] 5 + \left[\frac{\frac{l}{3}}{l} \right] 8$$

$$= \left[1 - \frac{1}{3} \right] 5 + \left[\frac{1}{3} \right] 8$$

$$\boxed{u = 6 \text{ mm.}} \quad \text{at } x = l/3$$



$$x = l/2$$

* Substituting $x = \frac{l}{2}$, $u_1 = 5 \text{ mm}$ & $u_2 = 8 \text{ mm}$ in eqn ①

$$u = \left[1 - \frac{1}{2}\right] 5 + \left(\frac{1}{2}\right) 8.$$

$$u = 6.5 \text{ mm at } x = l/2$$



Result:

$$u = 5.75 \text{ mm} \quad \text{at} \quad x = l/4$$

$$u = 6 \text{ mm} \quad \text{at} \quad x = l/3$$

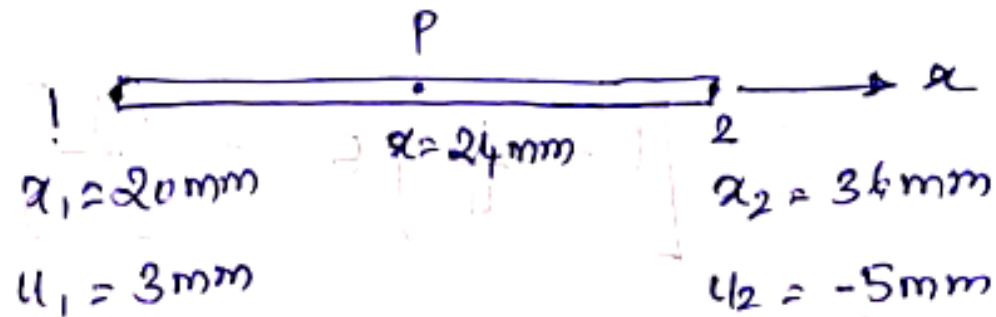
$$u = 6.5 \text{ mm} \quad \text{at} \quad x = l/2$$



Q A one dimensional bar is shown below. Calculate the following.

(i) Shape function N_1 & N_2 at point P.

(ii) If $u_1 = 3\text{mm}$ & $u_2 = -5\text{mm}$, calculate the displacement u at point P.





Soln:-

Actual length of the bar, $L = x_2 - x_1$
 $= 36 - 20$

$$L = 16 \text{ mm}$$

The distance b/w point I & point P is

$$x = 24 - 20$$

$$x = 4 \text{ mm}$$



Displacement function for two noded bar element

$$u = N_1 u_1 + N_2 u_2$$

$$N_1 = \frac{l-x}{l} = \frac{16-4}{16} = 0.75 \text{ mm}$$

$$N_2 = x/l = \frac{4}{16} = 0.25 \text{ mm}$$

$$(0.75)(3) + (0.25)(-5)$$
$$u = 1 \text{ mm.}$$



Result

* Shape Function

$$N_1 = 0.75 \text{ mm}$$

$$N_2 = 0.25 \text{ mm}$$

* Displacement u at

$$\text{Point } P = 1 \text{ mm}$$



Thank You