



$$\begin{bmatrix} - & - & - & - \\ - & - & - & - \\ - & - & - & - \\ - & - & - & - \end{bmatrix}
 \begin{bmatrix} v_1 & v_2 \\ v_3 & v_4 \end{bmatrix}
 \quad F = K v$$

ชิ้นส่วนที่ ① $Q = k U \rightarrow F = K v$

$$k = \frac{EA}{L} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} = \frac{200 \times 10^9 \times 5800 \times 10^{-6}}{10} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} = 116 \times 10^6 \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$K = T^T k T$$

$$\cos \theta = \frac{x^3 - x^1}{L} = \frac{6 - 0}{10} = 0.6$$

$$\sin \theta = \frac{y^3 - y^1}{L} = \frac{8 - 0}{10} = 0.8$$

$$K = \begin{bmatrix} 0.6 & 0 \\ 0.8 & 0 \\ 0 & 0.6 \\ 0 & 0.8 \end{bmatrix}_{4 \times 2} \cdot 116 \times 10^6 \cdot \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}_{2 \times 2} \begin{bmatrix} 0.6 & 0.8 & 0 & 0 \\ 0 & 0 & 0.6 & 0.8 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & 1 & 2 \\ 0 & 0 & -1 & -2 \\ 0 & 0 & 1 & -2 \\ 0 & 0 & -1 & 2 \end{bmatrix}$$

$\begin{matrix}
 K_{33} & K_{34} \\
 K_{43} & K_{44}
 \end{matrix}$

$\frac{8^2}{8 \times 10^3}$

$$K^{(2)} = \frac{EA}{L} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} = \frac{200 \times 10^9 \times 5800 \times 10^{-6}}{8} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$\cos \theta = \frac{x^3 - x^2}{L} = 0$$

$$\sin \theta = \frac{y^3 - y^2}{L} = \frac{8 - 0}{8} = 1$$

$$K = T^T K T = \begin{bmatrix} 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \frac{200 \times 10^9 \times 5800 \times 10^{-6}}{8} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\frac{827}{267} \cdot 3$$

$$k^{(3)}$$

$$\frac{EA}{L} = \frac{200 \times 10^9 \times 5800 \times 10^{-6}}{6} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$\cos \theta = \frac{x^3 - x^4}{L} = \frac{6 - 0}{6} = 1$$

$$\sin \theta = \frac{y^3 - y^4}{L} = \frac{0 - 0}{6} = 0$$

$$K^{(3)} = \frac{200 \times 10^9 \times 5800 \times 10^{-6}}{6} \begin{bmatrix} 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

$$K^{(2)} = \begin{bmatrix} 1 & -1 & 0 & 0 \\ -1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$S = \begin{bmatrix} K_{33}^{(1)} & K_{34}^{(1)} \\ K_{43}^{(1)} & K_{44}^{(1)} \end{bmatrix} + \begin{bmatrix} K_{33}^{(2)} & K_{34}^{(2)} \\ K_{43}^{(2)} & K_{44}^{(2)} \end{bmatrix} + \begin{bmatrix} K_{33}^{(3)} & K_{34}^{(3)} \\ K_{43}^{(3)} & K_{44}^{(3)} \end{bmatrix}$$

$$P = Sd$$

$$P = \begin{bmatrix} P_1 \\ P_2 \end{bmatrix} = \begin{bmatrix} 500 \cos 60^\circ \\ -500 \sin 60^\circ \end{bmatrix} = \begin{bmatrix} 250 \\ -216 \end{bmatrix}$$

$$d = S^{-1}P$$