er code: 119-114(T1)

Marking schemE

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T-1, FEA, CVPB11184A

FY M.Tech (structures)

(2018 R1-pattern)

Q1 $\Delta 1, \Delta 2$ at A $\overset{2}{\uparrow}\!\rightarrow 1$ -------- (2 Marks).

$[K][\Delta]=[P]$, , $\theta = 36.86^\circ$ --- (1 Mark)

$K_{11} = \Sigma \frac{AE}{L}\cos^2\theta = 1012$, $K_{22} = \Sigma \frac{AE}{L}\sin^2\theta = 288$

$K_{12} = K_{21} = \frac{AE}{L}\sin\theta\cos\theta = 384$ ------ (4 Marks)

$$\begin{bmatrix} 1012 & 384 \\ 384 & 288 \end{bmatrix} \begin{bmatrix} \Delta 1 \\ \Delta 2 \end{bmatrix} = \begin{bmatrix} 0 \\ -200 \end{bmatrix}$$, $\Delta 1 = 0.534$, $\Delta 2 = -1.406$ --- (2 marks)

$F_{AB} = 267$ KN(T), $F_{AC} = -333.410$ kN(comp) — (1 Mark)

10

Q2 (a) Expression $\varepsilon_x = \frac{\sigma x}{E} - \frac{\mu \sigma y}{E} - \mu\frac{\sigma z}{E}$, ε_y, ε_z, ——— (1 Mark)

$\gamma_{xy} = \tau_{xy}/G$, $\gamma_{yz} = \tau_{yz}/G$, $\gamma_{zx} = \tau_{zx}/G$.

$G = E/2(1+\mu)$ ——— (1) Mark

$\varepsilon_x = \frac{\sigma x}{E} - \frac{\mu\sigma y}{E} - \frac{\mu\sigma z}{E} + 0\tau_{xy} + 0\tau_{yz} + 0\tau_{zx}$ — (1)

$\varepsilon_y = -\frac{\mu\sigma x}{E} + \frac{\sigma y}{E} - \frac{\mu\sigma z}{E} + 0\tau_{xy} + 0\tau_{yz} + 0\tau_{zx}$ — (1)

similarly, ε_z, γ_{xy}, γ_{yz}, γ_{zx}

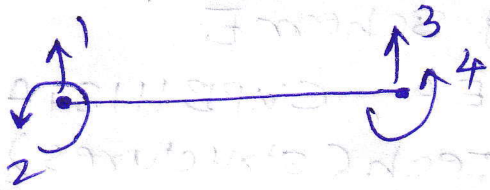
Matrix Form $\underset{6\times1}{\{\varepsilon\}} = \underset{\text{strain-stress}}{\{6\times6\}}\underset{6\times1}{\{\sigma\}}$, $\sigma = [C]^{-1}\{\varepsilon\}$ — (1)

$\{\sigma\} = \underset{\text{Elastic coef matrix.}}{\{D\}}\{\varepsilon\}$ ——— (1)

06.

(b) Advantages - (2), Disadvantages - (2) = 04

Q3 (a)



$K_{11} = 12EI/L^3$
$K_{21} = 6EI/L^2$
$K_{31} = -12EI/L^3$
$K_{41} = 6EI/L^2$
– (2 marks)

$K_{12} = 6EI/L^2$, $K_{32} = -\frac{6EI}{L^2}$ $K_{13} = -12EI/L^3$ $K_{33} = \frac{12EI}{L^3}$
$K_{22} = 4EI/L$ $K_{42} = 2EI/L$ $K_{23} = -6EI/L^2$ $K_{43} = -\frac{6EI}{L^2}$ 3
$K_{14} = 6EI/L^2$, $K_{24} = 2EI/L$, $K_{34} = -6EI/L^2$ $K_{44} = 4EI/L$

$$[K] = \frac{EI}{L^3}\begin{bmatrix} 12 & 6L & -12 & 6L \\ 6L & 4L^2 & -6L & 2L^2 \\ -12 & -6L & 12 & -6L \\ 6L & 2L^2 & -6L & 4L^2 \end{bmatrix}$$ — (1 mark)

$\underline{\underline{06}}$

Q3 (b) 1D, 2D, 3D elements, with nodes — (1+1+1+1)
nodes

Q4 (a). Field variable at any point in element related to nodal points of element — (1)

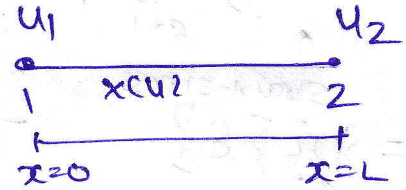
$$\{\delta\} = \{N\}\{\delta\}$$ — (2)

2×1
δ within element
shape function
Nodal displacement

example. — (1).

① Easy to handle,
② Approximated reasonably well
– (2 marks)

4(b).



$u = \alpha_1 + \alpha_2 x$ — 1 (mark)
At 1, $x=0$, $u=u_1$
At 2 $x=L$ $u=u_2$

$u_1 = \alpha_1$, $u_2 = \alpha_1 + \alpha_2 L$, $\alpha_2 = \frac{u_2 - u_1}{L}$ — 1 (mark)

$$u = u_1 + \left(\frac{u_2 - u_1}{L}\right).x$$

$$u = \frac{u_1 \times L + u_2 x - u_1 x}{L} = \frac{u_1(L-x)}{L} + \frac{u_2 x}{L}$$ (1 mark)

$$u = \underline{\underline{u_1}}\left(1 - \frac{x}{L}\right) + \left(\frac{x}{L}\right)\underline{\underline{u_2}}$$

$$u = N_1 u_1 + N_2 u_2$$

$N_1 = 1 - x/L$, $N_2 = x/L$ – shape function – (1 ma