

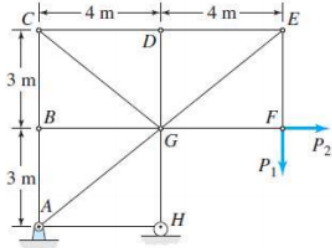
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Question: 3. The pin displacements of the truss were computed by the fi...

3. The pin displacements of the truss were computed by the finite-element method. The displacements in x and y directions given by u and v are given in Table P2.63. Determine the axial strains in members BC, CG, GB, and CD.



$u_B = 7.00 \text{ mm}$	$v_B = 1.500 \text{ mm}$
$u_C = 17.55 \text{ mm}$	$v_C = 3.000 \text{ mm}$
$u_D = 20.22 \text{ mm}$	$v_D = -4.125 \text{ mm}$
$u_E = 22.88 \text{ mm}$	$v_E = -32.250 \text{ mm}$
$u_F = 9.00 \text{ mm}$	$v_F = -33.750 \text{ mm}$
$u_G = 7.00 \text{ mm}$	$v_G = -4.125 \text{ mm}$
$u_H = 0$	$v_H = 0$

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Expert Answer



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Element	i	j
BC	B	C
CA	C	A
AB	B	A
CD	C	D

Element	length	cosine(c)	sine(s)
BC	3000	0	1
CA	5000	4/5	-3/5
AB	4000	1	0
CD	4000	1	0

$$\Rightarrow E_{BC} = \frac{1}{l} [-c \ -s \ c \ s] \begin{bmatrix} u_B \\ v_B \\ u_C \\ v_C \end{bmatrix}$$

$$= \frac{1}{3000} [0 \ -1 \ 0 \ 1] \begin{bmatrix} 7 \\ 1.5 \\ 17.55 \\ 3 \end{bmatrix}^T$$

$$= \frac{-1.5 + 3}{3000}$$

$$E_{BC} = 5 \times 10^{-4}$$

$$\Rightarrow E_{CA} = \frac{1}{l} [-c \ -s \ c \ s] \begin{bmatrix} u_C \\ v_C \\ u_A \\ v_A \end{bmatrix}^T$$

$$= \frac{1}{5000} \begin{bmatrix} -4/5 & +3/5 & 4/5 & -3/5 \end{bmatrix} \begin{bmatrix} 17.55 \\ 3 \\ 7 \\ -4.125 \end{bmatrix}^T$$

$$= \frac{-14.04 + 1.8 + 5.6 + 2.475}{5000}$$

$$E_{CA} = -8.33 \times 10^{-4}$$

$$E_{AB} = \frac{1}{l} [-c \ -s \ c \ s] \begin{bmatrix} u_B \\ v_B \\ u_A \\ v_A \end{bmatrix}^T$$

$$= \frac{1}{4000} [-1 \ 0 \ 1 \ 0] \begin{bmatrix} 7 \\ 1.5 \\ 7 \\ -4.125 \end{bmatrix}^T$$

$$= \frac{-7 + 7}{4000}$$

$$E_{AB} = 0$$

$$E_{CD} = \frac{1}{l} [-c \ -s \ c \ s] \begin{bmatrix} u_C \\ v_C \\ u_D \\ v_D \end{bmatrix}^T$$

$$= \frac{1}{4000} [-1 \ 0 \ 1 \ 0] \begin{bmatrix} 17.55 \\ 3 \\ 20.22 \\ -4.125 \end{bmatrix}^T$$

$$= \frac{-17.55 + 20.22}{4000}$$

$$E_{CD} = 6.675 \times 10^{-4}$$

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