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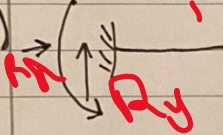
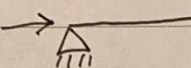
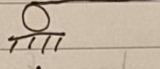
ACBA6007: Structural Analysis Exam

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Exam Questions

Question 1:

a) Fixed  Hinged (or pin)  Roller 

b)   

c) A determinate structure can be analysed through the use of basic equations alone. Indeterminate structures cannot be analysed through the use of basic equations alone.

d) Horizontal, vertical and moment.

$$\sum F_H = 0$$

$$\sum F_V = 0$$

$$\sum M = 0$$

e) For determinate structures $r = 3n$

For indeterminate structures $r > 3n$

Where:

n = the number of parts of the structure

r = the number of unknown reactive forces and moments.

f) 1. $r = 3$ $n = 1$ $\therefore r = 3n$ Structure is determinate

2. $r = 6$ $n = 2$ $\therefore r = 3n$ Structure is determinate

3. $r = 5$ $n = 1$ $5 - 3 = 2$ Structure is indeterminate to the 2nd degree

4. $r = 10$ $n = 3$ $10 - 9 = 1$ Structure is indeterminate to the 1st degree

g) The two basic classifications of frame structures are 'rigid frame' and 'braced frame'. (2)

h) An over-rigid truss has more members and joints, is stronger than may be required whilst an 'under-rigid' truss is weaker.

i) $m = 2j - 3$ (3)

where:

m = Number of members

j = Number of joints

j) i) Warren truss

ii) Pratt truss

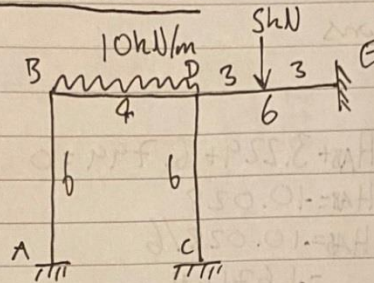
iii) Howe truss

iv) K-truss

v) Fink truss (5)

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Question 3:



$EI = \text{Constant}$

a) $K_{AB} = \frac{1}{6}$ $DF_{BA} = \frac{\frac{1}{6}}{\frac{1}{6} + \frac{1}{4}} = 0.4$
 $K_{BD} = \frac{1}{4}$ $DF_{BD} = \frac{\frac{1}{4}}{\frac{1}{4} + \frac{1}{6}} = 0.6$
 $K_{DC} = \frac{1}{6}$ $DF_{DB} = \frac{\frac{1}{4}}{\frac{1}{4} + \frac{1}{6} + \frac{1}{6}} = 0.428$ or 0.43 in 2dp
 $K_{DE} = \frac{1}{6}$ $DF_{DE} = \frac{\frac{1}{6}}{\frac{1}{4} + \frac{1}{6} + \frac{1}{6}} = 0.285$ or 0.29 in 2dp
 $DF_{DC} = \frac{\frac{1}{6}}{\frac{1}{4} + \frac{1}{6} + \frac{1}{6}} = 0.285$

$FEM_{BD} = WL^2/12 = 10 \times 4^2/12 = 13.333$

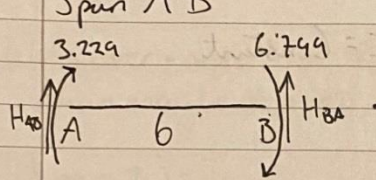
$FEM_{DE} = PL/8 = 3 \times 6/8 = 3.75$

	AB	BA	BD	DB	DC	DE	ED	CD
DF	0	0.4	0.6	0.428	0.285	0.285	0	0
FEM	0	0	13.3	-13.3	0	3.75	-3.75	0
BM		-5.32	-7.98	5.692	3.79	3.79		
COM	-2.66		2.946	-3.99			1.895	1.895
BM		-1.138	1.707	1.707	1.137	1.137		
COM	0.569		0.953	-0.853			0.569	0.569
BM		-0.541	-0.511	0.365	0.743	0.243		
Final end moments	-3.229	-6.799	6.901	-10.379	5.17	8.92	-1.286	2.464

Final end moments

b) Calculate support reactions

Span AB



$$6H_{AB} + 3.229 + 6.799 = 0$$

$$6H_{AB} = -10.028$$

$$H_{AB} = -10.028/6$$

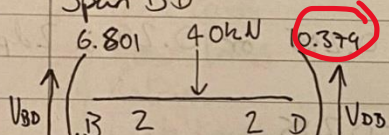
$$H_{AB} = -1.671 \text{ kN}$$

$$-6H_{BA} + 3.229 + 6.799 = 0$$

$$6H_{BA} = 10.028$$

$$H_{BA} = 1.671 \text{ kN}$$

Span BD



$$4V_{BD} - (40 \times 2) - 6.801 + 10.379 = 0$$

$$4V_{BD} = -76.422$$

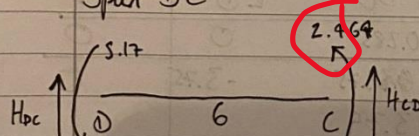
$$V_{BD} = -19.105 \text{ kN}$$

$$-4V_{DB} + (40 \times 2) - 6.801 + 10.379 = 0$$

$$4V_{DB} = 83.578$$

$$V_{DB} = 20.894 \text{ kN}$$

Span DC



$$6H_{DC} - 5.17 - 2.464 = 0$$

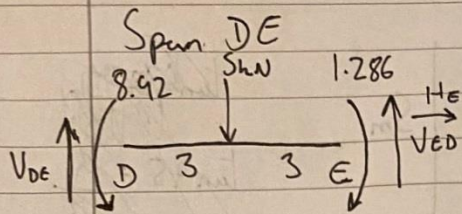
$$6H_{DC} = 7.634$$

$$H_{DC} = 1.272 \text{ kN}$$

$$-6H_{CD} - 5.17 - 2.464 = 0$$

$$6H_{CD} = -7.634$$

$$H_{CD} = -1.272 \text{ kN}$$



$$6V_{DE} + (5 \times 3) - 8.92 + 1.286 = 0$$

$$6V_{DE} = -22.634$$

$$V_{DE} = -3.772 \text{ kN}$$

$$-6V_{ED} + (5 \times 3) - 8.92 + 1.286 = 0$$

$$6V_{ED} = 7.366 \text{ kN}$$

$$\sum H = 0$$

$$-3.772 + 20.894 = 17.172$$

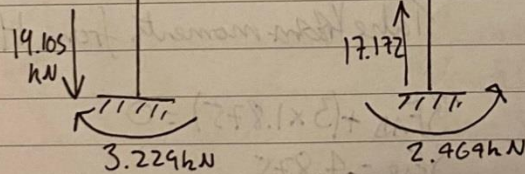
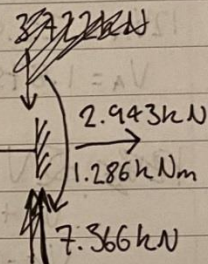
$$\therefore H_E + H_{BA} + H_{DC} = 0$$

$$H_E + 1.671 + 1.272 = 0$$

$$H_E + 2.943 = 0$$

$$H_E = -2.943 \text{ kN}$$

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Support reactions @ A = -19.105 kN

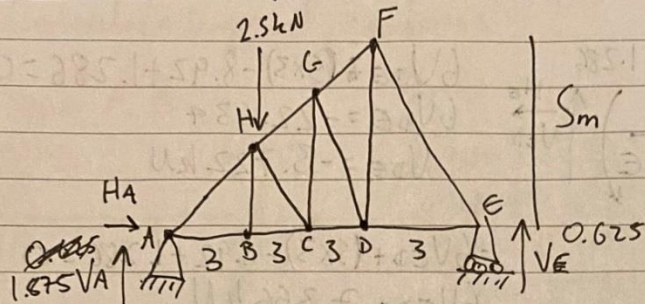
@ C = 17.172 kN

@ E = 7.366 kN

Q3-22

Question 5:

FE at end



~~tan 45 = y/x~~
~~tan 45 = y/3~~
~~y = 3~~

$$\sum H = 0$$

$$\therefore HA = 0$$

~~$$12VA - (3 \times 2.5) = 0$$~~

~~$$12VA = 7.5$$~~

~~$$VA = 0.625 \text{ kN}$$~~

$$12VA - (9 \times 2.5) = 0$$

$$12VA = 22.5$$

$$VA = 1.875$$

~~$$-12VE + (3 \times 2.5) = 0$$~~

(4)

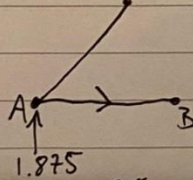
~~$$12VE - \sum V = 0$$~~

$$\therefore VA + VE - 2.5 = 0$$

$$VE = 2.5 - 1.875$$

$$VE = 0.625$$

↓ H



Take moments from H:

$$3F_{AB} + (3 \times 1.875) = 0$$

$$3F_{AB} = -4.875$$

$$F_{AB} = -1.625 \text{ (C)}$$

Take moments from C:

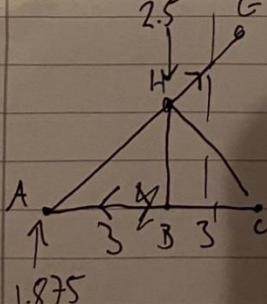
$$3F_{HG} - (3 \times 2.5) + (3 \times 1.875) = 0$$

$$3F_{HG} - 7.5 + 4.875 = 0$$

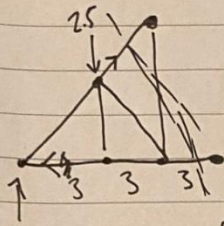
$$3F_{HG} = 2.625$$

$$F_{HG} = 0.875 \text{ (T)}$$

Take moments from



(2)



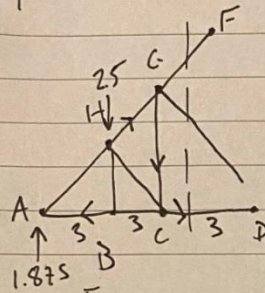
Take moments from H!

$$\frac{5}{3} = 1.666$$

$$3F_{GC} + (1.875 \times 3) + (1.666 \times 1.625) = 0$$

$$3F_{GC} = 8.332$$

$$F_{GC} = 2.777 \text{ (T)}$$



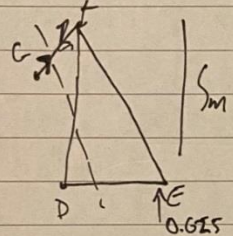
Take moments at G Take moments at G
Take moments at G

$$3.333$$

$$-3.333F_{CD} + (3.333 \times 1.625) + (1.875 \times 6) - (2.5 \times 3) = 0$$

$$3.333F_{CD} = -9.166$$

$$F_{CD} = -2.75 \text{ (C)}$$

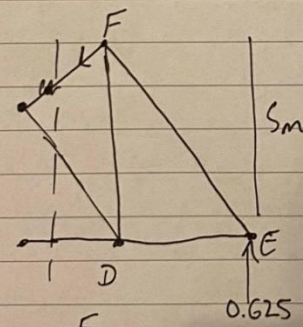


Take moments at D

$$5F_{GF} - (3 \times 0.625) = 0$$

$$5F_{GF} = 1.875$$

$$F_{GF} = 0.375 \text{ (T)}$$

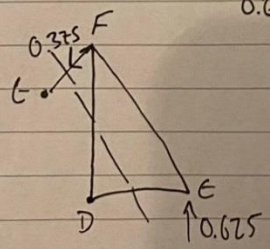


Take moments from F

$$3F_{ED} - 6(0.625) = 0$$

$$3F_{ED} = 3.75$$

$$F_{ED} = 1.25 \text{ (T)}$$



$$5F_{FE} - 5(0.375) - 3(0.625) = 0$$

$$5F_{FE} - 3.75 = 0$$

$$F_{FE} = 0.75 \text{ (T)}$$

Answers $F_{AB} = 1.625 \text{ kN (C)}$

$$F_{HG} = 0.875 \text{ kN (T)}$$

$$F_{GF} = 0.375 \text{ (T)} \quad F_{GC} = 2.777 \text{ kN (T)}$$

$$F_{CD} = 1.25 \text{ (T)} \quad F_{ED} = 2.75 \text{ kN (C)}$$

$$F_{FE} = 0.75 \text{ (T)}$$

Q5-12