

① Rhys Ratner (1803424) 14/1/21

60%

Q1 a) Pin Support Roller Support Fixed Support

b)

c) Determinate - These types of structures can be analysed by the basic equilibrium equation.

Indeterminate - These types of structures are unable to be analysed by the basic equilibrium equation.

d) $\sum F_x = 0$ Summation of vertical forces equals zero

$\sum F_y = 0$ Summation of horizontal forces equals to zero

$\sum M = 0$ Summation of moments must equal to zero

e) $r = 3n$ $r > 3n$ = indeterminate $r = 3n$ = determinate

f) $F1$ = Statically Indeterminate $r = 3, n = 1, 3 = 3$

$F2$ = Statically determinate to the second degree $r = 5, n = 1, 5 - 3(1) = 2$

$F3$ = Statically determinate $r = 6, n = 2, 6 = 3(2)$

$F4$ = Statically Indeterminate to the first degree $r = 10, n = 3, 10 - 3(3) = 1$

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③

②

g) Frame structures are structures that have a combination of beam, column and slab to resist lateral and gravity loads. Two types of classifications are rigid frames and under rigid.

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- rigid frame structure
- braced frame structure.

h) ~~rigid~~ rigid - Also known as perfect truss, is one which does not collapse and will remain in equilibrium under the action of external forces.

non rigid - imperfect truss. They do not obey the equation. They have a less lower number of members that are required or has a surplus member.

JD 15

100 205

I) $m = 2j - 3$ where m = number of members
 j = number of joints.

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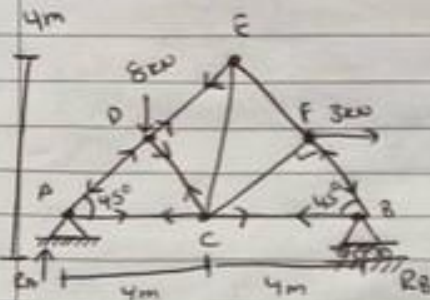
- J) i) Warren Truss
ii) Pratt Truss
iii) Howe Truss
iv) K-Truss
v) Fink Truss

⑤

1 - 31

(3)

Q4)



Support reactions @ B

$$\sum M_A = 0$$

$$R_B \times (4+4) + 3 \times 2 - 8 \times 2 = 0$$

$$8R_B - 3 \times 2 - 8 \times 2 = 0$$

$$8R_B = 22$$

$$R_B = 2.75 \text{ kN}$$

$$R_A = 8 - R_B$$

$$R_A = 8 - 2.75$$

$$R_A = 5.25 \text{ kN}$$

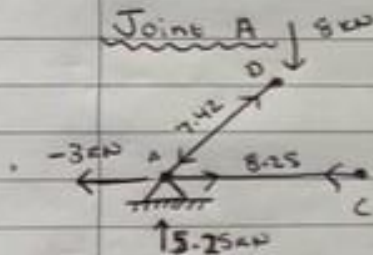
$$\sum M_A = 0$$

$$H_A + 3 = 0$$

$$H_A = -3$$

(6)

Joint A



$$\sum V_A = 0$$

$$5.25 + F_{AD} \sin 45 = 0$$

$$F_{AD} = \frac{5.25}{\sin 45}$$

$$\sin 45$$

$$F_{AD} = -7.42 \text{ (C)}$$

1 kN

$$\sum H = 0$$

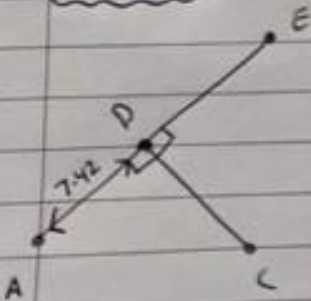
$$F_{AC} + F_{AD} \cos 45 - H_A = 0$$

$$F_{AC} - 3 - 7.42 \times \cos 45$$

$$F_{AC} = -8.25 \text{ (T)}$$

(3)

Joint D



$$\sum V_D = 0$$

$$8 - F_{DE} \sin 45 + F_{DC} \sin 45 - F_{AD} \sin 45 = 0$$

$$8 - 0.707 F_{DE} + 0.707 F_{DC} - 7.42 \times 0.707 = 0$$

$$2.75 - 0.707 F_{DE} + 0.707 F_{DC} = 0$$

$$\sum H_D = 0$$

$$F_{AD} \cos 45 + F_{DC} \cos 45 + F_{DE} \cos 45 = 0$$

$$5.25 + F_{DC} \cos 45 + 0.707 F_{DE} = 0$$

(4)

$$\Sigma V_F = 0$$

$$\frac{5.25 - 8}{\sin 45} + \frac{(FDE \sin 45)}{\sin 45} - \frac{(FDC \sin 45)}{\sin 45} = 0$$

$$FDE - FDC = \frac{2.75}{\sin 45}$$

$$FDE - FDC = 3.89 \quad (1)$$

$$\Sigma M_F = 0$$

$$FADC \cos 45 + FDE \cos 45 + FDC \cos 45 = 0$$

$$FDE + FDC = -742 \quad (2)$$

$$\text{Add (1) + (2)}$$

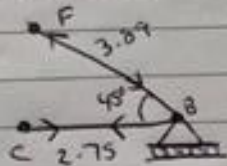
$$2FDE = -3.53$$

$$FDE = -1.77$$

$$-FDC = 3.89 (-1.77)$$

$$FDC = -5.66$$

Joint B



$$\Sigma M_B = 0$$

$$R_B + FBF \sin 45 = 0$$

$$FBF = \frac{2.75}{\sin 45}$$

$$FBF = 3.89 (L)$$

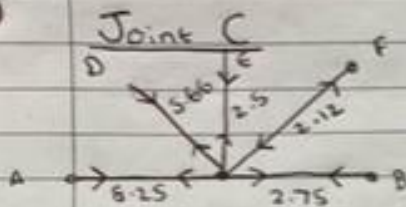
$$\Sigma M_B = 0$$

$$FBC + FBF \sin 45 = 0$$

$$FBC = -3.89 \sin 45$$

$$FBC = 2.75 (T)$$

5



$$\sum H_F = 0$$

$$-8.25 + (5.66 \cos 45^\circ) + 2.75 = 0$$

$$F_{FC} \cos 45^\circ = 8.25 - (5.66 \cos 45^\circ) - 2.75$$

$$F_{FC} = \frac{8.25 - (5.66 \cos 45^\circ) - 2.75}{\cos 45^\circ}$$

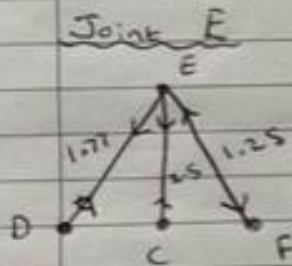
$$F_{FC} = 2.12 \text{ (T)}$$

$$\sum V_F = 0$$

$$(-5.66 \sin 45^\circ) + (F_{EC} \sin 45^\circ) + (2.12 \sin 45^\circ) = 0$$

$$F_{EC} = \frac{(5.66 \sin 45^\circ) - (2.12 \sin 45^\circ)}{\sin 45^\circ}$$

$$F_{EC} = 2.5 \text{ (T)}$$

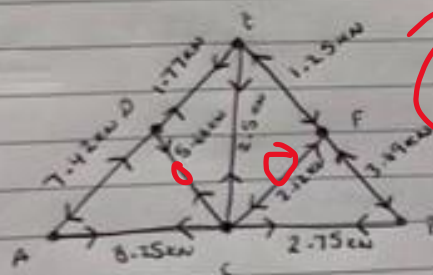


$$\sum H_F = 0$$

$$(-1.77 \cos 45^\circ) + F_{EF} = 0$$

$$F_{EF} = (-1.77 \cos 45^\circ)$$

$$F_{EF} = 1.25 \text{ (C)}$$



Q3 - 20

Q3

10 kN/m 30 kN $EI = \text{CONSTANT}$
 4 m 6 m 6 m 6 m
 A B D C E
 L

$AB (K_{AB}) = EI/L = 1/6$
 $BD (K_{BD}) = EI/L = 1/4$

Dist Factor $BA = K_{AB} / (K_{AB} + K_{AD})$
 $= 1/6 / (1/6 + 1/4)$
 $= 0.4$

Dist Factor $BD = K_{AD} / (K_{AB} + K_{AD})$
 $= 1/4 / (1/6 + 1/4)$
 $= 0.6$

$CD = K_{CD} = EI/L = 1/6$
 $DE = K_{DE} = EI/L = 1/6$

Dist Factor $DB = K_{BD} / (K_{BD} + K_{CD} + K_{DE})$
 $= 1/4 / (1/4 + 1/6 + 1/6)$
 $= 0.42$

Dist Factor $DC = K_{CD} / (K_{BD} + K_{CD} + K_{DE})$
 $= 1/6 / (1/4 + 1/6 + 1/6)$
 $= 0.29$

Dist Factor $DE = K_{DE} / (K_{BD} + K_{CD} + K_{DE})$
 $= 1/6 / (1/4 + 1/6 + 1/6)$
 $= 0.29$

Fixed End Moment = $FEM_{BD} = \frac{WL^2}{12} = \frac{(10 \times 4^2)}{12}$
 $= 13.3$
 $FEM_{DE} = \frac{PL}{8} = \frac{30 \times 6}{8}$
 $= 22.5 \text{ kN}$

15mm
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	A _B	B		D		E	E
		BA	BD	DA	DE	ED	ED
DF	0	0.4	0.6	0.42	0.29	0.29	0
FEM		0	13.3	-13.3	3.75	-3.75	0
Balance							
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