

LEVEL 4 ASSIGNMENT

Student Name:	MOHAMED ELHADI HUSSIEN SALIM
Student ID number:	2511440
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Lecturer:	Shaker Bitar
Internal Verifier:	Hannah Williams
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Method of joints

Question 1

(A)

$$\sum F_x = 0$$

$$A_x = 0$$

$$\sum F_y = 0$$

$$(20 \times 5) = (40 \times 10) - (C_y \times 20) = 0$$

$$100 + 400 + 20C_y$$

$$C_y = 25 \text{ kN}$$

$$\sum F_y = 0$$

$$A_y + 25 - 60 = 0$$

$$A_y = 35 \text{ kN}$$

$$\tan \theta = 5 \div 5 = 1$$

$$\theta = 45$$

Joint A

$$\sum F_y = 0$$

$$35 + F_{AD} \sin(45^\circ) = 0$$

$$F_{AD} = -35\sqrt{2} = -49.50 \text{ kN C}$$

$$\sum F_x = 0$$

$$F_{AB} + F_{AD} \cos(45^\circ) = 0$$

$$F_{AB} - 35 = 0$$

$$F_{AB} = 35 \text{ kN T}$$

Joint B

$$\sum F_y = 0$$

$$F_{BD} \sin 45^\circ + F_{BE} \sin 45^\circ = 0$$

$$F_{BE} = -F_{BD} = -(-5\sqrt{2}) = 7.07 \text{ KN T}$$

Joint C

$$\sum F_Y = 0$$

$$25 + F_{CE} \sin(45^\circ) = 0$$

$$F_{CE} = -25\sqrt{2} = -35.36 \text{ KN C}$$

$$\sum F_X = 0$$

$$-F_{BC} - F_{CE} \cos(45^\circ) = 0$$

$$-F_{BC} + 25 = 0$$

$$F_{BC} = 25 \text{ KN T}$$

Joint F

$$\sum F_X$$

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

$$F_{DF} = F_{EF}$$

$$\sum F_Y = 0$$

$$-40 - 2 F_{DF} \sin(45^\circ) = 0$$

$$F_{DF} = -20\sqrt{2} = -28.28 \text{ KN C}$$

$$F_{EF} = 28.28 \text{ KN C}$$

Joint D

$$\sum F_Y = 0$$

$$F_{DF} \sin 45^\circ - F_{DA} \sin 45^\circ - F_{DB} \sin 45^\circ - 20 = 0$$

$$-20 + 35 - F_{DB} (1/\sqrt{2}) - 20 = 0 \quad -F_{DB} = -5\sqrt{2} = 7.07 \text{ KN C}$$

$$\sum F_X = 0$$

$$F_{DE} + F_{DF} \cos 45^\circ + F_{DB} \cos 45^\circ - F_{AD} \cos 45^\circ = 0$$

$$F_{DE} - 20 - 5 + 35 = 0$$

$$F_{DE} = -10 \text{ KN C}$$

2 TRUSS

(B)

$$\sum F_Y = 0$$

$$40(5) + 40(10) + 40(15) - E_X(5) = 0$$

$$E_X = 240 \text{ KN}$$

$$\sum F_X = 0$$

$$A_X + E_X = 0$$

$$A_X = -240 \text{ KN}$$

$$\sum F_X = 0$$

$$A_Y + E_Y - 3(40) = 0$$

$$E_Y = 80 \text{ KN}$$

$$A_Y = 40 \text{ KN}$$

Joint D

$$\sum F_Y$$

$$-40 + F_{GD} \sin(18.4^\circ) = 0$$

$$\sum F_X - F_{CD} - F_{GD} \cos(18.4^\circ) = 0$$

$$F_{GD} = -126.5 \text{ C}$$

$$F_{CD} = 120 \text{ T}$$

Joint C

$$\sum F_Y$$

$$-40 - F_{CG} = 0$$

$$\sum F_X$$

$$F_{CD} - F_{BC} = 0$$

$$F_{CG} = 40 \text{ C}$$

$$F_{BC} = 120 \text{ T}$$

Joint G

$$\sum F_X$$

$$F_{GD} \cos \theta - F_{GB} \cos \theta - F_{GF} \cos \theta = 0$$

$$\sum F_Y$$

$$F_{GD} \sin \theta + F_{CG} + F_{GB} \sin \theta - F_{GF} \sin \theta = 0$$

$$F_{GB} = 63.2 \text{ T}$$

$$F_{GF} = 189.7 \text{ C}$$

$$\sum F_Y$$

$$F_{GD} \sin \theta + F_{CG} + F_{GB} \sin \theta - F_{GF} \sin \theta = 0$$

$$F_{GF} = 189.7 \text{ C}$$

$$F_{BF} = 60 \text{ C}$$

Joint B

$$\sum F_Y$$

$$-40 - F_{BF} - F_{BG} \sin \theta = 0$$

$$\sum F_X$$

$$F_{BC} - F_{AB} + F_{BG} \cos \theta = 0$$

$$F_{BF} = -60 \text{ C}$$

$$F_{AB} = 180 \text{ T}$$

Joint F

$$\sum F_X$$

$$F_{FG} \cos \theta_{ED} - F_{FE} \cos \theta_{ED} - F_{FA} \cos \theta_{AF} = 0$$

$$\sum F_Y$$

$$F_{FG} \sin \theta_{ED} + F_{FB} - F_{FE} \sin \theta_{ED} + F_{FA} \sin \theta_{AF} = 0$$

$$F_{FA} = 72.1 \text{ T}$$

$$F_{EF} = -253 \text{ C}$$

Question 2

(A)

$$\text{TOTAL VERTICAL LOAD} = 20\text{KN} + 20\text{KN} + 20\text{KN} = 60\text{KN}$$

$$A_Y = E_Y = 60\text{KN}/2 = 30\text{KN}$$

METHOD OF SECTIONS

HG

$$\sum M_C = 0$$

$$30\text{KN} \times 4 \text{ M} - 20 \text{ KN} \times 120 - 40 + 3.46 F_G = 0$$

$$F_{HG} = -80/3.46 = 23.1\text{KN C}$$

JC

$$F_{JC} = 10\text{KN}/\sin 60^\circ = 11.5\text{KN}$$

(B)

$$\sum M_A = 0$$

$$(60 \text{ KN} \cdot 6\text{M}) + (50 \text{ KN} \cdot 3\text{M}) - (C_Y \cdot 12\text{M}) = 0$$

$$360$$

$$150 = 12C_Y$$

$$C_Y = 422.5\text{KN}$$

$$\sum F_Y = 0$$

$$A_Y + C_Y - 60 \text{ KN} = 0$$

$$A_Y = 42.5 - 60 = 0$$

$$A_Y = 17.5\text{KN}$$

$$\sum F_X = 0$$

$$A_X + 50 \text{ KN} = 0$$

$$A_X = -50 \text{ kN}$$

$$\sum F_X = F_{FC} \cos \theta - F_{DF} \cos \theta + 50 = 0$$

$$\sum F_Y = C_Y + F_{CD} \sin 45^\circ = 0$$

$$42.5 + F_{CD} (0.707) = 0$$

$$F_{CD} = -60.1 \text{ kN (C)}$$

$$F_{CH} = 42.5 \text{ kN (T)}$$

$$F_{CF} = 60.1 \text{ kN (C)}$$

$$\sum F_X = 50 + F_{FC} \cos 45^\circ - F_{DF} \cos 45^\circ = 0$$

$$50 + (-60.1 \cdot 0.707) = F_{DF} (0.707)$$

$$50 - 42.5 = 0.707 F_{DF}$$

$$F_{DF} = 10.61 \text{ kN (T)}$$

$$\sum F_Y = 17.5 + F_{AE} \sin 45^\circ = 0$$

$$F_{AE} = -24.75 \text{ kN (C)}$$

$$\sum M_D = 0 \quad (17.5 \cdot 6) - (50 \cdot 6) + (F_{GB} \cdot 12) = 0$$

$$F_{DG} = 24.75 \text{ kN (T)}$$

$$D_G = 24.75 \text{ kN (T)}$$

$$D_F = 10.61 \text{ kN (T)}$$

Question 3 (A)

$$\sum MC = 0$$

$$-10 \text{ KN} \cdot \text{M} = (300 \text{ KN} \times 2 \text{ M}) - (RD \times 8 \text{ M}) = (50 \text{ KN} \times 12 \text{ M}) = 0$$

$$-10 + 600 - 8RD + 600 = 0$$

$$1190 = 8RD$$

$$RD = 148.75 \text{ KN}$$

$$\sum FY = 0$$

$$RC + 148.75 - 350 = 0$$

$$RC = 201.25 \text{ KN}$$

SFD

$$X = 0 \text{ TO } 4 \text{ M}$$

$$V(X) = -25X. \text{ AT } X = 4 -$$

$$V = -100 \text{ KN}$$

$$\text{AT } X = 4 \text{ M } RC \quad V = -100 + 201.25 = 101.25 \text{ KN.}$$

$$X = 4 \text{ TO } 12 \quad V(X) = 101.25 - 25(X - 4)$$

$$\text{SHEAR AT } 0$$

$$101.25 = 25(X - 4)$$

$$X = 8.5 \text{ M}$$

$$\text{AT } X = 12 - V = N \quad 101.25 - 200 = -98.75 \text{ KN}$$

$$\text{AT } X = 12 \text{ M } RD \quad V = -98.75 + 148.75 = 50 \text{ KN}$$

$$X = 12 \text{ TO } 16 \text{ M } V = 50 \text{ KN AT } X = 16 - V = 50 \text{ KN}$$

BMD

$$X = 0$$

$$M = -10 \text{ KN}$$

$$X = 4 \text{ M } M = -10 - (25 \times 4 \times 2) = -210 \text{ KN}$$

$$X = 12 \text{ M } M = -210 + 101.25(8) - 12.5(8)^2 = -200 \text{ KN M}$$

$$X = 16 \text{ M } M - 200 + (50 \times 4) = 0$$

(B)

$$(FY) 80 \sin (60^\circ) = 96.28 \text{ KN}$$

$$(FX) 80 \cos (60^\circ) = 40 \text{ KN}$$

$$\sum M_L = 0$$

$$(60 \times 5) + (96.28 \times 10) + (50 \times 15) - (R_P \times 20) = 0$$

$$300 + 962.8 + 750 = 20 R_P$$

$$R_P = 87.14 \text{ KN} \uparrow$$

$$\sum F_Y = 0$$

$$R_{LY} - 60 - 96.28 - 50 = 0$$

$$R_{LY} = 206.28 \text{ KN} \uparrow$$

$$\sum F_X = 0$$

$$R_{LX} - 40 = 0$$

$$R_{LX} = 40 \text{ KN} \rightarrow$$

ff

