Carleton University

Department of
Civil & Environmental
Engineering

CIVE3203
Introductory Structural Analysis

Assignment HW#2
Oct 11, 2019
Solution

#pages: 6 + cover

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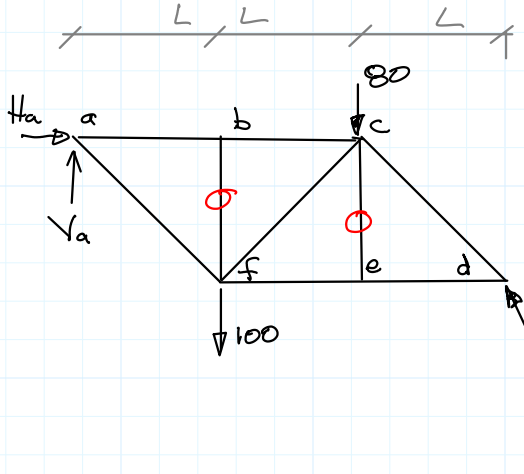
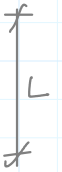
Oct 7/2019

Question 1





By inspection
$T_{bf} = T_{ec} = 0$
$T_{bc} = T_{ab}$
$T_{ef} = T_{ed}$

$\theta = \tan^{-1}\frac{1}{3} = 18.435°$
$\cos\theta = 3/\sqrt{10}$
$\sin\theta = 1/\sqrt{10}$

$\Sigma M_a = 0 \quad (+\circlearrowleft)$

$-80 \times 2L - 100 \times L - R_d\left(\frac{1}{\sqrt{10}}\right)L + R_d\left(\frac{3}{\sqrt{10}}\right)3L = 0$

$R_d \frac{8}{\sqrt{10}} = 260$

$R_d = 102.77 \quad (\therefore \uparrow)$

$\Sigma F_x = 0 \quad +\rightarrow$

$H_a - R_d \frac{1}{\sqrt{10}} = 0$

$H_a = 102.77 \times \frac{1}{\sqrt{10}}$

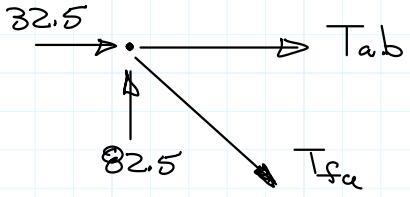
$H_a = 32.5 \quad (\therefore \rightarrow)$

$\Sigma F_y = 0 \quad +\uparrow$

$V_a - 80 - 100 - R_d \frac{3}{\sqrt{10}} = 0$

$V_a = 82.5 \quad (\therefore \uparrow)$

Joint a



$\Sigma F_y = 0 \quad +\uparrow$

$+82.5 - T_{fa}\frac{1}{\sqrt{2}} = 0$

$T_{fa} = 116.7 \quad (\therefore T)$

$\Sigma F_x = 0 \quad +\rightarrow$

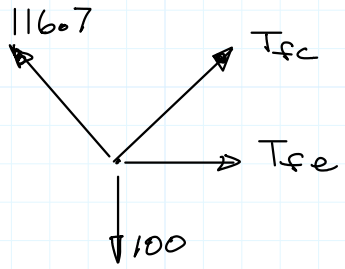
$+32.5 + T_{ab} + T_{fa}\frac{1}{\sqrt{2}} = 0$

$T_{ab} = -32.5 - 116.7\frac{1}{\sqrt{2}} = 0$

$T_{ab} = -115 \quad (\therefore C)$

$\therefore$ $T_{bc} = -115$ (C)

joint f



$\Sigma F_y = 0$ $+\uparrow$

$116.7 \times \frac{1}{\sqrt{2}} + T_{fc} \times \frac{1}{\sqrt{2}} - 100 = 0$

$T_{fc} = 24.75$ (T)

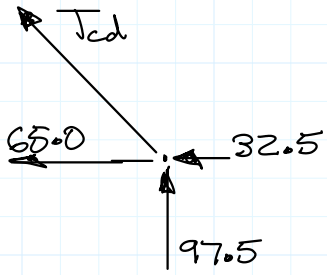
$\Sigma F_x = 0$ $\rightarrow +$

$-116.7 \times \frac{1}{\sqrt{2}} + 24.75 \times \frac{1}{\sqrt{2}} + T_{fe} = 0$

$T_{fe} = 65.0$ (T)

$\therefore$ $T_{ed} = 65.0$ (T)

joint d



$\Sigma F_y = 0$ $+\uparrow$

$T_{cd} \frac{1}{\sqrt{2}} + 97.5 = 0$

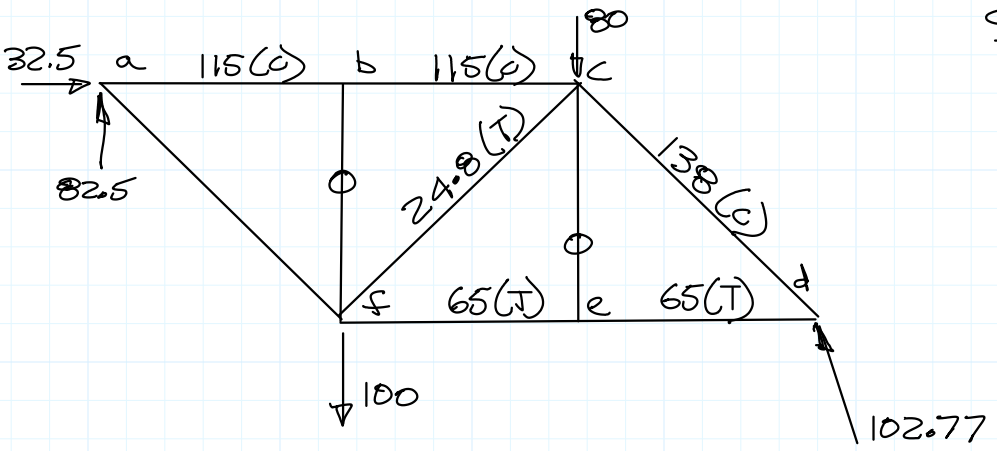
$T_{cd} = -137.9$ (C)

check $\Sigma F_x = -65.0 - 32.5 - \frac{T_{cd}}{\sqrt{2}}$

$= -65.0 - 32.5 + \frac{137.9}{\sqrt{2}}$

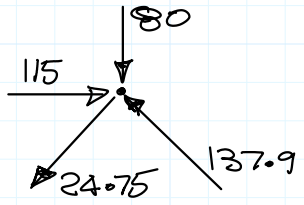
$= 0.01 \approx 0$ Ok.

Summary



check joint c (over)

joint c (check)



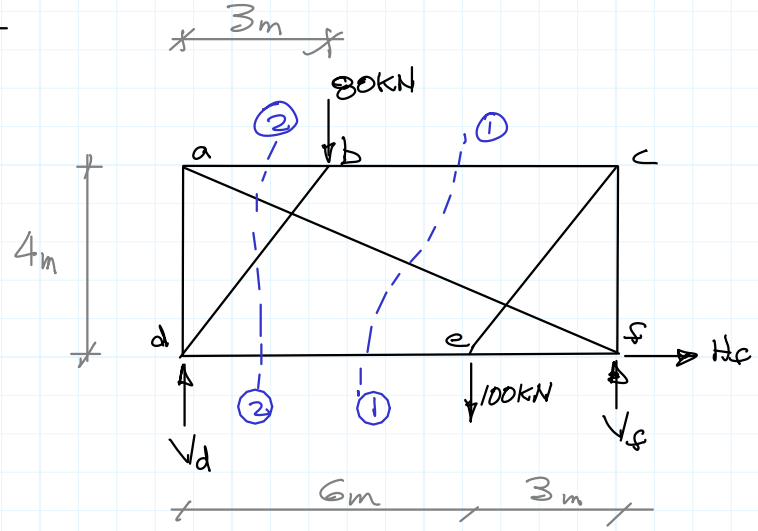
$$\Sigma F_x = 115 - 137.9\frac{1}{\sqrt{2}} - 24.75\frac{1}{\sqrt{2}}$$

$$= -0.01 \quad \text{OK.}$$

$$\Sigma F_y = -80 + 137.9\frac{1}{\sqrt{2}} - 24.75\frac{1}{\sqrt{2}}$$

$$= 0.01 \quad \text{OK.}$$

Question 2



$\Sigma M_d = 0$ (+↺)

$-80\times3 - 100\times6 + V_f\times9 = 0$

$V_f = 93.33\ kN$ (∴ ↑)

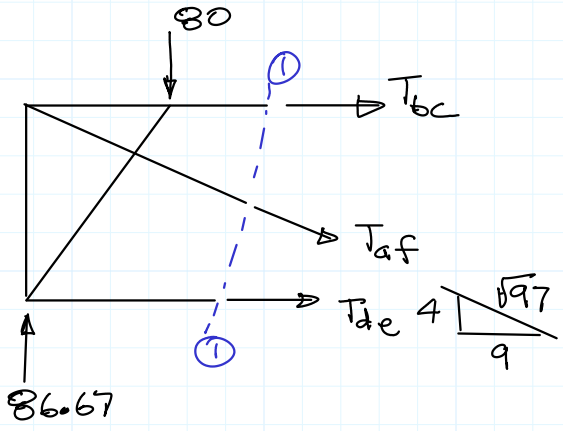
$\Sigma F_y = 0$ +↑

$V_d + 93.33 - 80 - 100 = 0$

$V_d = 86.67\ kN$ (∴ ↑)

by inspection $H_f = 0$

Section ① - ①



$\Sigma F_y = +\uparrow$

$+86.67 - 80 - \frac{4}{\sqrt{97}} T_{af} = 0$

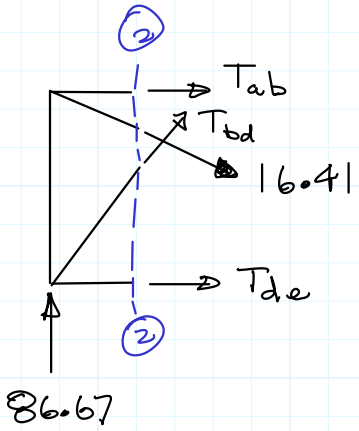
$T_{af} = 16.41\ kN$ (∴ T)

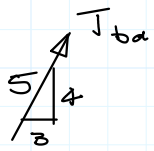
$\Sigma M_f = 0$ (+↺)

$80\times6 - 86.67\times9 - T_{bc}\times4 = 0$

$T_{bc} = -75\ kN$ (∴ C)

Section ②-②



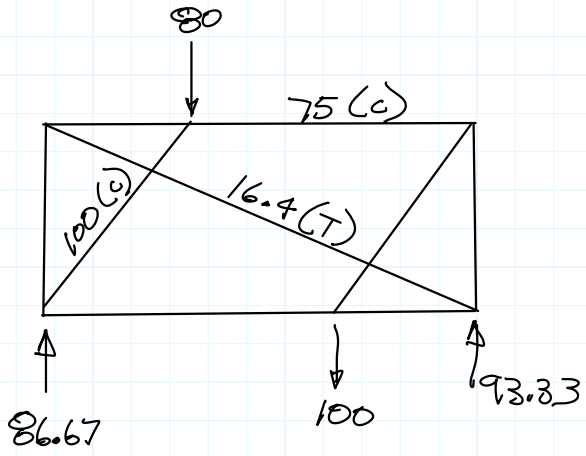


$$\Sigma F_y = 0 \quad +\uparrow$$

$$86.67 - 16.41 \times \frac{4}{\sqrt{97}} + T_{bd}\frac{4}{5} = 0$$

$$T_{bd} = -100 \quad (\text{e.o. C})$$

Summary



Marking Scheme:

Question 1

1 mark for 3 reactions
1 mark each for 9 member forces
/10

Deduct up to 3/10 if not properly summarized in a table or on a sketch.

Question 2

1 marks for 3 reactions
3 marks each for 3 member forces
/10

Deduct up to 3/10 if not properly summarized in a table or on a sketch.

Overall Mark Deductions:

up to -5/20 for untidy, disorganized, hard to read work

-3/20 no cover page

-3/20 improper paper (i.e, not quad paper with titleblock each page)