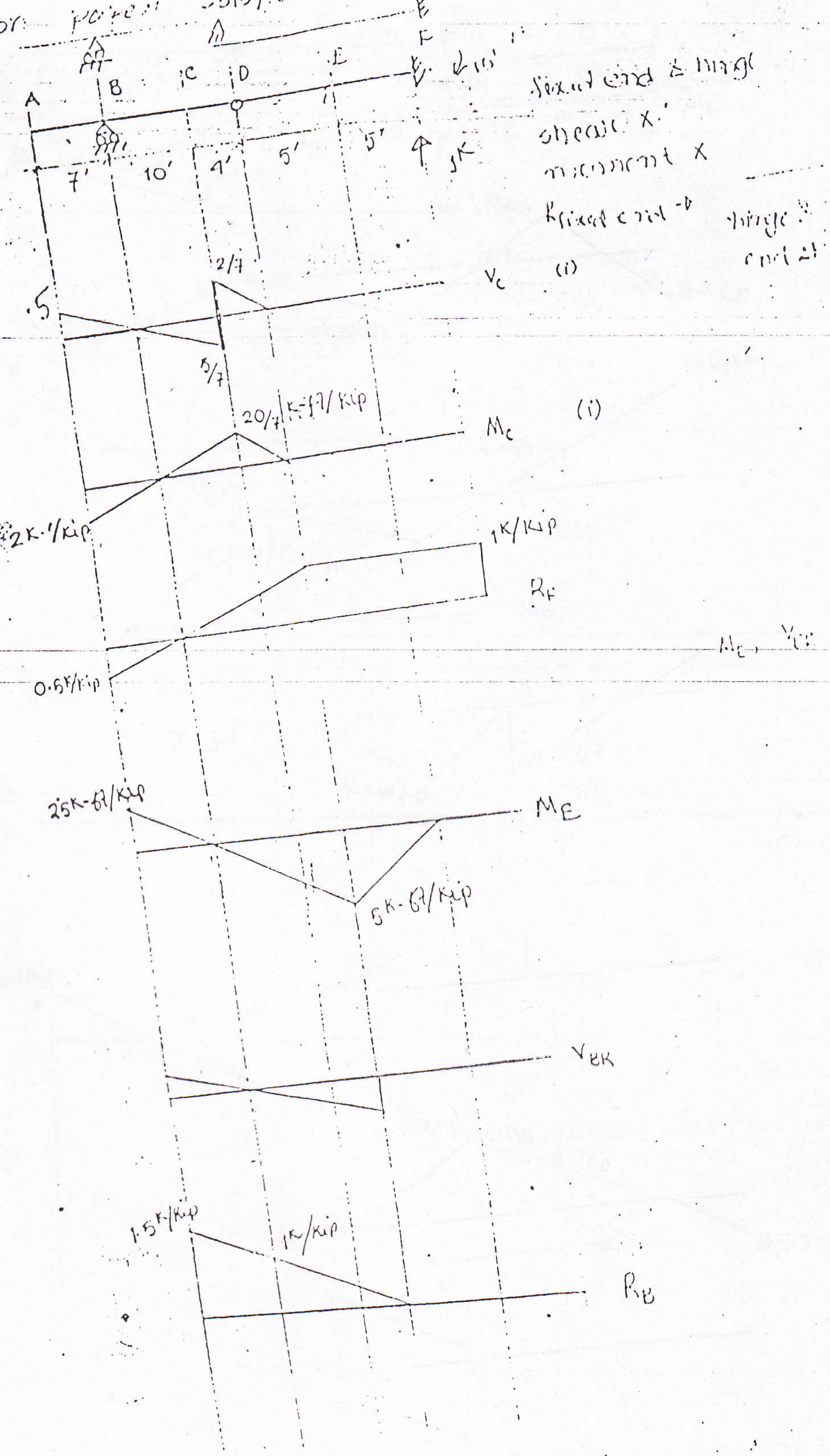
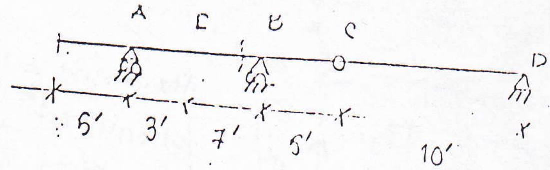
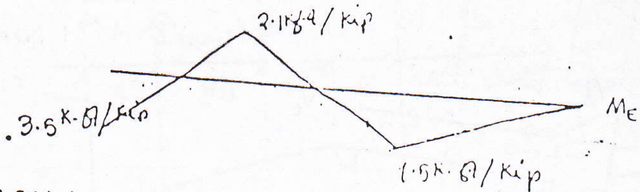
Question paper solution

95-96 (*)

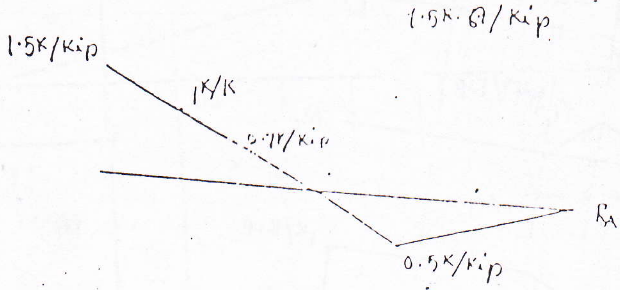


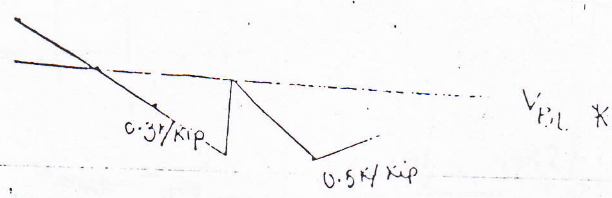


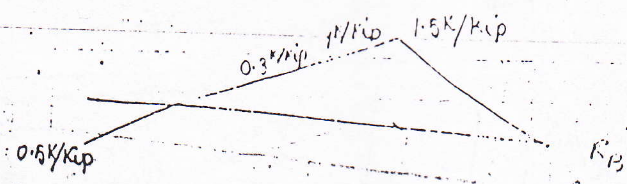
M_E, R_A, V_{BL}, V_{BR}



* full diagram



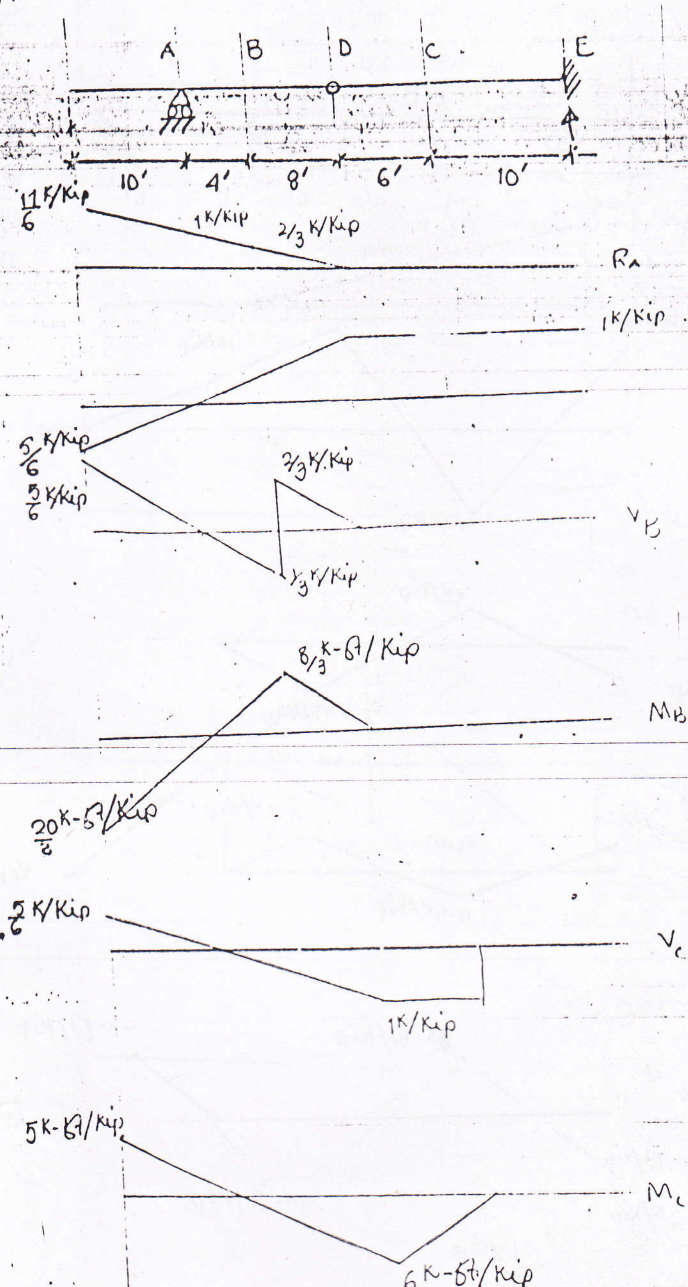


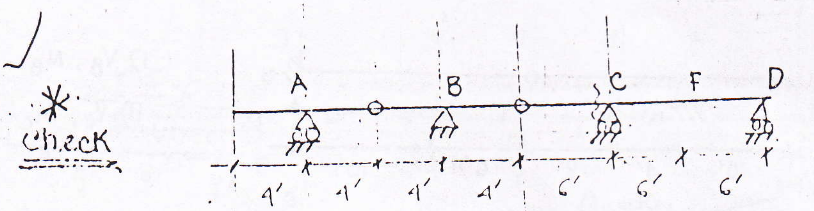


98-99

I) V_B, M_B

II) V_C, M_C



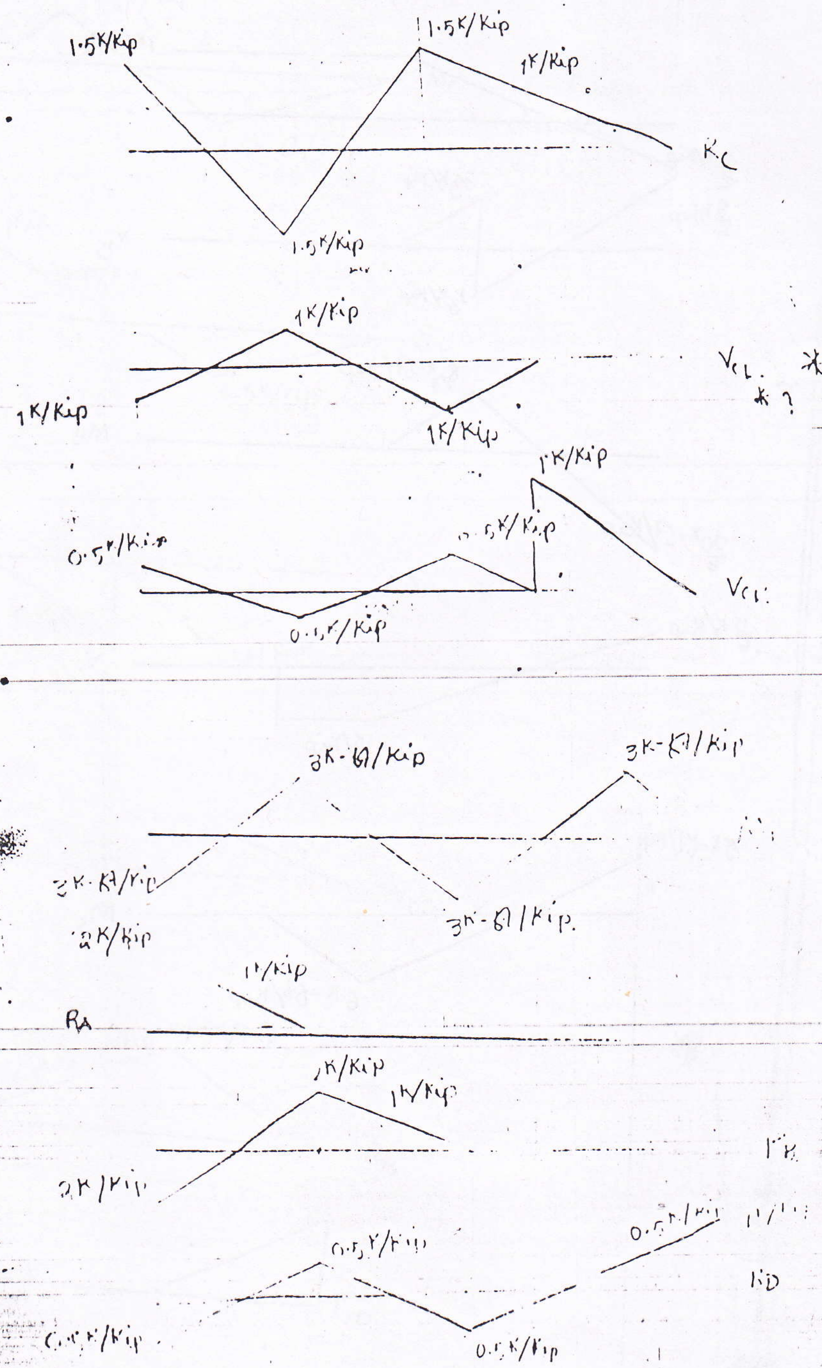


I) R_C

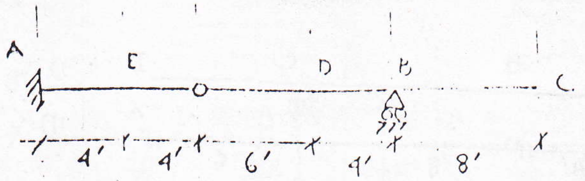
II) V_{CL}

III) V_{CR}

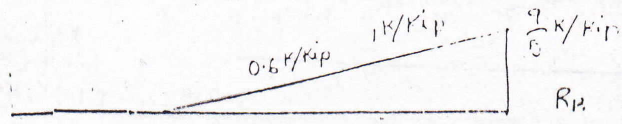
IV) M_F

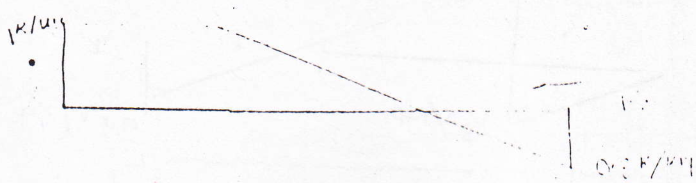


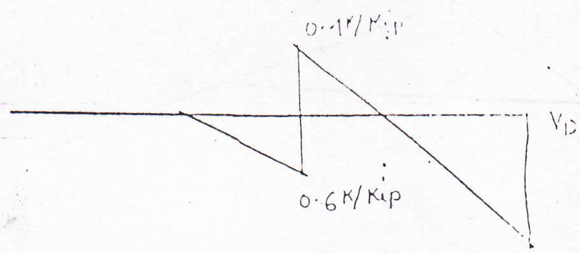
92-93

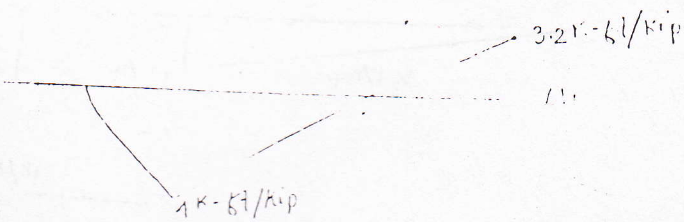


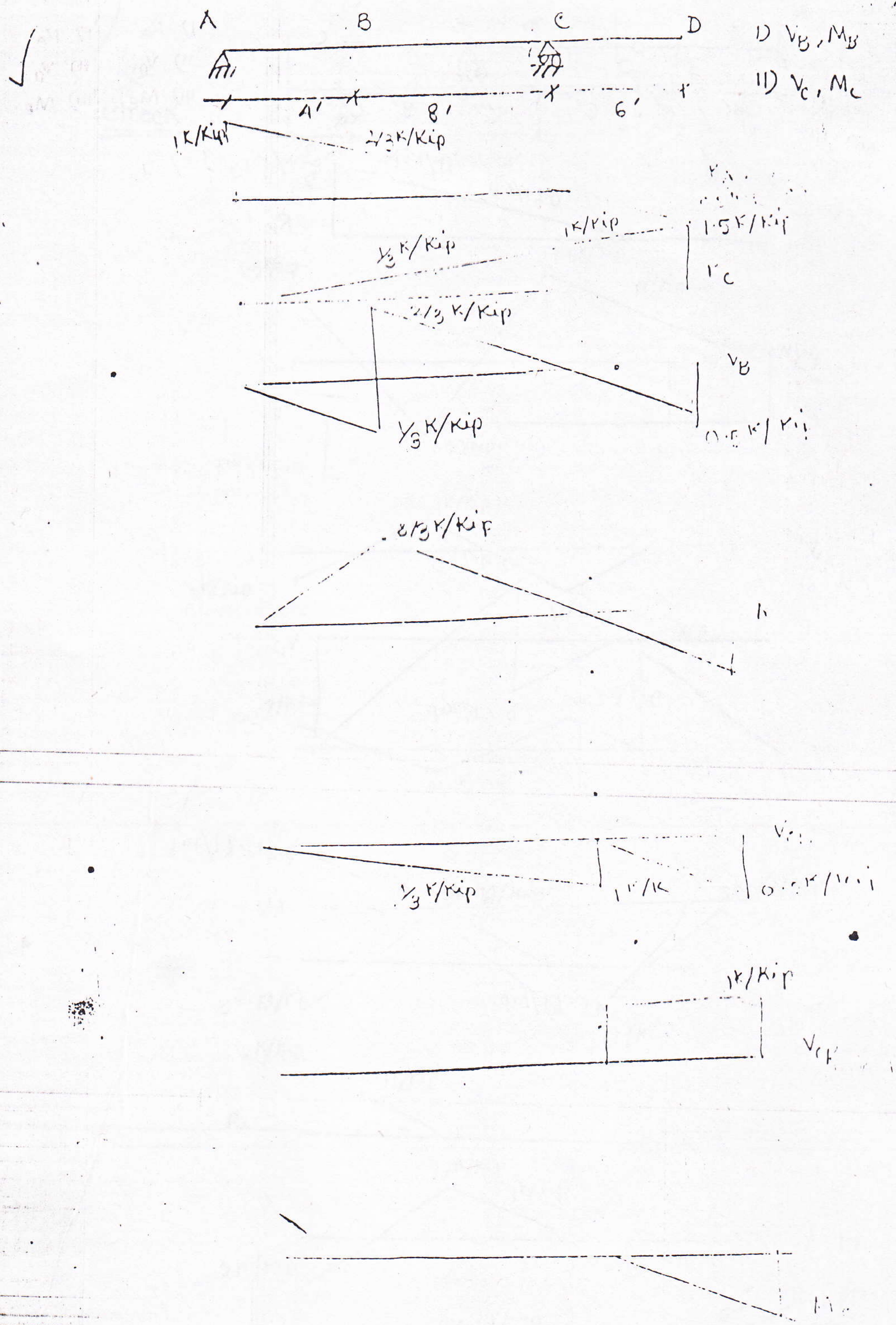
i) R_A
ii) V_D
iii) M_E



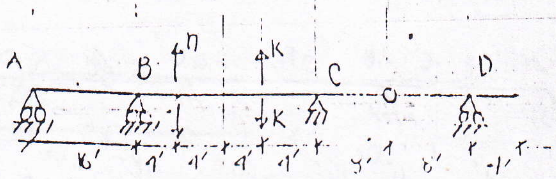








A
B
C
D
I) V_B, M_B
II) V_C, M_C
4'
8'
6'
1 K/Kip
2/3 K/Kip
1/3 K/Kip
1 K/Kip
1.5 K/Kip
V_C
2/3 K/Kip
V_B
1/3 K/Kip
8/3 K/Kip
1/3 K/Kip
1 K/K
1 K/Kip



I) R_B

II) V_{BL}

III) V_{BR}

IV) M_{n-n}

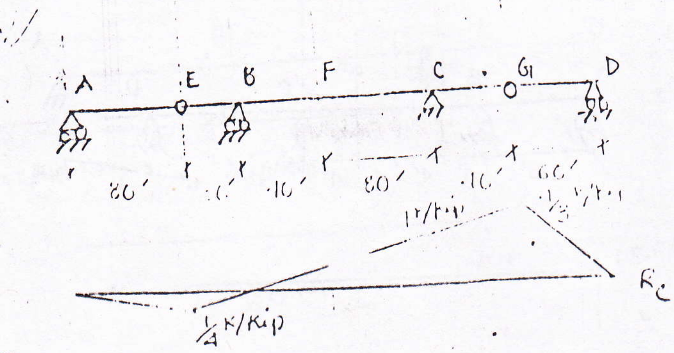
V) M_{k-k}

i) R_c

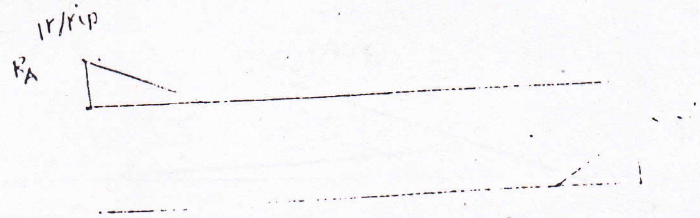
ii) V_{BL}

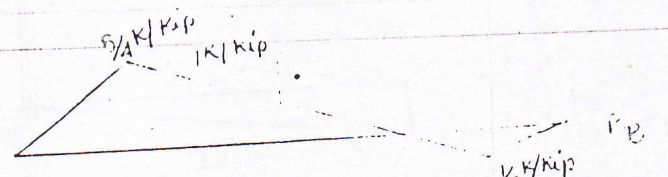
iii) M_B

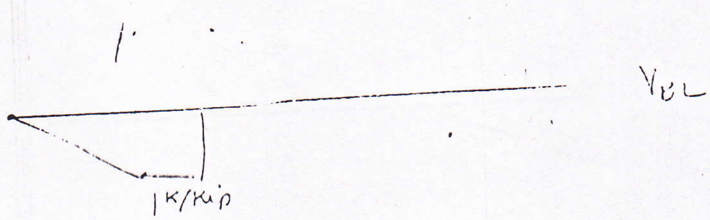
iv) Pin Reaction at F

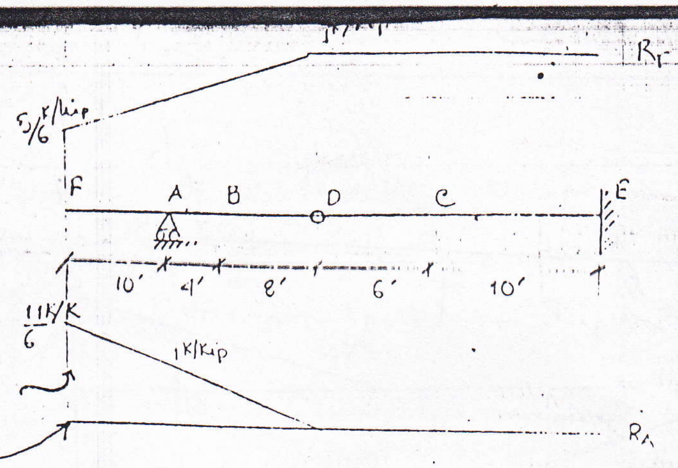


(M_F) * ?

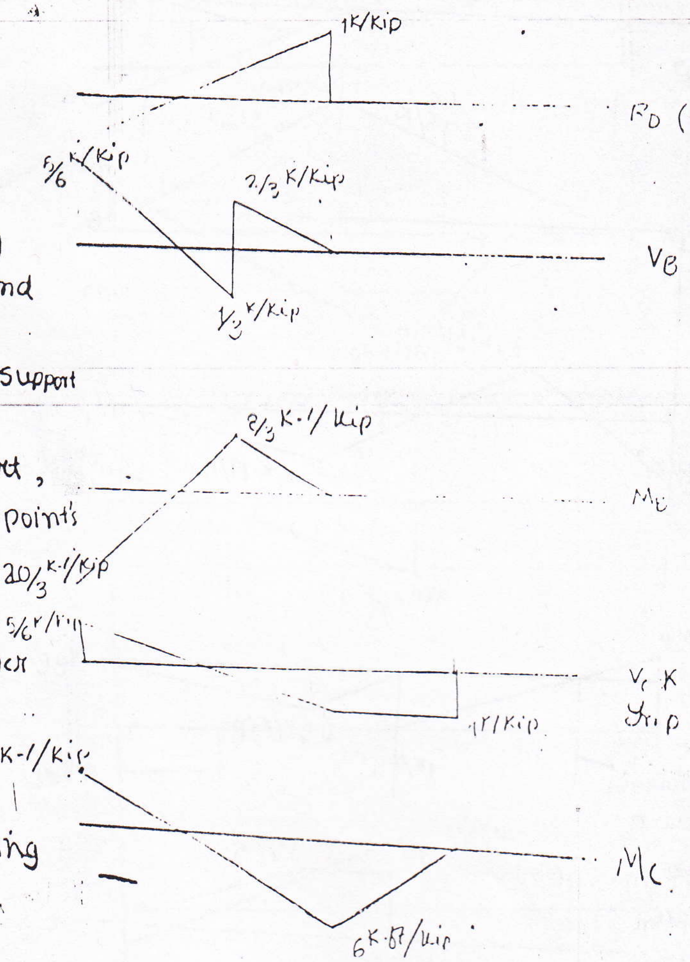








Reactⁿ at point A when load (1K) applied at F



Another part (not the part of fixed support) hinge upto shear and moment diagram.

V or M (moment at support must be zero.

Moment at another part,

I) find the left most point's moment.

II) then draw straight line considering other condition.

Load at	V_C
F to A	$-1 + R_A = -1$
A to D	$-1 + R_A = R_A$
D to C	$-1 + R_A = R_A$
to E	

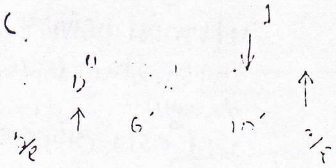
Shear IL for fixed portion

I) Left most value using reaction IL then.

II) Join upto hinge

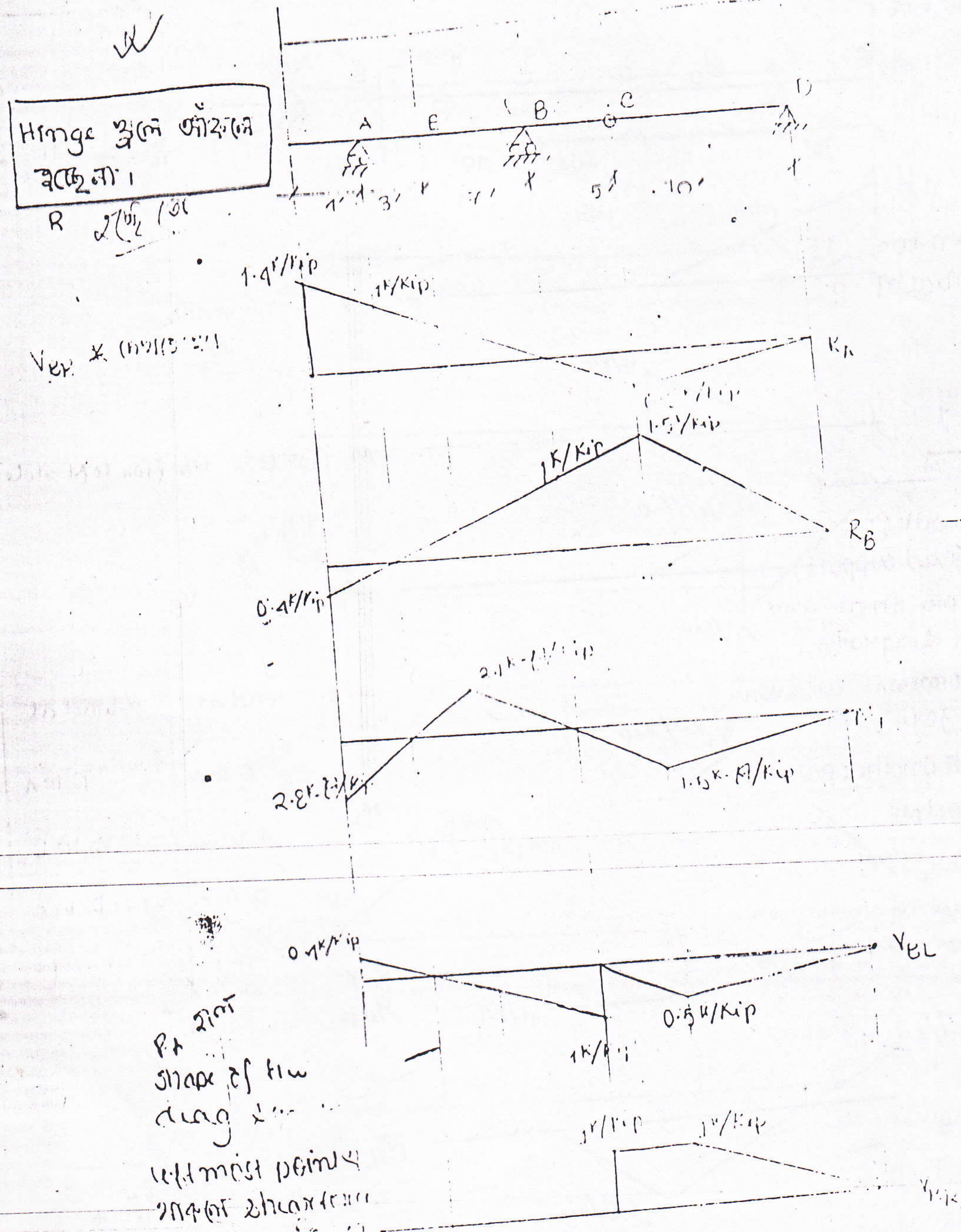
III) no shear after that point to fixed support

Sure that, fixed support reaction

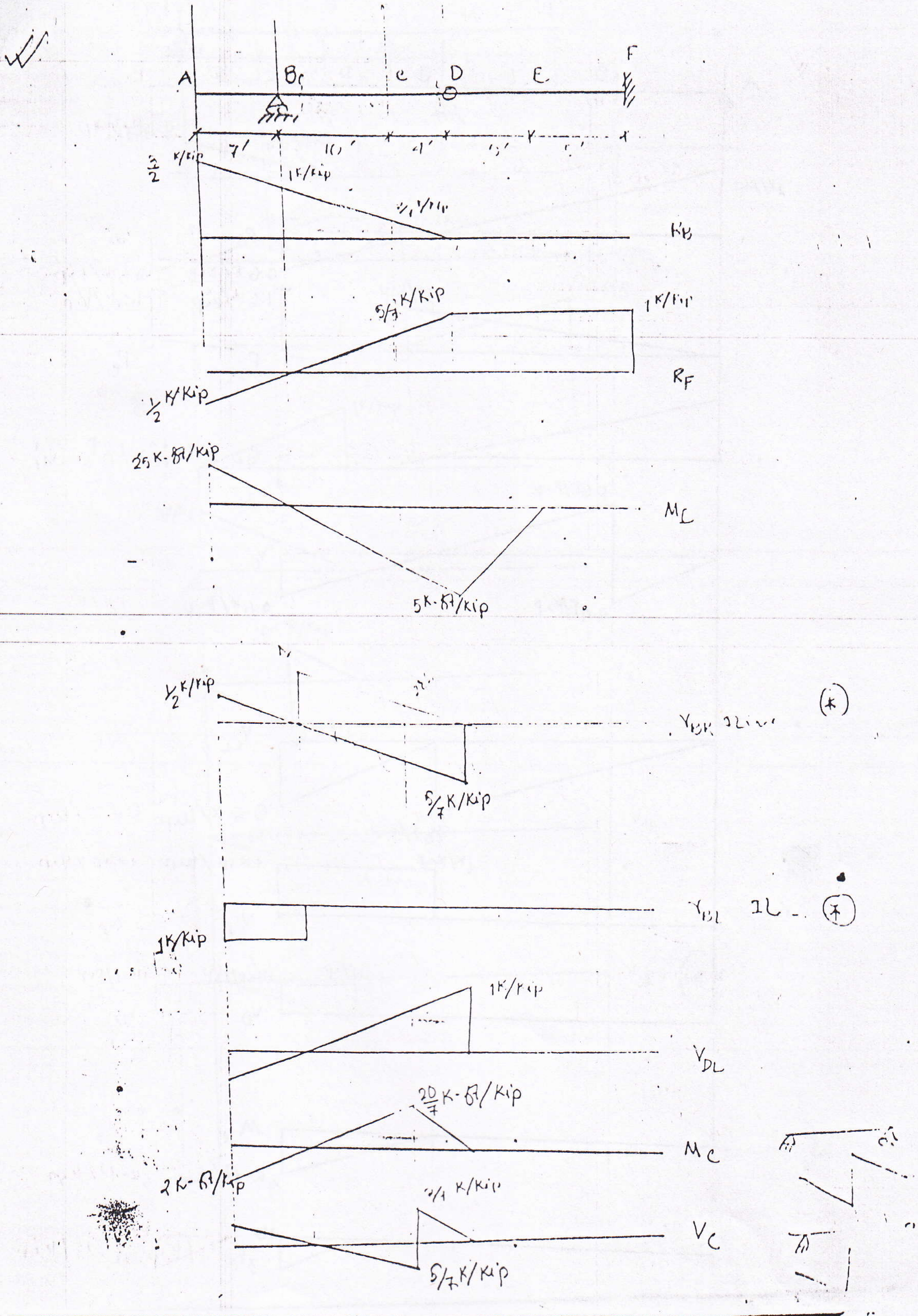


Moment^IL at fixed support portion

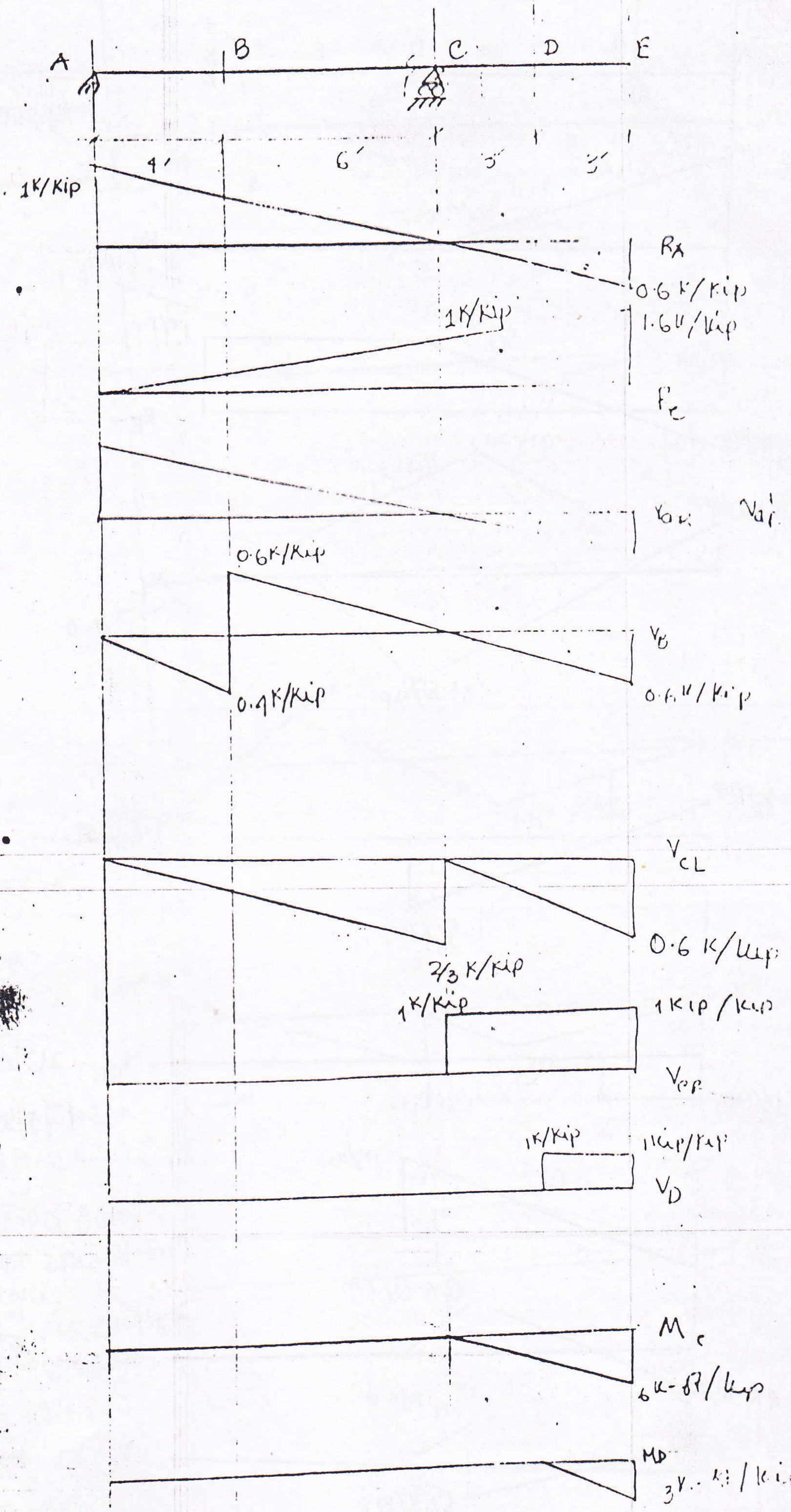
I) Left most point using 1K load and support reaction hinge → moment value maximum.



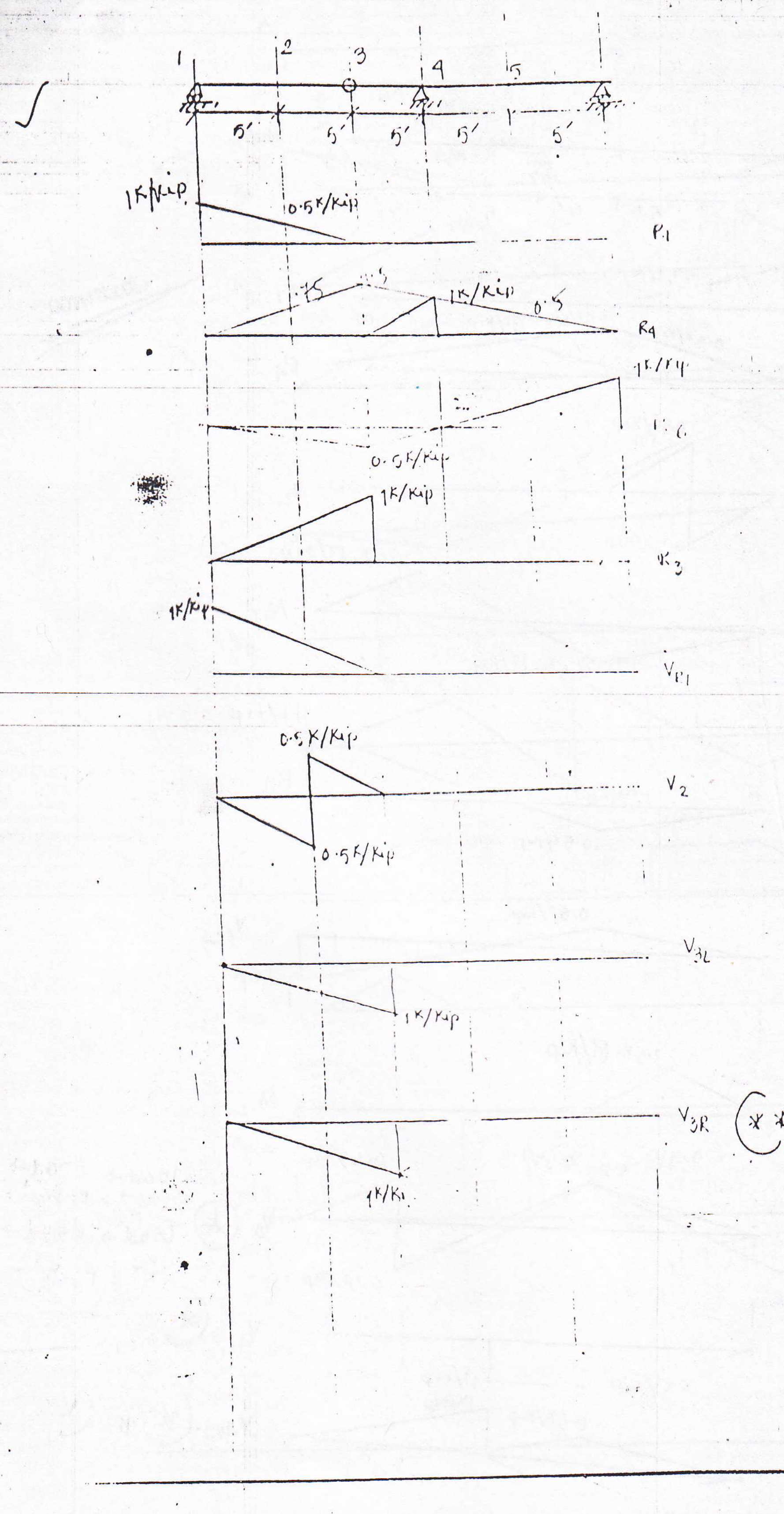
Hinge থাকলে আঁকতে হবেনা।
A
E
B
C
D
1.4k/Kip
1k/Kip
V_{ER}
R_A
1.5k/Kip
1k/Kip
R_B
0.4k/Kip
2.8k-ft/Kip
1.5k-ft/Kip
0.4k/Kip
V_{BL}
0.5k/Kip
1k/Kip
1k/Kip
1k/Kip
V_{BR}



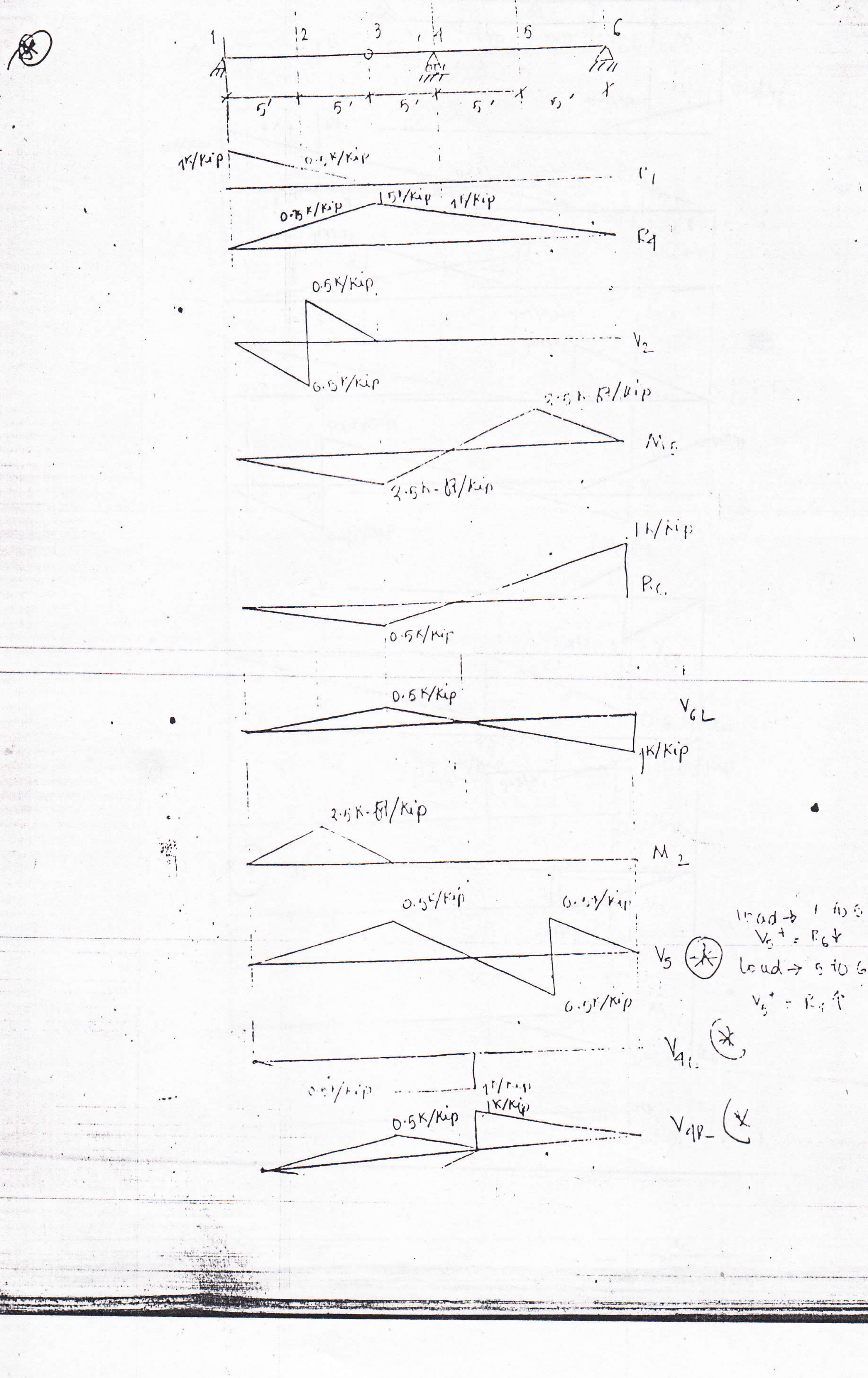
A
B
C
D
E
F
7'
10'
4'
1K/Kip
5/7 K/Kip
R_B
1 K/Kip
1/2 K/Kip
R_F
25 K-ft/Kip
M_L
5K-ft/Kip
1/2 K/Kip
5/7 K/Kip
1K/Kip
V_DL
20/7 K-ft/Kip
M_C
2K-ft/Kip
5/7 K/Kip
V_C



A
B
C
D
E
4'
6'
5'
5'
1K/Kip
RA
0.6K/Kip
1.6K/Kip
1K/Kip
FC
VAR
0.6K/Kip
VB
0.4K/Kip
0.6K/Kip
VCL
0.6 K/Kip
2/3 K/Kip
1K/Kip
1 Kip/Kip
VCR
1K/Kip
1Kip/Kip
VD
MC
6K-ft/Kip
MD
3K-ft/Kip



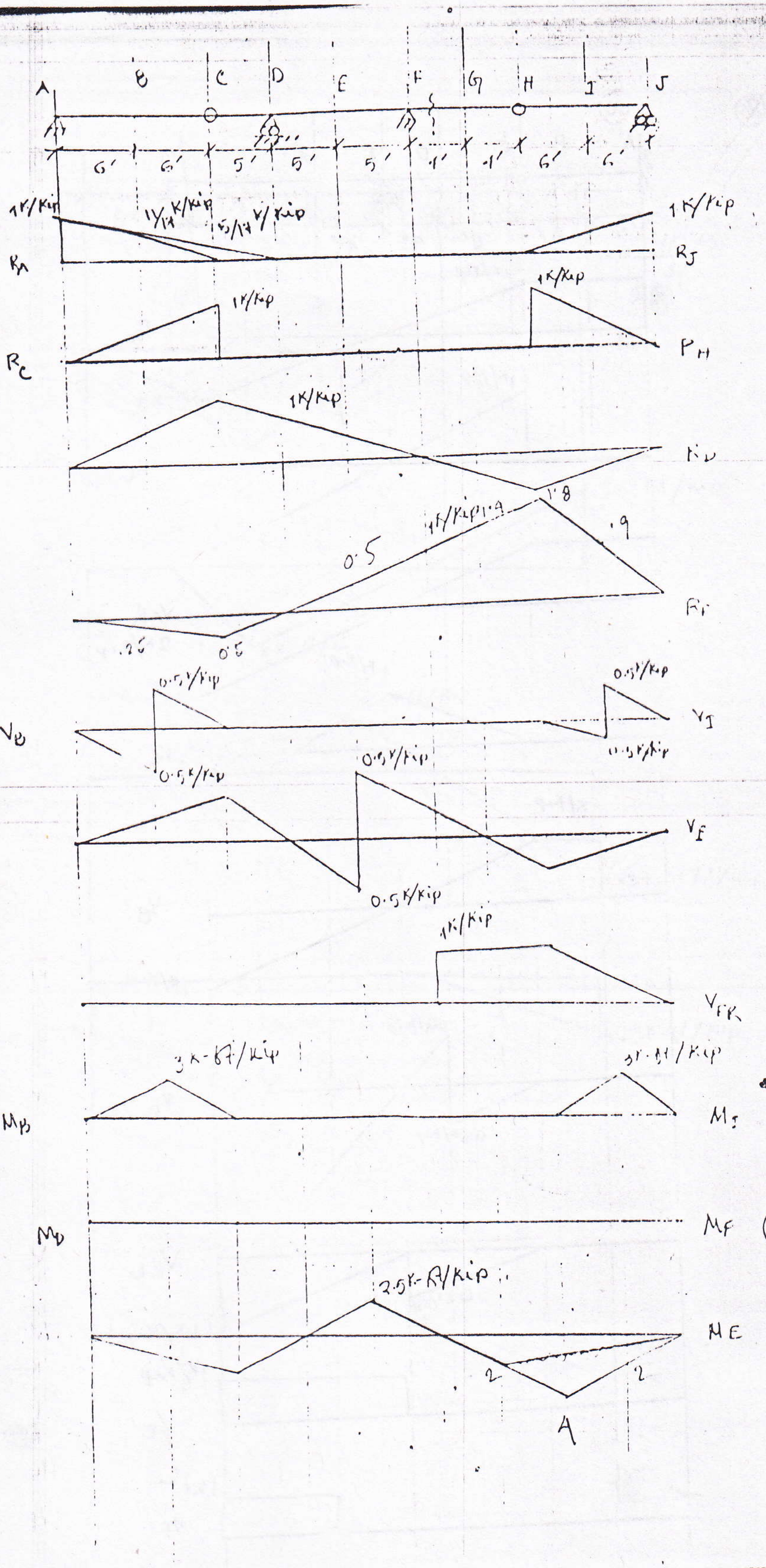
1
2
3
4
5
5'
5'
5'
5'
5'
1K/Kip
0.5K/Kip
R1
.75
1K/Kip
0.5
R4
0.5K/Kip
1K/Kip
R3
1K/Kip
VR1
0.5K/Kip
V2
0.5K/Kip
V3L
1K/Kip
V3R
1K/Ki



1
2
3
4
5
6
5'
1K/Kip
0.5K/Kip
R_1
0.75K/Kip
1.5K/Kip
1K/Kip
R_4
0.5K/Kip
0.5K/Kip
V_2
2.5K-ft/Kip
M_5
2.5K-ft/Kip
1K/Kip
R_6
0.5K/Kip
0.5K/Kip
V_{6L}
1K/Kip
2.5K-ft/Kip
M_2
0.5K/Kip
0.5K/Kip
V_5
0.5K/Kip
load → 1 to 5
$V_5^+ = R_6$↓
load → 5 to 6
$V_5^+ = R_4$↑
V_{4L}
0.5K/Kip
1K/Kip
1K/Kip
0.5K/Kip
V_{4R}

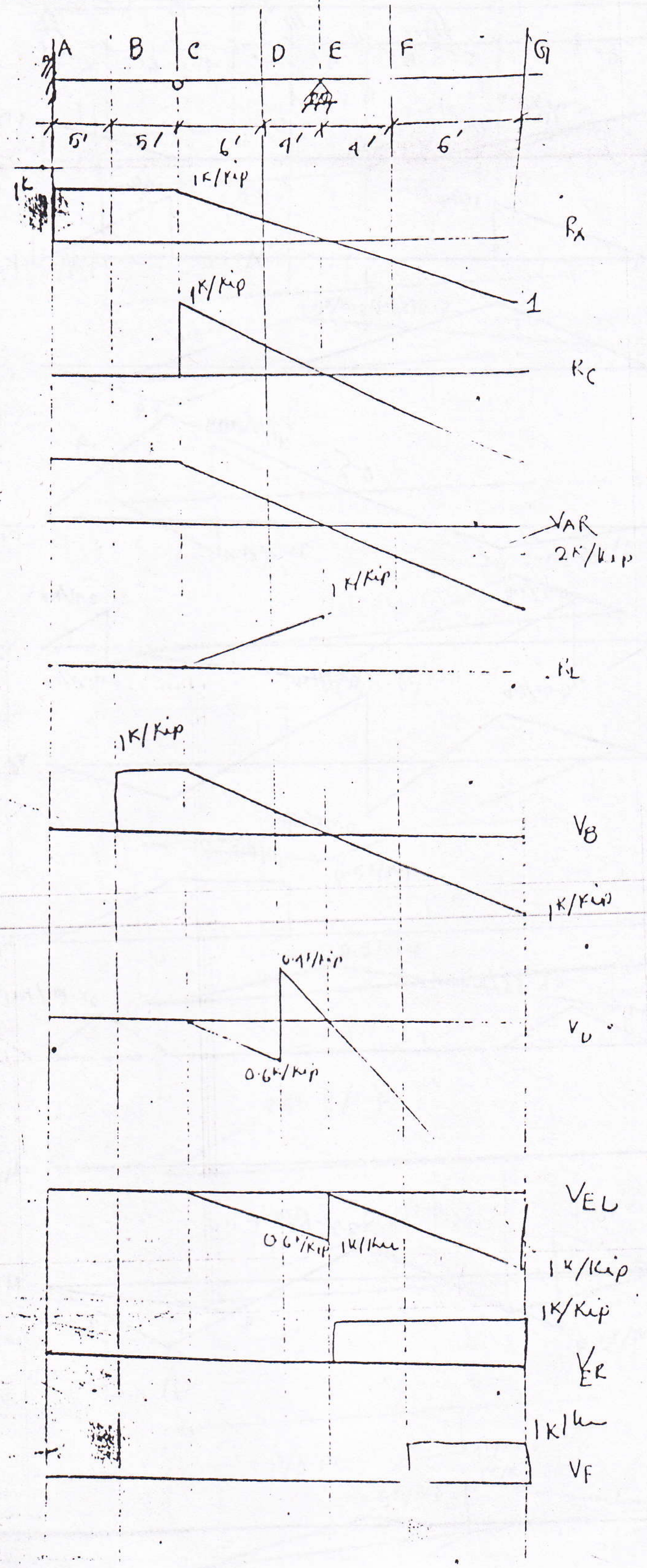
7

correct

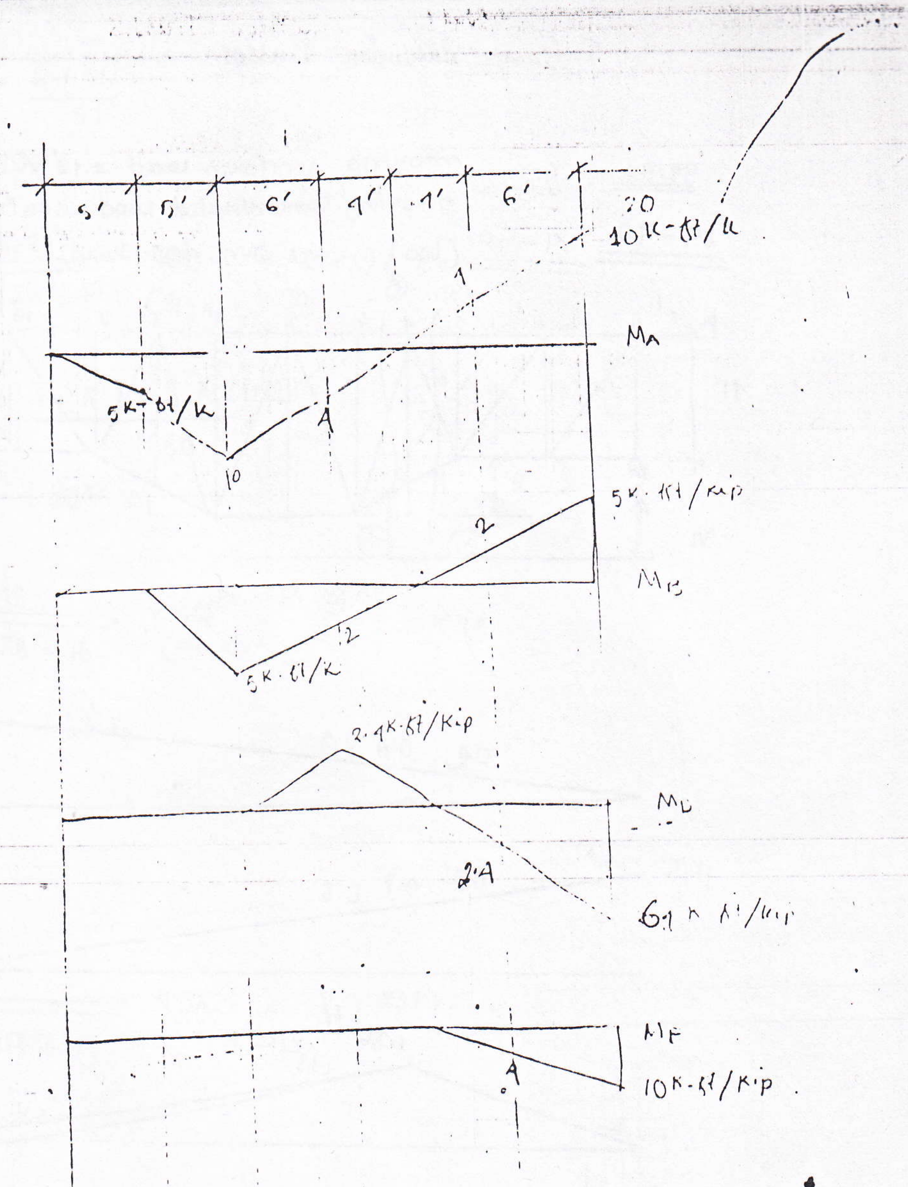


A B C D E F G H I J
6' 6' 5' 5' 5' 4' 4' 6' 6'
1K/Kip
1/14 K/Kip
15/14 K/Kip
1K/Kip
R_A
R_J
1K/Kip
1K/Kip
R_C
R_H
1K/Kip
R_D
1.8
0.5
1K/Kip 1.9
.9
.25
0.5
R_F
0.5K/Kip
0.5K/Kip
0.5K/Kip
0.5K/Kip
V_B
V_I
0.5K/Kip
0.5K/Kip
0.5K/Kip
V_E
1K/Kip
V_{FR}
3K-ft/Kip
3K-ft/Kip
M_B
M_I
M_D
M_F
2.5K-ft/Kip
M_E
2
2
A

(28)



A
B
C
D
E
F
G
5'
5'
6'
4'
4'
6'
1k
1K/Kip
R_A
1
1K/Kip
R_C
V_{AR}
2K/Kip
1K/Kip
R_E
1K/Kip
V_B
1K/Kip
0.4K/Kip
V_D
0.6K/Kip
V_{EL}
0.6K/Kip
1K/Kip
1K/Kip
1K/Kip
V_{ER}
1K/kip
V_F



5'
5'
6'
6'
10 K-ft/K
MA
5K-ft/K
A
10
5K-ft/Kip
2
MB
5K-ft/K
MD
MF
A
10K-ft/Kip

Influence Line for Trusses

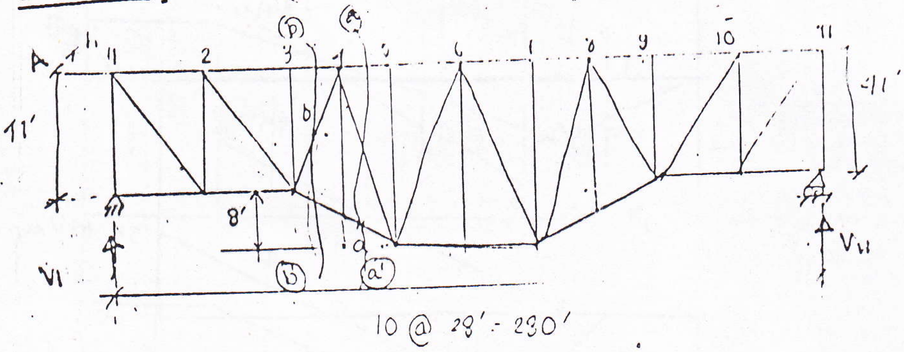
93-96

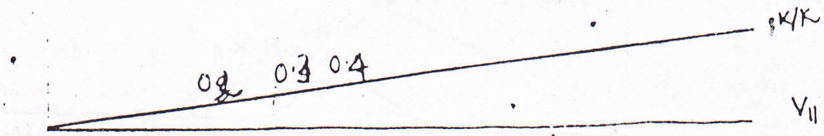
→ 89-90

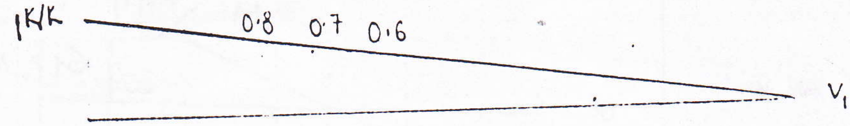
moving uniform load = $12^k/'$

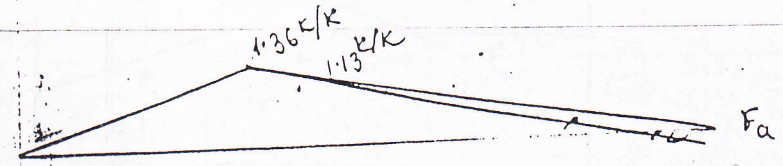
moving Concentrated Load = 60^k

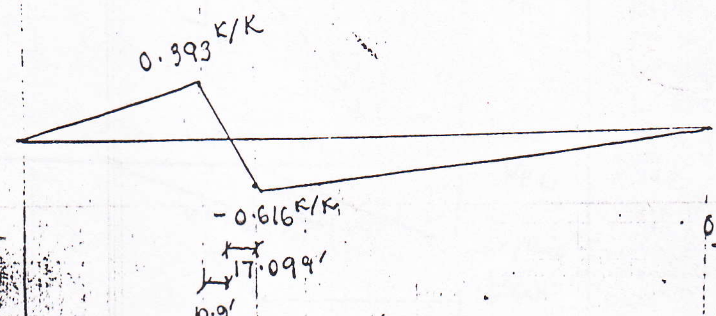
(Load moves over top chord)











$$\frac{0.393}{x} = \frac{0.616}{28-x}$$

$\therefore x = 10.9'$

$$\frac{h+3\times 28}{45} = \frac{h+56}{41}$$

$\therefore h = 231'$

$\Sigma M_{U_1} = 0$

$$F_a * \frac{28}{\sqrt{28^2+4^2}} \times \frac{45}{(41+4)} = V_{11} \times 7\times 28$$

$$\therefore F_a = \frac{V_{11} \times 7\times 28 \times 28.28}{1260}$$

$= 4.39 V_{11}$

$$F_a * \frac{28}{\sqrt{28^2+16}} \times \frac{45}{(41+4)} = V_0 \times 3\times 28$$

$\therefore F_a = 1.88 V_q$

for bar force b

$\Sigma M_A = 0$

$$F_b \times \frac{41}{\sqrt{41\times 41+28\times 28}} \times (3\times 28 + 231) + V_1 \times 231 = 0$$

$\Rightarrow F_b = -0.88 V_1$

$$F_b \times \frac{41}{\sqrt{41\times 41+28\times 28}} \times (3\times 28+231) - V_{11} \times (231+280) = 0$$

$\therefore F_b = 1.96 V_{11}$

for bar a

maximum comp = 0

" Tension = $1.36\times 60 + \frac{1}{2}\times 1.36\times 280\times 12$

$= 2366^K$

for bar b

maximum compression

$= 0.616\times 60 + \frac{1}{2}\times(17.8941 + 7\times 28)\times 0.616 \times 12$

$= 827^K$

maximum tension

$= 0.393\times 60 + \frac{1}{2}\times(3\times 28 + 10.9)\times 0.393\times 12$

$= 181.3^K$

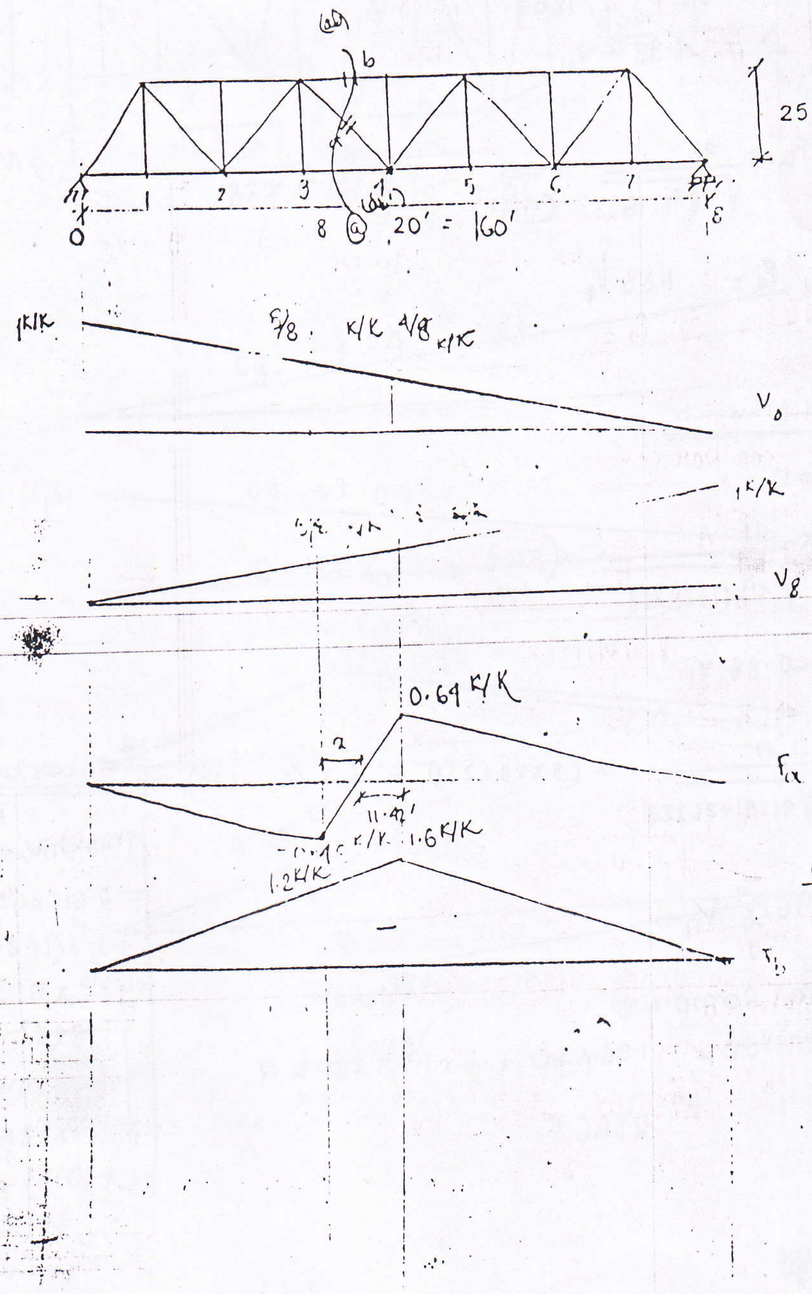
* ~~Dead load~~

D.L = 2K/'

L.L = 3K/'

concentrated moving load = 30K

Fa(max) = ? Fb(max) = ?



$\frac{0.48}{x} = \frac{0.64}{20-x}$

$x = 8.57'$

$\Sigma M_{L_4} = 0$

$$\Rightarrow F_b = \frac{-V_8 \times 80}{25}$$

$\Sigma M_{L_4} = 0$

$$\Rightarrow F_b = -\frac{V_0 \times 80}{25}$$

$$\text{shear in panel } L_3L_4 = F_a \times \frac{25}{\sqrt{25^2+20^2}}$$

$$\text{from 1 to 3}, \quad F_a = -V_8 \times \frac{\sqrt{25^2+20^2}}{25}$$

$$\text{for 4 to 8}, \quad F_a = V_0 \times \frac{\sqrt{25^2+20^2}}{25}$$

---

for bar a

compression due to L.L $= 0.48 \times 30 + \frac{1}{2} \times 0.48 \times (3\times20 + 8.57) \times 3$
$= 63.77^K$

force due to D.L $= \frac{1}{2} \times 0.48 \times (3\times20 + 8.57) \times 2$
$+ \frac{1}{2} \times 0.61 \times (1\times20 + 11.12) \times 2$

$= 25.59\ K$

maximum compression $= (-63.77 + 25.59)\ K = -32.18\ K$

tension due to L.L $= 0.61\times30 + \frac{1}{2} \times 0.61 \times (11.12 + 80) \times 3$

$= 106.96^K$

maximum tension $= (25.59 + 106.96)^K$
$= 132.55^K$

for bar b

compression due to D.L $= \frac{1}{2} \times 1.6 \times 160 \times 2\ K = 256^K$

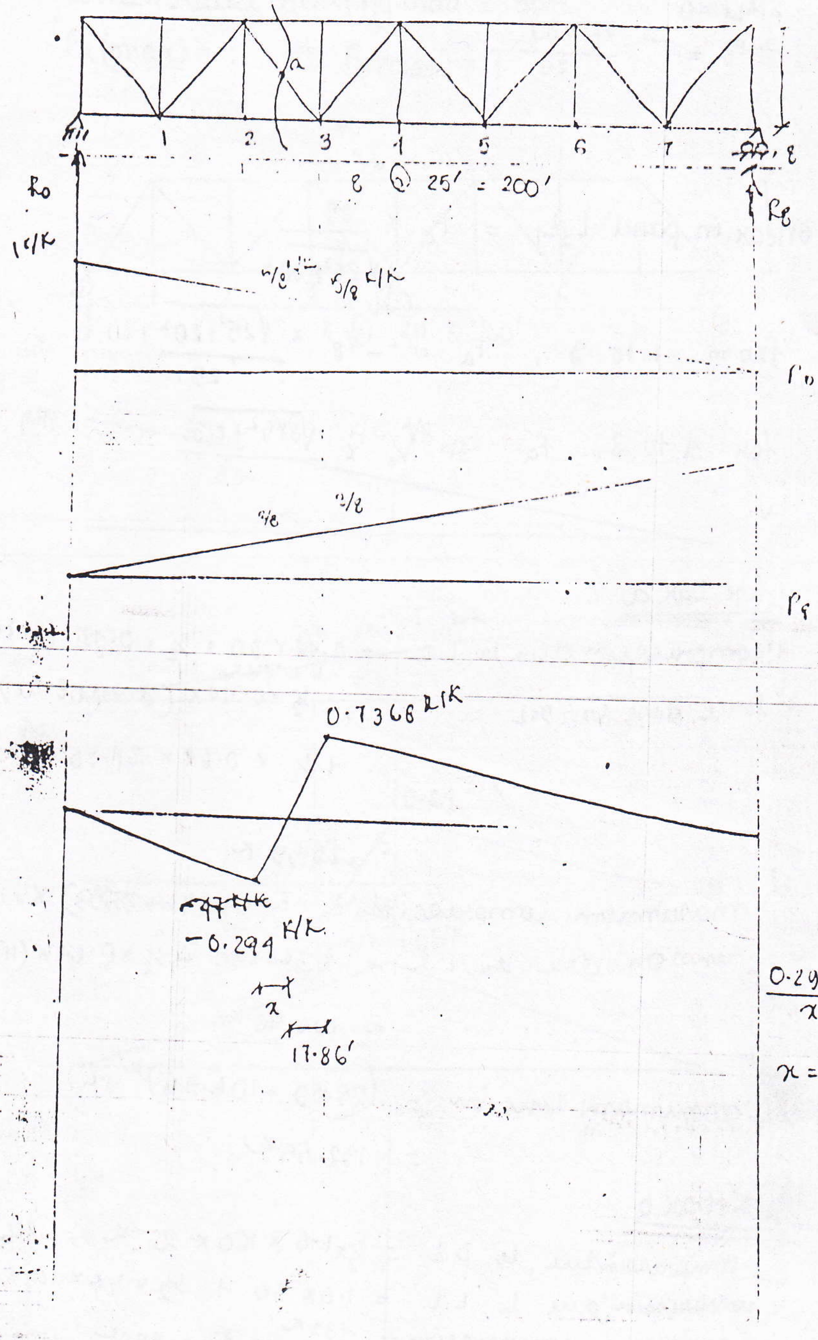
compression due to L.L $= 1.6\times 30 + \frac{1}{2} \times 1.6 \times 160 \times 5$
$= 432^K$

maximum compression $= 256 + 432 = 688^K$

$(F_a)_{max} = ?$

for uniform D load = 5 K/ft

" moving live load = 3 K/ft



$$\frac{0.294}{x} = \frac{0.736}{25 - x}$$

$$x = 7.13'$$

from 1 to 2,

$$F_a \times \frac{35}{\sqrt{40^2+25^2}} = -R_8$$

$$\therefore F_a = -R_8 \times \frac{\sqrt{40^2+25^2}}{40}$$

$$= ~~1.88R_8~~ -1.179R_8$$

from 3 to 8,

$$F_a \times \frac{35}{\sqrt{40^2+25^2}} = R_0$$

$$F_a = ~~1.88R_0~~ + 1.179R_0$$

maximum compression →

force due to D.L = ~~0.294 × ½~~

$$-\tfrac{1}{2} \times 0.294 \times (3\times25+7.13)\times5 + \tfrac{1}{2}\times0.7368\times(5\times25+17.86)\times5$$

$$= 220.8^K$$

compression due to ~~live-load~~ L.L $= \tfrac{1}{2}\times0.294\times(3\times25+7.13)\times3$

$$= 25.19^K$$

tension due to ~~live-l~~ L.L $= \tfrac{1}{2}\times0.7368\times(5\times25+17.86)\times3$

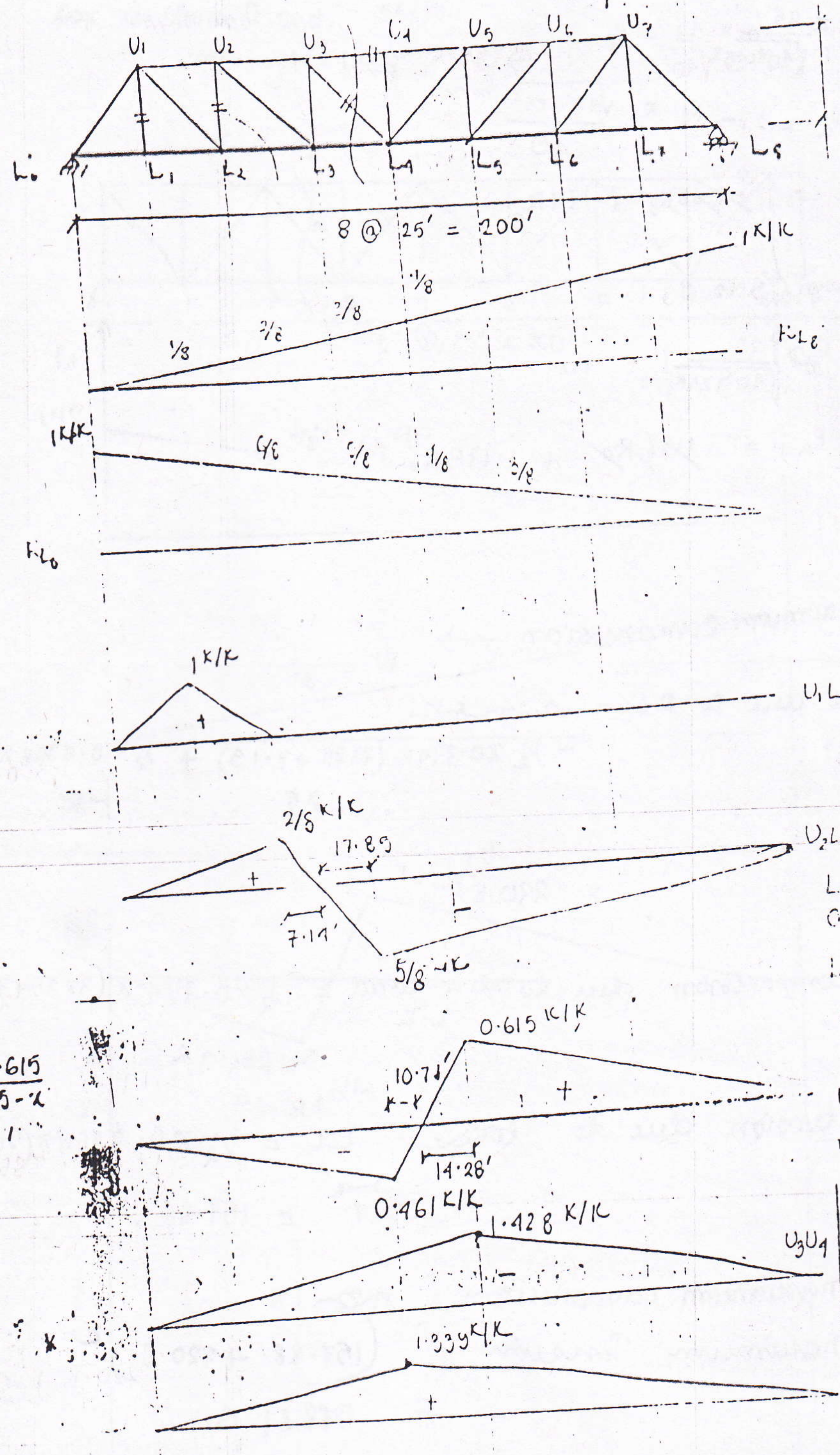
$$= 157.88.$$

maximum compression = ~~22~~ x

maximum Tension $= (157.88 + 220.8)^K$

$$= 378.81\ K.$$

. Draw IL for stresses in U_1L_1, U_2L_2,
U_3U_4, U_3L_4
L_3L_4



$\frac{2}{x} = \frac{5}{25-x}$

$x = 7.14$

L0 to L2,
at L2, ...

L3 to L8,
at L3, U_2L_2 ...

$\frac{0.461}{x} = \frac{0.615}{25-x}$

$x = 10.71'$

U_3L_4

at L_3 · $\frac{U_3L_4}{\sqrt{35^2+25^2}} \times 35$ ...

$\Rightarrow 0.8137\,U_3L_4 =$

at L_4, $0.8137\,U_3L_4$

L.L + UDL = 5K/'

D.L + UDL = 2K/'

<u>U_3L_4</u>

compression area : $= \frac{1}{2}(75 + 10.71) \times 0.461$

$= 19.75$

Tension area $= \frac{1}{2}(100 + 14.28) \times 0.615$

$= 35.14$

Stress due to D.L = $-19.75 \times 2 + 35.14 \times 2$

$30.88^K (+)$

Stress due to L.L (compression) $= 19.75 \times 5 = 98.75^K (-)$

" " " " (tension) $= 35.14 \times 5 = 175.7^K (+)$

---

max^m compression $= -67.$

max^m tension $= 206.58^K$

reversal of stress

Counter req'd.

<u>U_2L_2</u>

max (U_2L_2) comp

(+) area $= \frac{1}{2} \times \frac{2}{8} \times (50 + 7.14) = 7.14$

(−) area $= \frac{1}{2} \times (125 + 17.85) \times \frac{5}{8} = 44.6$

due to D.L $= -74.92^K$ (compression)

due to L.L (+ve) $= 35.7^K$ (Tension

(−ve) $= 223^K$ (compression

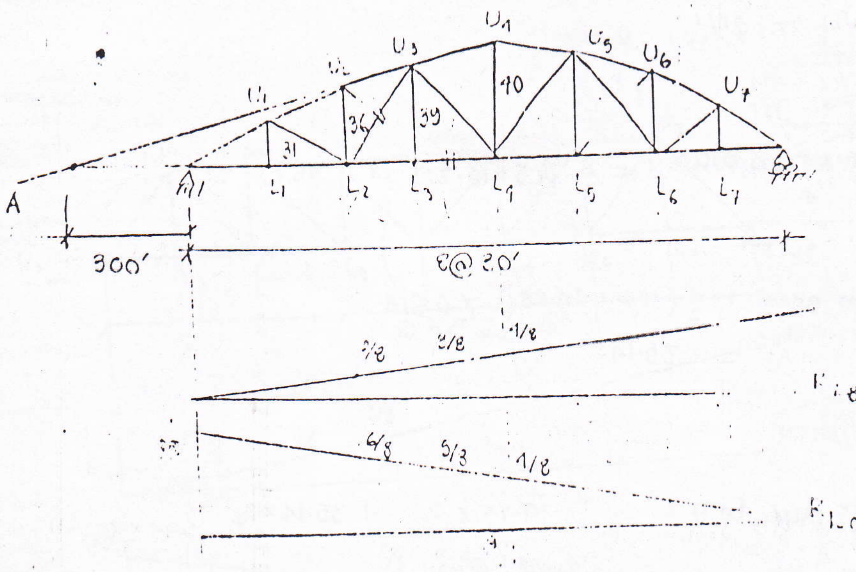
Max^m (+ve) $= -39.2^K$ (−ve)

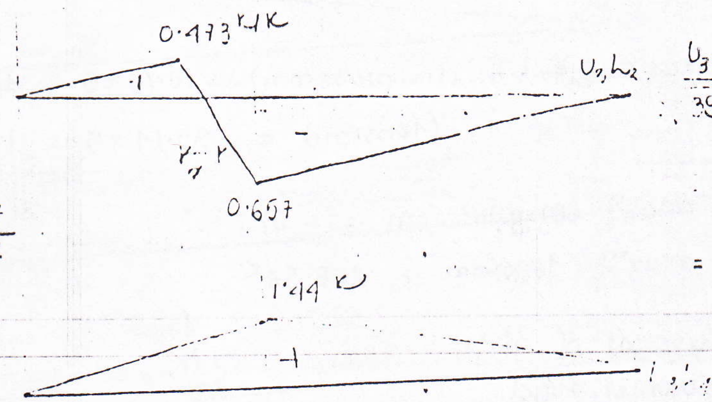
max^m (−ve) $= -297.92^K$ (−ve)

no reversal of stress
no counter required

$$\frac{h+90}{39} = \frac{h+60}{56}$$

$\Rightarrow h = 300'$





$\frac{U_3L_2}{\sqrt{39^2+30^2}} \times 39 \times (3$

$R_{L8} \times (300$

at (L_2)

$= R_1 \times (300)$

at $(L$

unit

$$\frac{0.473}{x} = \frac{0.657}{30-x}$$

$x = 12.55'$

যখন load member এ যে point এ load করিলে m হইবে maximum

i) Moving UDL = 3K/ft

Moving concentrated load = 60K

DL = UDL = 1.5K/ft

@ due to live load, $(L_3L_1)_{tension} = \left(\frac{1}{2} \times 1.44 \times 240 \times 3 + 1.44 \times 60\right)^K$

$= 604.8^K$

due to DL, $(L_3L_1)^{max}_{tension} = 259.2^K$

(b) $(U_3L_2)^{comp}_{max} = \frac{1}{2} \times (17.45 + 5 \times 30) \times 0.657 \times 3 + 60 \times 0.657$

$= 204.4^K$

$(U_3L_2)^{tension}_{max} = \frac{1}{2}(12.55 + 2 \times 30) \times 0.473 \times 3 + 0.47 \times 60$

$= 79.6^K$

---

due to DL.

$(U_3L_2)_{max} = -56.77$ (c)

max^m tension = 22.4

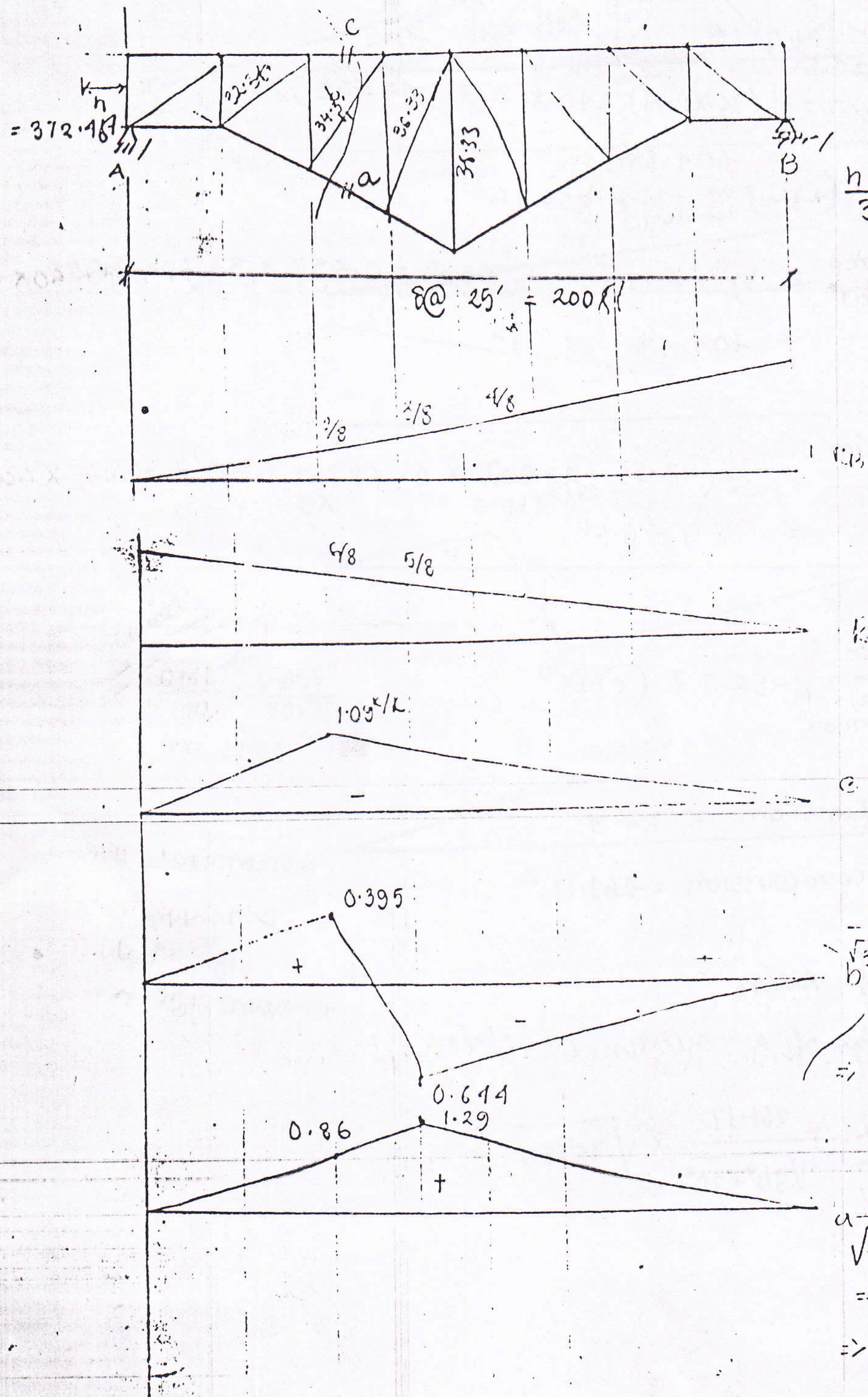
max^m compression = -261.17^K.

reversal of stress,

∴ provision of a counter is effective.

$(U_2L_3)_{tension} = \frac{261.17}{\sqrt{39^2+30^2}} \times \sqrt{36^2+30^2}$

90-91



$\frac{h+50}{34.9} = \frac{h+75}{36.35}$

$h = 372.4'$

$\frac{h+25}{32.3} = \frac{h+50}{34.3}$

$h = 378.75$

$\frac{F_b \times 34.3\,(372+75)}{\sqrt{34.3^2+25^2}}$

$= F_b \times (372+200)$

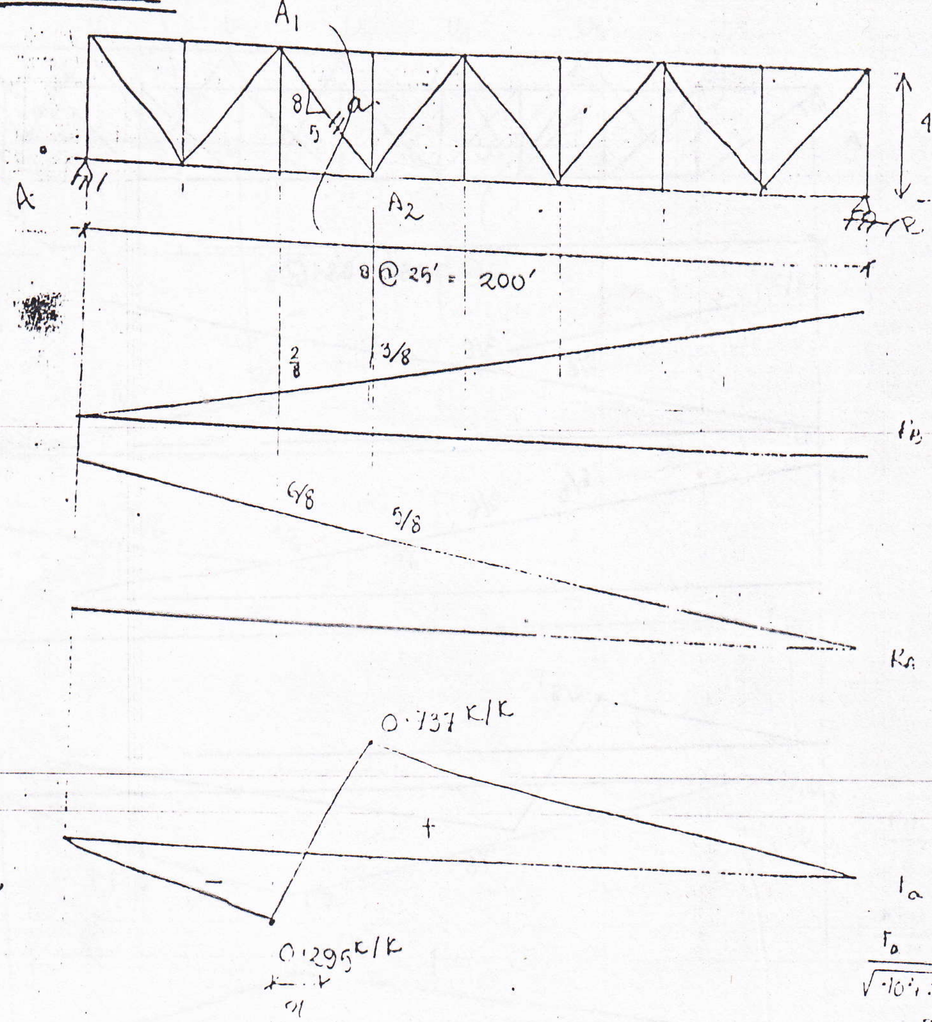
$\Rightarrow 361\,F_b = F_b(\ldots)$

$a\quad \frac{F_a \times 2.03 \times (372+75)}{\sqrt{2.03^2+25^2}}$

$= R_B \times 5 \times 25$

$\Rightarrow 36.1F_a = R_A \times 75$

1990-1991



$\frac{95}{x} = \frac{0.737}{25-x}$

$x = 7.14'$

force in the bar and stress!

$\frac{F_a}{\sqrt{10^2+25^2}} \times 10 = F_B (AD) = F_A (A_2)$

i) UDL (D.L) = $5^{k/'}$

ii) moving UDL (L.L) = $3^{k/'}$

$-$ve area = $\frac{1}{2} \times 0.295 \times (2 \times 25 + 7.14) = 8.428$

$+$ve area = $\frac{1}{2} \times 0.737 \times (5 \times 25 + 17.86) = 52.64$

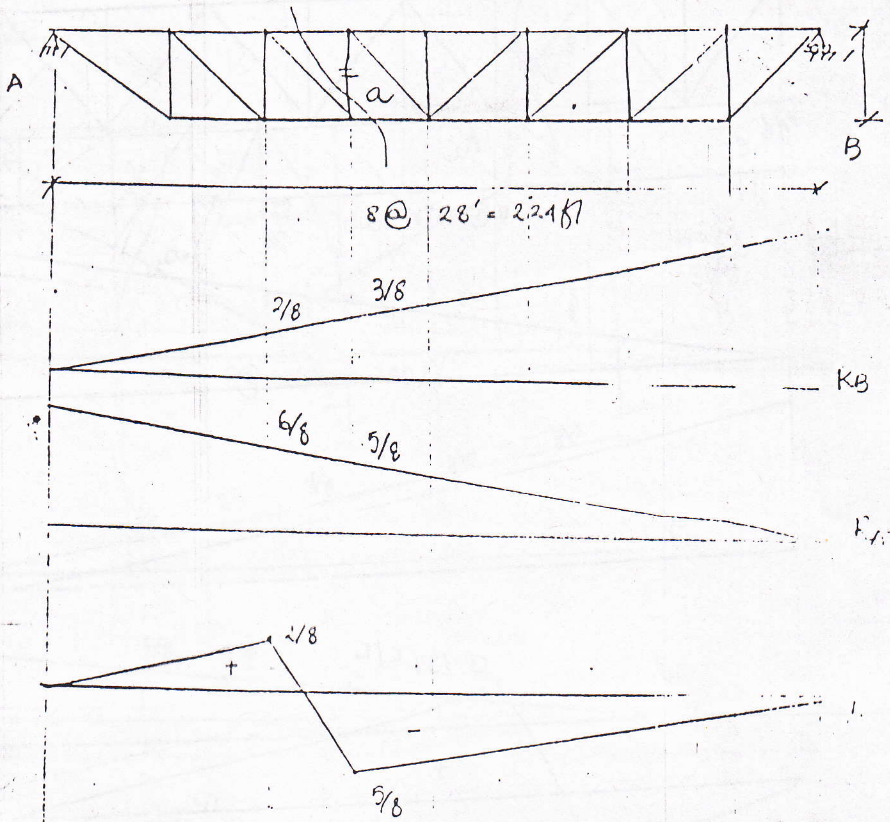
force due to DL = $+221.06^{k}$ (t)

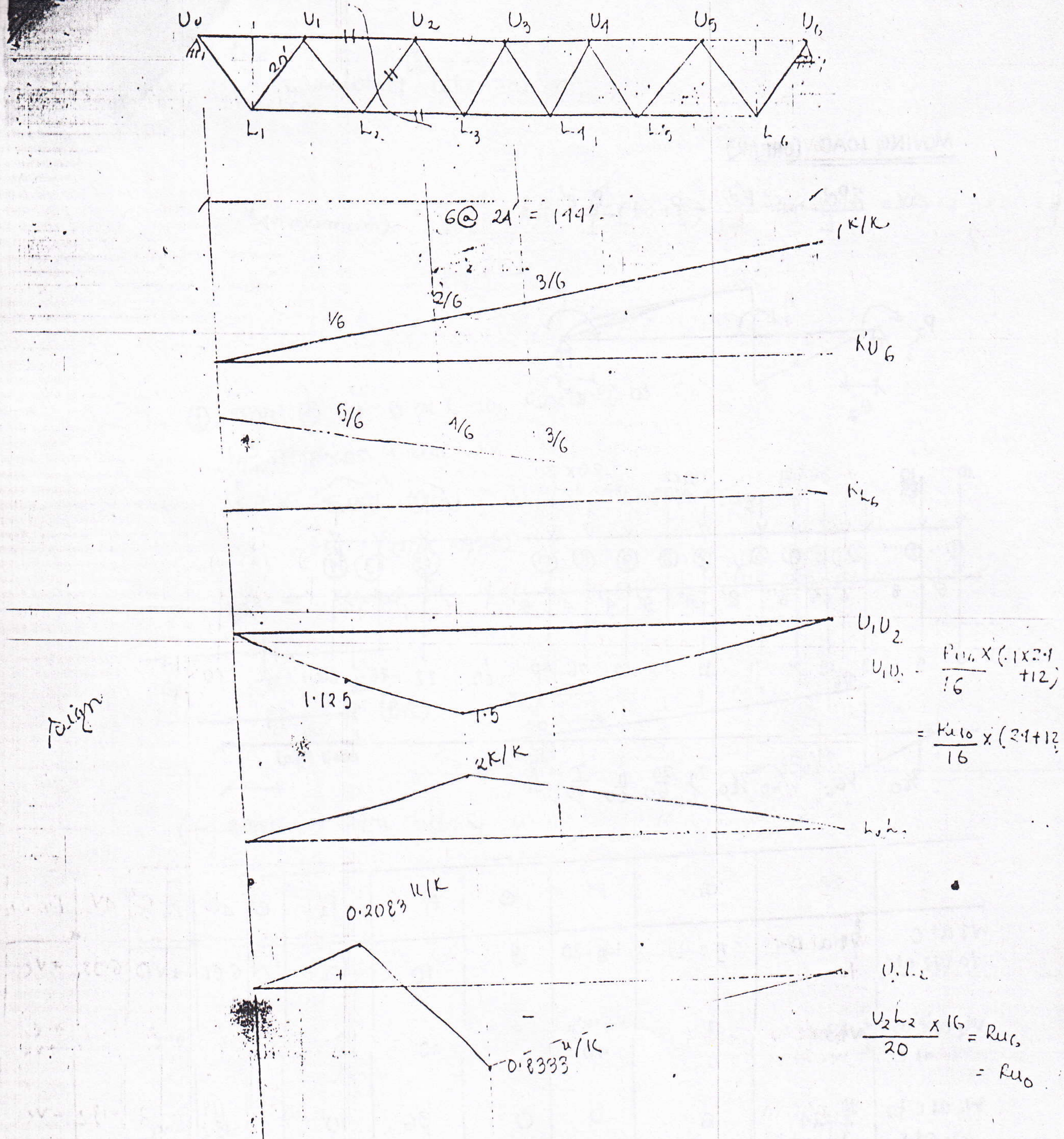
$(F_a)^{tension}_{max} = 157.92^{k} (+)$

$(F_a)^{compression}_{max} = 25.284^{k} (-)$

maximum compression = -195.77 (t) ×

maximum tension = 378.98^{k} (t)

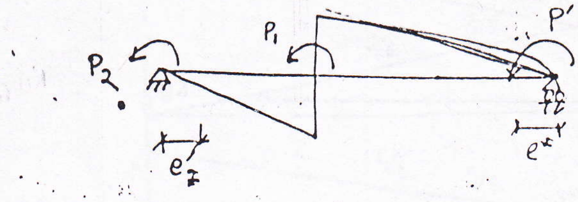

A
a
B
8 @ 28' = 224 ft
2/8
3/8
KB
6/8
5/8
2/8
+
-
5/8

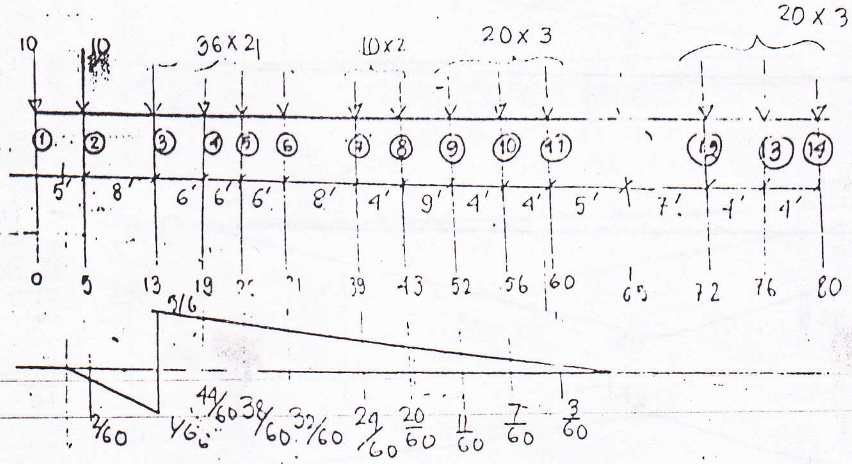


U0 U1 U2 U3 U4 U5 U6
L1 L2 L3 L4 L5 L6
20'
6@ 24' = 144'
1 K/K
1/6
2/6
3/6
RU6
5/6
4/6
3/6
RL6
U1U2
1.125
1.5
2K/K
L2L3
0.2083 K/K
0.8333 K/K
U2L2

MOVING LOAD (SHEAR)

$$\Delta V = \frac{\Sigma P d_1}{L} + \frac{P' e}{L} - P_1 + \frac{P_2 e'}{L}$$





	ΣP	d_1	P'	e	P_1	P_2	e'	ΔV	
W1 at C to W2 at C	$\sum_{1}^{8} W = 184$	5	$W_8 = 20$	3	10	0	0	6.33	$+V_c$
W_2 at C to W_3 at C	$\sum_{2}^{9}$ 194	[illegible]	$W_{10}+W_{11}$ 40	[illegible]	10	10	[illegible]	[illegible]	[illegible]
W_3 at C to W_4 at C	$\sum_{3}^{11}$ 224	6	0	0	36	10	2	-13.2	$-V_c$

V_{max} (3) wheel when at C.

$$V_{(maximum)} = \frac{1}{60}\left[-2 \times 10 + 36\left(50 - \frac{18}{2}\right) + 2 \times 10\,(50 - 2e) + 3 \times 20 \times 7\right]$$

$= 112.4$

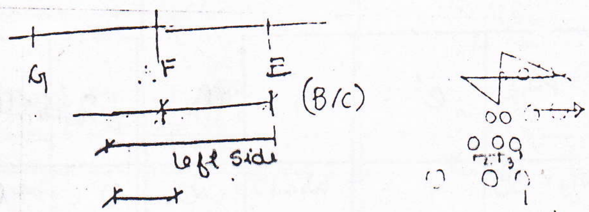
(1) wheel (1) at B or C to wheel (2) at C

[illegible] ΔV

$\Sigma P = \Sigma W$ (1) at B or C to [illegible]

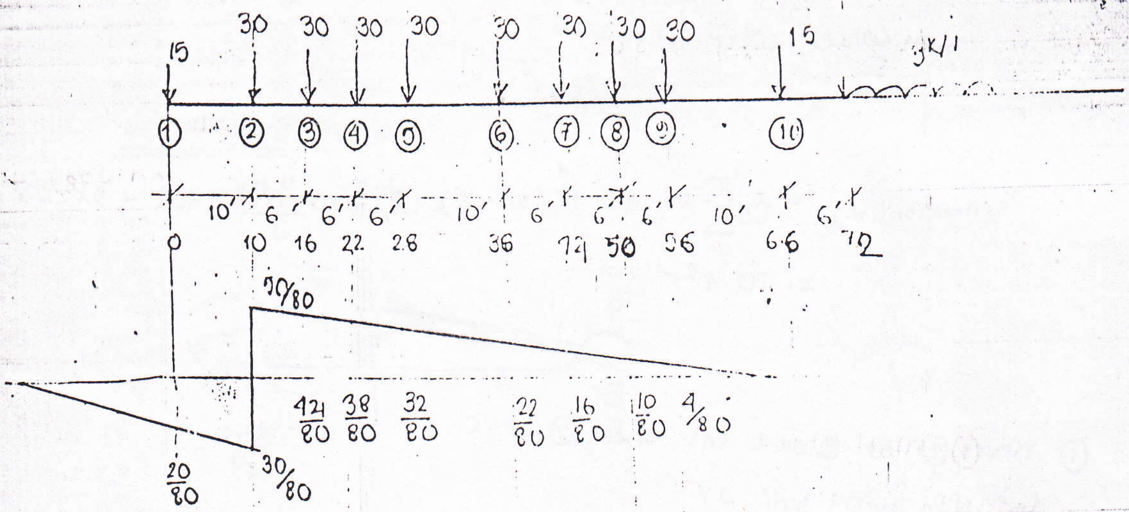
$P_1 = W$ ([illegible])

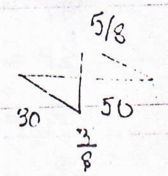
P_2 = record [illegible] B or C [illegible]



(- [illegible] + [illegible]) = +ve [illegible]

1995-1996





$$\Delta V = \frac{\Sigma P d_1}{L} - P_1 + \frac{P' e'}{L} + \frac{P_2 e_2}{L}$$

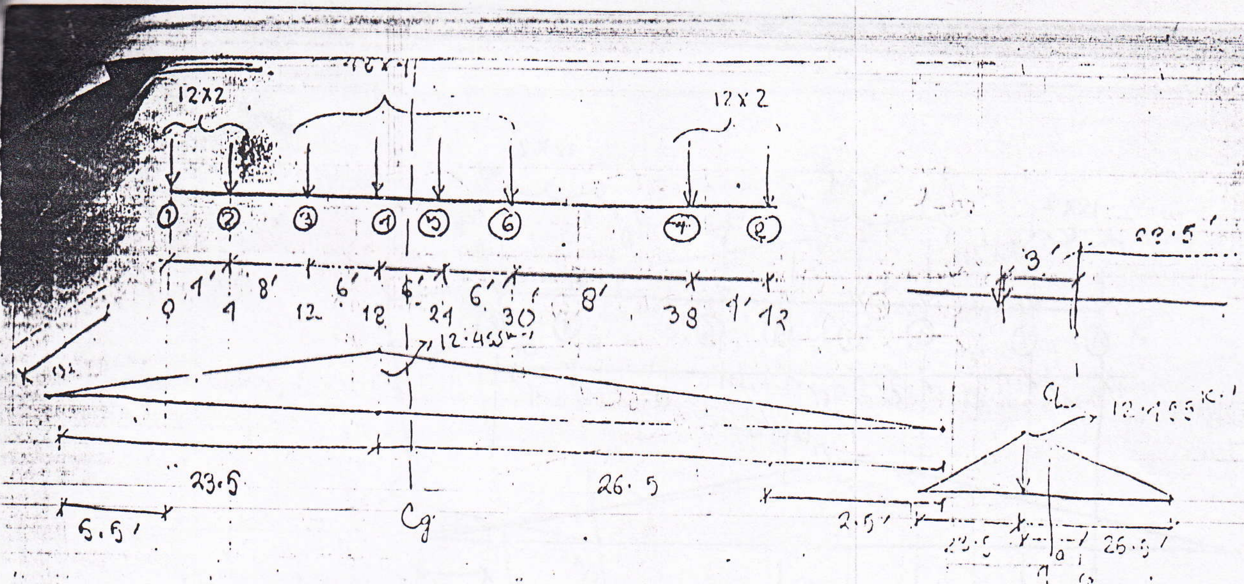
...	ΣP	d_1	P′	e′	P_1	P_2	e_2	ΔV
W1 at c to W2 at	$\sum_{1}^{8} W = 15 + 30 \times 7 = 225^{k}$	10	$W_9 = 30$	4	$W_1 = 15$	0	0	14.625
	15+30×6 = 195	10	30 + 30	7	15	0	0	14.625
W_2 at c to W3 at c	$\sum_{2}^{9} W = 225 + 30 = 255$	6	0	0	30	0	0	-10.3

$V_2 > V_3$

V_c max when wheel ② at c.

$$V_c(\max) = \frac{1}{80}\left[-20 \times 15 + 30 \times 4 \times (50 - 9) + 30 \times 4 \times (9 + 4)\right]$$

$$= 77.25^{K}$$



	State	W_1/L	W/L	
Wheel 2 at B	R	12/25	168/50	[illegible]
	L	24/25	168/50	
Wheel 3 at B	R	24/25	216/50	
	L	72/25	216/50	
Wheel 4 at B	R	72/25	240/50	
	L	120/25 =	240/50	
Wheel 5 at B	R	120/25	240/50	
	L	168/25	240/50	

Wheel 4 at mid point gives the maximum [illegible]

Cg of the Wheel (due to the effect) $= \dfrac{12\times4 + 48\times4\times21 + 12\times2\times40}{12\times2 + 48\times4 + 12\times2}$

$a = (24-21)\,ft = 3'$ $\qquad = 21'$

$x = L/2 - a/2$

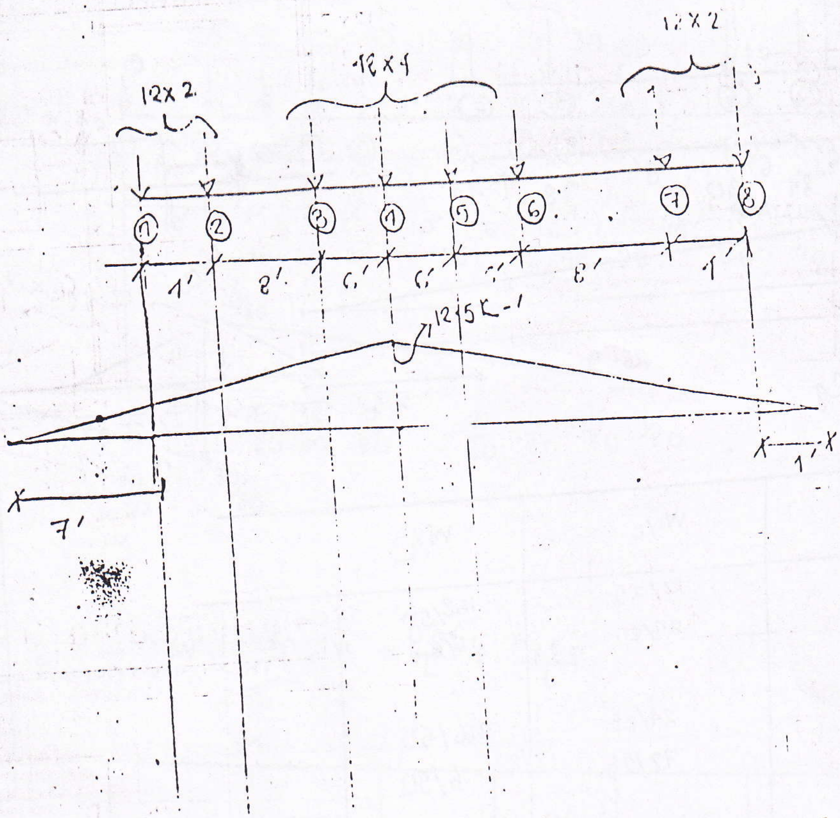
$= 23·5'$

Wheel 4 at C R $72/23·5 =$ $240/50 = 4·8$

L $120/23·5 = 5·1 > 240/50 = 4·8$

$M_{at\,C} = \dfrac{12·455}{26·5}\left[2\times12\times(2·5+12) + 2\times48\,(26·5-6)\right] + \dfrac{12·455}{23·5}\left[12\times2\times7·5 + 48\times17·5\right.$

$= 1978·3\,K\text{-}'$



$$M_{max} = \frac{12.5}{25}\left[12\times2\,(9) + 48\times2\times(25-3) + 48\times2\times(25-9) + 12\times2\times(3)\right]$$

$$= 1968^{K-'}$$