## Influence line:

An influence line is a diagram showing the variation in the shear, moment, stress in a member, reaction or other direct function at a particular section or point or member, due to a unit load moving across the structure.

**Construction of Influence Line:** An influence line is constructed by plotting directly under the point where the unit load is placed and ordinate the height of which represents to some scale the value of the particular function being studied when the load is in that point.

## Purpose of Influence Lines:

Influence lines can be used for two very important purposes -

1. To determine what position of live loads will lead to a maximum value of the particular function for which an influence line has been constructed.

2. To compute the value of that function with the loads sot so placed or in fact for any loading condition.

**Theorem 1:** ~~The~~ To obtain the maximum value of a function due to a single concentrated live load, the load should be placed at the point where the ordinate to the influence line for the function is a maximum.

Theorem 02: The value of a function due to the action of a single concentrated live load equals the product of the magnitude of the load and the ordinate to the influence line for that function, measured at the point of application of load.

Theorem-03: To obtain the maximum value of a function due to a uniformly distributed live load, the load should be placed over all those portions of the structure for which the ordinates to the influence line for that function have the sign of the character of the function desired.

CE 1201 – Analysis of statically determinate arches, beams, frames, trusses and cables.

- Analysis of statically determinate arches.
- Influence lines for statically determinate structures.
- " & moving loads on beam, frames and trusses
- " Cable supported structures and
- " Space trusses.

## Kind of loads

1. Dead load:

Dead loads are loads which always fixed in position, always acting, and of unchanging magnitude.

The dead load in a building includes the weight of walls, permanent partitions, farming, floors, roofs and all other stationary construction entering into building

(a) Weight of material of which a structure is composed

b. Permanent equipments such as gas/water/sewerage pipe/electric cables e.t.c.

2. Live loads:
The live load includes all loads ~~exp~~ except dead loads.
Live loads which can move or movable

Theorem-04

preparation of Influence line

1. Select function of influence line you need
(Function - Reaction, shear force, bending moment, axial force, deflection et.c)

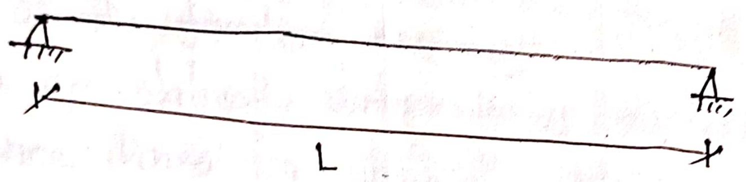
2. Place a unit load at various locations along the structure

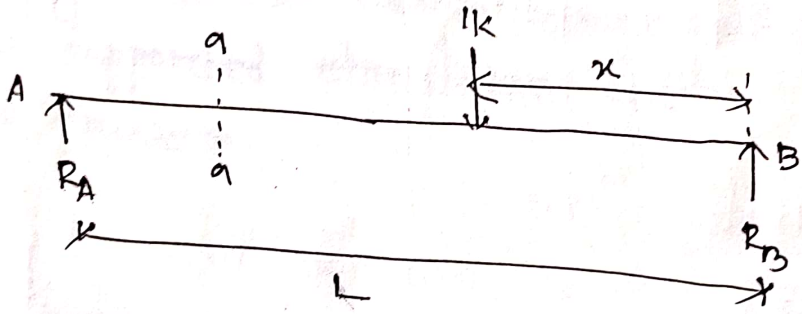
3. Compute the value ~~of~~ of the function for that particular position of the unit load.

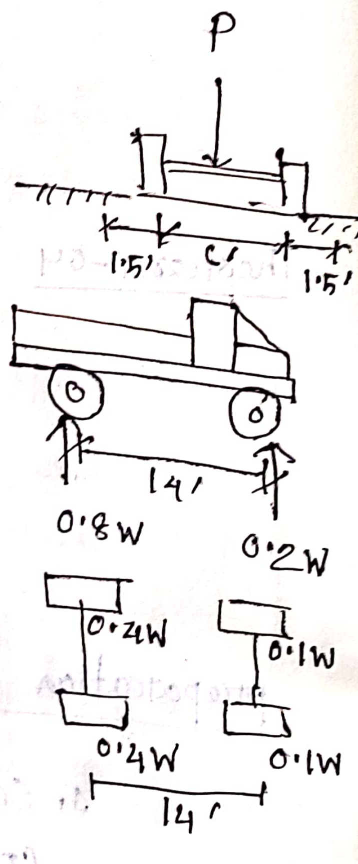
4. Locate the magnitude of the function on the structural member at current position

of the unit load

3. Draw a line by joing the ordinate along the member/ structure.




$$R_A = \frac{x}{L}$$

$$R_B = 1 - \frac{x}{L}$$

## Influence line for reaction:

Unit load at A

$\Sigma M_B = 0$; $R_{Ay} \times L - 1 \times L = 0$

$R_{Ay} = 1k$, $R_B = 0k$

$\Sigma F_y = 0$ $R_{Ay} = 1k$, $R_B = 0k$

Unit load at mid span

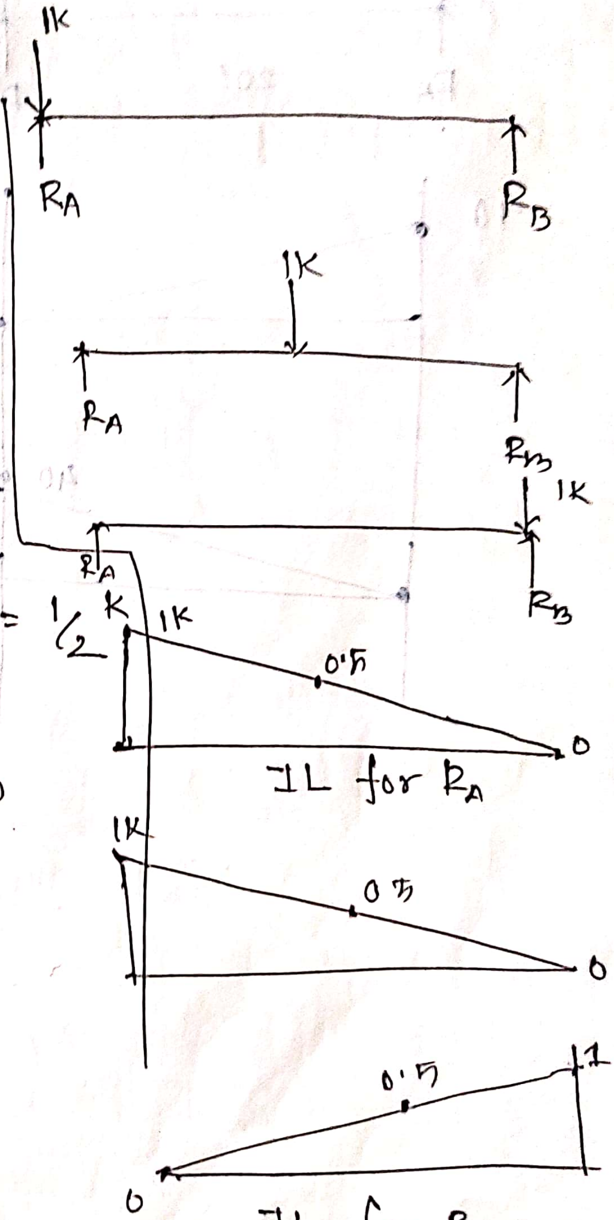
$\Sigma M_B = 0$; $R_{Ay} \times L - 1 \times \frac{L}{2} = 0$

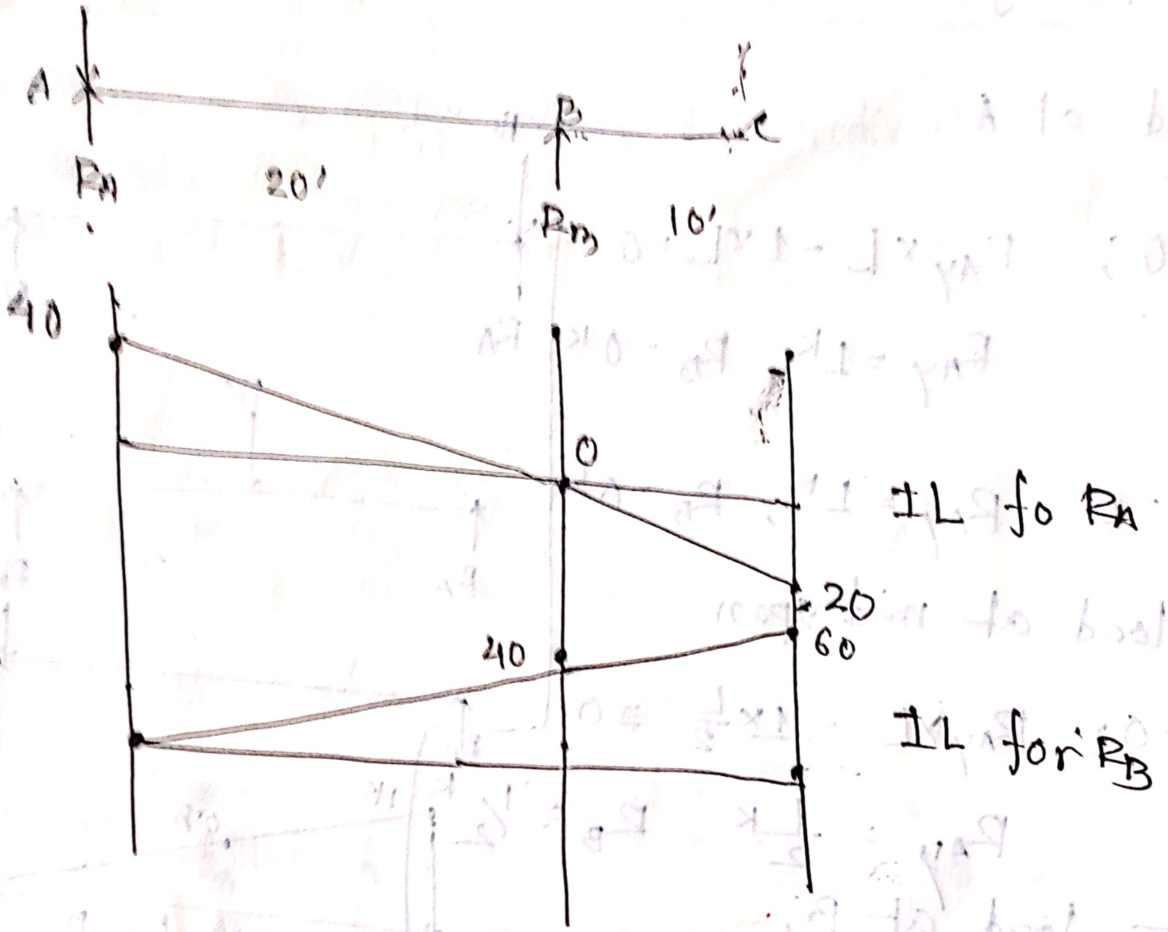
$R_{Ay} = \frac{1}{2}k$ $R_B = 1/2\,k$

Unit load at B,

$\Sigma M_B = 0$; $R_{Ay} \times L - 1 \times 0 = 0$

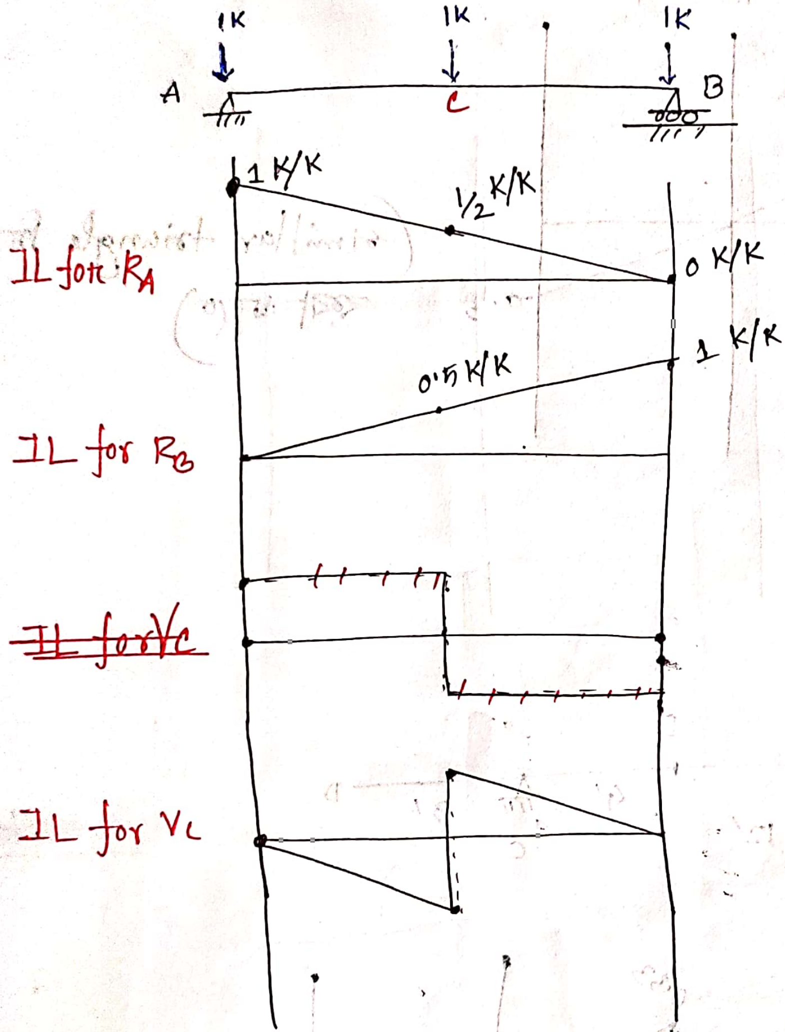
$R_{Ay} = 0$; $R_B = 1k$




A
B
C
$R_A$
20'
$R_B$
10'
40
0
20
40
60
IL fo $R_A$
IL for $R_B$

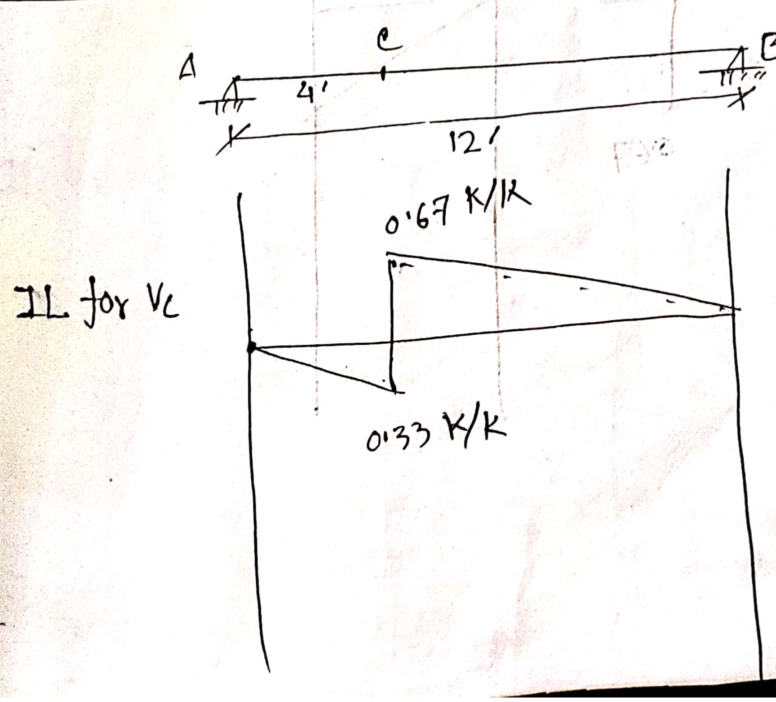
# Influence Line

Problem-01

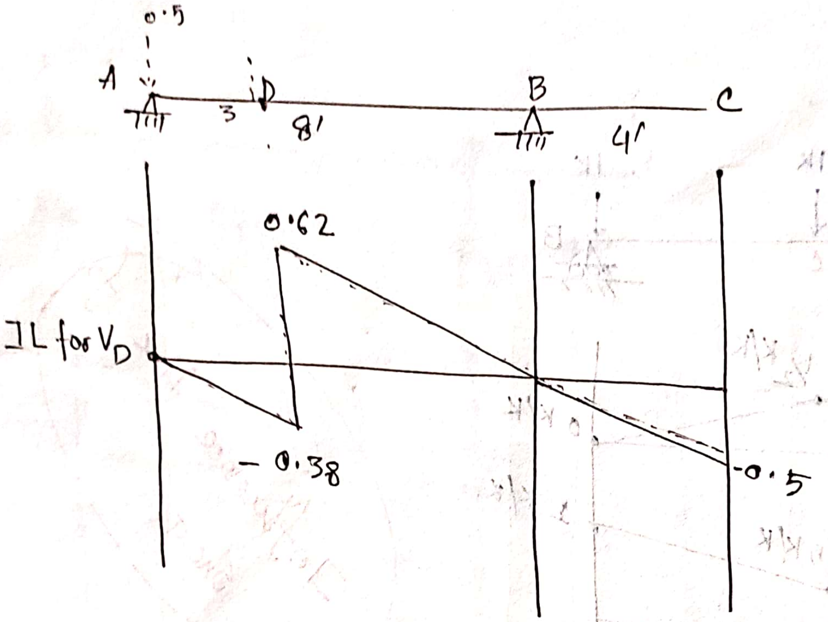



Influence line for shear

Problem-02

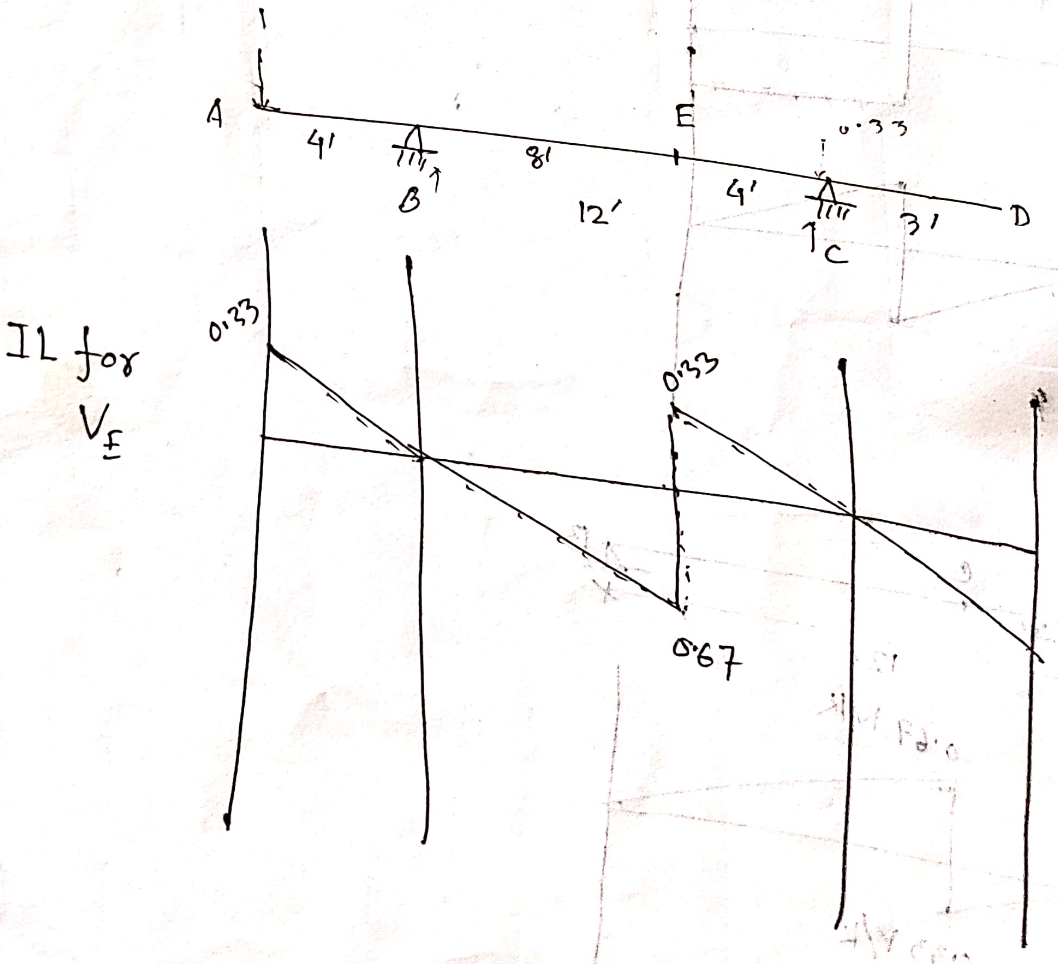


Problem-02

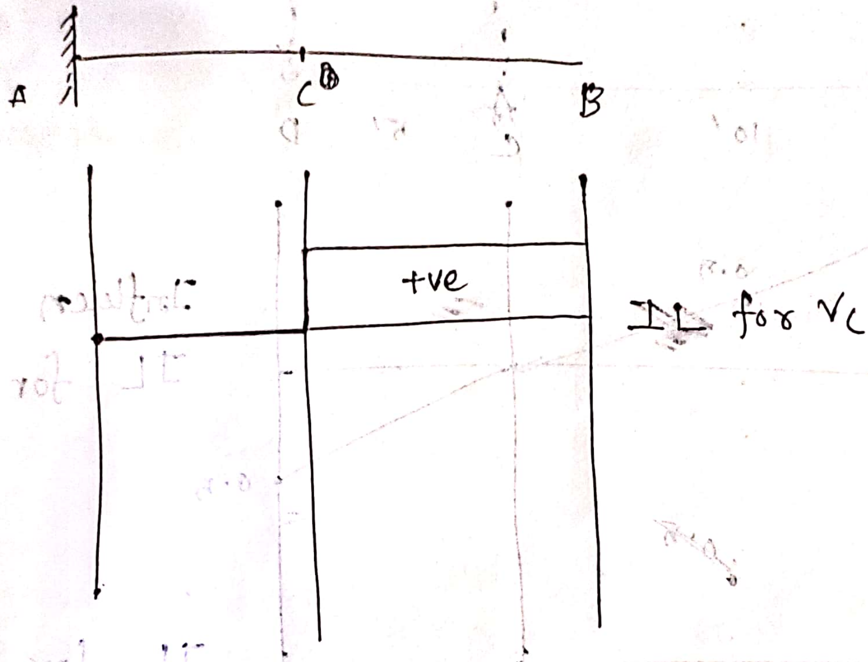



(simillar triangle দিয়ে করা যাবে)

Problem-03

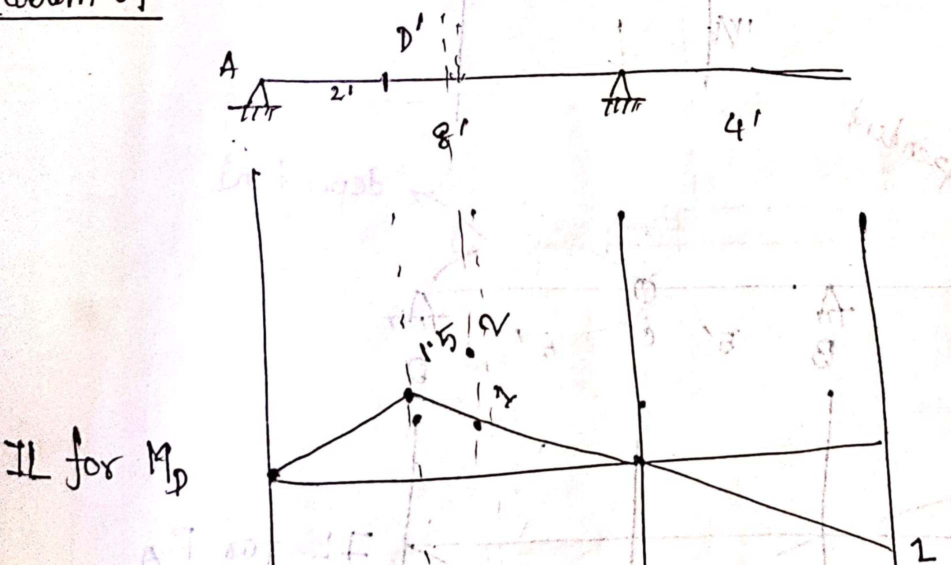


Problem-04

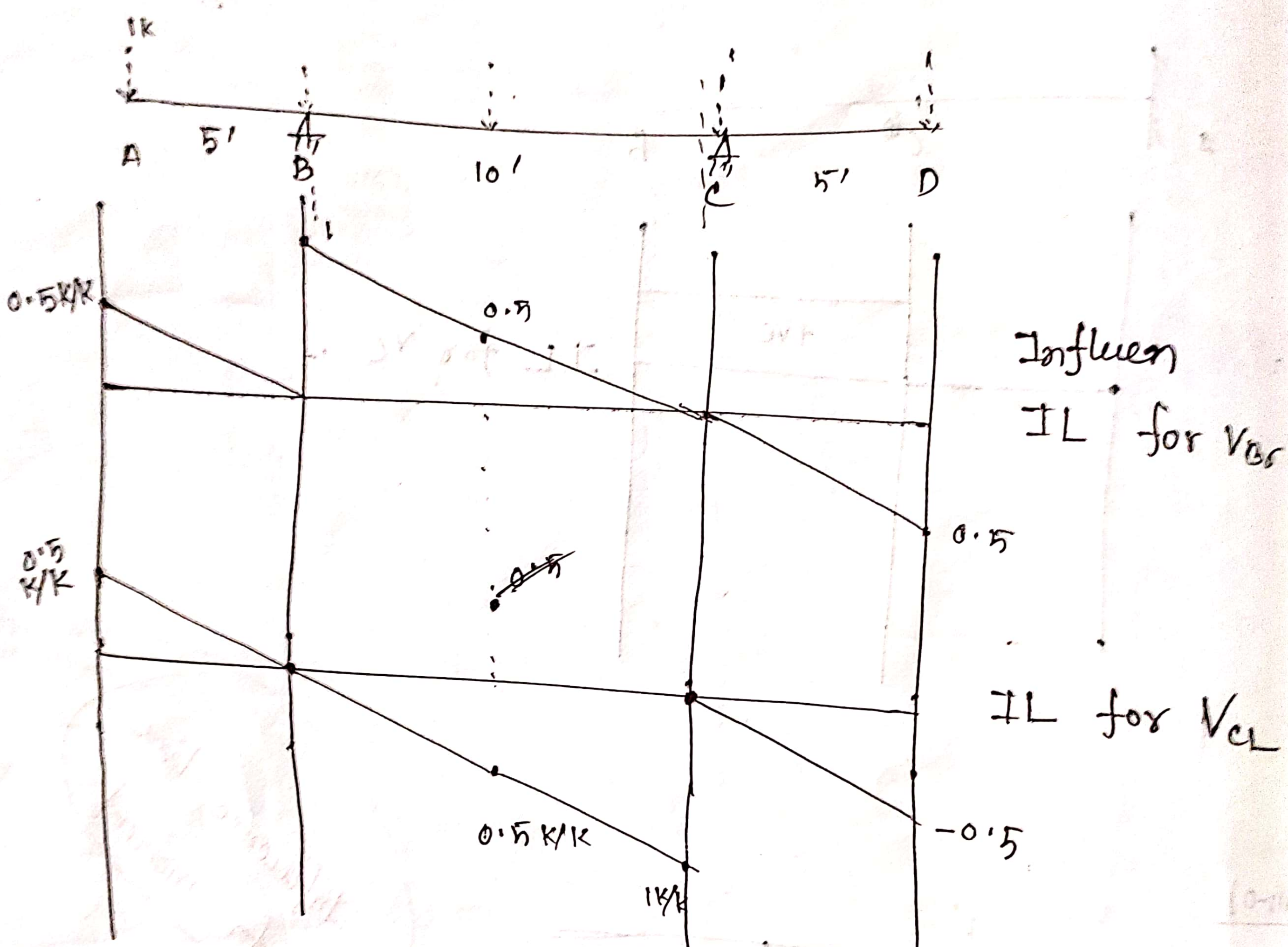



Influence line for moment

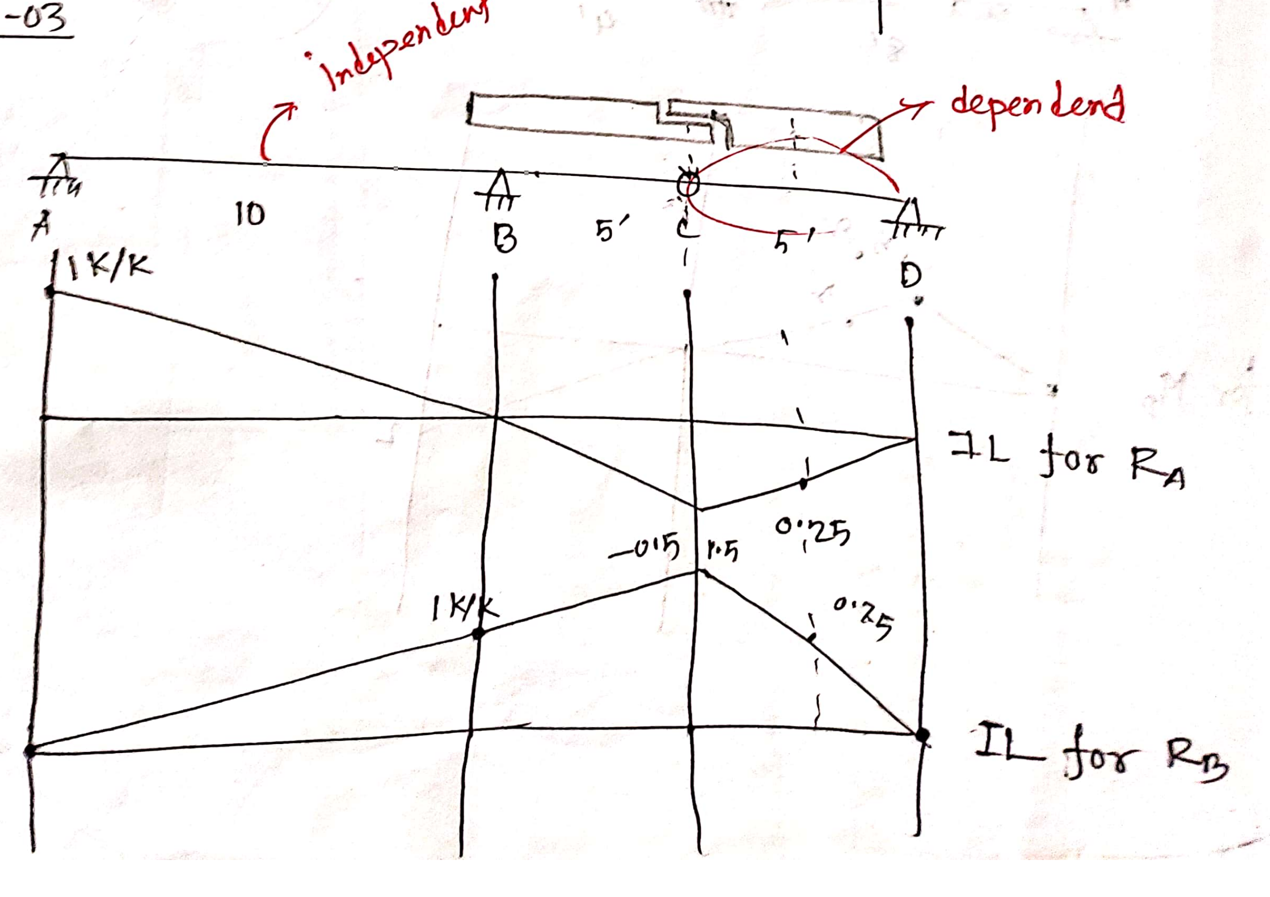
Problem-01



Problem-02



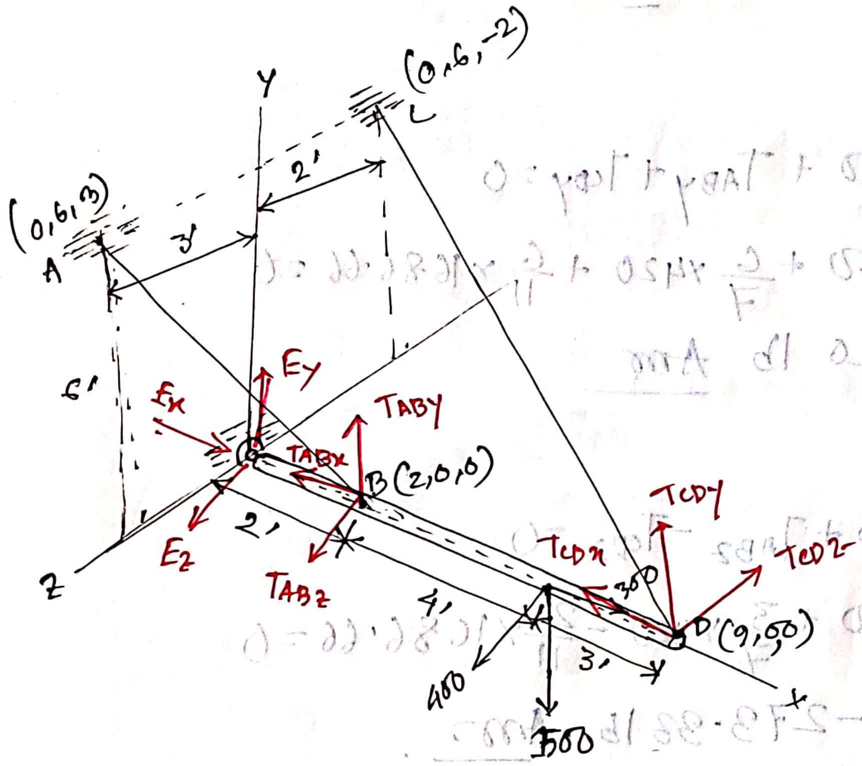

Problem-03



3D

767: The boom DE of the following figure carries a load $F = (300i - 1500j + 400k)$ lb as shown and is supported by a ball and socket at E and two wires AB and CD. Determine the five unknown forces (or components) acting on the boom.

Soln




$$T_{ABx} = \frac{2}{\sqrt{2^2+6^2+3^2}} \times T_{AB} = \frac{2}{7} T_{AB}$$

$$T_{ABy} = \frac{6}{7} T_{AB}$$

$$T_{ABz} = \frac{3}{7} T_{AB}$$

$$T_{CDx} = \frac{9}{\sqrt{9^2+6^2+2^2}} = \frac{9}{11} T_{CD}$$

$$T_{CDy} = \frac{6}{11} T_{CD}$$

$$T_{CDz} = \frac{2}{11} T_{CD}$$

$\Sigma M_y = 0$

$T_{ABz} \times 2 + 400 \times 6 - T_{CDz} \times 9 = 0$

$\frac{3}{7} T_{AB} \times 2 - \frac{2}{11} T_{CD} \times 9 + 2400 = 0$

$\Sigma M_z = 0$

$-1500 \times 6 + T_{CDy} \times 9 + T_{ABy} \times 2$

$\Rightarrow \frac{6}{7} T_{AB} \times 2 + \frac{6}{11} T_{CD} \times 9 - 9000 = 0$

$T_{AB} = 420$ lb

$T_{CD} = 1686.66$ lb

Ans.

$\sum F_x = 0$

$E_x + 300 - T_{ABx} - T_{CDx} = 0$

$\Rightarrow E_x + 300 - \frac{2}{7} T_{AB} - \frac{9}{11} T_{CD} = 0$

$\Rightarrow E_x = 1200$ lb Ans.

$\sum F_y = 0$

$E_y - 1500 + T_{ABy} + T_{CDy} = 0$

$E_y - 1500 + \frac{6}{7} \times 420 + \frac{6}{11} \times 1686.66 = 0$

$E_y = 220$ lb Ans

$\sum F_z = 0$

$E_z + 400 + T_{ABz} - T_{CDz} = 0$

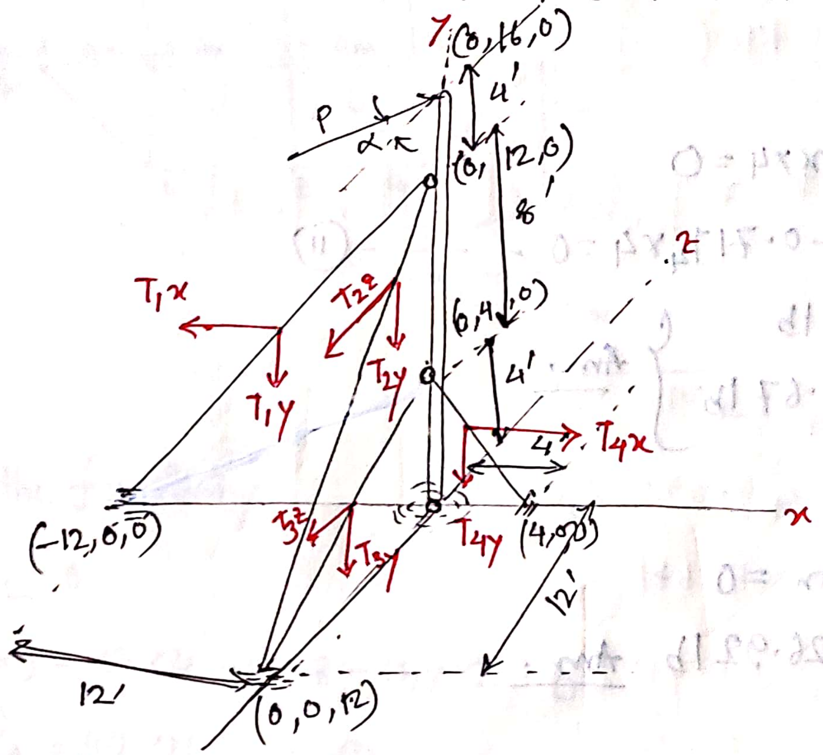
$E_z + 400 + \frac{3}{7} \times 420 - \frac{2}{11} \times 1686.66 = 0$

$E_z = -273.33$ lb Ans.

734

A 16 ft boom is hold by a ball and socket at A and by two cables ECF and FBG which pass around frictionless pulleys at C and B. A horizontal load P of magnitude 900 lb is applied at the top of the boom at D. If P is parallel to the z axis (x=0), determine the reaction at A and the tension in each cable.

Soln




$T_1 = T_2$ and $T_3 = T_4$

(i) $T_1x = \frac{12}{\sqrt{12^2+12^2}} T_1 = 0.71 T_1$

$T_1y = \frac{12}{\sqrt{12^2+12^2}} T_1 = 0.71 T_1$

$T_2y = \frac{12}{\sqrt{12^2+12^2}} T_2 = 0.71 T_2$

$T_2z = \frac{12}{\sqrt{12^2+12^2}} T_2 = 0.71 T_2$

(ii) $T_3y = \frac{4}{\sqrt{12^2+4^2}} T_3 = 0.32 T_3$

$T_3z = \frac{12}{\sqrt{12^2+4^2}} T_3 = 0.95 T_3$

$T_4x = \frac{4}{\sqrt{4^2+4^2}} T_4 = 0.7 T_4$

$T_4y = \frac{4}{\sqrt{4^2+4^2}} T_4 = 0.7 T_4$

$\Sigma M_x = 0$

$T_{2z} \times 12 + T_{3z} \times 4 - 900 \times 16 = 0$

$0.71 T_2 \times 12 + T_{3z} \times 4 - 900 \times 16 = 0$

$\Rightarrow 0.71 \times 12 T_1 + 0.95 \times 4 T_4 - 900 \times 16 = 0$ ---------- (i)

$\Sigma M_z = 0$

$-T_{1x} \times 12 + T_{4x} \times 4 = 0$

$\Rightarrow 0.71 T_1 \times 12 - 0.71 T_4 \times 4 = 0$ ---------- (ii)

$$\left.\begin{array}{l} T_1 = 723 \text{ lb} \\ T_4 = 2168.67 \text{ lb} \end{array}\right\} \text{Ans.}$$

$\Sigma F_x = 0$

$T_{1x} - T_{4x} - A_x = 0$

$A_x = -1026.92 \text{ lb}$ Ans.

$\Sigma F_y = 0$

$T_{1y} + T_{2y} + T_{3y} + T_{4y} - A_y = 0$

$A_y = 3260.23 \text{ lb}$ Ans.

$\Sigma F_z = 0$

$\cancel{T_{1y} + T_{2y} + T_{3y} + T_{4y} - A_y = 0}$

$\cancel{A_y}$

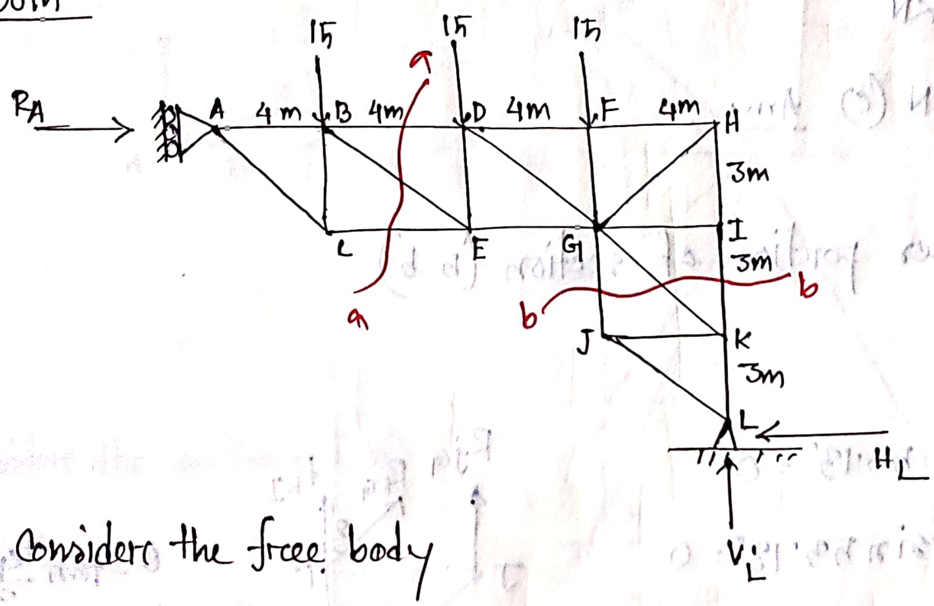
$T_{2z} + T_{3z} + A_z - 900 = 0$

$A_z = -1673.56 \text{ lb}$ Ans.

TRUSS

381. Determine the force in the members BD, BE, CE, GJ, GK and IK of the truss shown

Soln




Consider the free body

$\Sigma M_L = 0$

$R_A \times 9 - 15\times 4 - 15\times 8 - 15\times 12 = 0$

$\therefore R_A = 40 \text{ KN}$ ---- (i)

$\Sigma F_x = 0$

$H_L - R_A = 0$

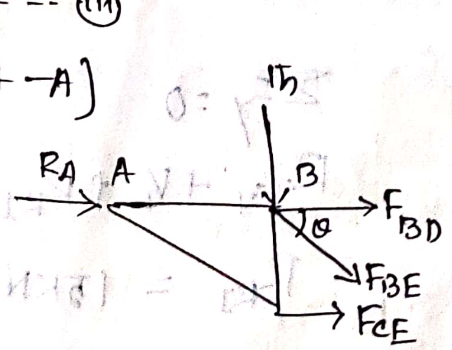
$H_L = 40 \text{ KN}$ --- (ii)

$\Sigma F_y = 0$

$V_L - 15 - 15 - 15 = 0$

$V_L = 45 \text{ KN}$ ---- (iii)

Consider the left portion of section (A – A)




$\theta = \tan^{-1}\frac{3}{4}$

$= 36.87°$

$\Sigma F_y = 0$

$15 + F_{BE}\sin 36.87° = 0$

$F_{BE} = 25 \text{ KN (C)}$ Ans.

$\Sigma M_B = 0$

$F_{CE} \times 3 = 0$

$F_{CE} = 0 \text{ KN}$ Ans

$\Sigma F_x = 0$

$R_A + F_{CE} + F_{BD} + F_{BE}\cos\theta = 0$

$40 + 0 + F_{BD} - 25\cos 36.87^\circ = 0$

$F_{BD} = -20\text{ KN}$

$F_{BD} = 20\text{ KN (C)}$ Am.

Consider the lower portion of section (b-b)

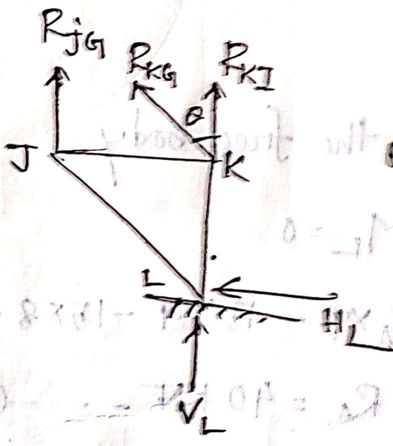
$\Sigma F_x = 0$

$H_L + R_{KG}\sin 53.13^\circ = 0$

$40 + R_{KG}\sin 53.13^\circ = 0$

$R_{KG} = -50\text{ KN}$

$R_{KG} = 50\text{ KN (C)}$ Am




$\theta = \tan^{-1}\frac{4}{3} = 53.13^\circ$

$\Sigma M_K = 0$

$R_{JG} \times 4 + 3 \times H_L = 0$

$R_{JG} = 30\text{ KN (C)}$ Am.

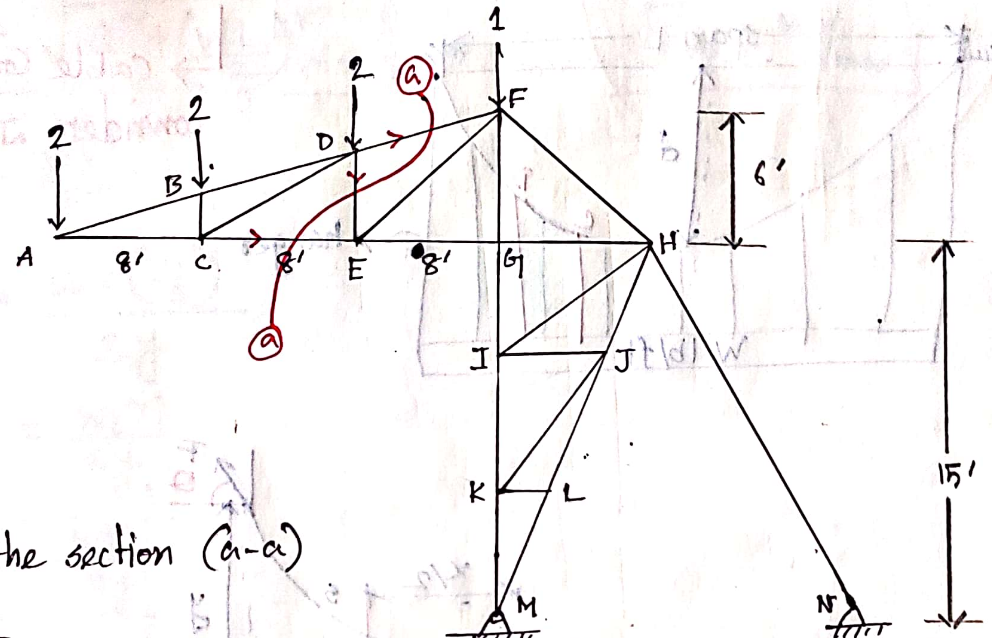
$\Sigma F_y = 0$

$R_{JG} + V_L + R_{KI} + R_{KG}\cos 53.13^\circ = 0$

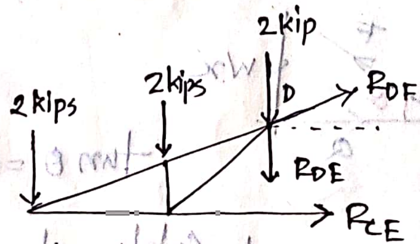
$R_{KI} = 15\text{ KN (T)}$ A.

368

Determine the force in member DF, DE, and CE of the truss shown.




Considere the section (a-a)




$\Sigma M_D = 0$

$-2\times8 - 2\times16 - R_{CE}\times4 = 0$

$\Rightarrow R_{CE} = -12$ kips.

$R_{CE} = 12$ kips (com) Ans.

$\Sigma F_x = 0$

$R_{CE} + R_{DF} \times \cos 14° = 0$

$R_{DF} = 12.36$ kips (T) Ans.

$\Sigma F_y = 0$

$-R_{DF}\sin 14° + 2 + 2 + 2 + R_{DE} = 0$

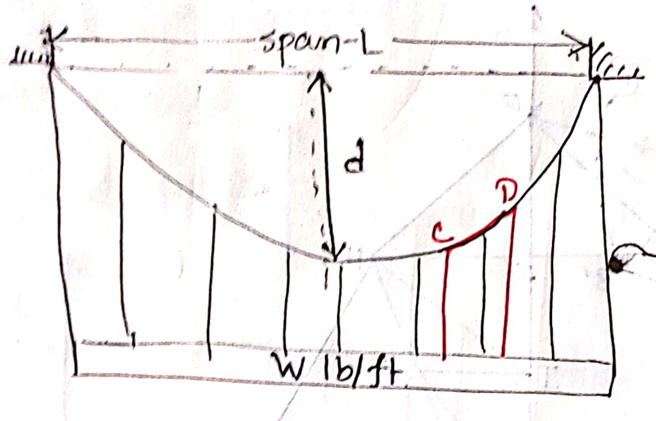
$R_{DE} = -3$ kips

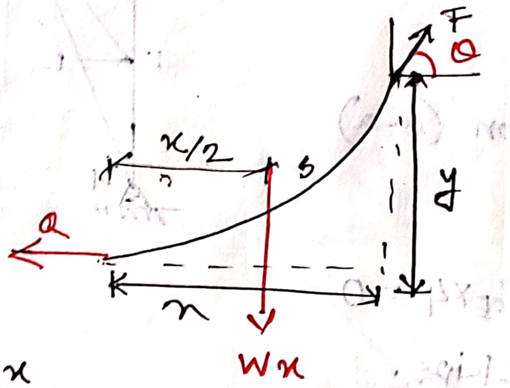
$R_{DE} = 3$ kips (C) Ans.

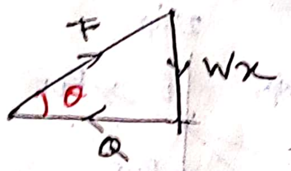
# Cable:

Cable take only tension

(Parabolic)
↳ cable এর weight consider না করে




$$\tan\theta = \frac{Wx}{Q}$$

$\therefore$ Cable slope, $\theta = \tan^{-1}\frac{Wx}{Q}$

$$\therefore \boxed{\theta = \tan^{-1}\frac{WL}{2Q}} \qquad \boxed{L = 2x}$$

$\sum F_x = 0$

$\Rightarrow Q = F\cos\theta$ - - - - (i)

$\sum F_y = 0$

$Wx = F\sin\theta$ - - - - (ii)

s = half length of cables

$\sum M_c = 0$

$-Q \times y + Wx \times \left(\frac{x}{2}\right) = 0$

$$\Rightarrow \boxed{y = \frac{Wx^2}{2Q}}$$

Tension

$$F' = \sqrt{Q^2 + (wx)^2}$$

$$\boxed{F'_{max} = \sqrt{Q^2 + \left(\frac{wL}{2}\right)^2}} \text{ ----- (iv)}$$

$$\boxed{F'_{max} = w y_{max}}$$

$$Q = \frac{wx^2}{2y}$$

$$= \frac{w \times \left(\frac{L}{2}\right)^2}{2y}$$

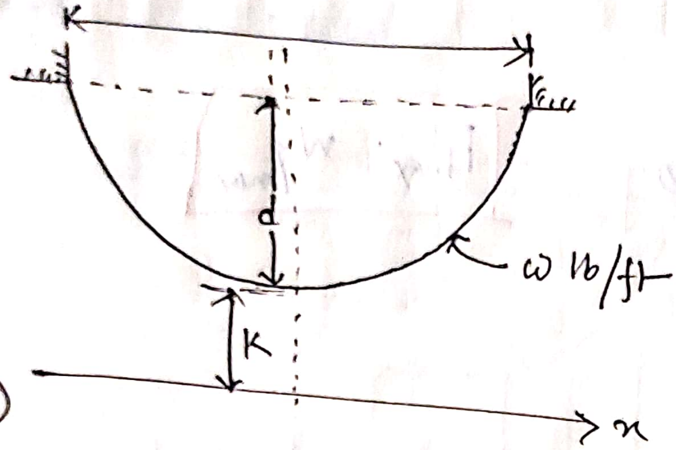
$$= \frac{wL^2}{8y}.$$

$$\therefore \boxed{Q = \frac{wL^2}{8y}}$$

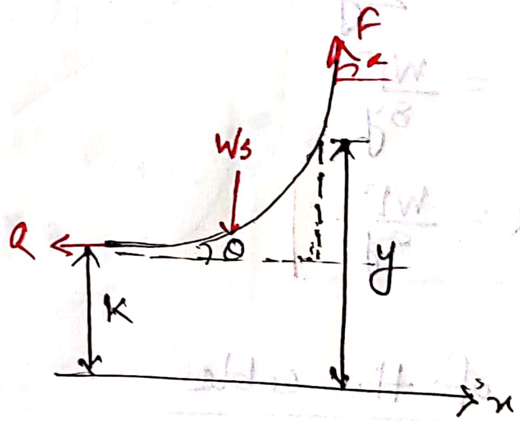
Length of the cable

$$\boxed{s = L + \frac{8d^2}{3L} - \frac{32d^4}{5L^3}}$$

(Catenary)
→ Cable এর নিজের weight consider করে;




Parabolic থেকে — catenary তে d বড় হবে (বেশি)




$$Y = K + d$$

$$\boxed{y = \sqrt{s^2 + K^2}}$$

$\Sigma F_x = 0$

$F\cos\theta = Q$ —— (i)

$\Sigma F_y = 0$

$F\sin\theta = Ws$ —— (ii)

(ii) ÷ (i)

$$\tan\theta = \frac{Ws}{Q} \qquad \left(\boxed{\frac{Q}{W} = K}, \text{ let}\right)$$

$$\therefore \tan\theta = \frac{s}{K} = \frac{dy}{dx}$$

$$\boxed{Q = WK}$$

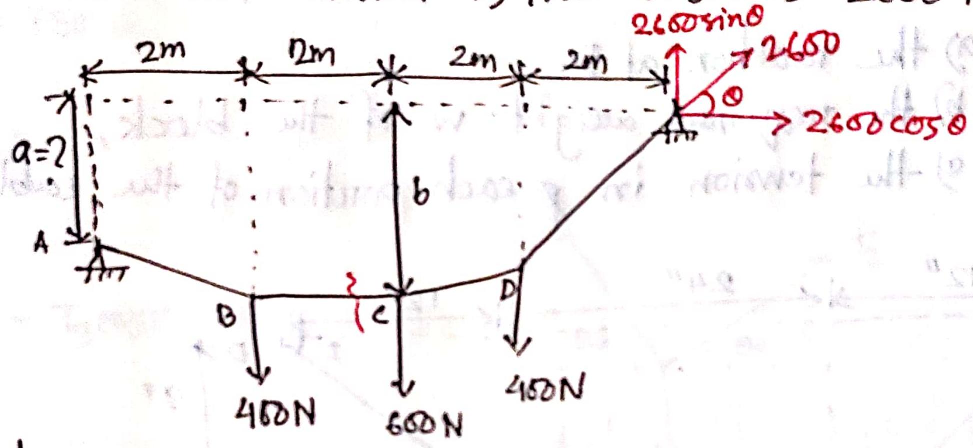
$$\boxed{F = Wy = W\sqrt{s^2 + K^2}}$$

$$\boxed{s = K\sinh\left(\frac{x}{K}\right)}$$

$$\boxed{Y = K\cosh\left(\frac{x}{K}\right)}$$

Problem 1348:

Determine the distance a if the portion BC of the cable is horizontal and if the maximum tension is the cable is 2600 N




At point C

$F_y = 0$

$400 + 600 = 2600 \sin\theta$

$\theta = 22.62°$

$\sum M_A = 0$

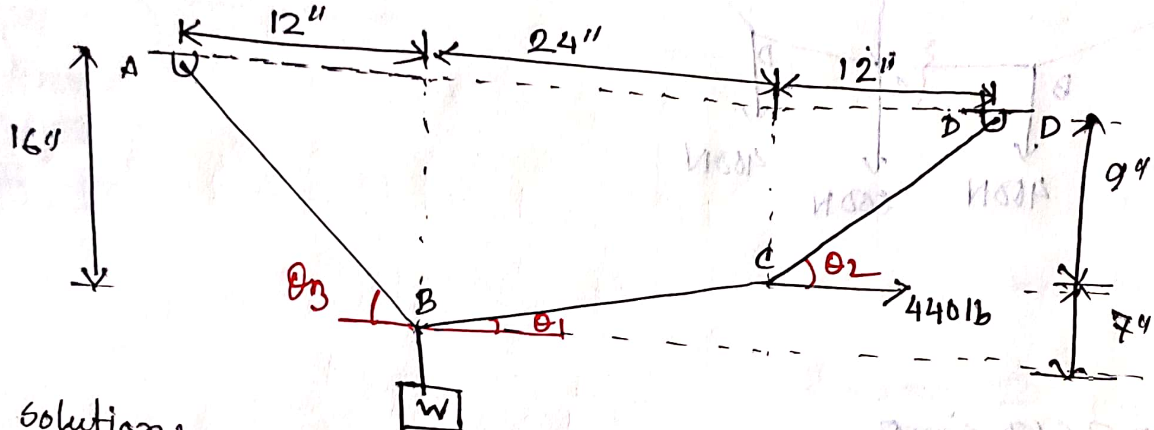
$a \times 2600 \cos 22.6° - 8 \times 2600 \sin 22.6° + 400 \times 2 + 600 \times 4 + 6 \times 400 = 0$

$a = 1m$ Ans.

## Problem 1405:

knowing that the 400 lb force applied at C and the block attached at B maintain the cable in the position shown, determine

a) the reaction at D,
b) the required weight W of the block,
c) the tension in each portion of the cable.



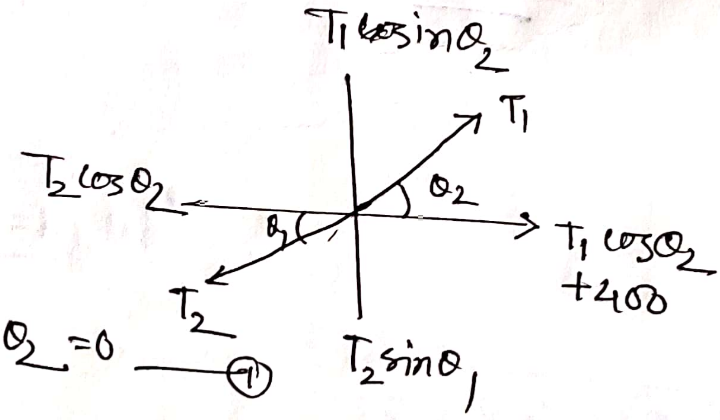

### Solution:

$$\theta_1 = \tan^{-1}\frac{7}{24} = 16.26^\circ$$

$$\theta_2 = \tan^{-1}\frac{9}{12} = 36.87^\circ$$

$$\theta_3 = \tan^{-1}\frac{16}{12} = 53.13^\circ$$

### At point C




$\Sigma F_x = 0$

$T\cos\theta_2 + 400 - T_2\cos\theta_2 = 0$ —— (i)

$\Sigma F_y = 0$

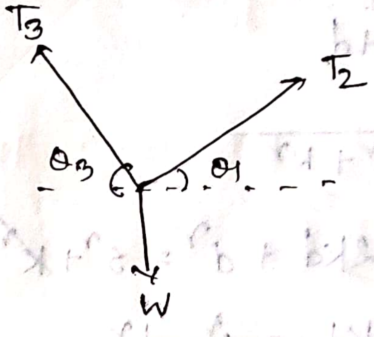
$T_1 \sin\theta_2 - T_2 \sin\theta_1 = 0$ —— (ii)

From equation (i) and (ii)

$T_1 = 350$ lb } Ans.

$T_2 = 750$ lb

At point B,




$\Sigma F_x = 0$

$\Rightarrow T_2 \cos\theta_1 - T_3 \cos\theta_3 = 0$ —— (iii)

$\Sigma F_y = 0$

$T_2 \sin\theta_1 + T_3 \sin\theta_3 - W = 0$ —— (iv)

Solving (iii) and (iv)

$T_3 = 1200$ lb

$W = 1170$ lb } Ans.

Problem - 1802

A 60ft cable which weight - 360 lb and d = 15 ft. Find the tem[sion]
at support and span.

Solution:

We know,

$y = k + d$

$y = \sqrt{s^2 + k^2}$

$\Rightarrow \cancel{y^2}\ \cancel{k^2} + 2kd + d^2 = s^2 + \cancel{k^2}$

$\Rightarrow 2kd = s^2 - d^2$

$\Rightarrow k = \frac{s^2 - d^2}{2d}$

$= \frac{30^2 - 15^2}{2 \times 15}$

$= 22.5$

$y = k + d$

$= 22.5 + 15$

$= 37.5$

$s = \frac{L}{2} = \frac{60}{2} = 30 ft$

$w = \frac{360}{60} = 6\ lb/ft$

$\therefore F = wy$

$= 6 \times 37.5$

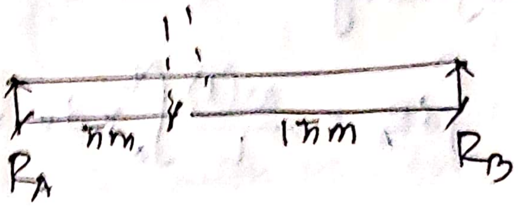
$= 225$

Problem (Class)

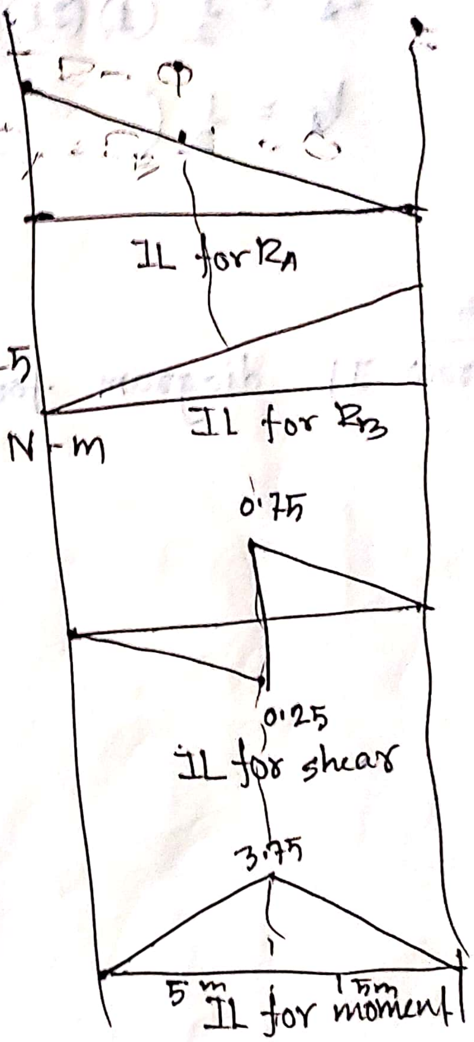
If $a = 5m$, $b = 15m$, draw influence line diagrams for reactions $R_A$ and $R_B$ as well as $V_1$ and $M_1$ at section 1

Soln

When a unit load at A




$R_A = 1KN$, $R_B = 0$, $V_1 = 0$, $M_1 = 0$




When a unit load at just left of section 1, Using equilibrium equation

$R_A = 0.75 KN$, $R_B = 0.25$, $V_1 = -0.25$

$M_1 = 0.75 \times 5 = 0.25 \times 15 = 3.75 N-m$

When a unit load at just right of section

$R_A = 0.75$, $R_B = 0.25 KN$

$V_1 = +0.75 KN$,

$M_1 = 0.75 \times 5 = 3.75 N.m$

When a unit load at B.

Integrating

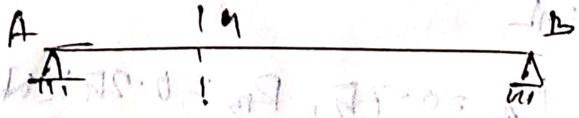
$$\int dR_A = \frac{\omega(1)}{L}\int_0^L x\,dx = \frac{\omega(1)L}{2}$$

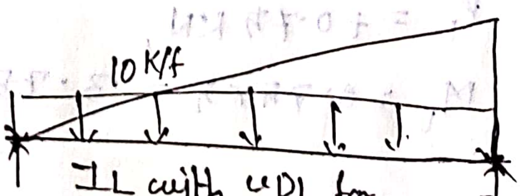
- $R_A = \frac{1}{2}(1)(25)(10) = 125$ kips

$V_a = \frac{1}{2}($

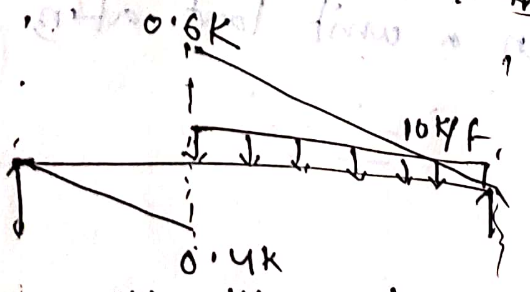
**Q.3**

Draw IL diagram for $R_A$, $R_B$, $V_a$ and $M_a$ of the following

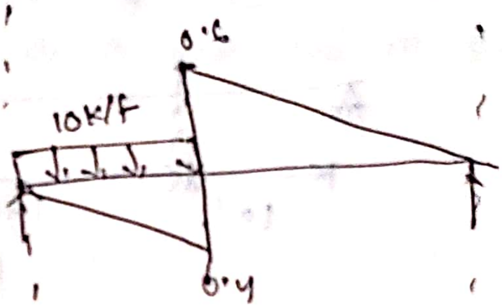



IL with UDL for max $R_B$




IL with UDL for max $+V_a$



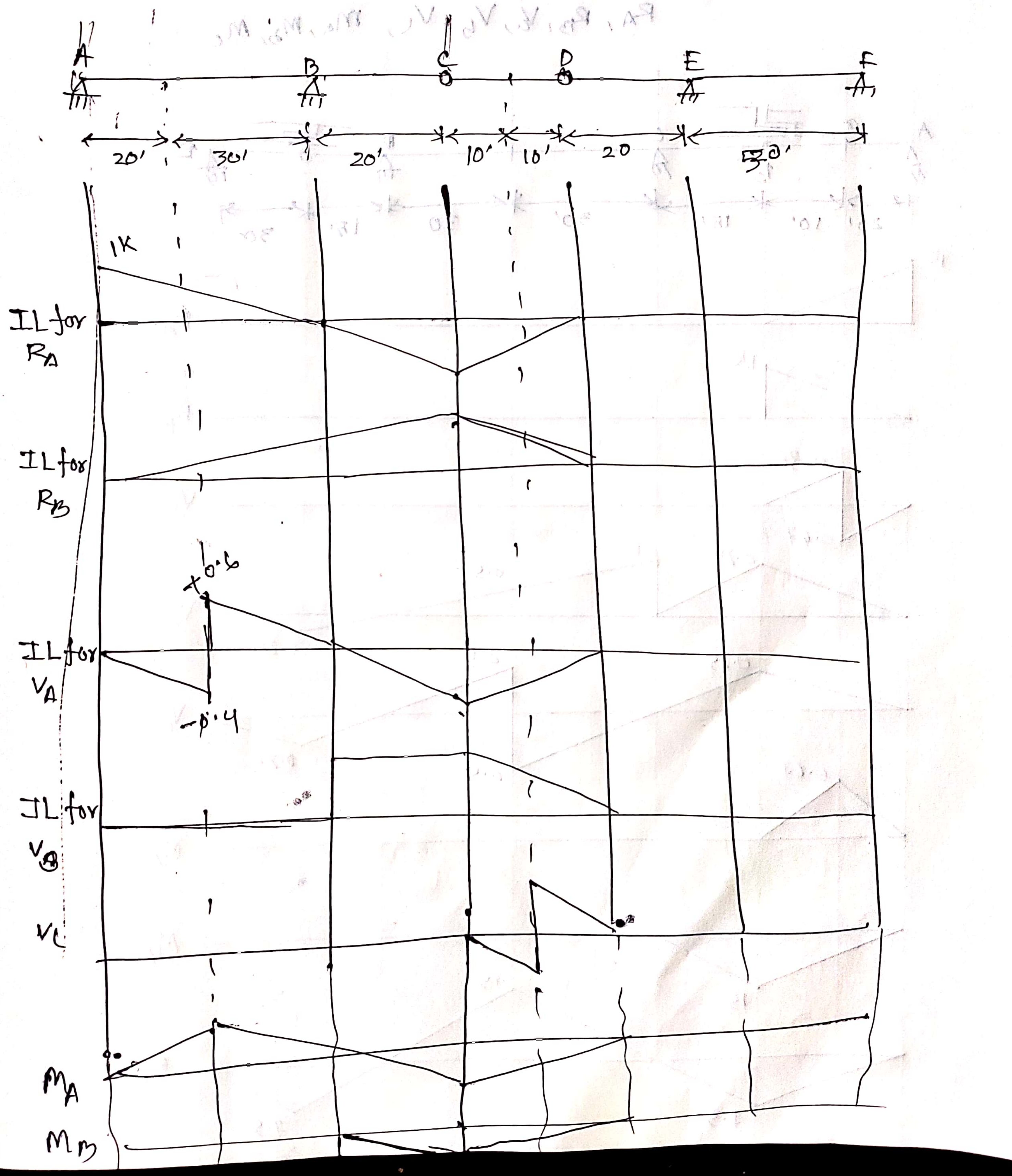

IL with UDL for max $-V_A$

$$-\left(\frac{1}{2}\times 10\times 0.4\times 10\right)+\left(\frac{1}{2}\times 15\times 0.6\times 10\right)$$

$$= 25$$

10'
15'
5'

2. Draw IL diagram for $R_A$, $R_B$, $V_A$, $V_b$, $M_a$, $M_b$ and $M_c$ of the following balance cantilever bridge as a unit load moves from A to F

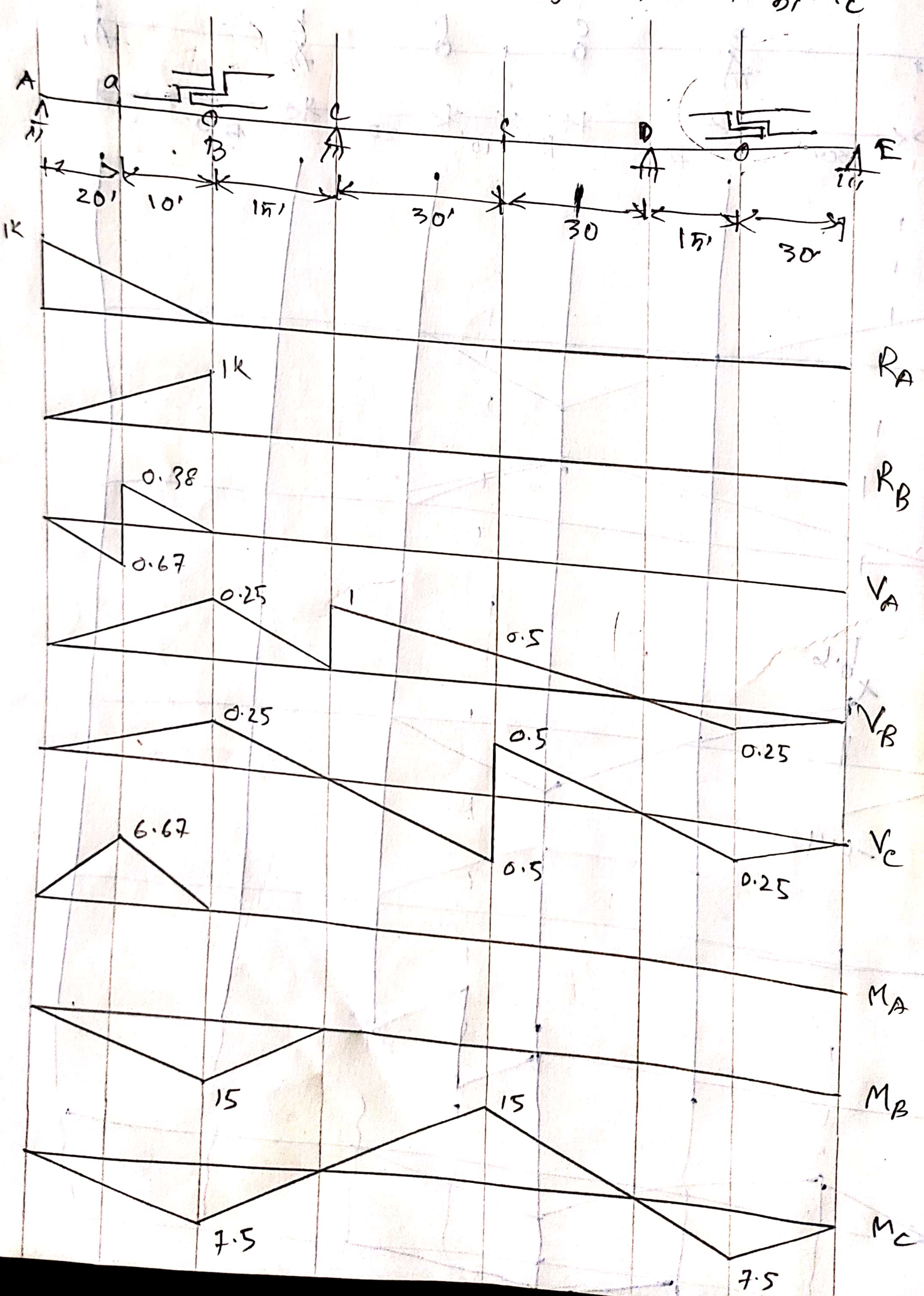


$\Sigma M_b = 0$

$M_b - 1 \times x = 0$

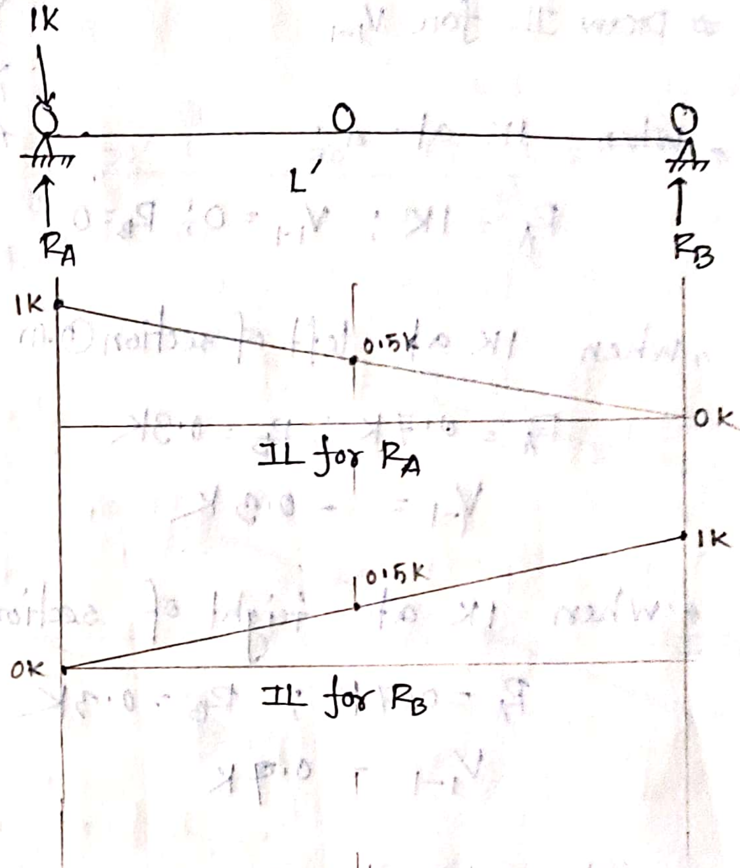
$M_b = x$

$R_A, R_B, V_a, V_b, V_c, M_a, M_b, M_c$



## Influence line for Reaction:

# Draw IL for $R_A$ and $R_B$




When 1K at A:

$R_A = 1K$ ; $R_B = 0K$

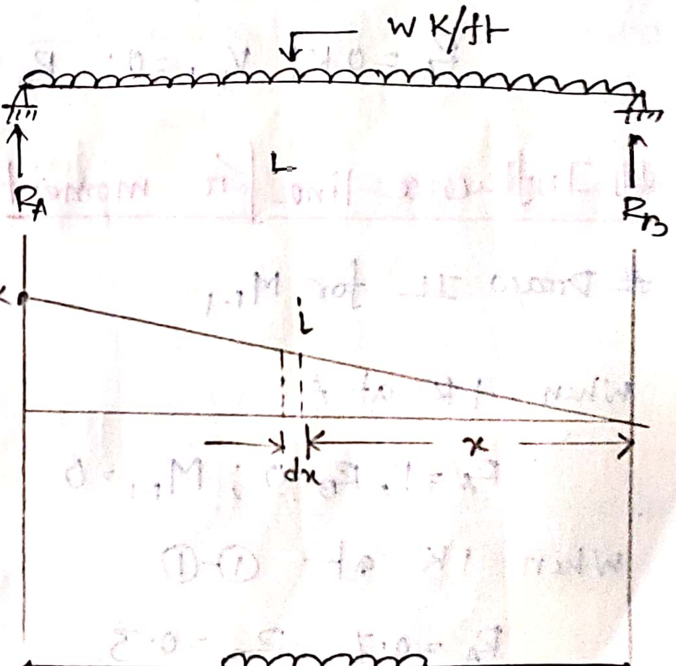
When 1 K at L/2 from A:

$R_A = 0.5K$; $R_B = 0.5K$

When 1K at B:

$R_A = 0K$; $R_B = 1K$

In case of distribution load




$\frac{1}{L} = \frac{i}{x}$ [From similar Triangle]

$i = \frac{x}{L}$

Now,

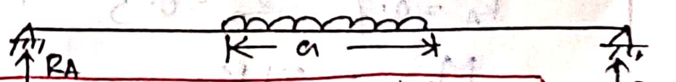
$$\int_0^L dR_A = \int_0^L i \times w \times dx$$

$$\Rightarrow R_A = \int_0^L \frac{x}{L} w\, dx$$

$$R_A = \left[\frac{w}{2}\frac{x^2}{L}\right]_0^L$$

$$R_A = \frac{wL}{2}$$

$$\therefore R_A = \frac{1}{2} \times (1 \times L) \times w$$

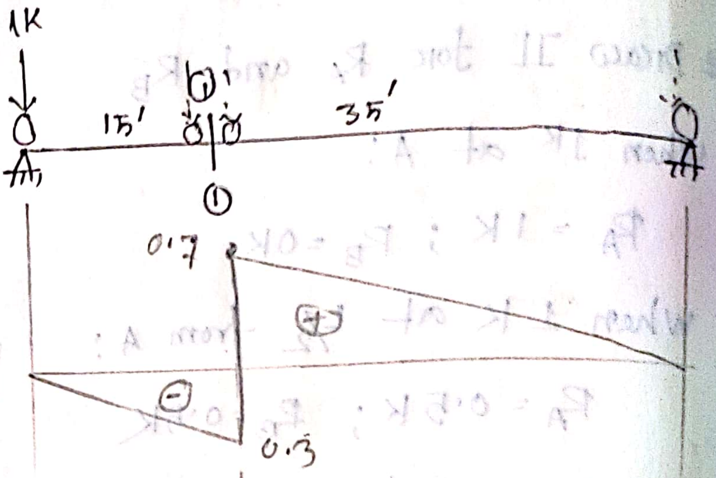



$\therefore \boxed{R_A = \text{Area of the influence line} \times \text{distributed load}}$


$\therefore R_A = \underbrace{\frac{i_1 + i_2}{2} \times a}_{\text{area of the influence line.}} \times w$

## Influence Line for shear force:

# Draw IL for $V_{1-1}$




" When 1K at A:

$R_A = 1K$ ; $V_{1-1} = 0$; $R_B = 0$

" when 1K at left of section ①-①

$R_A = 0.7K$ ; $R_B = 0.3K$

$V_{1-1} = -0.3K$

" when 1K at right of section ①-①

$R_A = 0.7K$ ; $R_B = 0.3K$

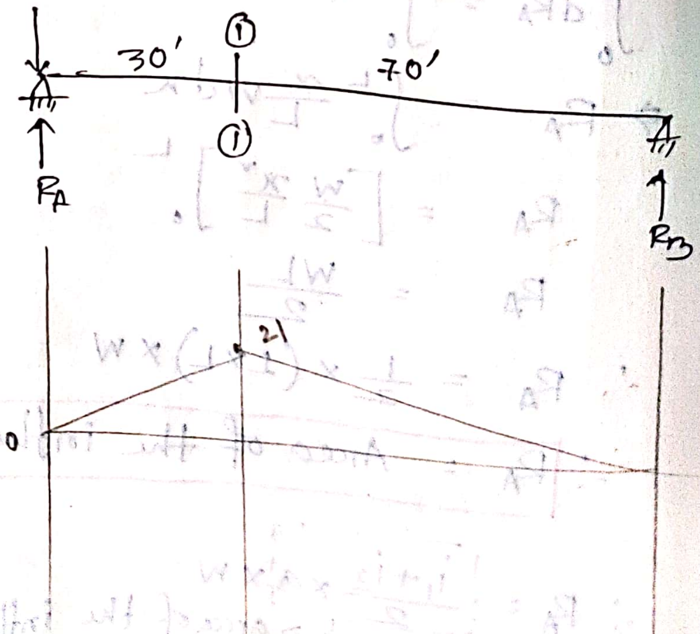
$V_{1-1} = 0.7K$

" When 1K at B;

$R_A = 0K$; $V_{1-1} = 0$; $R_B = 1$

## Influence line for moment:

# Draw IL for $M_{1-1}$




When 1K at A:

$R_A = 1$, $R_B = 0$ ; $M_{1-1} = 0$

When 1K at ①-①

$R_A = 0.7$ $R_B = 0.3$

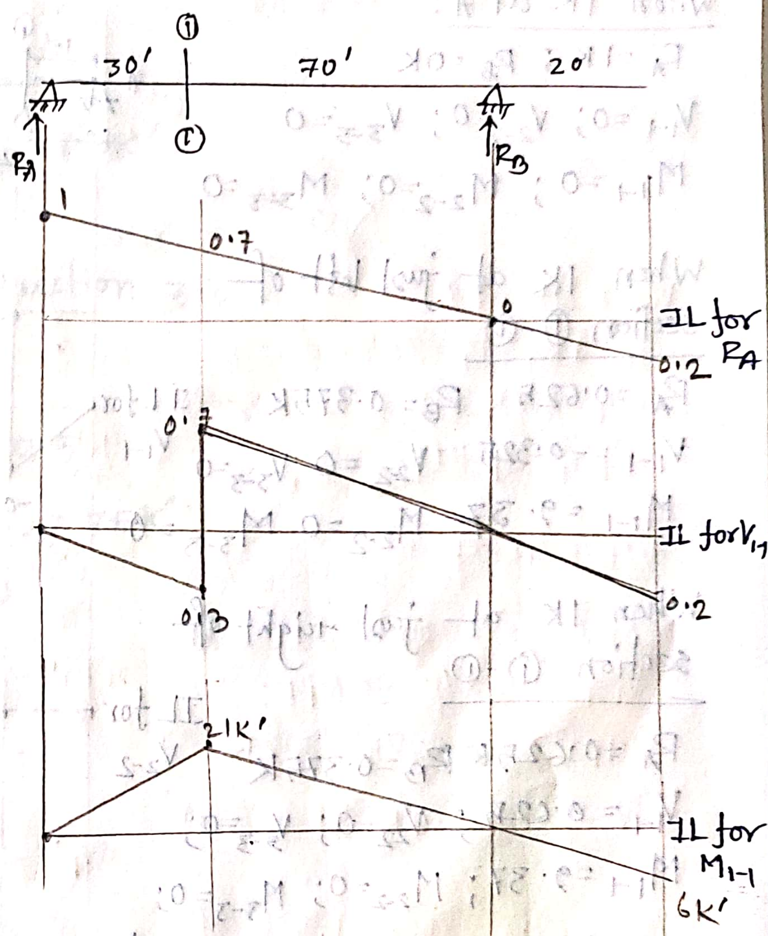
$M_{1-1} = 21K$

when 1K at B

$R_A = 0$; $R_B = 1$; $M_{1-1} = 0$

## Problem-01

Draw IL for $R_A$, $V_{1-1}$, $M_{1-1}$




// When 1K at A

$R_A = 1$; $R_B = 0$

$V_{1-1} = 0$; $M_{1-1} = 0$

// When 1K at just left from section (1-1)

$R_A = 0.7K$; $R_B = 0.3K$

$V_{1-1} = -0.3$; $M_{1-1} = 21K'$.

// When 1K at just right from section (1-1)

$R_A = 0.7K$; $R_B = 0.3K$

$V_{1-1} = 0.7$; $M_{1-1} = 21K'$

// When 1K at B

$R_A = 0$; $R_B = 1K$

$V_{1-1} = 0$; $M_{1-1} = 0$

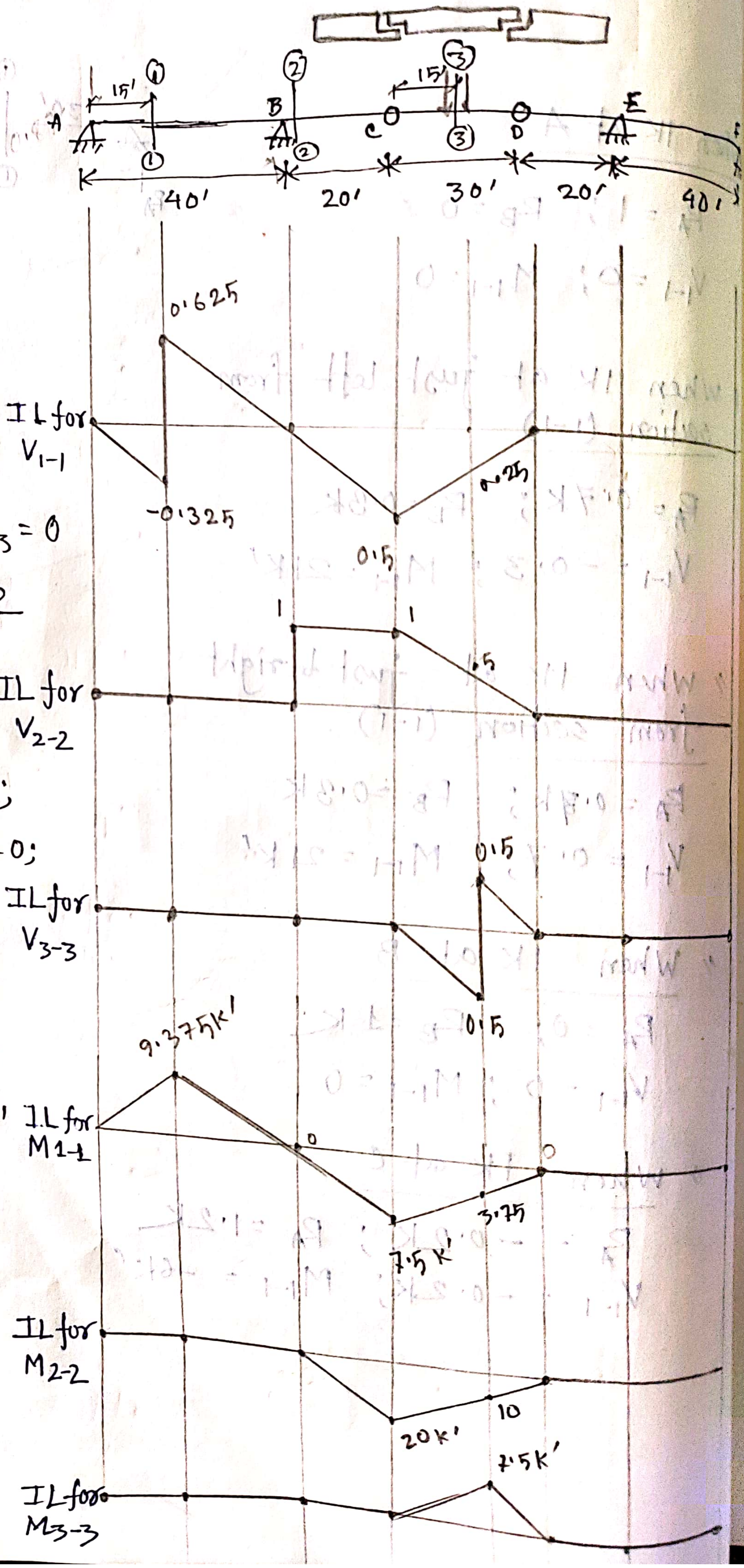
// When 1K at C

$R_A = -0.2K$; $R_A = 1.2K$

$V_{1-1} = -0.2K$; $M_{1-1} = -6K'$

## Problem-02

Draw IL for $V_{1-1}$, $V_{2-2}$, $V_{3-3}$, $M_{1-1}$, $M_{2-2}$, $M_{3-3}$




**When 1K at A:**

$R_A = 1K$ ; $R_B = 0K$

$V_{1-1} = 0$; $V_{2-2} = 0$; $V_{3-3} = 0$

$M_{1-1} = 0$; $M_{2-2} = 0$; $M_{3-3} = 0$

**When 1K at just left of section ①-①**

$R_A = 0.625$ $R_B = 0.375K$

$V_{1-1} = -0.325$ $V_{2-2} = 0$ $V_{3-3} = 0$

$M_{1-1} = 9.37$ $M_{2-2} = 0$ $M_{3-3} = 0$

**When 1K at just right of section ①-①**

$R_A = 0.625K$ $R_B = 0.375K$

$V_{1-1} = 0.625$; $V_{22} = 0$; $V_{3-3} = 0$;

$M_{1-1} = 9.37$; $M_{2-2} = 0$; $M_{3-3} = 0$;

**When 1K at B**

$R_A = 0$; $R_B = 1K$

$V_{1-1} = 0$; $V_{2-2} = 0$; $V_{3-3} = 0$;

$M_{1-1} = 0$; $M_{2-2} = 0$; $M_{3-3} = 0$,

**When 1K at just left of section ②-② C**

$R_A = -0.5K$ $R_B = 1.5K$

$V_{1-1} = 0.5$; $V_{22} = 1$; $V_{3-3} = 0$

$M_{1-1} = -7.5$; $M_{22} = 20K$

$M_{3-3} = 0$

**When 1K at just left of section 3-3**

$R_A = -0.25K$; $R_B = 0.75K$

$V_{1-1} = 0.25$; $V_{2-2} = 1$; $V_{3-3} = -0.5$

$M_{1-1} = -3.75$; $M_{2-2} = -10K'$; $M_{3-3} = 7.5K'$

**When 1K at just right of section 3-3**

$R_A = -0.25K$; $R_B = 0.75K$

$V_{1-1} = 0.25$; $V_{22} = 1$; $V_{3-3} = 0.5$

$M_{1-1} = -3.75$; $M_{2-2} = 10$; $M_{3-3} = 75K'$;

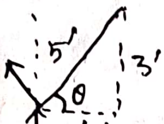
**When 1K at point D**

$V_{1-1} = 0$; $V_{2-2} = 0$; $V_{3-3} = 0$

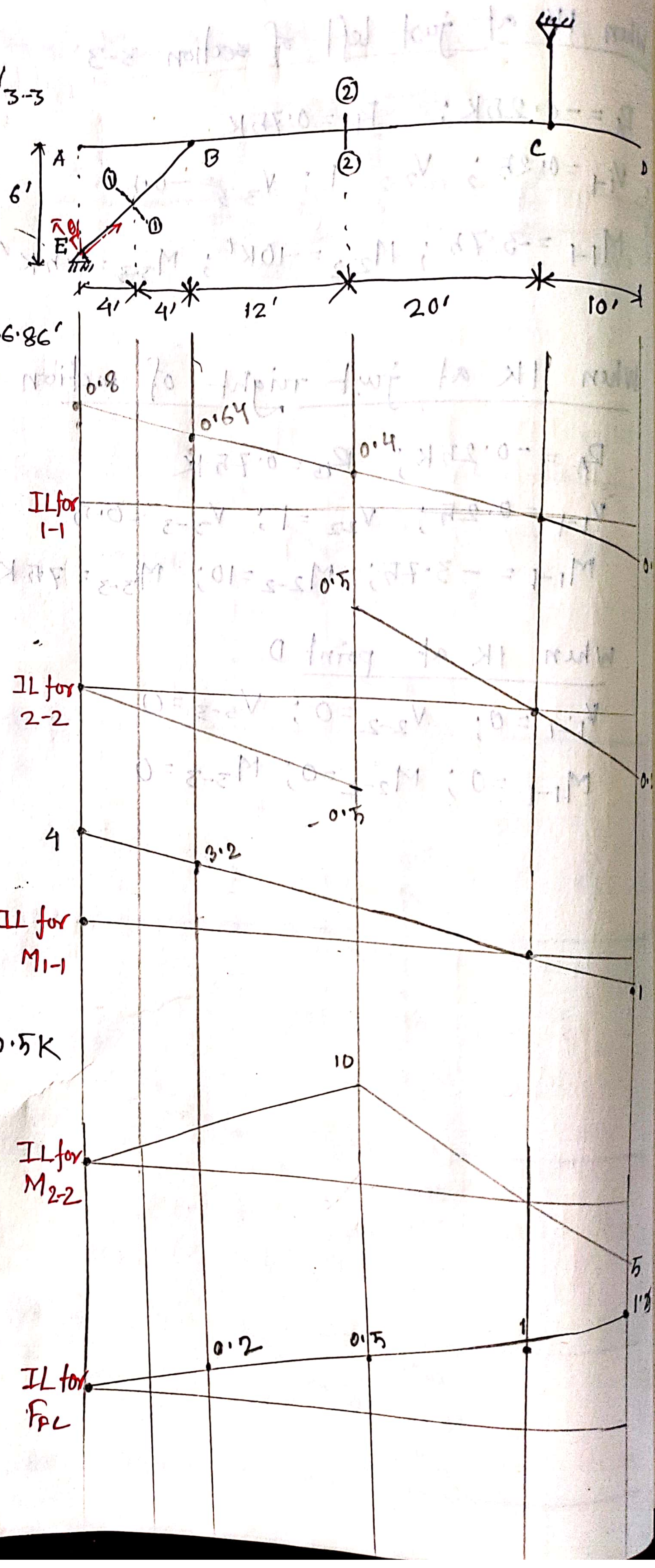
$M_{1-1} = 0$; $M_{2-2} = 0$; $M_{3-3} = 0$

## Problem-03

Draw IL for $V_{1-1}$, $V_{2-2}$, $V_{3-3}$, $M_{1-1}$, $M_{2-2}$




$\theta = 36.86'$




### When 1K at A

$R_E = 1K$; $R_F = 0$

$V_{1-1} = 0.8K$; $V_{2-2} = 0$; $F_{FC} = 0$

$M_{1-1} = 4$; $M_{2-2} = 0$;

### When 1K at B

$R_E = \frac{32}{40} = 0.8K$; $R_F = 0.2K$

$V_{1-1} = 0.8 \times \frac{4}{5} = 0.64K$;

$M_{1-1} = (0.64 \times 5) = 3.2K'$

$V_{2-2} = -0.2K$ $M_{2-2} = 4K'$

### When 1K at just left of section 2-2

$R_E = 0.5K$; $R_F = 0.5K$

$V_{1-1} = -0.5 \times \frac{8}{10}$; $V_{2-2} = -0.5K$

$F_{FC} = 0.5K$

$M_{1-1} = (0.4 \times 5) = 2K$

$M_{2-2} = 10K'$

When 1K at just Right of section 2-2

$R_E = 0.5K$ ; $R_F = 0.5K$

$V_{1-1} = 0.4K$ ; $V_{2-2} = 0.5K$ ; $F_{FC} = 0.5K$

$M_{1-1} = 2K$ ; $M_{2-2} = 10K$ ;

When 1K at C:

$R_E = 0$ ; $R_F = 1K$ ;

$V_{1-1} = 0$ ; $M_{1-1} = 0$ ; $F_{FC} = 1K$

$V_{2-2} = 0$ ; $M_{2-2} = 0$

When 1K at D:

$R_E = -0.25K$ ; $R_F = 1.25K$

$V_{1-1} = \left(-0.25 \times \frac{8}{10}\right) = -0.2K$ ;

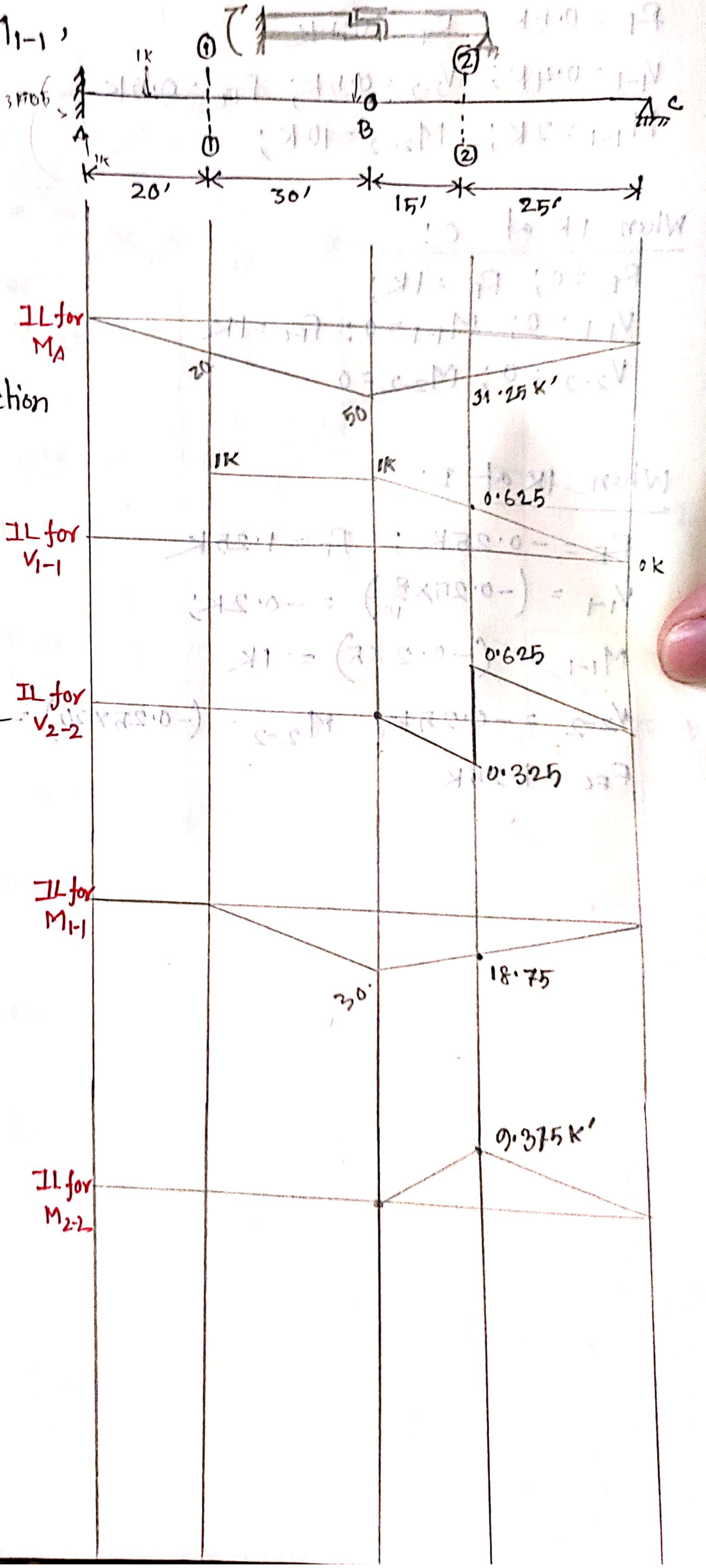
$M_{1-1} = (-0.2 \times 5) = 1K$

$V_{2-2} = -0.25K$ ; $M_{2-2} = (-0.25 \times 20) = -0.5K'$

$F_{FC} = 1.25K$

Problem - 04:

Draw IL for $V_{1-1}$, $V_{2-2}$, $M_{1-1}$, $M_{2-2}$, $M_A$ :




When 1K at A

$R_A = 1K$ ; $R_C = 0$

$V_{1-1} = 0$; $V_{2-2} = 0$; $M_A = 0$;

When 1K at just left of the section (1-1)

$R_A = 1K$; $R_C = 0K$

$V_{1-1} = 0$; $V_{2-2} = 0$

$M_{1-1} = 0$; $M_{2-2} = 0$

$M_A = 20K'$;

When 1K at just right of the section (1-1):

$R_A = 1K$; $R_C = 0K$

$V_{1-1} = 1K$; $V_{2-2} = 1K$

$M_{1-1} = 0K'$; $M_{22} = 0K'$

$M_A = -20K'$;

When 1K at B

$R_A = 1K$; $R_C = 0K$

$V_{1-1} = 1K$; $V_{2-2} = 0K$

$M_{1-1} = 30K'$ $M_{22} = 0K'$

$M_A = -50K'$;

when 1k at just left of the section (2-2)

$R_B = 0.625\,K$; $R_C = 0.375\,K$ $\left(R_C = \frac{15}{210}\right)$

$V_{1-1} = 0.625\,K$ $V_{22} = 0.325\,K$

$M_{1-1} = 18.75\,K'$ $M_{2-2} = 9.375\,K'$

$M_A = -31.25\,K'$

when 1k at just right of the section (2-2)

$R_C = 0.375\,K$ $R_B = 0.625\,K$

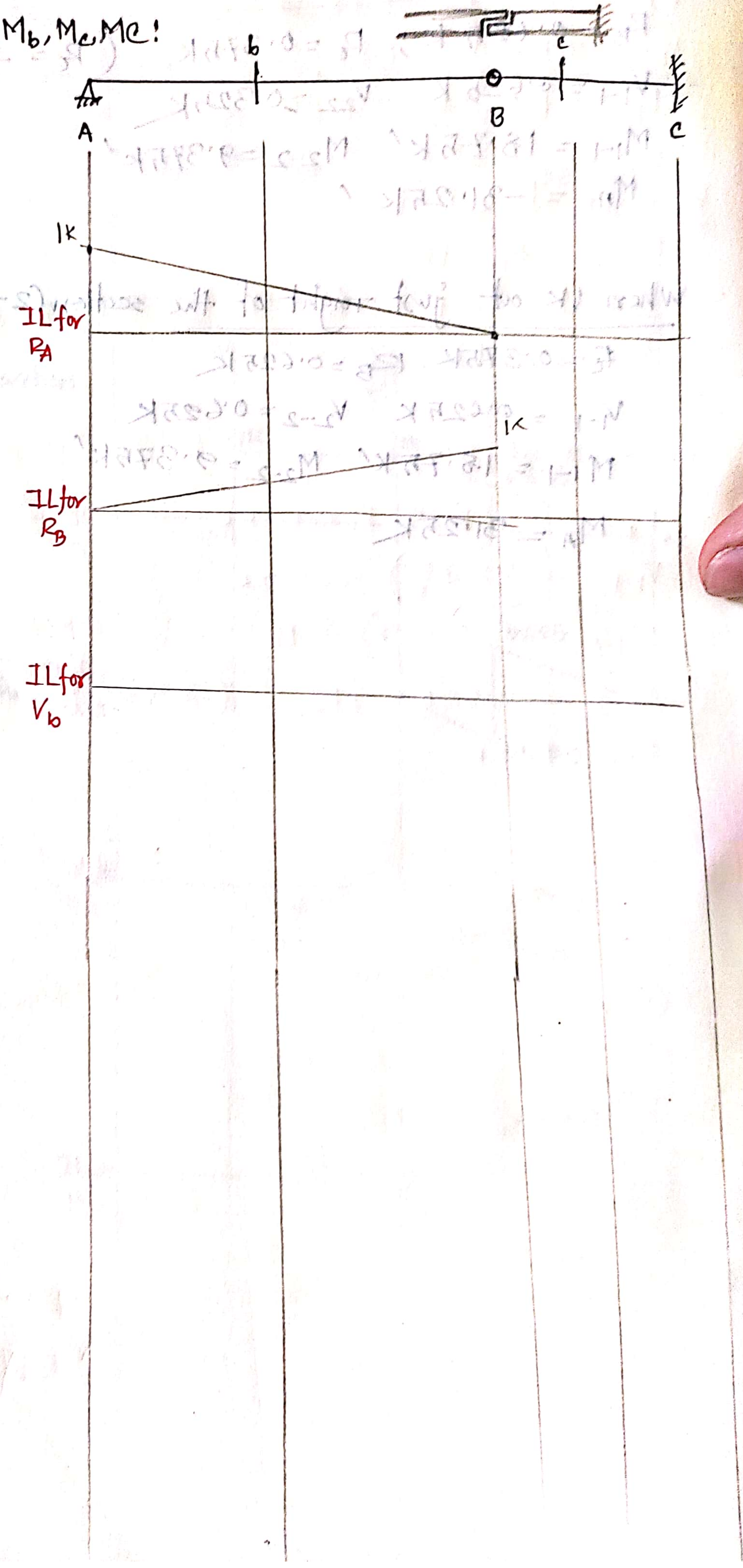
$V_{1-1} = 0.625\,K$ $V_{2-2} = 0.625\,K$

$M_{1-1} = 18.75\,K'$ $M_{2-2} = 9.375\,K'$

$M_A = 31.25\,K$

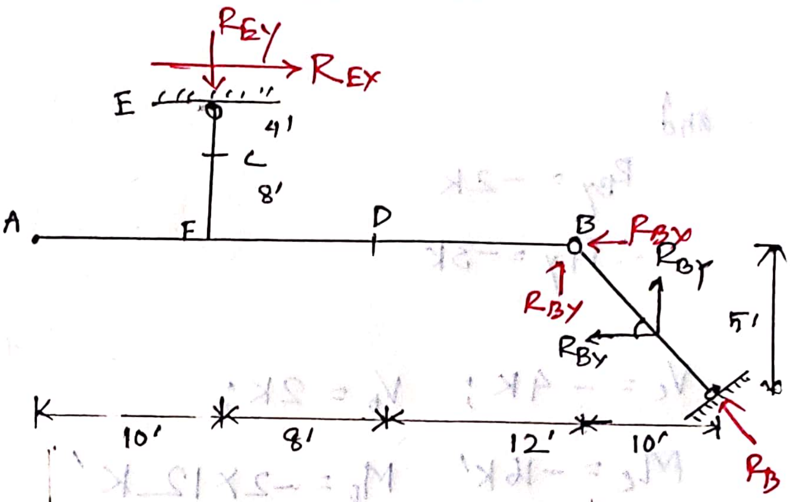
Problem-05

Draw IL for $R_A$, $R_B$, $V_b$, $V_c$, $M_b$, $M_c$, $M_C$!



## Problem - 06

Draw IL for $V_C$, $V_D$, $M_C$, $M_D$ and $R_B$




$\theta = \tan^{-1}\frac{5}{10}$

$= 26.565°$

**When 1K at A:**

$\Sigma M_E = 0$

$-1\times10 + R_B\cos\theta\times12 - R_B\sin\theta\times20 = 0$

$R_B = 5.59\ K$

$R_{Bx} = 5.59\cos26.565° = 5K$

$R_{By} = 5.59\sin26.565° = 2.5K$

$\Sigma F_x = 0$

$R_{Bx} = R_{Ex} = 5K$

$\Sigma F_y = 0$

$R_{Ey} + 1 = R_{By}$

$R_{Ey} = 1.5K$

$V_C = 5K$ ; $V_D = -(1+1.5)K$

$= -2.5K$

$M_C = +20K'$ $M_D = \overset{2.5\times12}{\cancel{-1\times18+1.5\times8}}$

$= 30K'$

এইটা করা হয়নি Extra moment E point এ count করতে হবে।

**When 1K at F:**

All values are zero

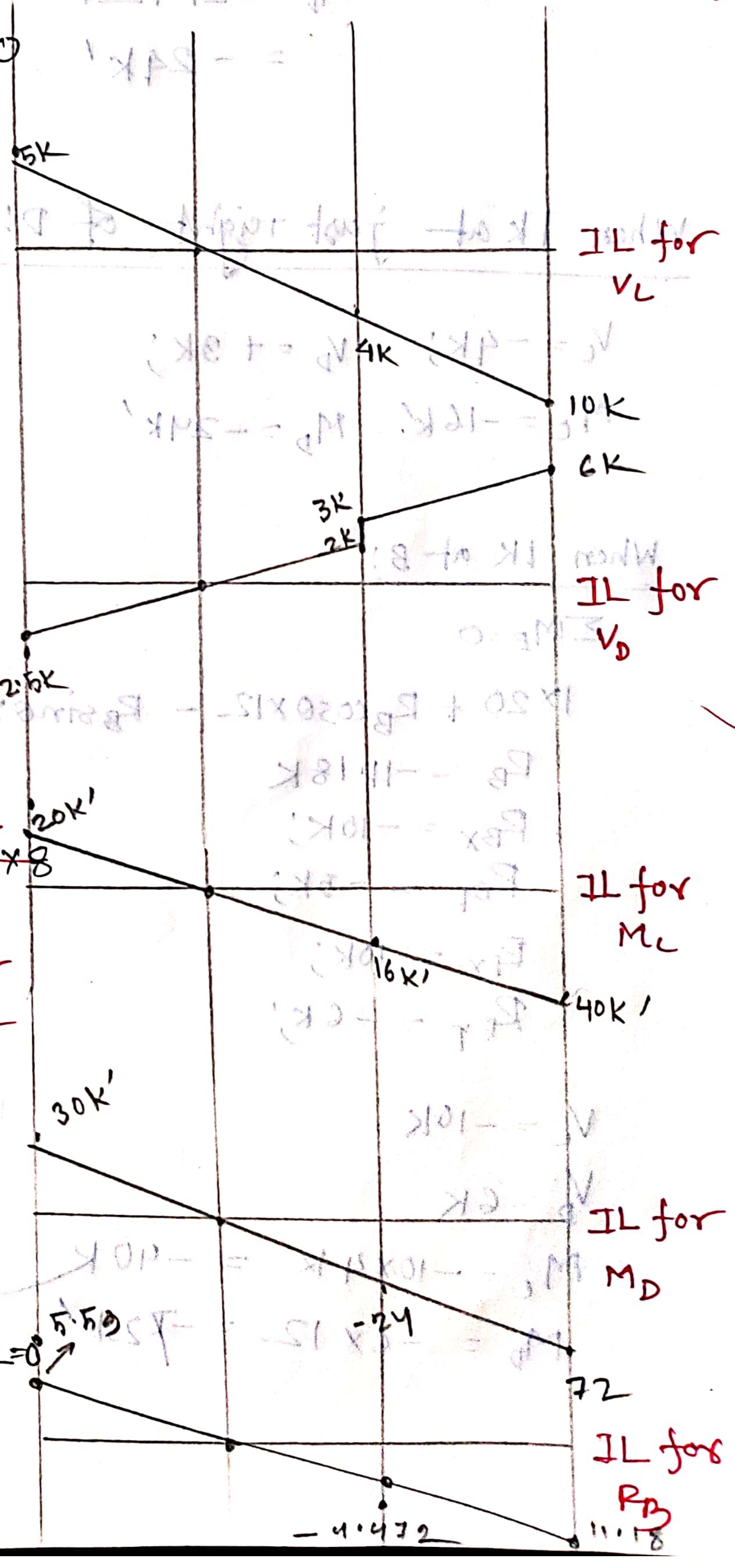
**When 1K at just left of D:**

$\Sigma M_E = 0$

$1\times8 - R_B\sin\theta\times20 + R_B\cos\theta\times12 = 0$

$R_B = -4.472K$

$R_{Bx} = -4K = R_{Ex}$



and

$R_{Dy} = -2K$

$\therefore R_{Ey} = -3K$

$V_C = -4K$; $V_D = 2K$;

$M_C = -16K'$ $M_D = -2 \times 12 K'$

$= -24K'$

When 1K at just right of D:

$V_C = -4K$; $V_D = +3K$;

$M_C = -16K'$ $M_D = -24K'$

When 1K at B:

$\Sigma M_E = 0$

$1 \times 20 + R_B \cos\theta \times 12 - R_B \sin\theta \times 20 = 0$

$R_B = -11.18K$

$R_{Bx} = -10K$;

$R_{By} = -5K$;

$R_{Ex} = -10K$;

$R_{Ey} = -6K$;

$V_C = -10K$

$V_D = 6K$

$M_C = -10 \times 4K = -40K$

$M_D = -6 \times 12 = -72K'$

When 1K at F

$R_F = 1K$;

all values are 0