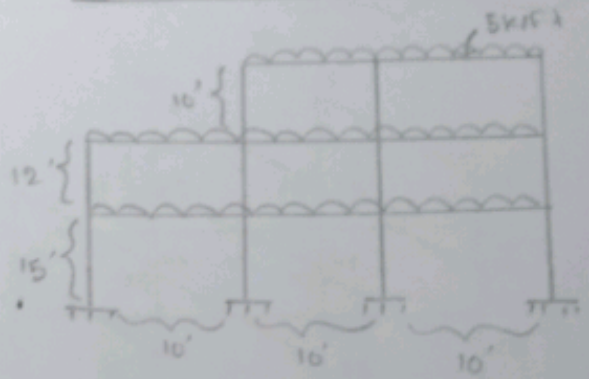
Question - 01 : Vertical method



(a) ~~Max~~ BM in Beams :

10' span:

Positive moment (+ve) = $0.08 wL^2$

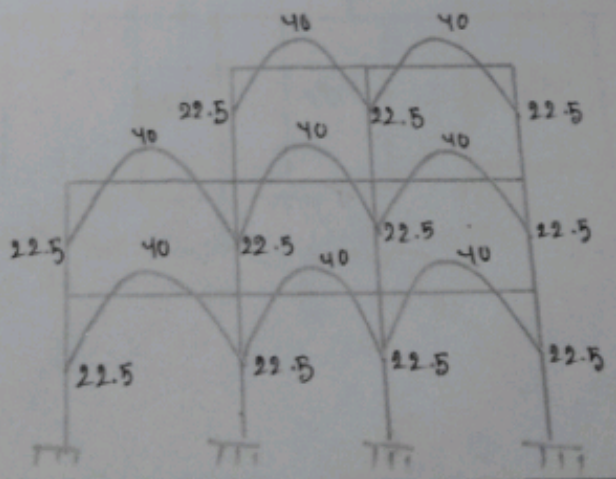
= 40 on (Roof)

= 40 on (Floor)

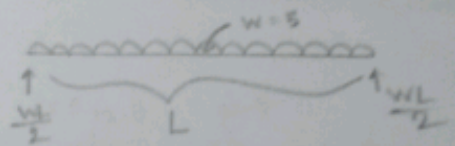
Negative moment (-ve) = $0.045 wL^2$

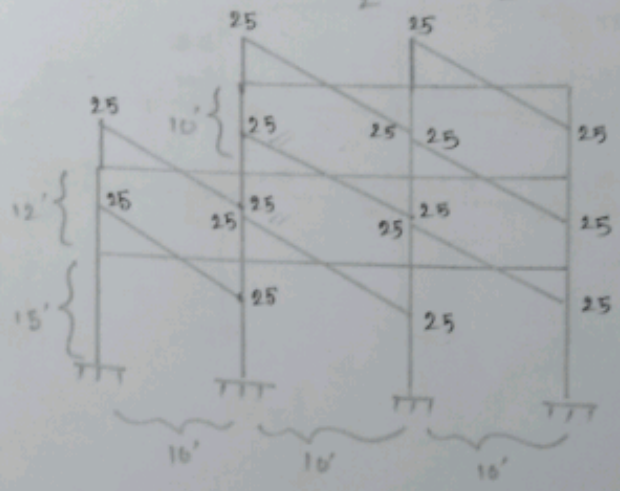
= 22.5 on roof

= 22.5 on Floor

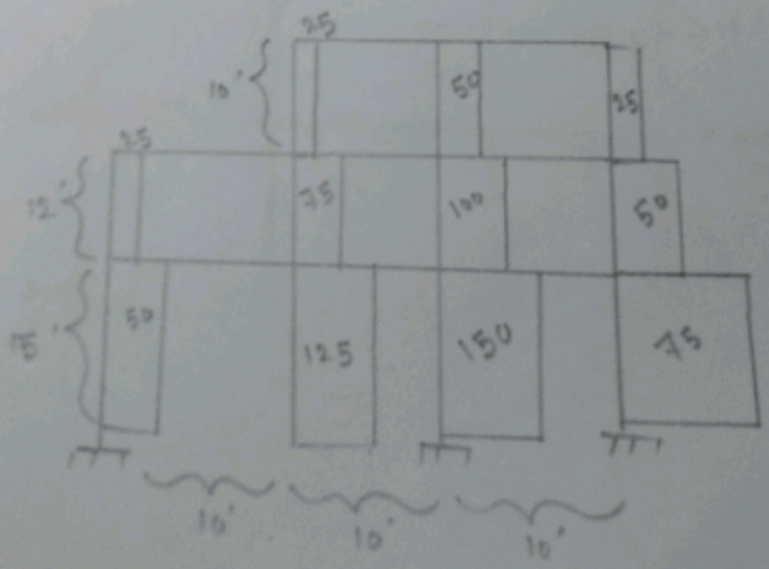


Girder shear:

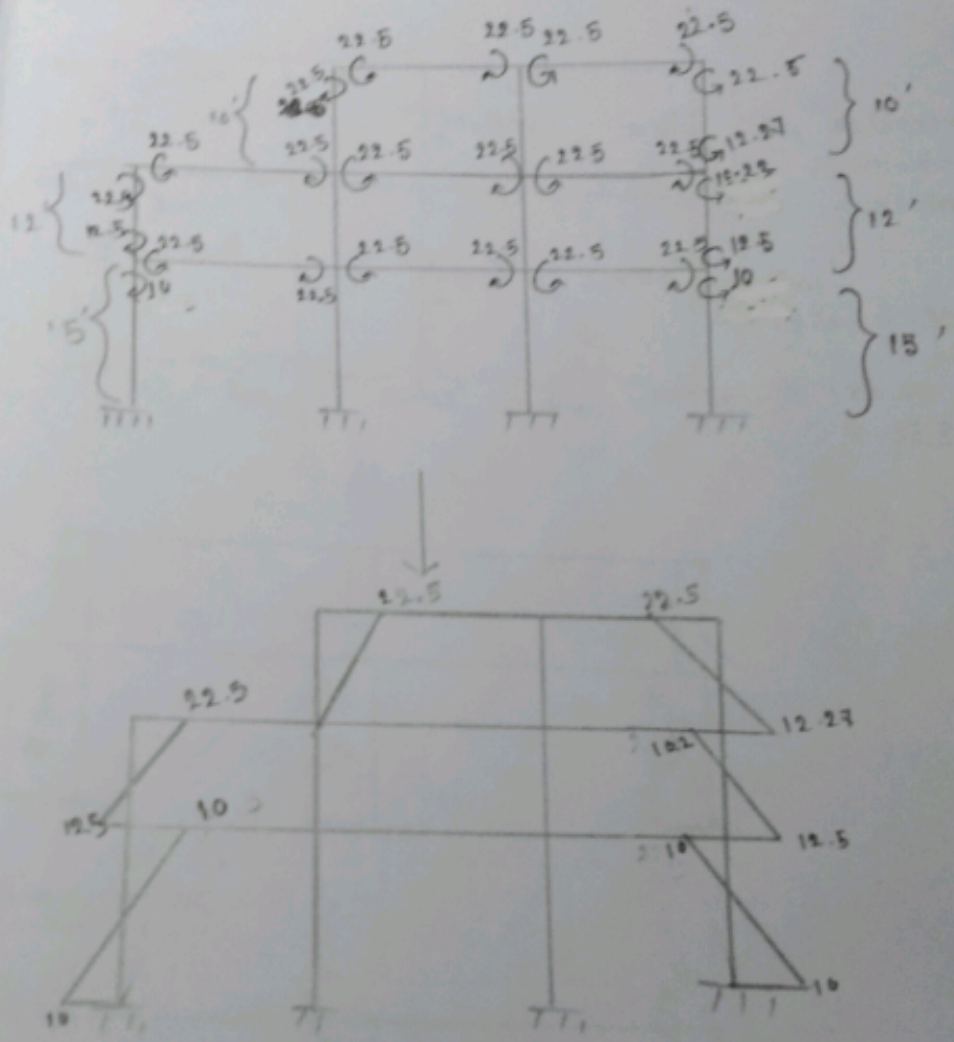




Exterior column compression:

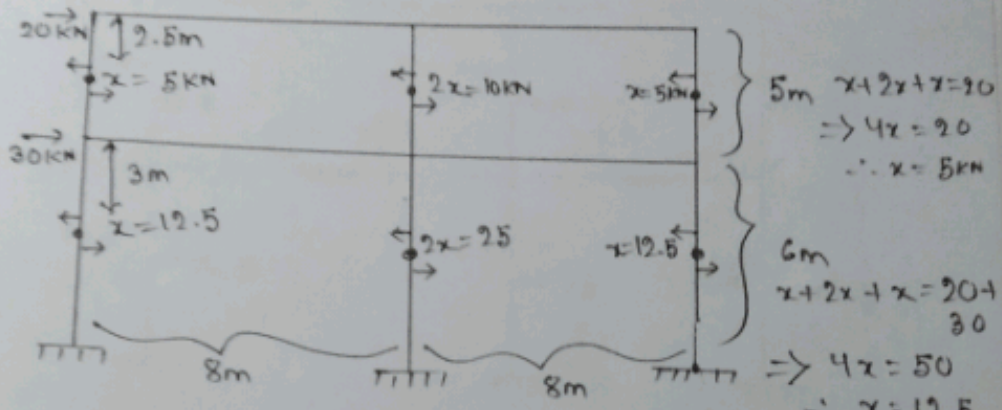


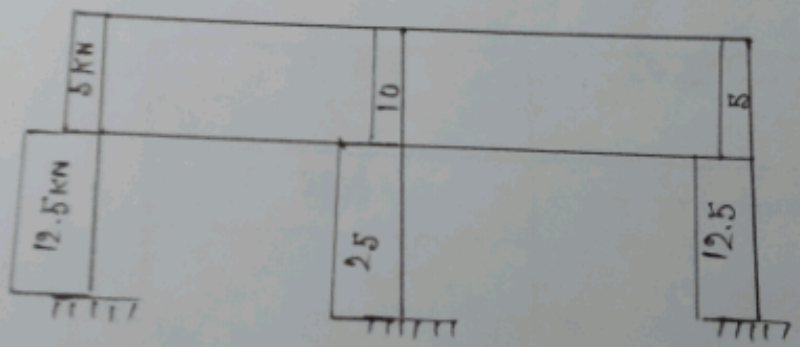
Column BMD :



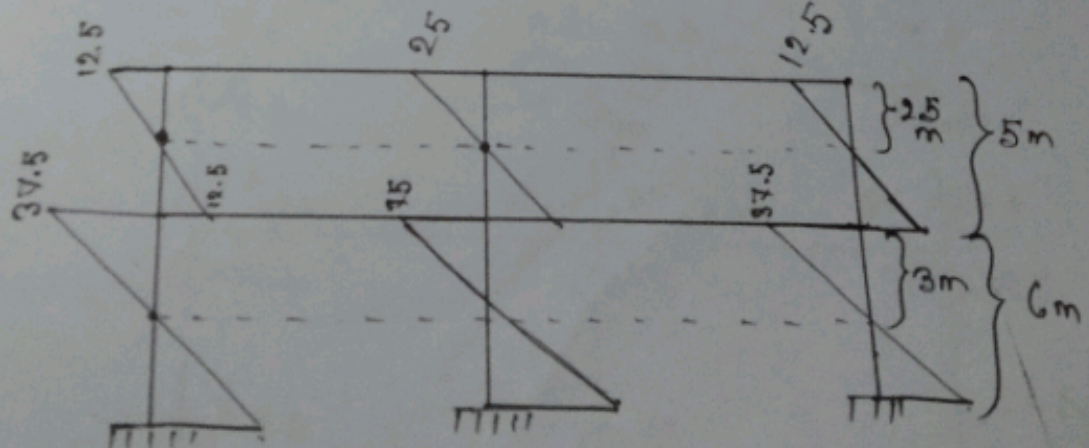
Portal method - Question - 1

Column SFD:

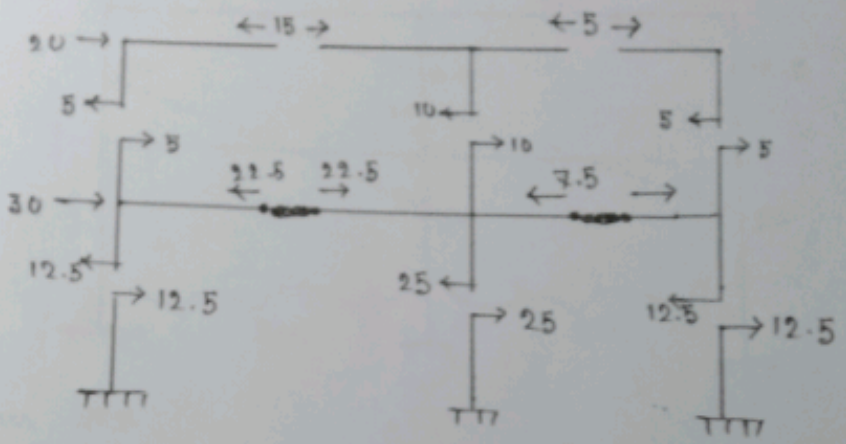


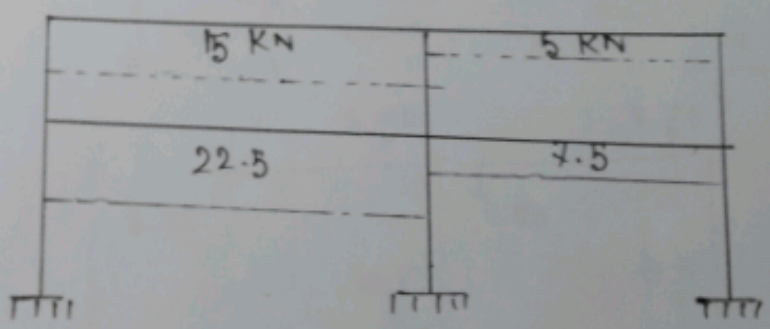


Column BMD:

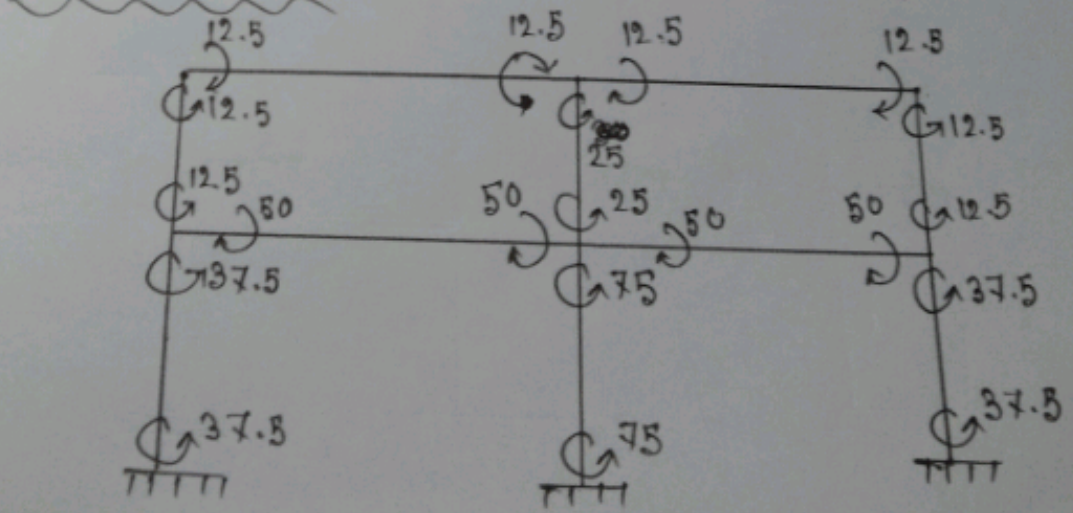


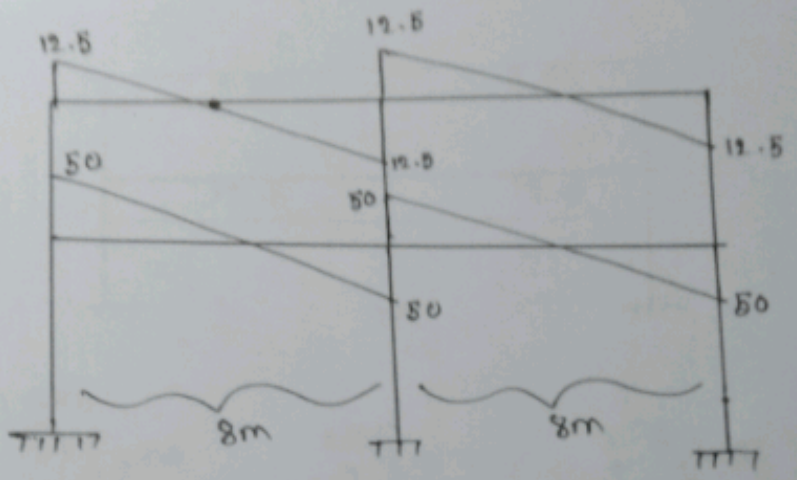
Beam AFD :



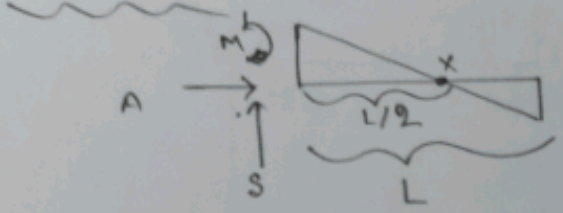


Beam (BMD):





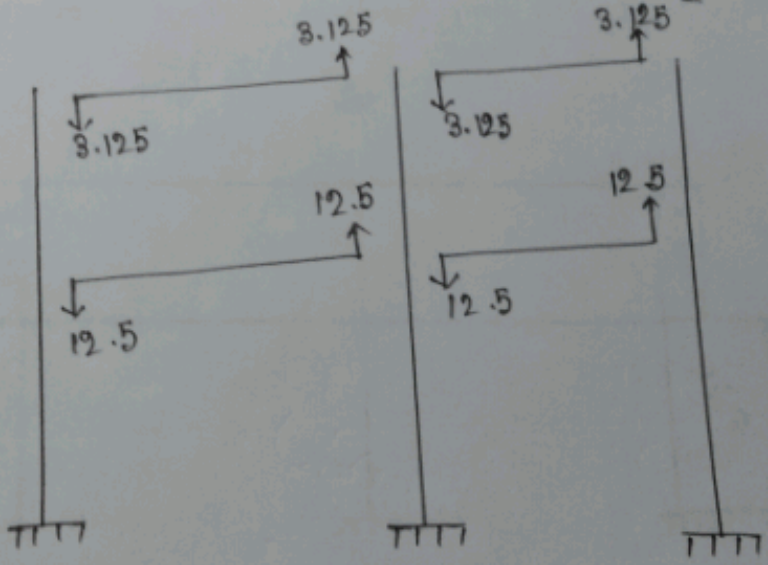
Beam SFD :

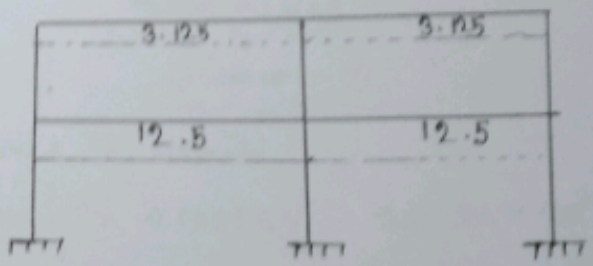


$+\circlearrowleft M_x = 0$

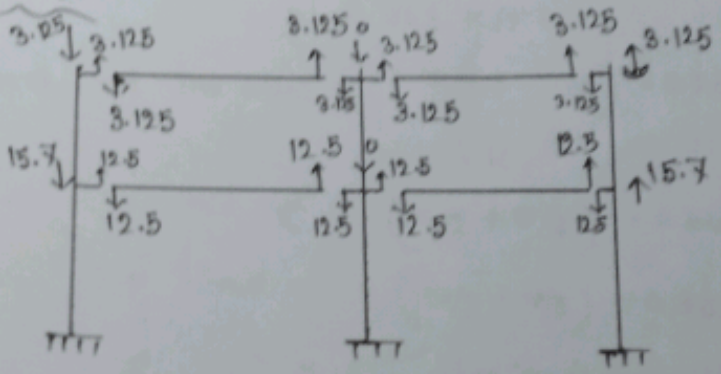
$\Rightarrow \frac{SL}{2} - M = 0$

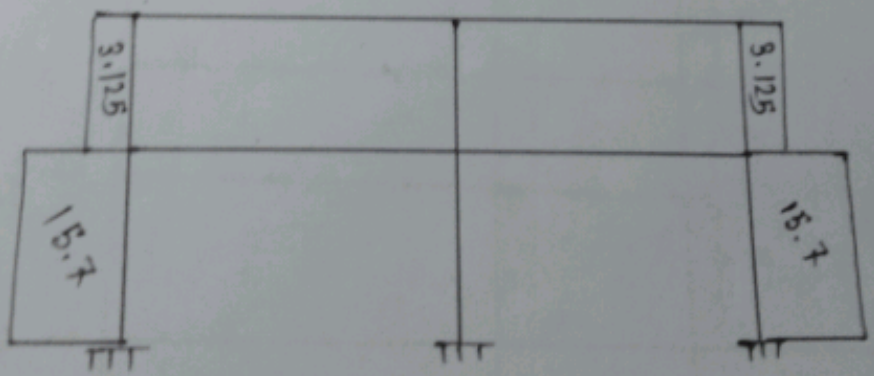
$\Rightarrow S = \frac{2M}{L}$




3.125
3.125
12.5
12.5

Column AFD:


3.125
3.125
3.125
3.125
3.125
3.125
3.125
3.125
3.125
15.7
12.5
12.5
12.5
12.5
12.5
12.5
12.5
15.7
12.5
12.5


3.125
3.125
15.7
15.7

Pordal method

Question – 02

Wind speed, $v = 120$ mph

$\therefore$ Pressure, $P = 0.00256V^2 = 0.00256 \times 120^2 = 37$ psf

$\therefore$ $w = 37 \times 15 = 555$ lb/ft

$= 0.555$ K/ft

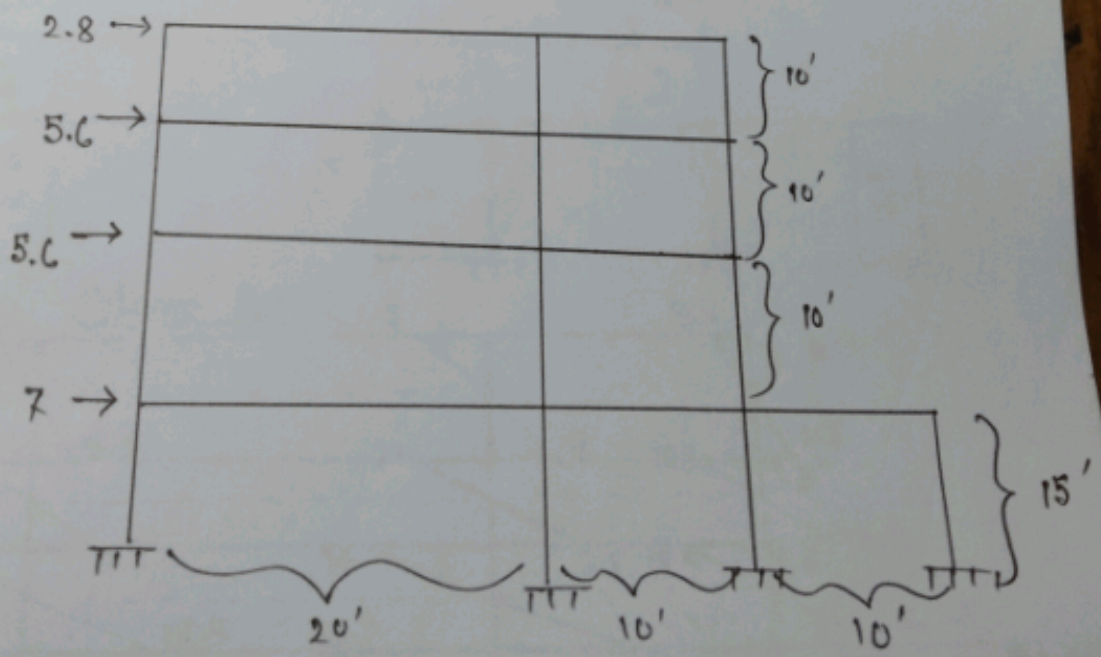
$\therefore$ Force at 1st Floor $= \left(\frac{15}{2} + \frac{10}{2}\right) \times 0.555$

$= 7$ K

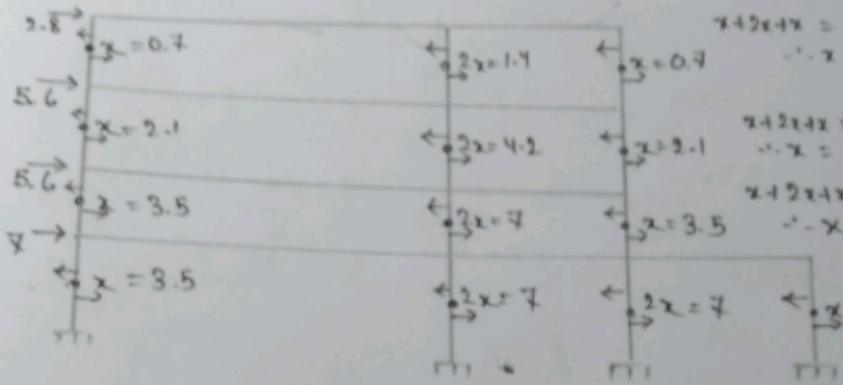
$\therefore$ " " 2nd " $= \left(\frac{10}{2} + \frac{10}{2}\right) \times 0.555 = 5.6$ K

$\therefore$ " " 3rd " $= \left(\frac{10}{2} + \frac{10}{2}\right) \times 0.555 = 5.6$ K

$\therefore$ " " 4th " $= \frac{10}{2} \times 0.555 = 2.8$ K



Column SFD:

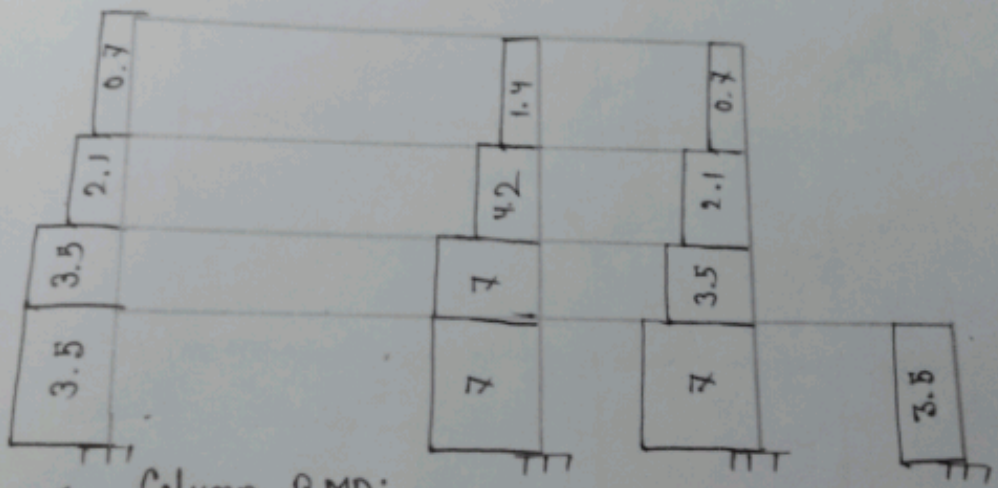


$x+2x+4x = 2.8$
$\therefore x = 0.7$

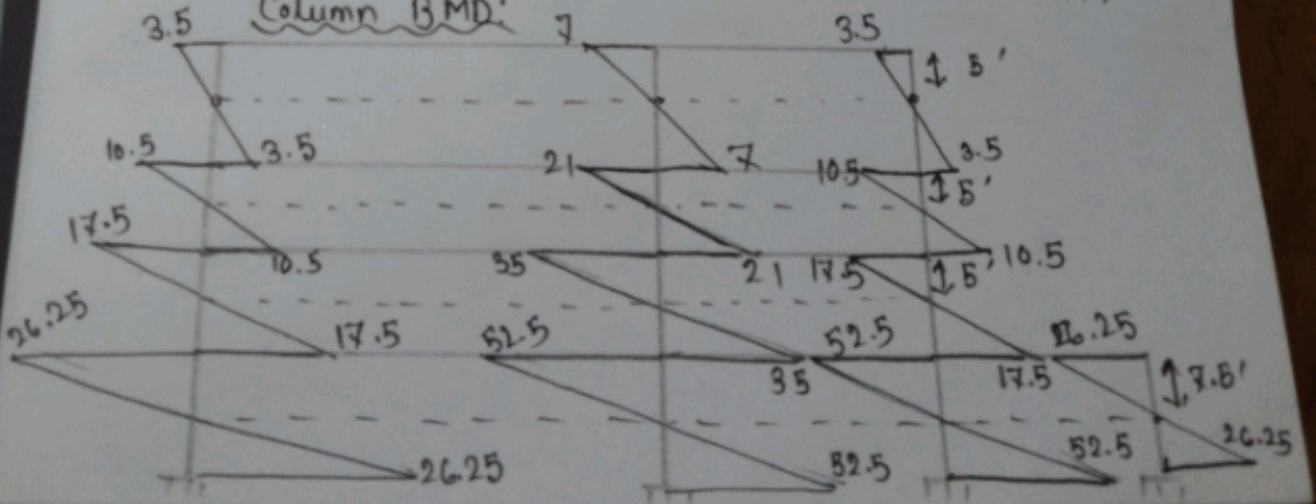
$x+2x+4x = 2.8+5.6$
$\therefore x = 2.1$

$x+2x+4x = 2.8+2\times5$
$\therefore x = 3.5$

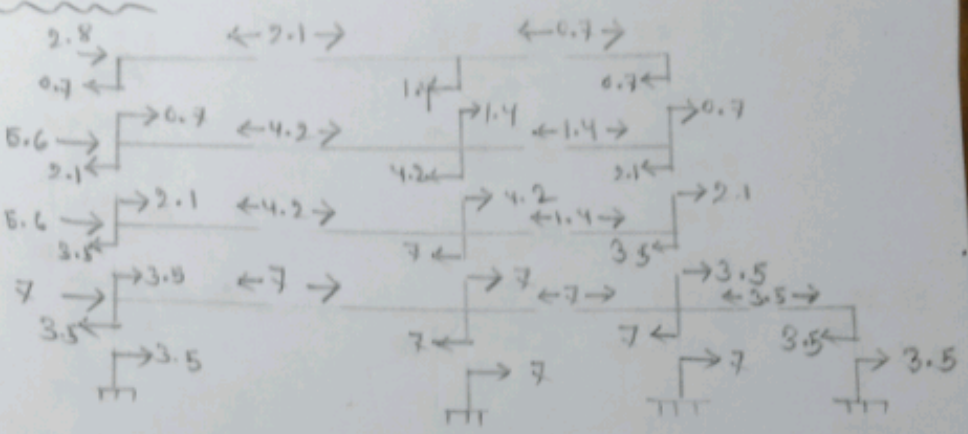
$x+2x+2x+4x = 2.8+$
$+ 5.6\times2+7$
$\therefore x = 3.5$

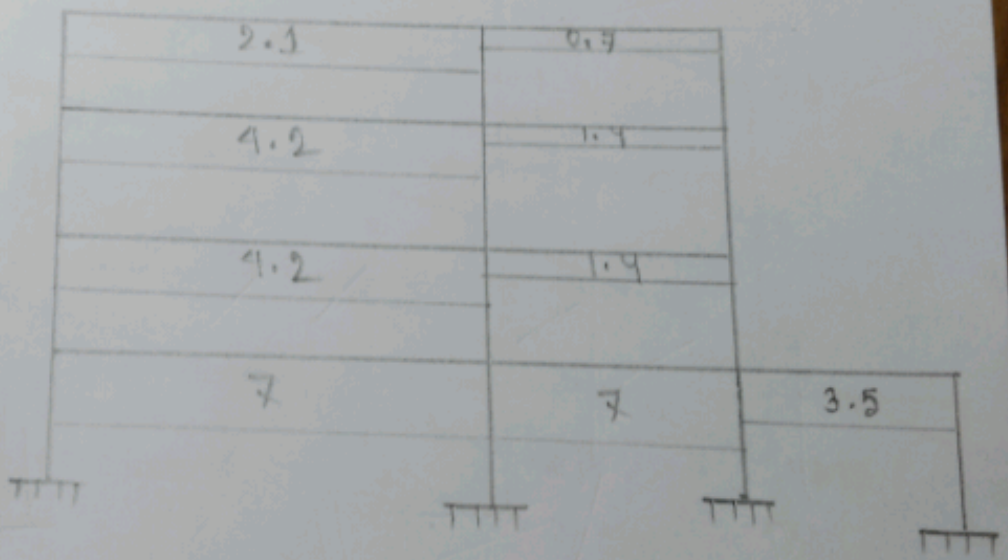


Column BMD:

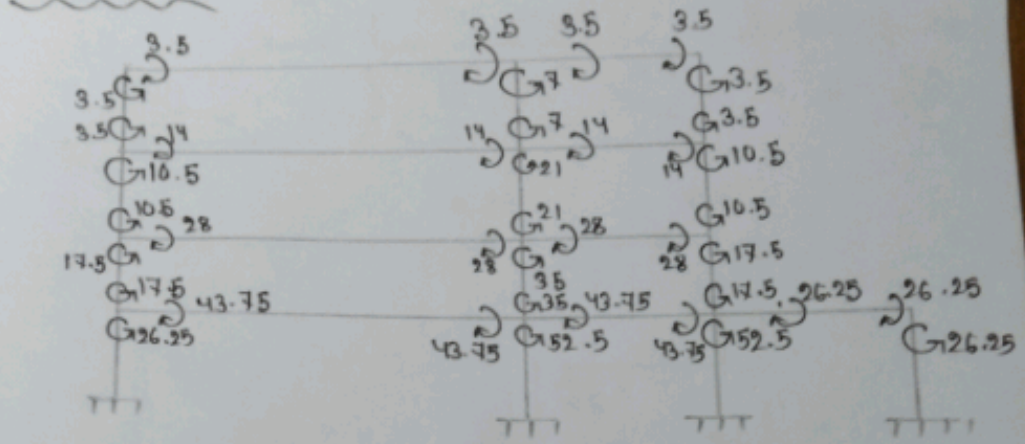


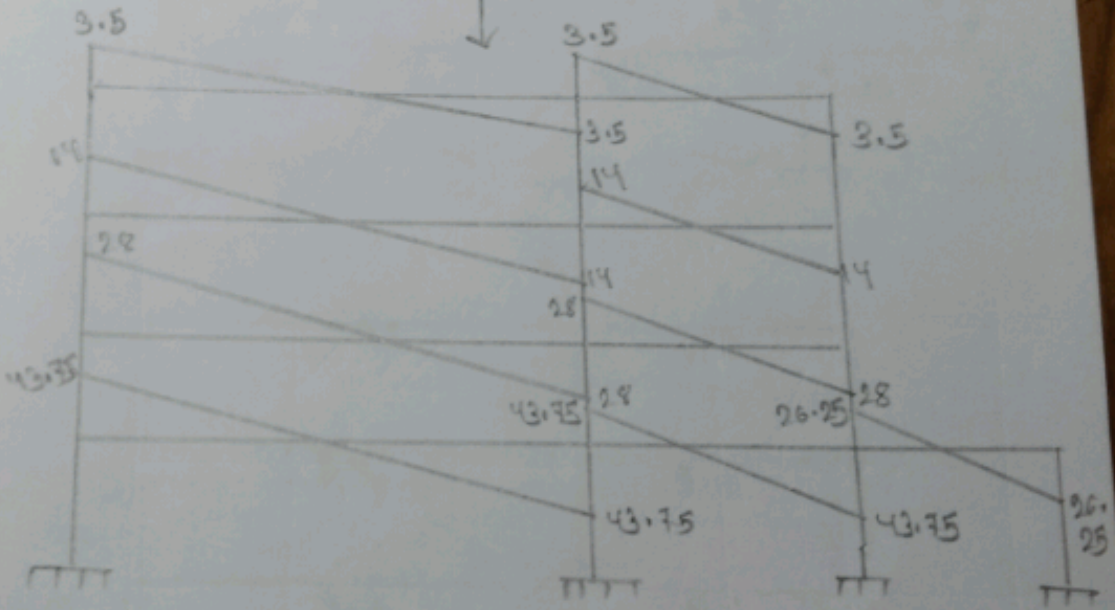
Beam AFD :


2.8
2.1
0.7
0.7
0.7
1.4
0.7
5.6
0.7
4.2
1.4
0.7
2.1
1.4
2.1
5.6
2.1
4.2
4.2
1.4
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7
7
7
3.5
3.5

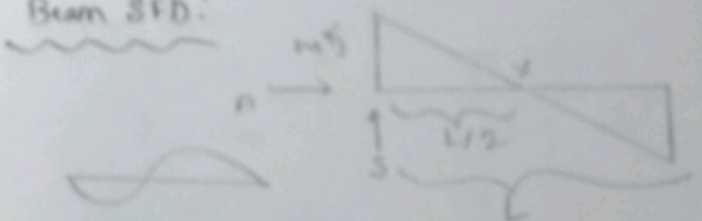

2.1
0.7
1.2
1.4
1.2
1.4
7
7
3.5

Beam BMD:





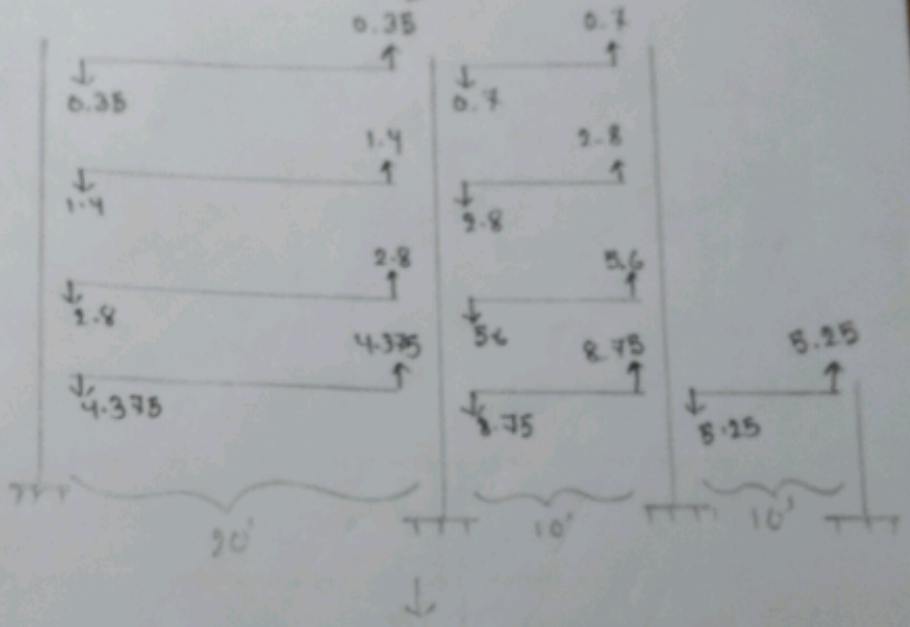
Beam SFD:

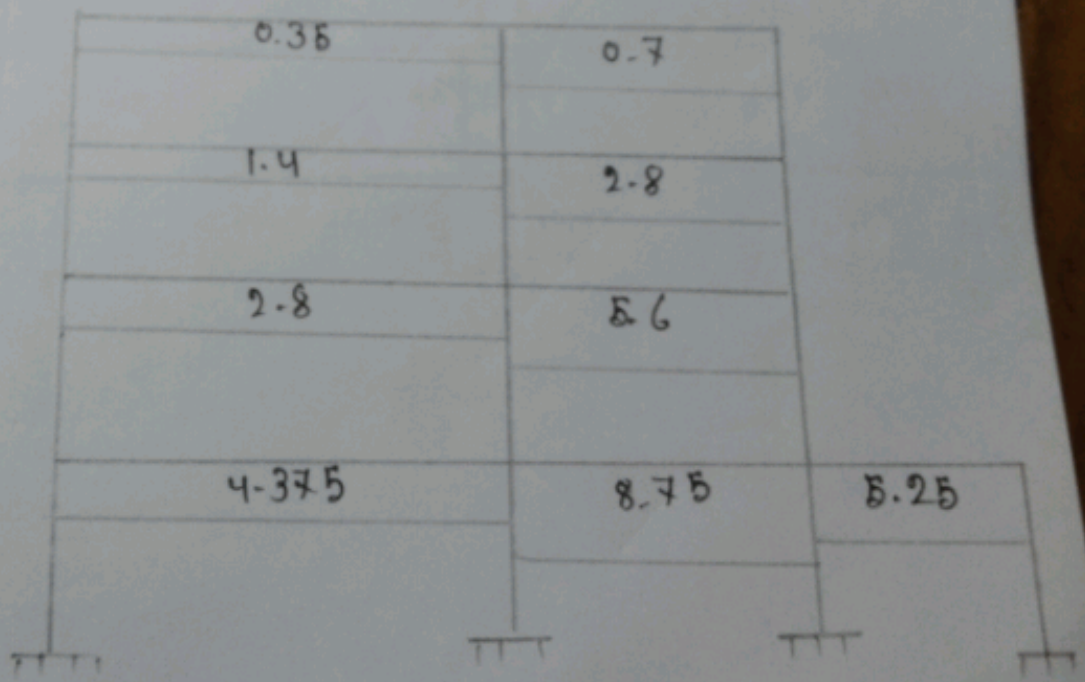


$+\circlearrowleft \sum M_x = 0$

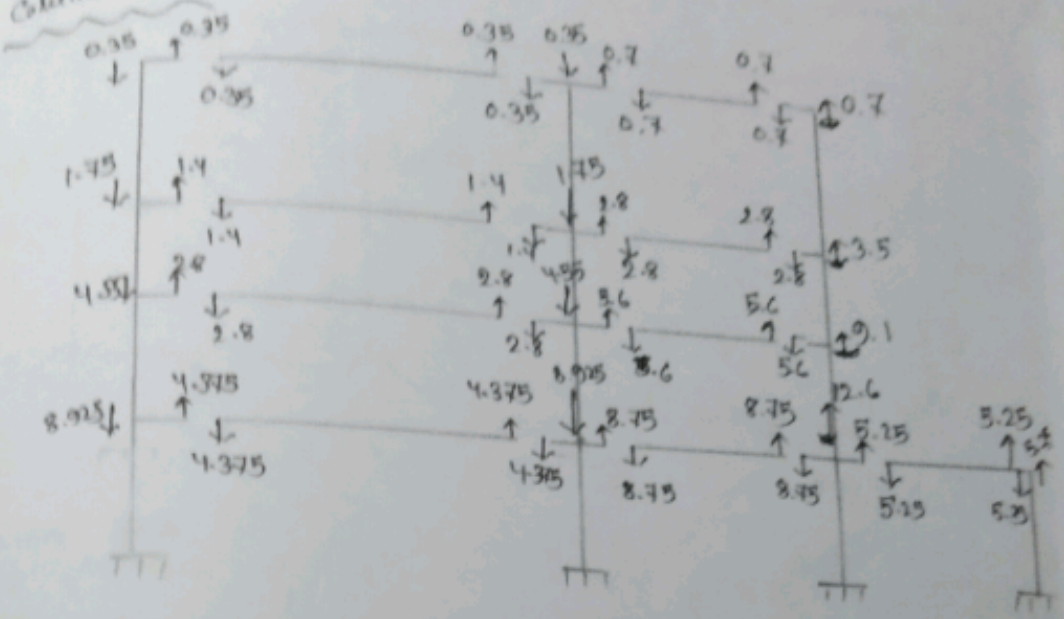
$\Rightarrow S \times \frac{L}{2} - M = 0$

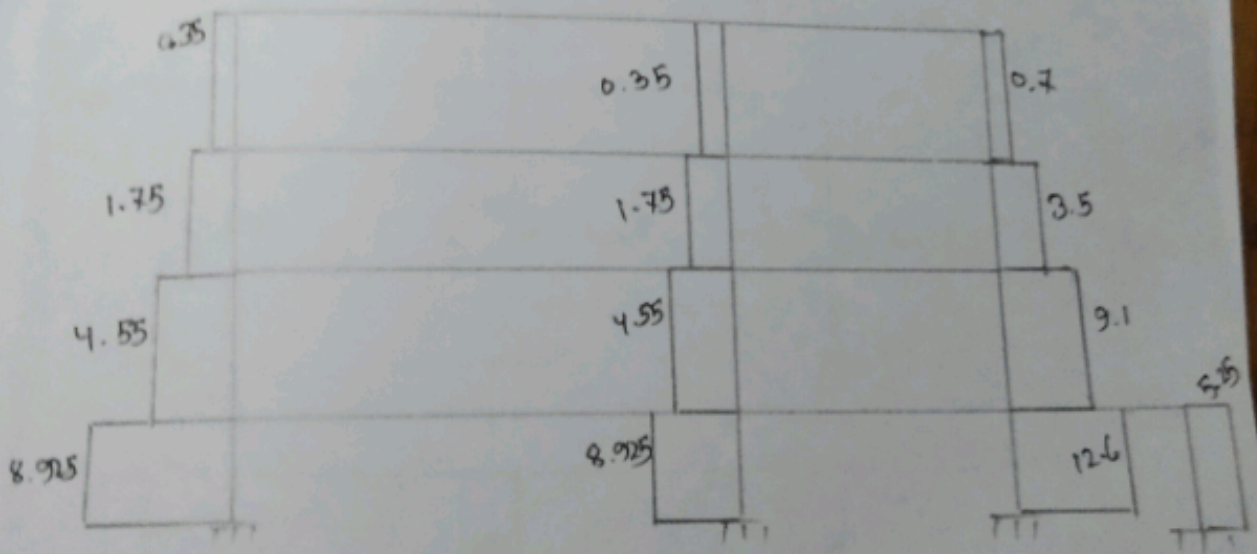
$\therefore S = \frac{2M}{L}$



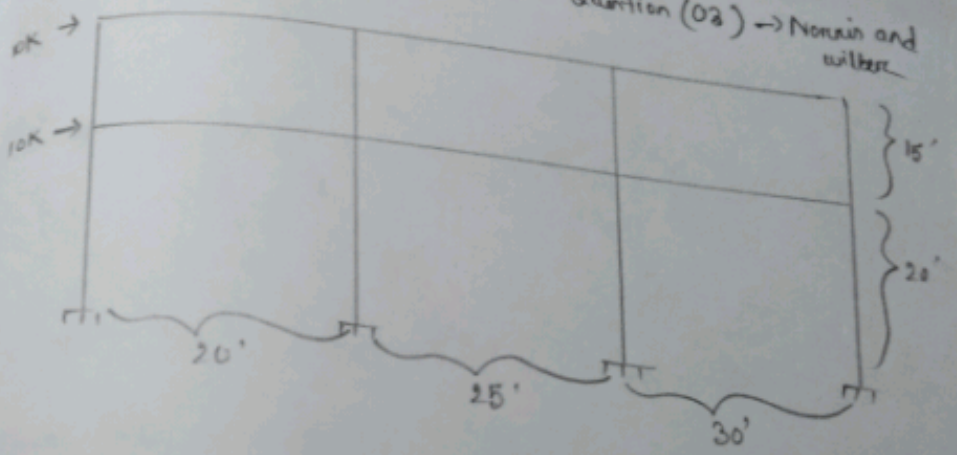


Column AFD :

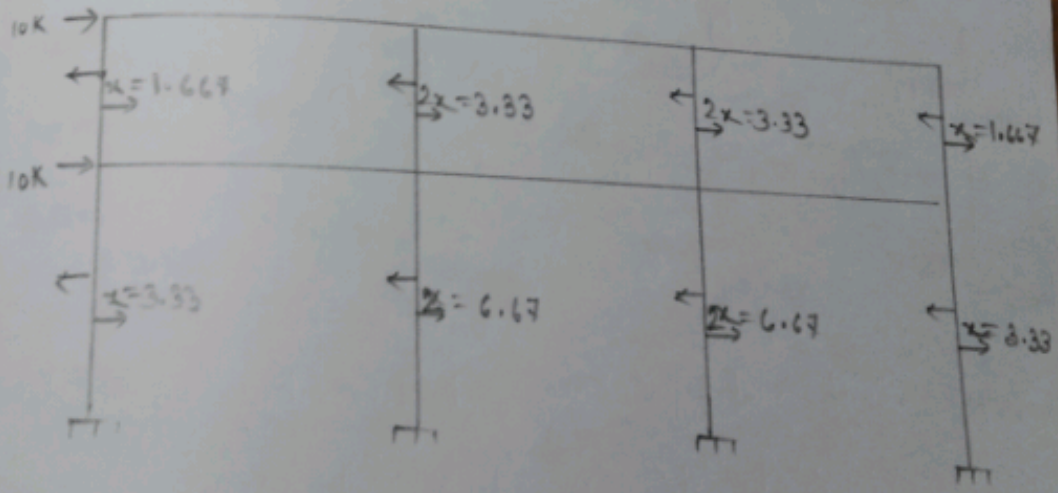

0.35
0.35
0.35
0.35
0.7
0.7
0.7
0.7
1.75
1.4
1.4
1.75
1.4
2.8
2.8
2.8
3.5
4.55
2.8
4.55
2.8
5.6
5.6
9.1
8.925
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8.75
8.75
12.6
5.25
5.25
5.25

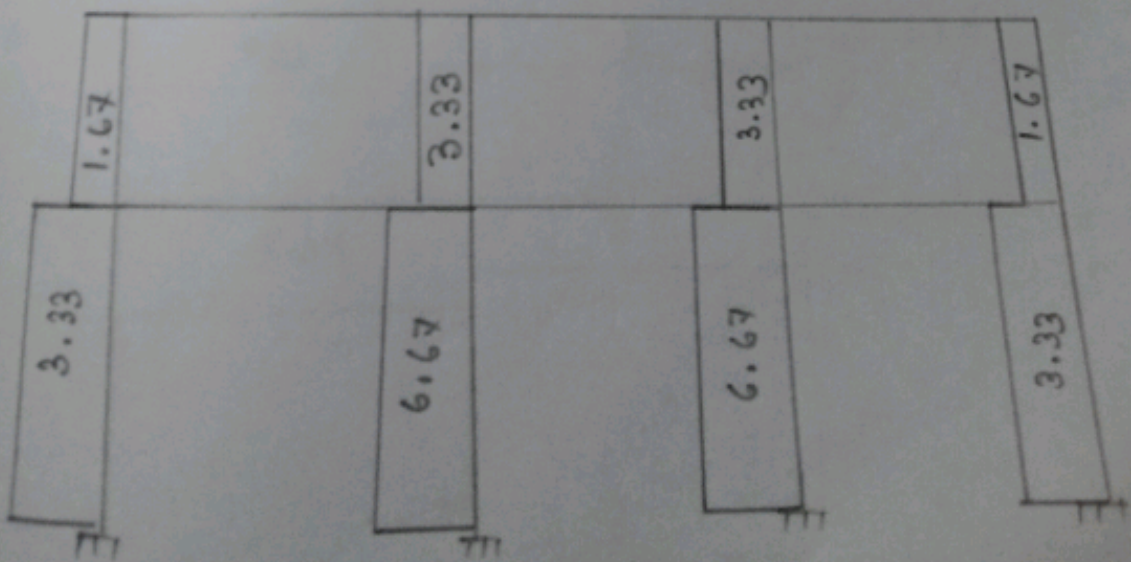

0.35
0.35
0.7
1.75
1.75
3.5
4.55
4.55
9.1
8.925
8.925
12.6
5.25

Portal method - Question (02) → Noman and wilbert

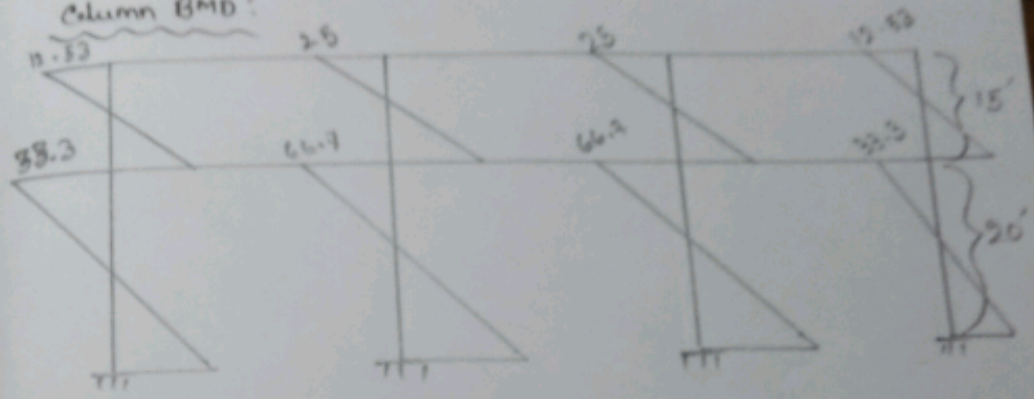


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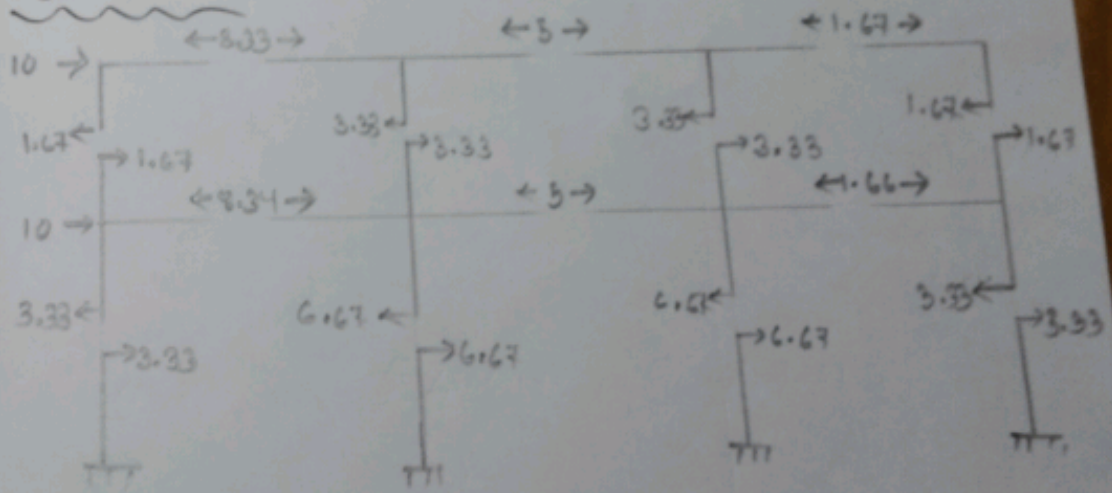


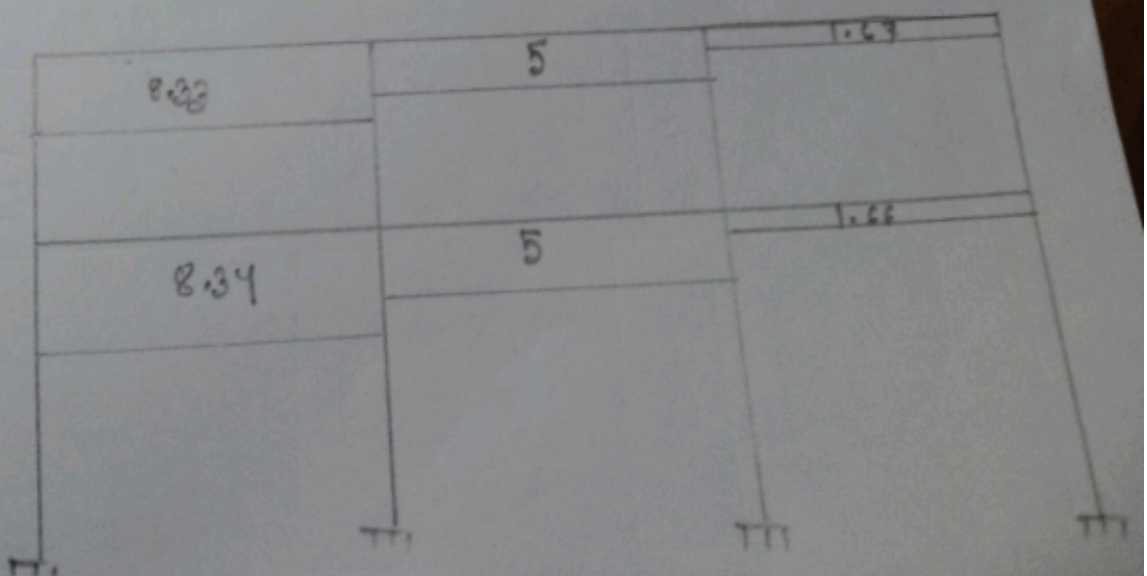


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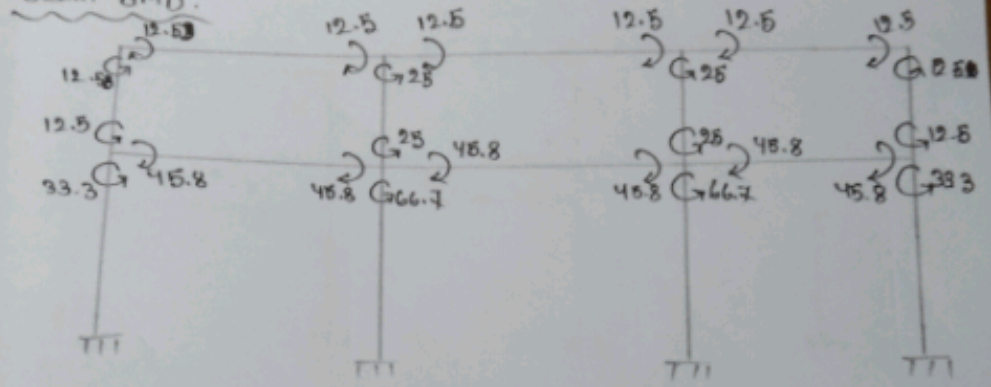


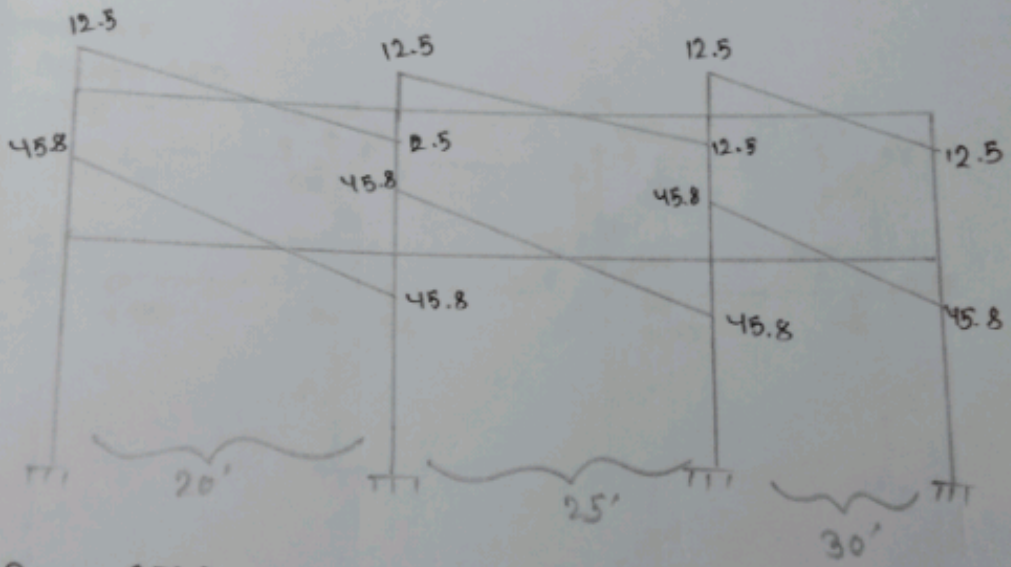
Beam AFD:



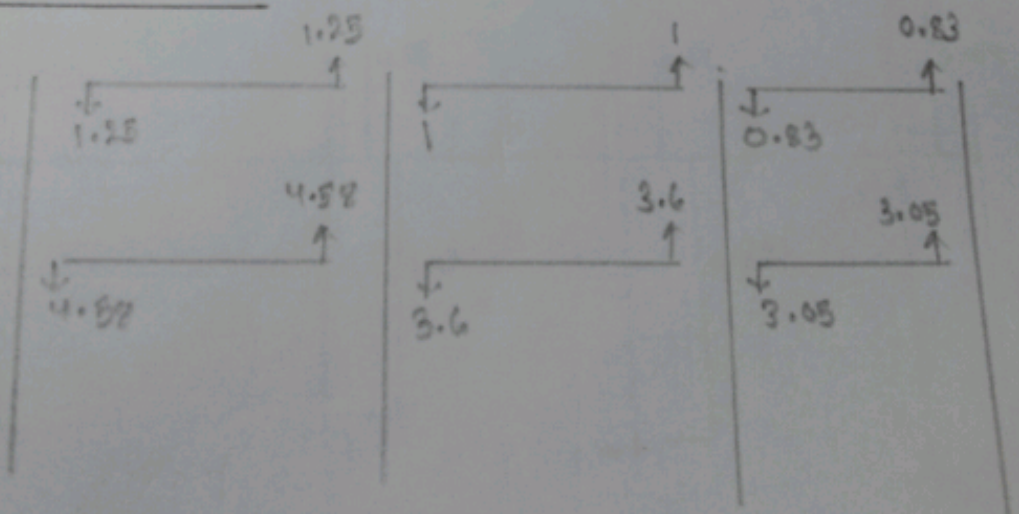


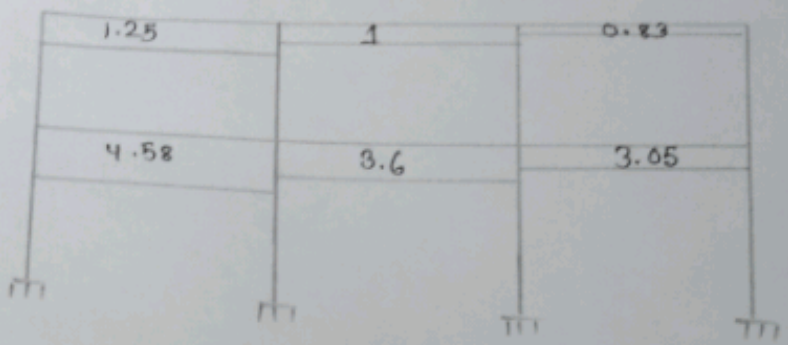
Beam BMD:





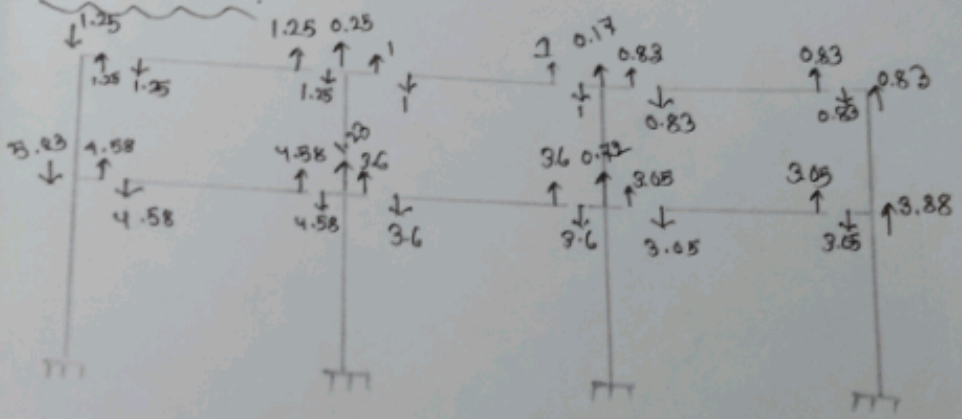
Beam SFD:

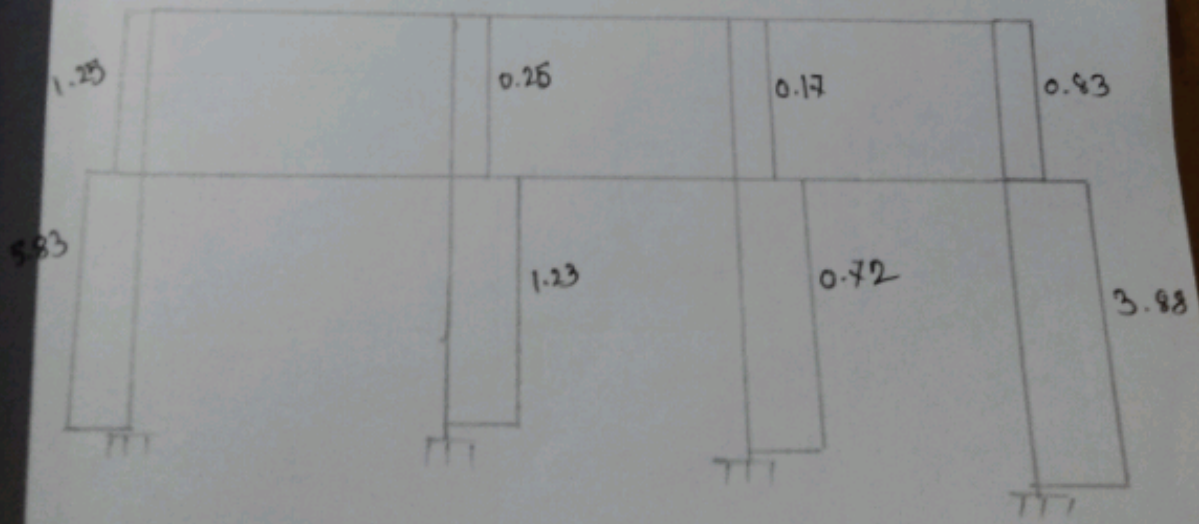




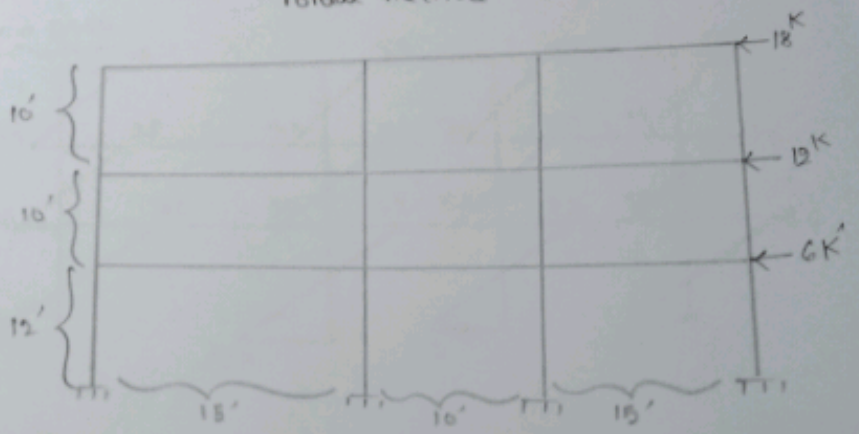
~~Beam AF~~

Column AFD:

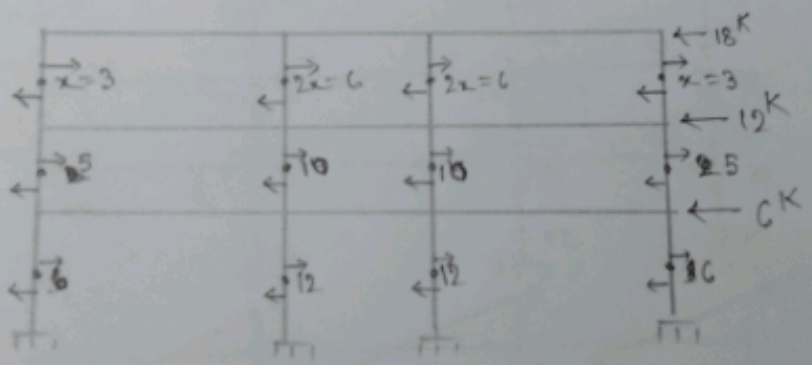


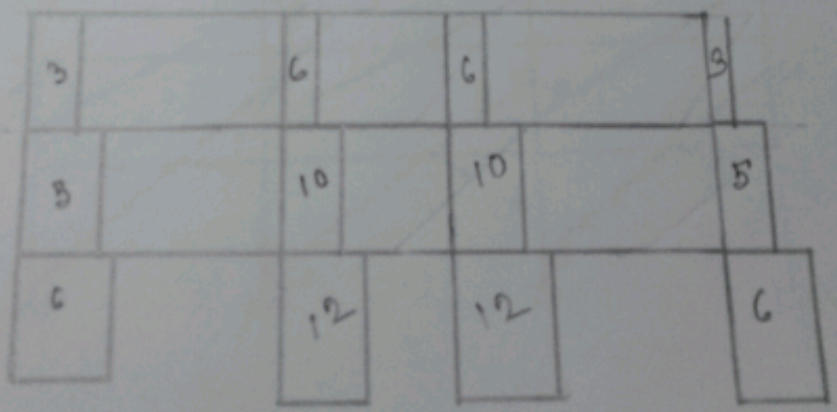


Portal method - Question -05

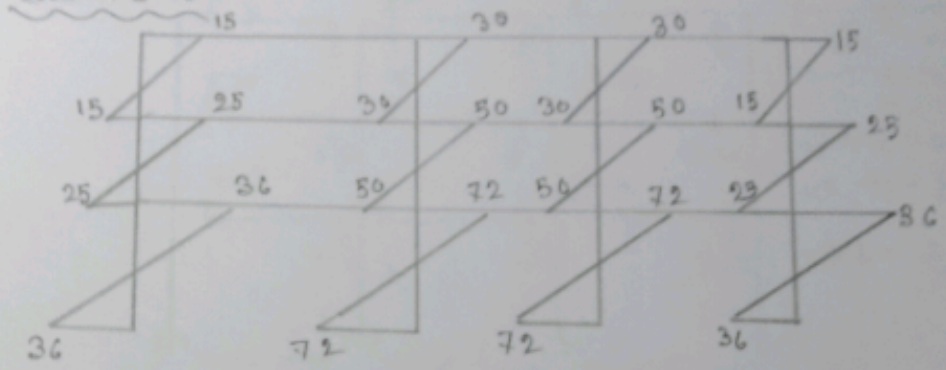


Column SFD:

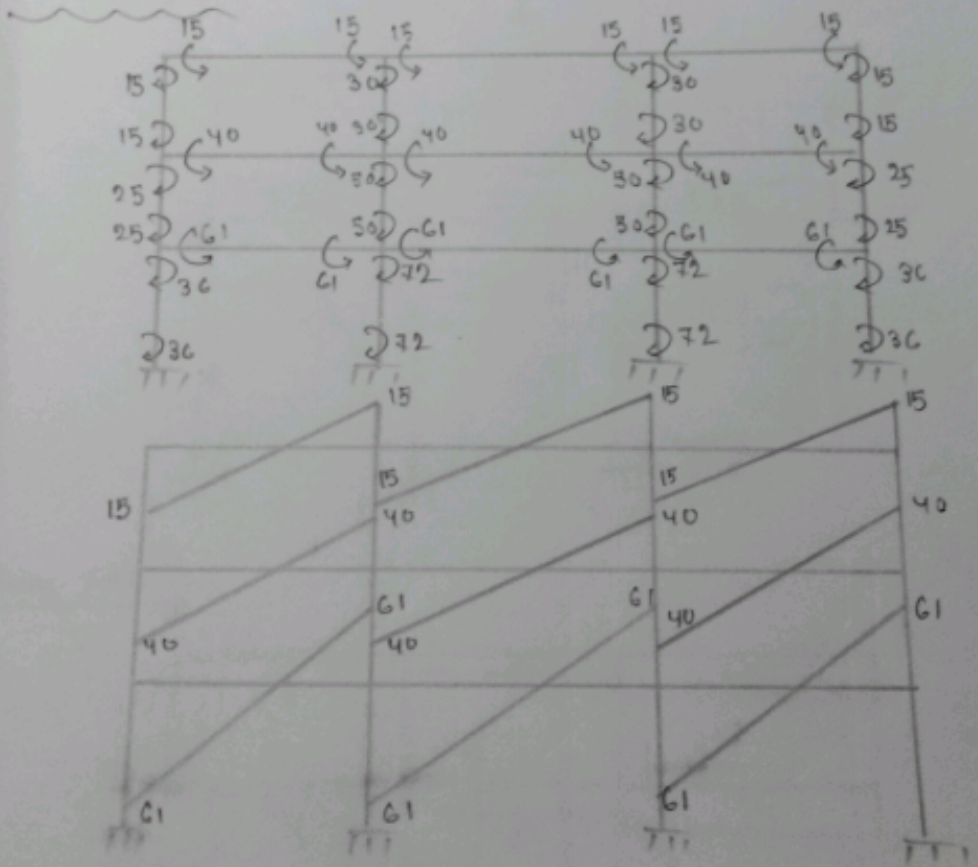




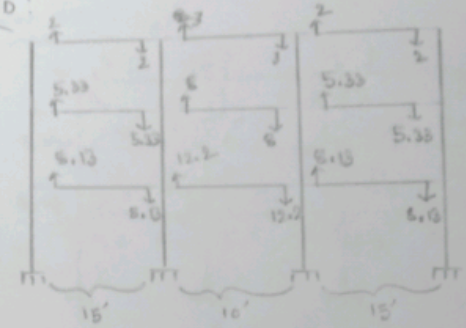
Column BMD :



Beam BMD :



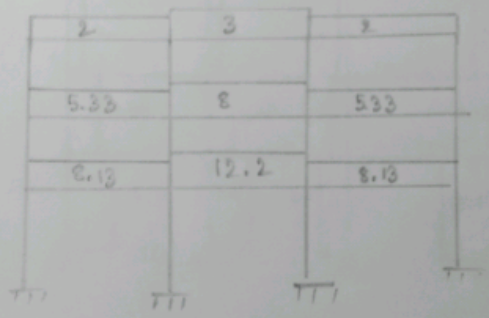
Beam SFD :



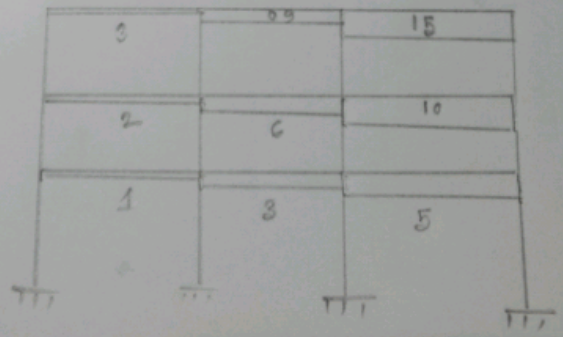
$+\circlearrowleft M_x = 0$

$\Rightarrow M - \frac{SL}{2} = 0$

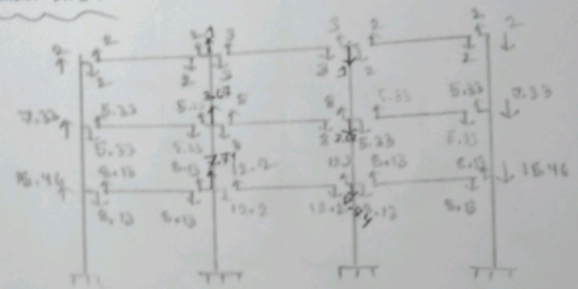
$\Rightarrow S = \frac{2M}{L}$

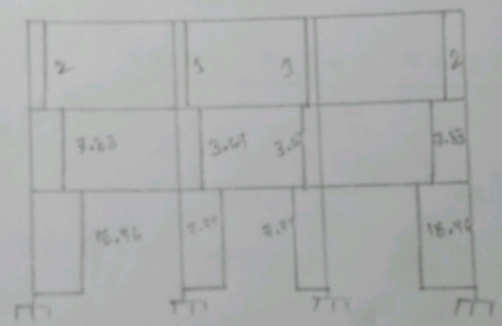


Beam AFD :



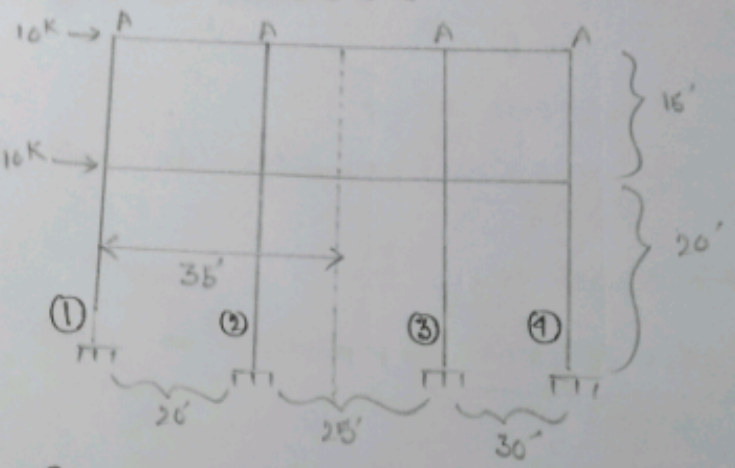
Column AFD:





Cantilever

Question-01



Locating CG: (From LC)

$$\bar{x} = \frac{A\times 0 + A\times 20 + A\times 45 + A\times 75}{9A}$$

$$= \frac{A(20+45+75)}{9A} = 35'$$

∴ Moment of inertia, $I = \Sigma A d^2$ (From CG)

$$\Rightarrow I = A\times 35^2 + A\times 15^2 + A\times 10^2 + A\times 40^2$$

$$= 3150A$$

∴ Axial Force at column 1 $= \frac{My}{I} \times$ Area

$$= \frac{M(35)}{3150A} \times A$$

$$= 0.0111M$$

Axial Force at column 2 = $\frac{M \times (35-20)}{3150A} \times A$

$= 0.00476\,M$

Axial Force at column 3 = $\frac{M \times (35-45)}{3150A} \times A$

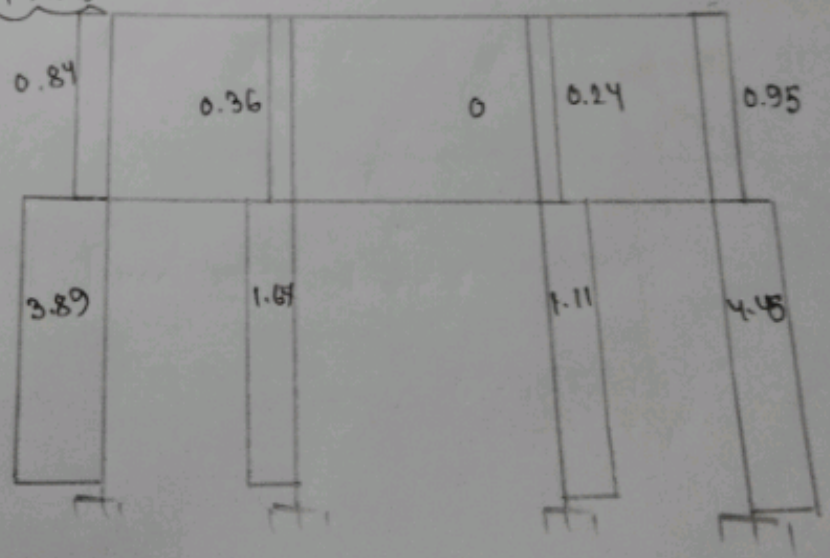
$= -0.0037\,M$

Axial Force at column 4 = $\frac{M \times (35-75) \times A}{3150A}$

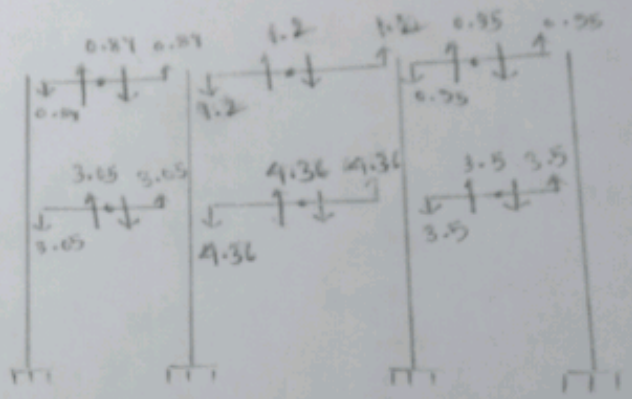
$= -0.0127\,M$

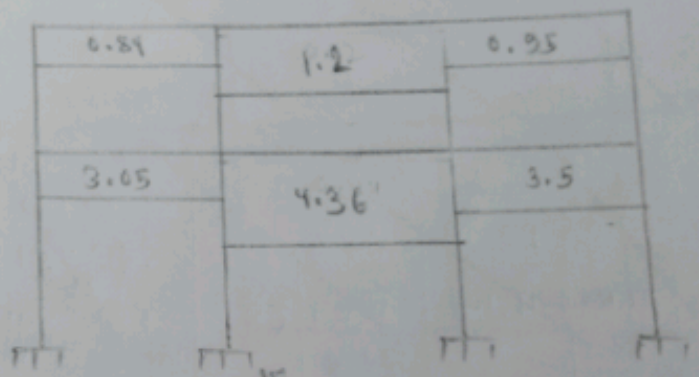
Floor	Moment (Ft-K)	AFD			
		①	②	③	④
~~1st~~ TF ~~GF~~	10 x 7.5 = 75	0.84	0.36	-0.24	-0.95
~~Top~~ GF	10 x 25 + 10 x 10 = 350	3.89	1.67	-1.11	-4.45

Column AFD:

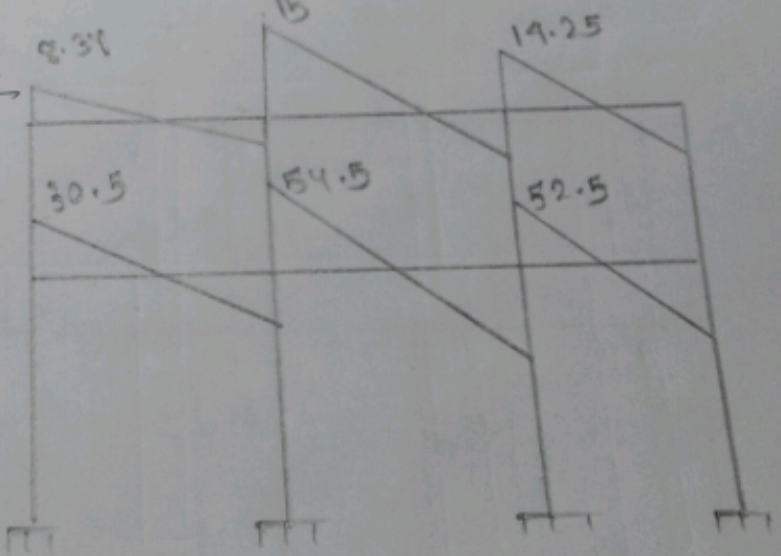


Beam SFD :

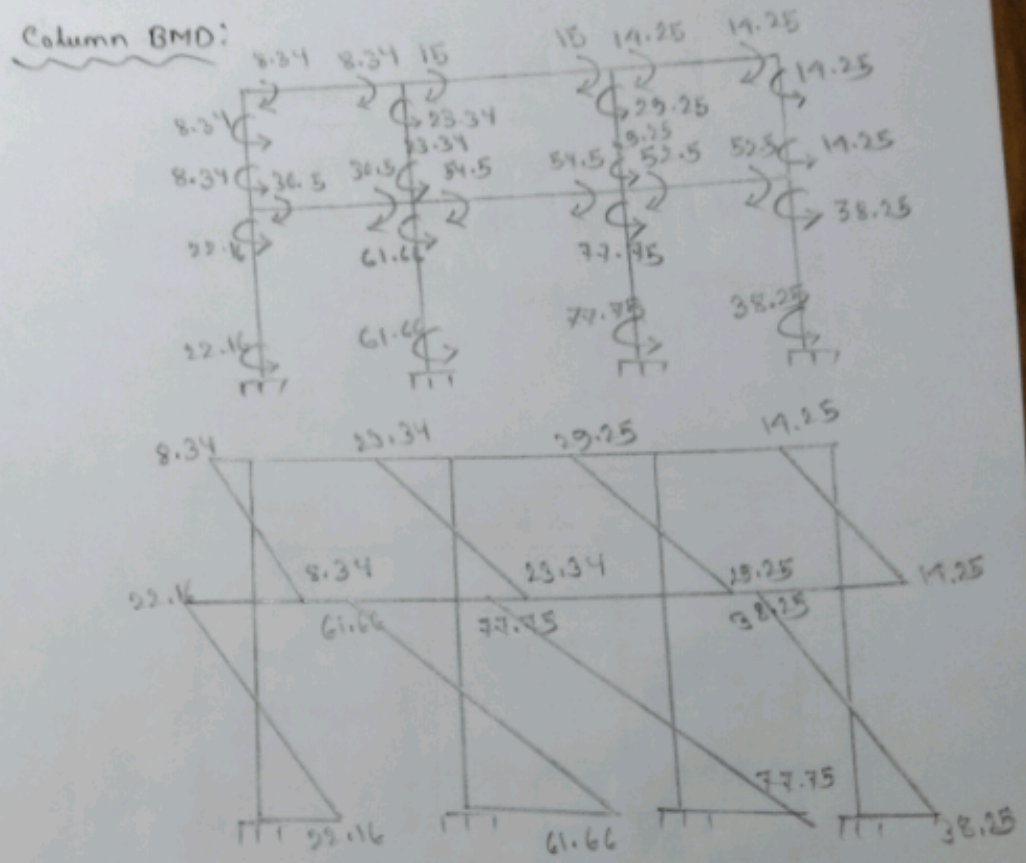




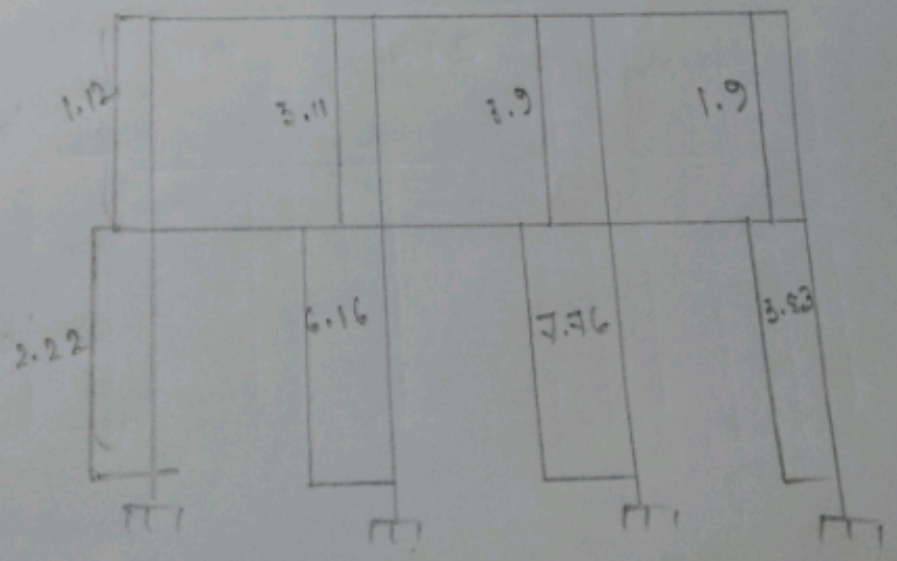
Beam BMD :



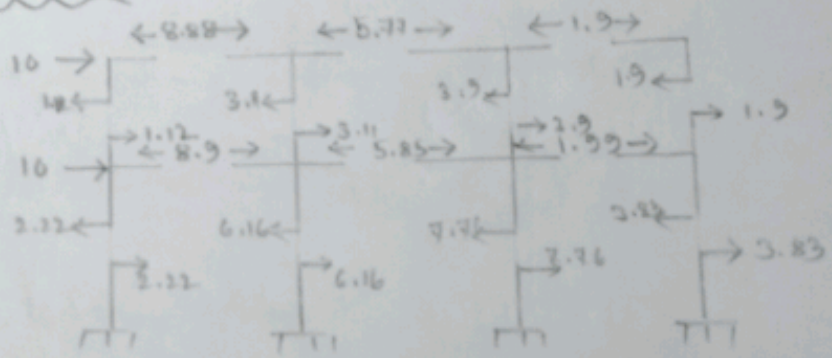
Column BMD:

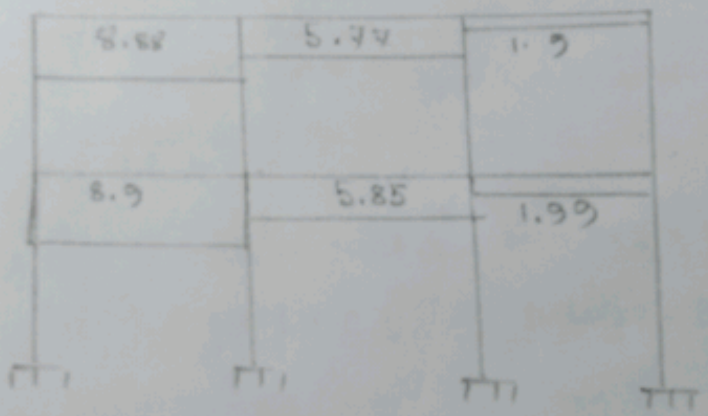


Column SFD:

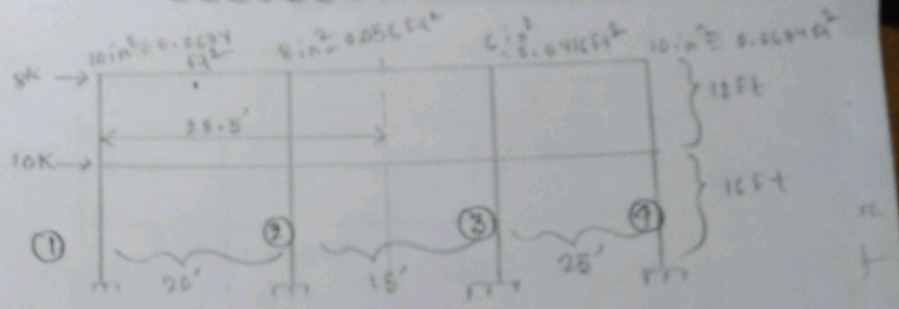


Beam AFD:


8.88
5.77
1.9
10
3.11
3.9
1.9
1.12
8.9
3.11
5.85
7.9
1.99
1.9
10
2.22
6.16
7.76
2.22
2.22
6.16
7.76
3.83


8.88
5.77
1.9
8.9
5.85
1.99

Cantilever Question-02



Centroid From column 1:

$$\bar{x} = \frac{0.0694 \times 0 + 0.056 \times 20 + 0.0416 \times 35 + 0.0694 \times 60}{0.0694 + 0.056 + 0.0416 + 0.0694}$$

$$= 28.5'$$

$$I = \sum Ad^2 = 0.0694 \times 28.5^2 + 0.056 \times 8.5^2 + 0.0416 \times 6.5^2 + 0.0694 \times 31.5^2$$

$$= 131.03 \text{ ft}^4$$

Column 1 & axial force $= \frac{M \times 28.5}{131.03} \times 0.0694$

$$= 0.0151 M$$

" 2 " " $= \frac{M \times (28.5 - 20)}{131.03} \times 0.056$

$$= 0.00363 M$$

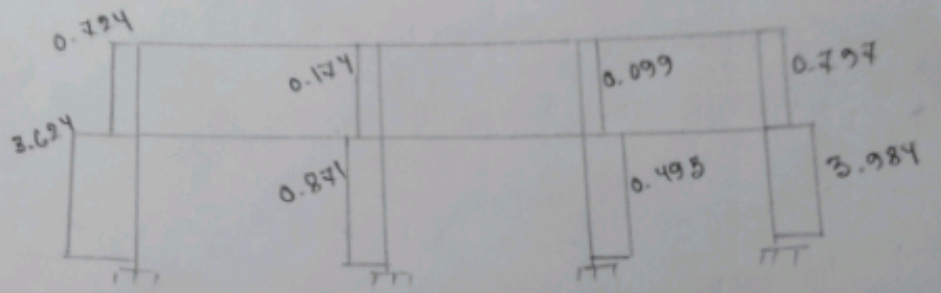
" 3 " " $= \frac{M (28.5 - 35)}{131.03} \times 0.0416$

$$= -0.002063 M$$

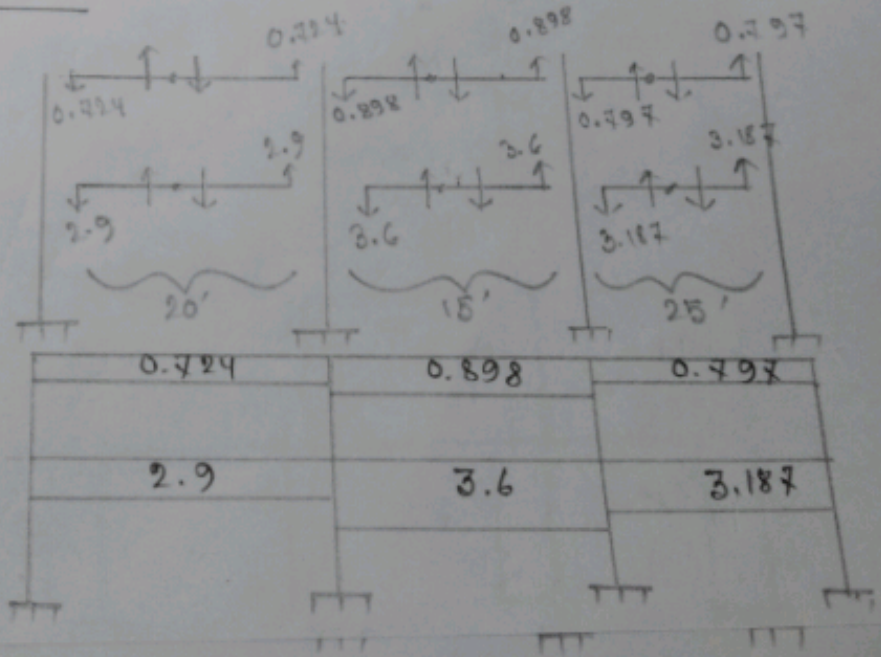
" 4 " " $= \frac{M (28.5 - 60)}{131.03} \times 0.0694 = -0.0166 M$

Column AFD:

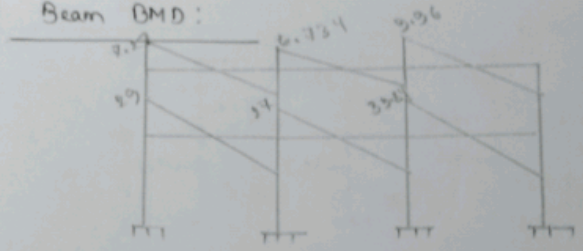
Floor	Moment ('Ft-K)	At ①	②	③	④
1st	8×6 = 48	0.724	0.174	-0.[illegible]	-0.[illegible]
GF	8×20 + 10×8 = 240	3.624	0.871	-0.[illegible]	-3.[illegible]



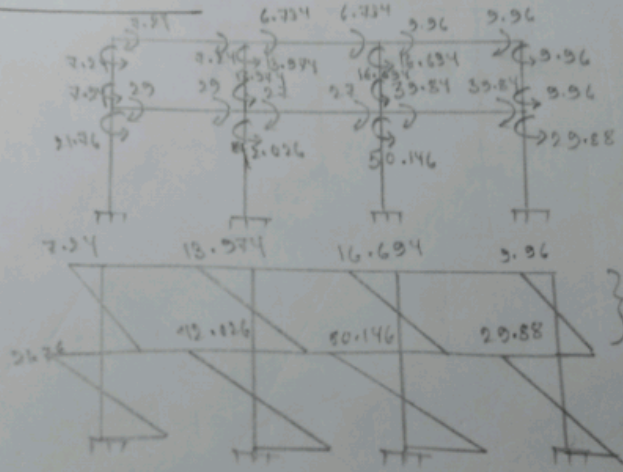
Beam SFD:



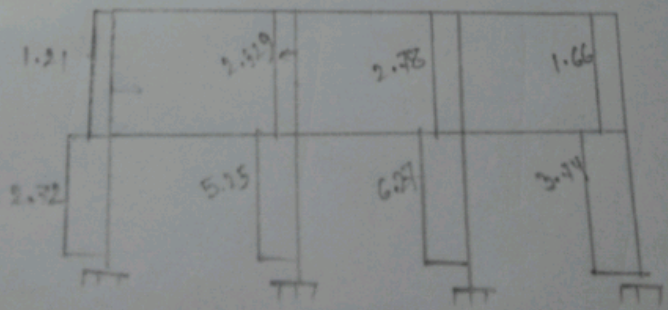
Beam BMD:



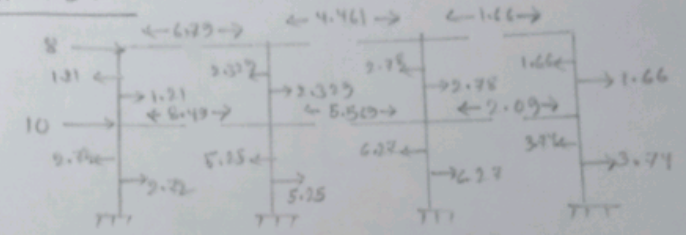
Column BMD:

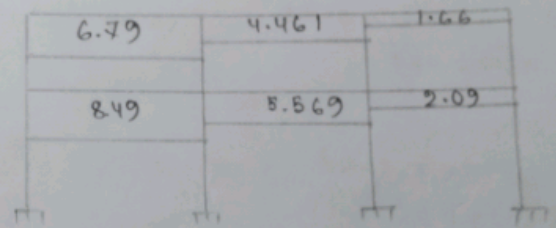


Column SFD:

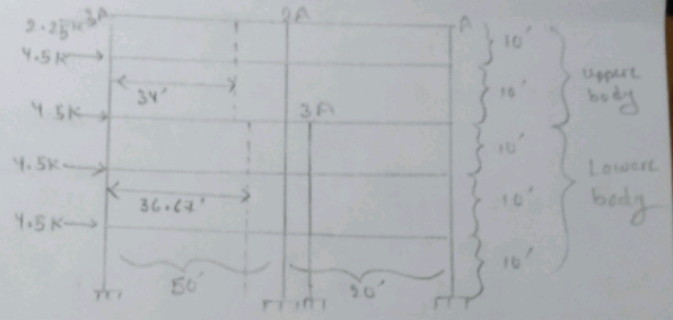


Beam AFD:


8
10
1.31
1.31
6.79
5.25
5.25
2.78
2.09
1.66
1.66
3.74


6.79
4.461
1.66
8.49
5.569
2.09

Cantilever Question - 03



Upper body centroid, $\bar{x}_1$ = (From LC) $= \frac{2A\times0 + 2A\times50 + A\times70}{2A+2A+A}$

$= 34'$

Lower body centroid, $\bar{x}_2 = \frac{2A\times0 + 3A\times50 + A\times70}{2A+3A+A}$

$= 36.67'$

Moment of inertia of upper body,

$I_1 = \Sigma Ad^2 = 2A\times34^2 + 2A\times16^2 + A\times36^2$

$= 4120A$

Moment of inertia of lower body,

$I_2 = \Sigma Ad^2 = 2A\times36.67^2 + 3A\times13.33^2 + A\times33.33^2$

$= 4333.33A$

∴ For upper body:

Axial force at column 1 = $\frac{M\times34}{4120A}\times2A = 0.0165M$

" " " " 2 = $\frac{M\times(34-50)}{4120A}\times2A = -0.0077M$

Axial Force at column 3 = $\frac{M \times (34-70) A}{4120 A}$

= $-0.0087 M$

For lower body:

Axial Force at column 1 = $\frac{M \times 36.67}{4333.33 A} \times 2A$

= $0.0169 M$

" " " " 2 = $\frac{M(36.67-50) \times 3A}{4333.33 A}$

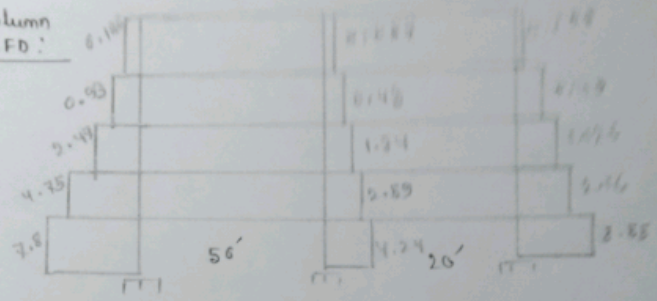
= $-0.0092 M$

" " " " 3 = $\frac{M(36.67-50) A}{4333.33}$

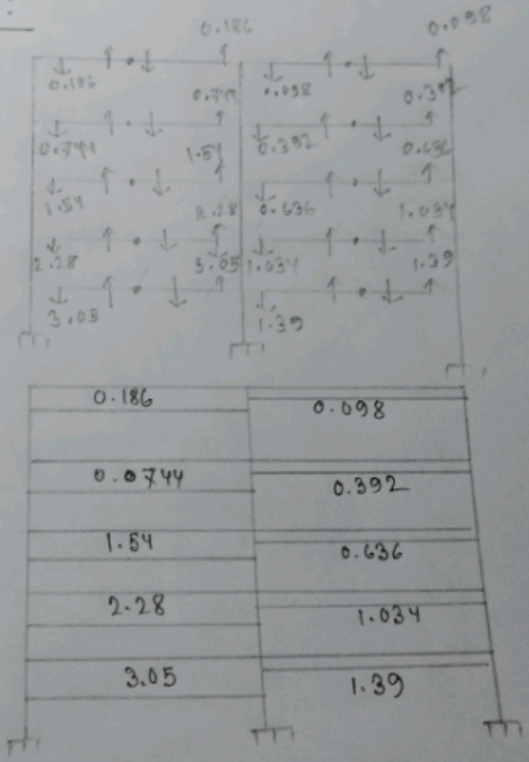
= $-0.0077 M$

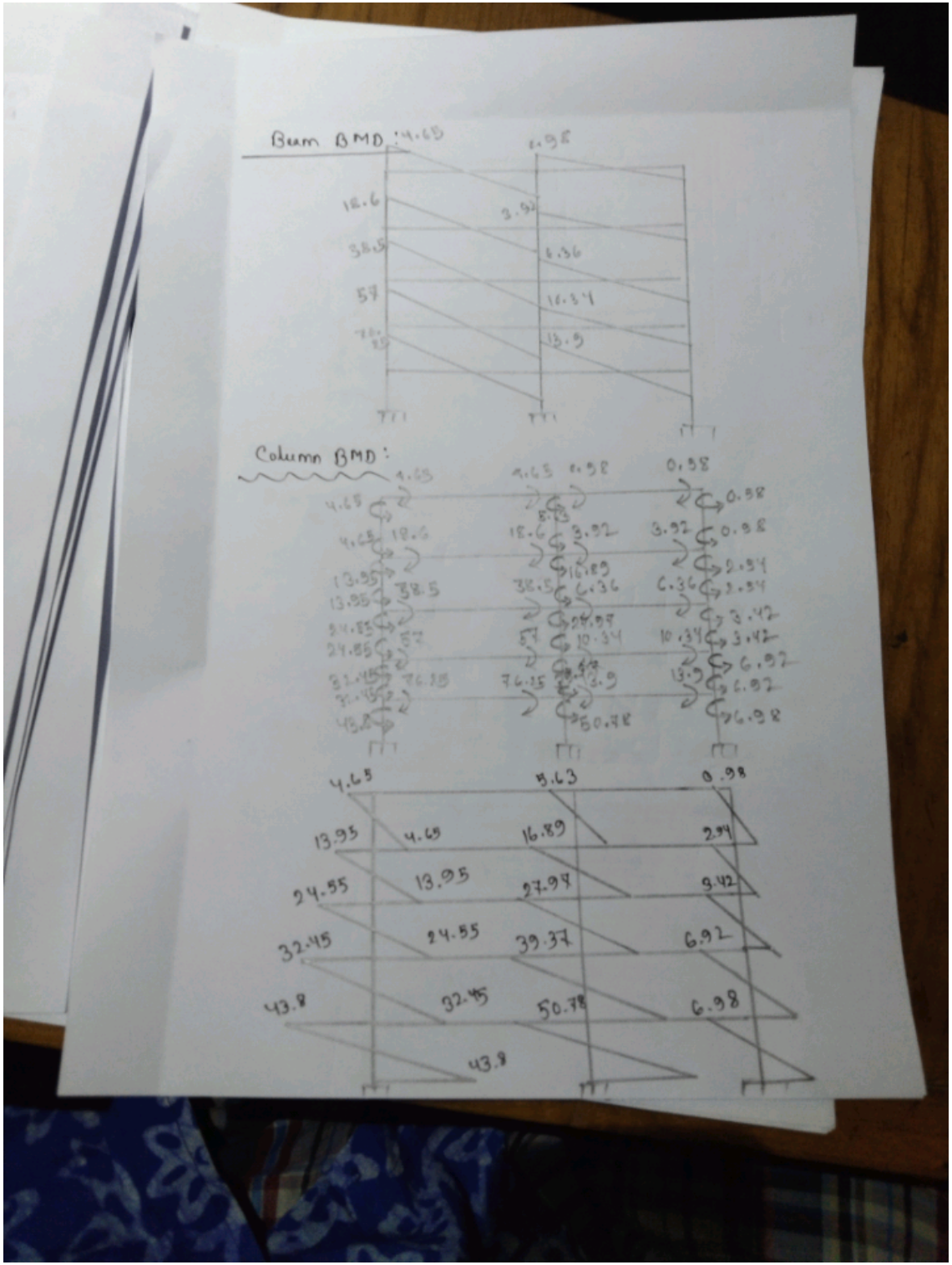
Floor	Moment (ft-k)	AF		
		Le	Mc	Rc
4th	11.25	0.186	-0.087	-0.098
3rd	56.25	0.93	~~-0.52~~ -0.43	-0.49
2nd	196.25	2.47	-1.34	-1.126
1st	281.25	4.75	-2.59	-2.16
GF	461.25	7.8	-4.24	-3.55

Column AFD :

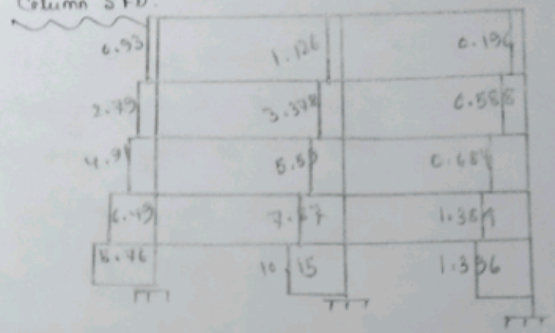


Beam SFD :

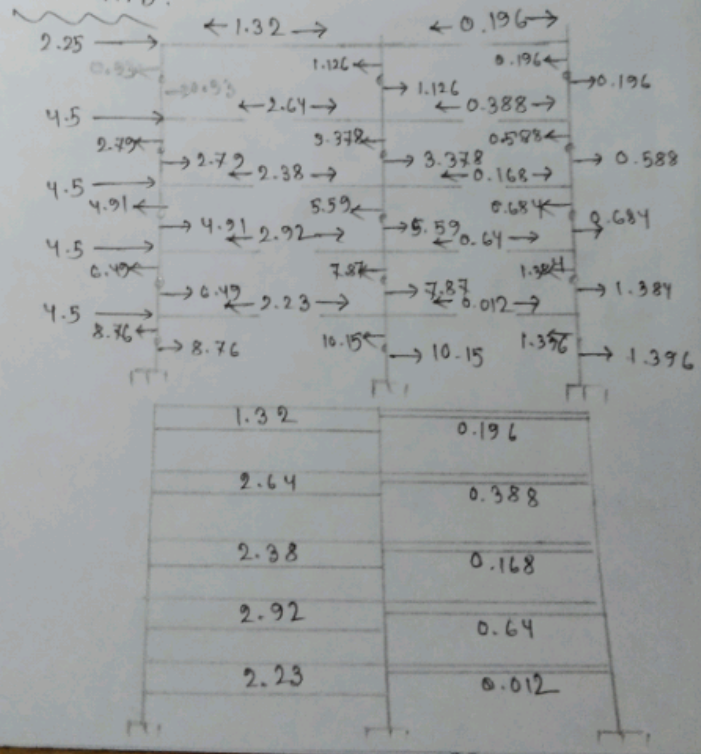



Beam BMD :
Column BMD :

Column SFD:



Beam AFD:



Question - 05

Cantilever method

Wind pressure = 40 psf

Tributary height of 3rd floor = $\frac{20+10}{2}$ = 15'

Tributary height of 2nd floor = $\frac{10+10}{2}$ = 10'

Tributary height of 3rd floor = $\frac{10+10}{2}$ = 10'

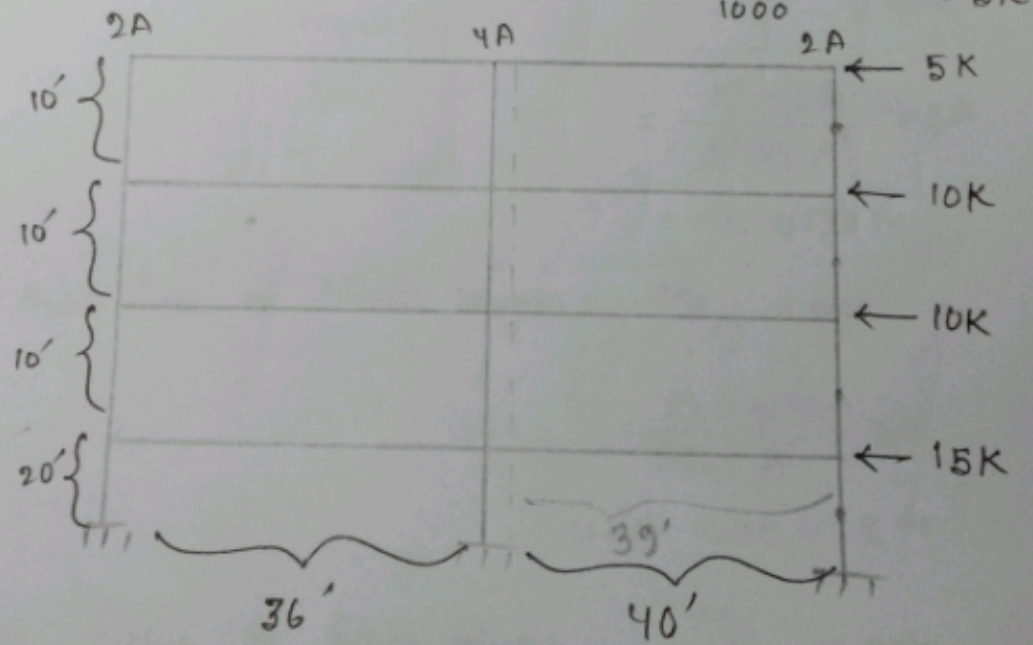
Tributary height of 4th floor = $\frac{10+0}{2}$ = 5'

∴ Wind force at 3rd floor = $\frac{40 \times 15 \times 25}{1000}$ = 15 K

∴ Wind force at 2nd floor = $\frac{40 \times 10 \times 25}{1000}$ = 10K

∴ Wind force at 3rd floor = $\frac{40 \times 10 \times 25}{1000}$ = 10K

∴ Wind force at top floor = $\frac{40 \times 5 \times 25}{1000}$ = 5K



Determination of Centroid:

$$\bar{x} = \frac{A_1x_1 + A_2x_2 + A_3x_3}{A_1 + A_2 + A_3} = \frac{2A\times 0 + 4A\times 40 + 2A\times 76}{2A+4A+2A}$$

$$= 39' \text{ (From RC)}$$

∴ Moment of inertia, $I = \Sigma Ad^2$

~~$= 2A\times 0^2 + 4A\times 40^2 + 2A\times 76^2$~~

$$= 2A\times 39^2 + 4A\times 1^2 + 2A\times 37^2$$

$$= 5784A$$

∴ ~~Force~~ Axial Force at left column = Stress × area

$$= \frac{My}{I} \times \text{area}$$

$$= \frac{M\times(39-76)}{5784A}\times 2A$$

$$= -0.0128M$$

∴ Axial Force at Middle column = $\frac{My}{I}$ × area

$$= \frac{M\times(39-40)}{5784A}\times 4A$$

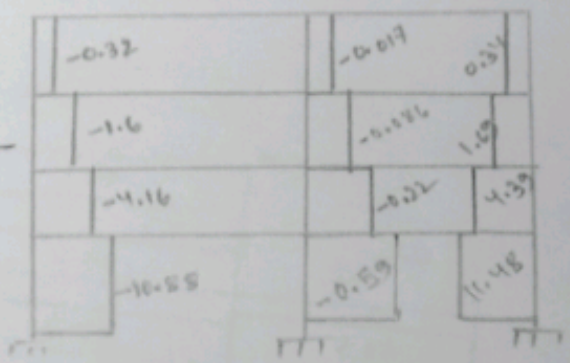
$$= -0.000692M$$

∴ Axial Force at Right column = $\frac{My}{I}$ × area

$$= \frac{M\times 39}{5784}\times 2A$$

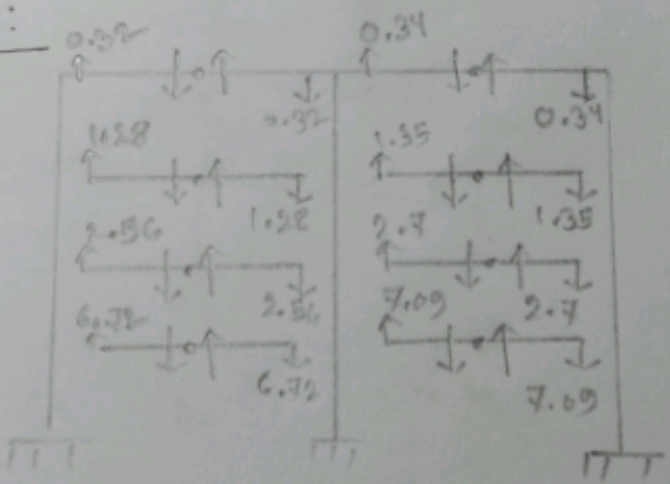
$$= 0.0135M$$

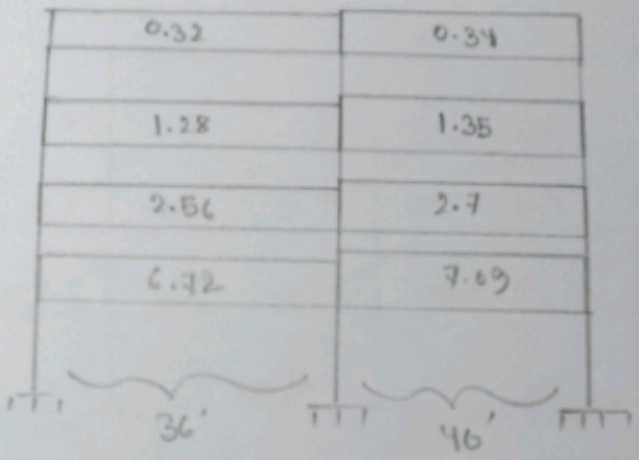
Column AFD:



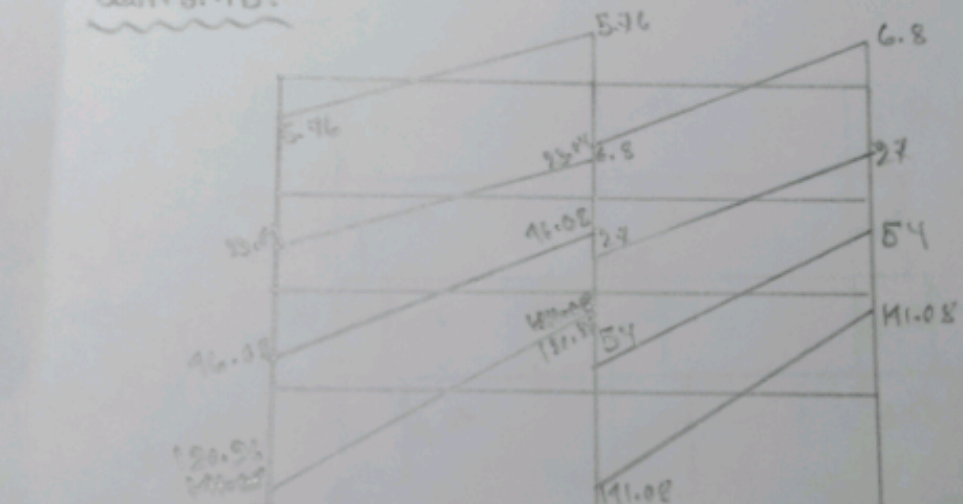
Floor	Moment (Ft-K)	AFD		
		LC	MC	RC
3rd	5×5 = 25	−0.32	−0.017	0.34
2nd	5×15 + 10×5 = 125	−1.6	−0.086	1.69
1st	5×25 + 10×5 + 10×5 = 325	−4.16	−0.22	4.39
GF	5×40 + 10×30 + 10×20 + 15×10 = 850	−10.88	−0.59	11.48

Beam SFD:

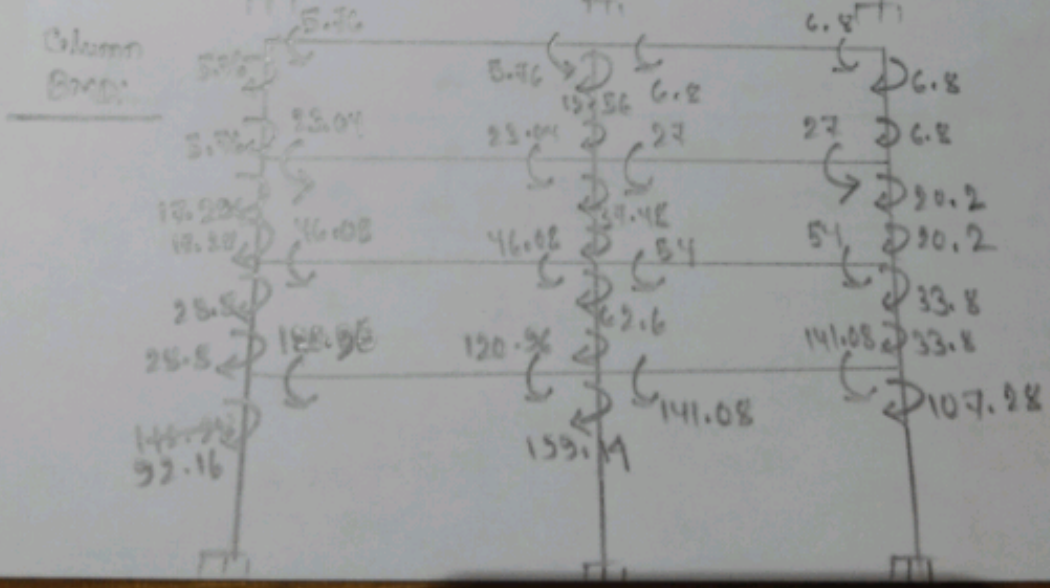


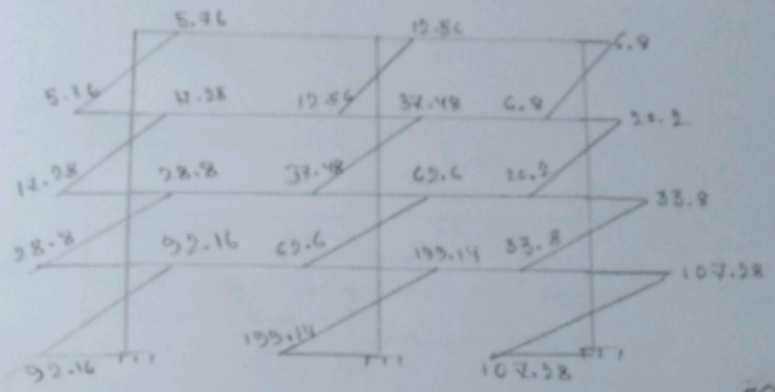


Beam BMD:

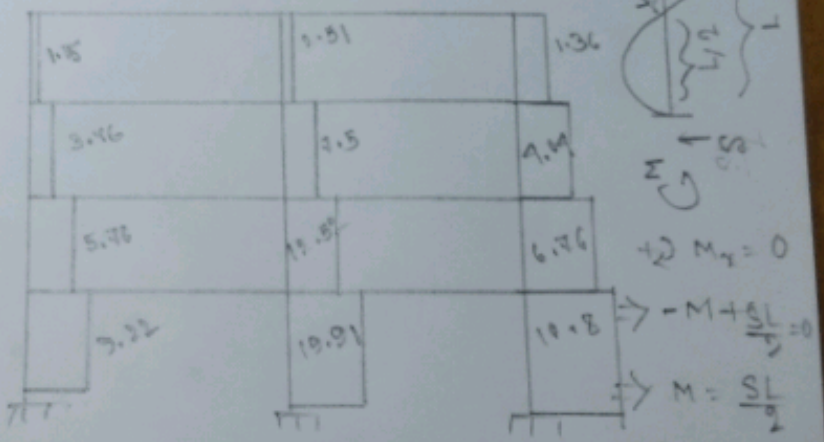


Column BMD:

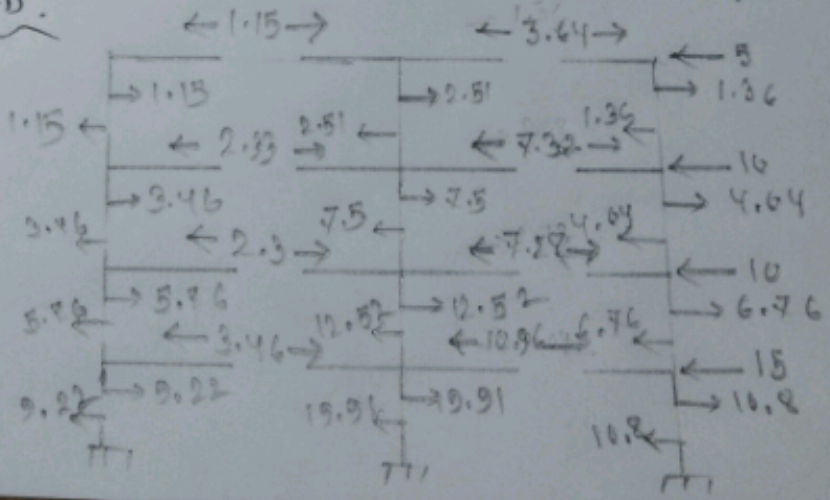


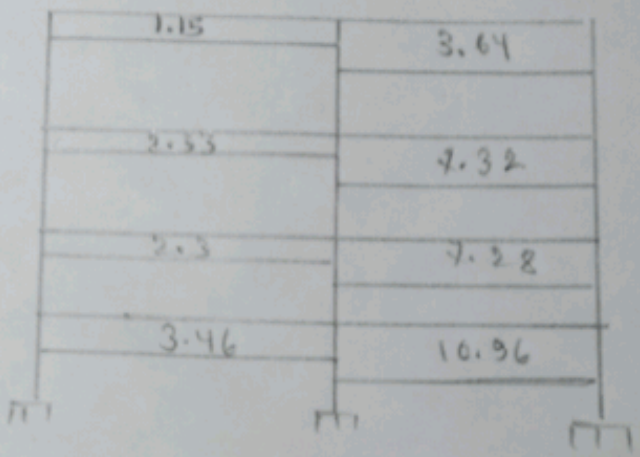


Column SFD :

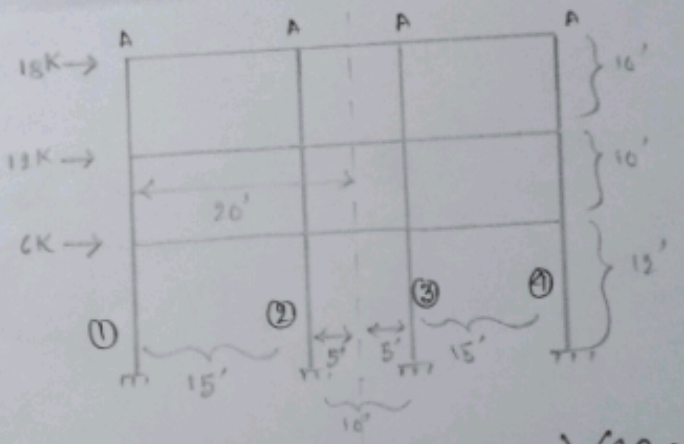


Beam AFD :




2.15
3.64
2.33
4.32
2.3
4.28
3.46
10.96

Cantilever Question - 04



$$CG = \frac{(A\times 0 + A\times 15 + A\times 25 + A\times 40)}{4A} = 20'$$

$$I = \Sigma Ad^2 = A\times 20^2 + A\times 5^2 + A\times 5^2 + A\times 20^2$$

$$= 850A$$

∴ Axial force at column 1 $= \frac{M\times 20}{850A} \times A = 0.0235M$

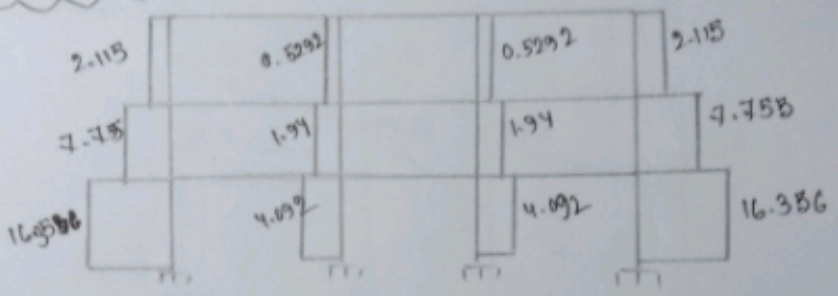
∴ " " " " 2 $= \frac{M\times(20-15)}{850A} \times A = 0.00588M$

∴ " " " " 3 $= \frac{M\times(20-25)}{850A} \times A = -0.00588M$

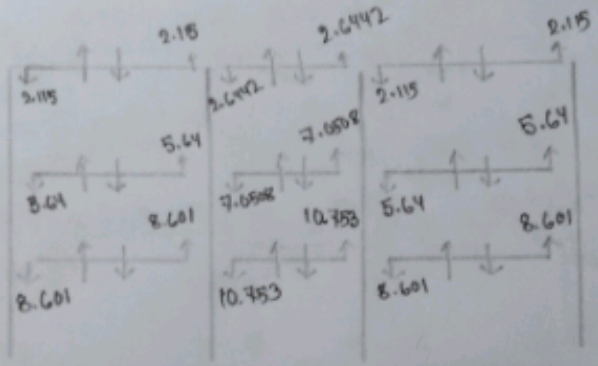
∴ " " " " 4 $= \frac{M\times(20-40)\times A}{850A} = -0.0235M$

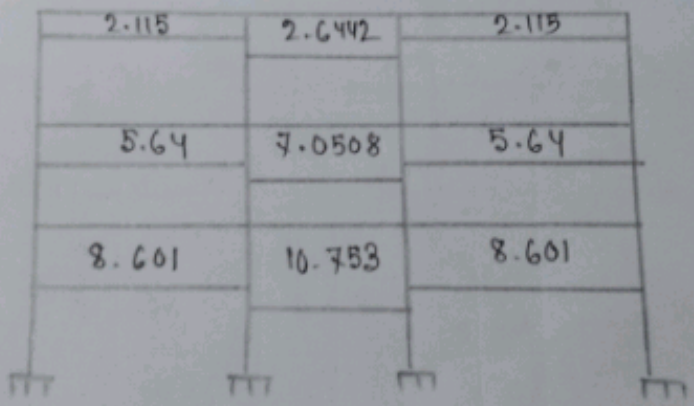
Floor	Moment (Ft-K)	AF			
		1	2	3	4
2nd	90	2.115	0.5292	−0.529	−2.115
1st	330	7.755	1.94	−1.94	−7.755
GF	696	16.356	4.092	−4.092	−16.356

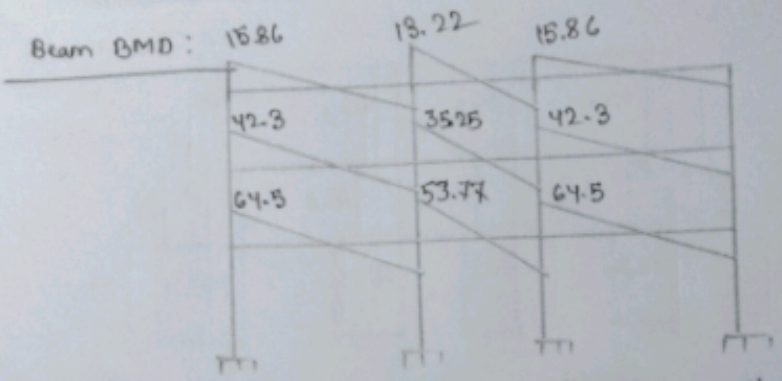
Column AFD:

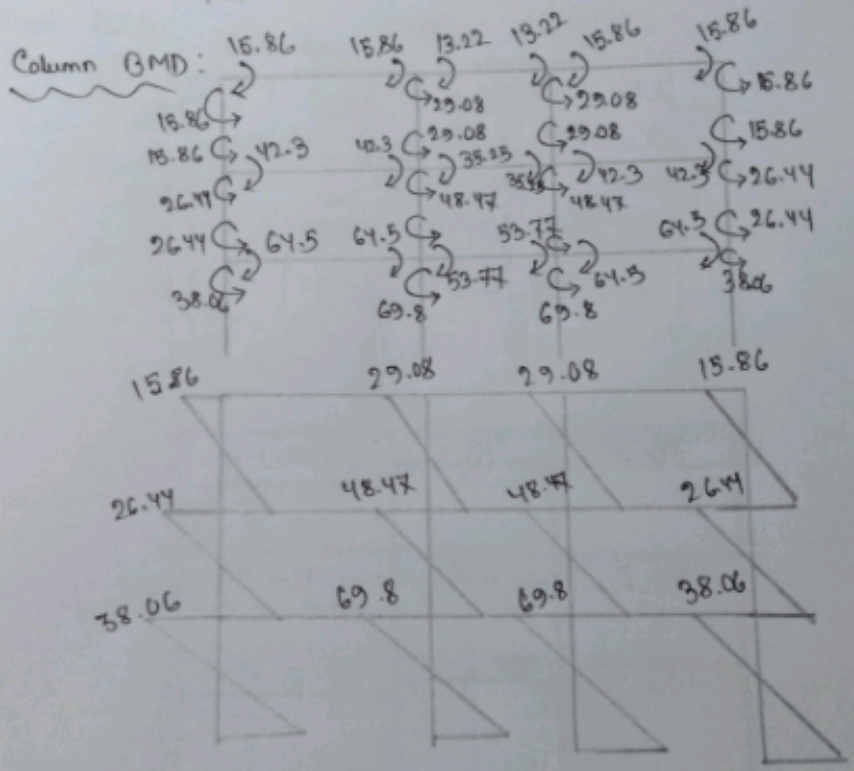


Beam SFD:

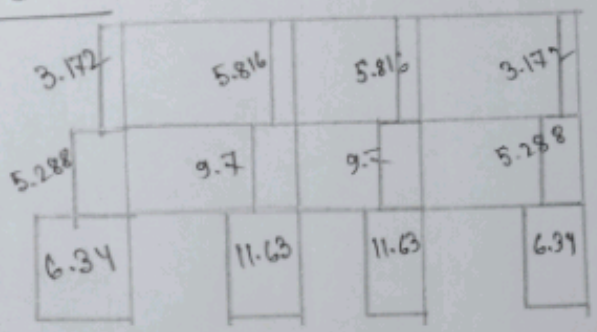





Beam BMD :
15.86
13.22
15.86
42.3
35.25
42.3
64.5
53.77
64.5


Column BMD :
15.86
15.86
13.22
13.22
15.86
15.86
29.08
29.08
15.86
15.86
42.3
29.08
29.08
15.86
26.44
38.25
42.3
48.47
48.47
64.5
64.5
64.5
53.77
53.77
64.5
26.44
69.8
69.8
38.06
15.86
29.08
29.08
15.86
26.44
48.47
48.47
26.44
38.06
69.8
69.8
38.06

Column SFD :



Beam AFD:

