UNIVERSITY OF ENGINEERING TECHNOLOGY, PESHAWAR.
CIVIL ENGINEERING DEPARTMENT

STRUCTURE ANALYSIS-1
CE-215
INSTRUCTOR: Dr. M. Ashraf
SEMESTER 4th

Assignment: Complex Engineering Problem, CEP

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CLASS No. : 99
SEC: "C"
Reg No. : 18PWCIV5030

QUESTION:

A bus stop is required to be analyzed and designed as a reinforced concrete (RC) plan frame. Detail of the bus stop is shown below. The plan frame which supports 6” thick RC slab comprises three 12”x12” RC columns and one 12”x18” RC continuous beam. The connections between beam and columns are rigid. Columns are supported on isolated footings. The RC slab is subjected to a live load of 30 lb/ft2 and superimposed dead load of 60 lb/ft2
in addition to self-weight of the frame. The modulus of elasticity of concrete is 3000 ksi. To estimate self-weight of beams, slabs and masonry parapet walls, the unit weights of concrete and masonry equal to 150 lb/ft3 and 120 lb/ft3 respectively shall be used.

Students are required to:

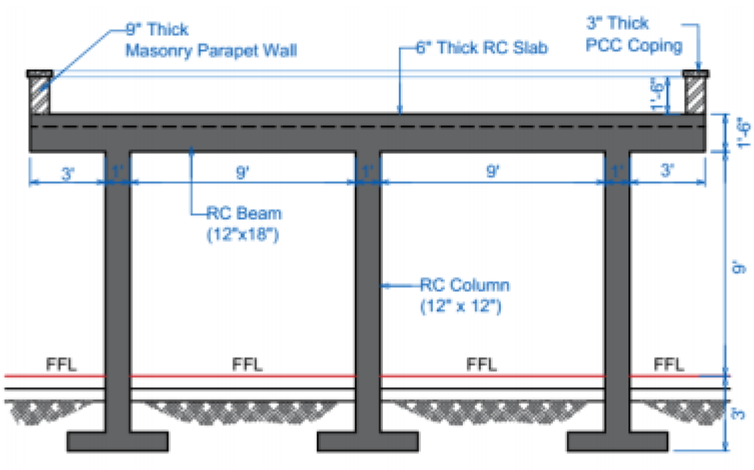
1. Estimate uniformly distributed and concentrated load on beam of the frame.

2. Make the analysis model of the plane frame from the given information, showing the support Conditions and load on the structure.

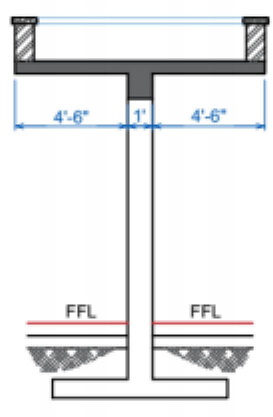
3. Determine static and kinematic indeterminacy of the structure.

4. Analyze the frame model to determine support reactions and member end forces.

5. Draw shear force and bending moment diagram of the frame. Also sketch the elastic curve.



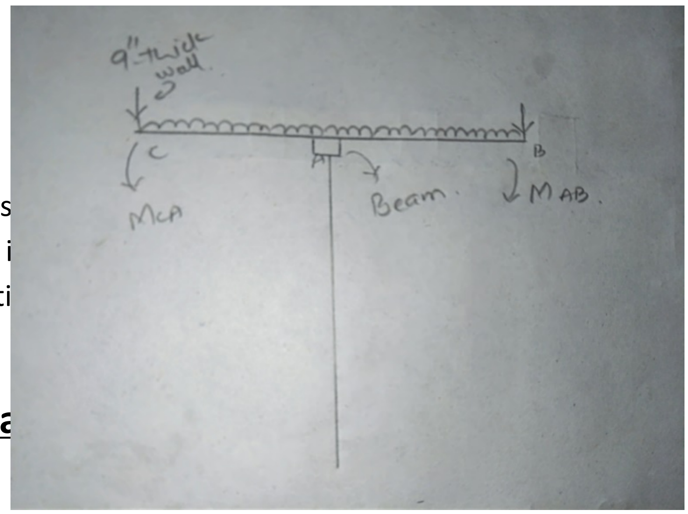
SECTION A-A



SECTION B-B

GIVEN DATA:

- Slab thickness=6'
- Cross section of column= 12"×12"
- Slab cross section = 12"×18"
- Beam and column have rigid connection and column supported on isolated footing
- The unit weights of concrete and masonry equal to 150 lb/ft3 and 120 lb/ft3
- Modulus of elasticity of concrete =E=3000 ksi
- As we have three types of loading
    1. Dead load=30 lb/ft^2
    2. Live load=60 lb/ft^2
    3. Self load of frame=?



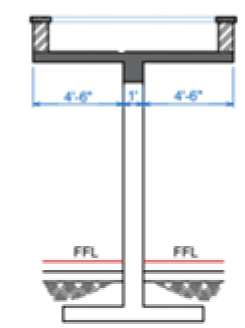
SOLUTION:

As the bus stand is given for which analaysis is coping and parapet wall and than distributed i reach to ground. As we are given raft foundati are rigid.

1.Estimate uniformly distributed a the frame.

The laods on the beam are calculated as

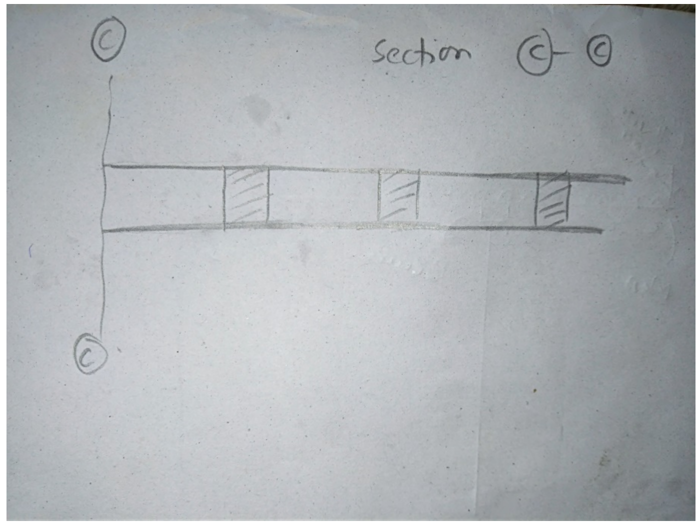
Consider section B B as shown.



SECTION B-B

As the Mab and Mca are equal in magnitude but opposite in direction so they cancel each other so we are left only forces on both sides of cantilever portion.

So considering the loads



Load of slab(self weight) = (6/12*4.5)*2*150

Slab self weight= 675 lb/ft

Load of coping and parapet wall:

= (9/12*1.5*120)*2 + (3/12*10/12*150)*2

= 332.5 lb/ft

Dead load:

= 30*4.5*2

= 270 lb/ft

Live load:

=60*4.5*2

= 540 lb/ft

Now considering the only loads on beam due to slab,parapet walls, live and dead load:

Live load:

= 60 * 1

= 60 lb/ft

Dead load:

= 30*1

= 30 lb/ft

Parapet and coping load:

As on section B B we have no parapet wall and coping so consider it both load zero.

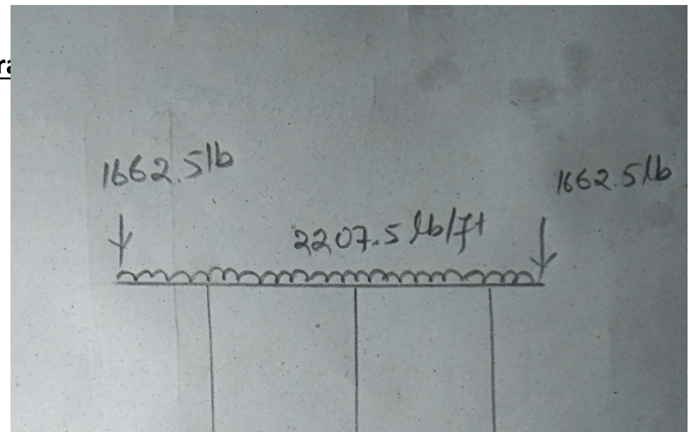
Parapet wall and coping load = 0

Slab load:

Slab load = (1*6/12)*150

= 75 lb/ft

As the concentrated load due to parapet wall on sides not calculated in order to calculate that consider another section C C as shown.



So load of parapet wall and coping as concentra

= (9/12*1.5*10*120) + (3/12*10/12*10*150)

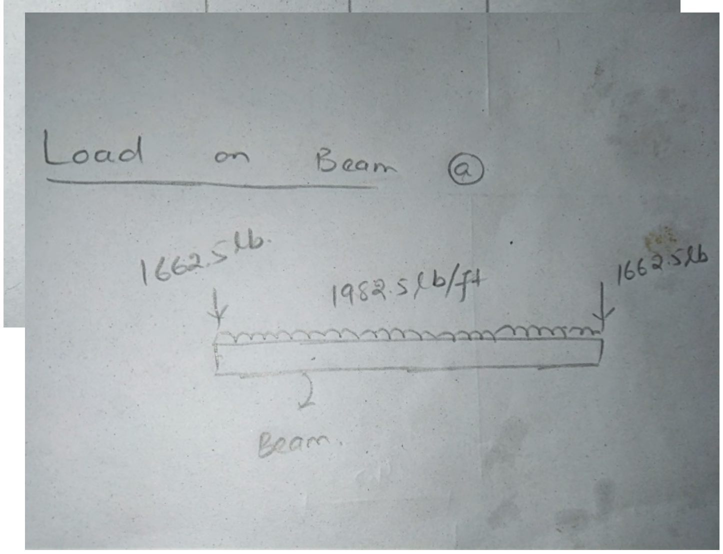
=1662.5 lb

Total load on beam will be:

Distributed load:

= (675+332.5+270+540+165)lb/ft

= 1982.5 lb/ft



Concentrated load:

Load of parapet wall and coping on sides i.e

= 1662.5 lb

=1.66k

The loads on beam are shown in figure.

2. Make the analysis model of the plane frame from the given information, showing the support conditions and load on the structure.

The self weight of beam is:

= (12/12*18/12*150)

= 225 lb/ft

So total load on frame will be;

Distributed load:

That is load on the beam and total load that is calculated on beam.

Total load = 1982.5 + 225

=2207.5 lb/ft

=2.207 k/ft

Concentrated load;

This is because of parapet wall at sides that acts as concentrated load

Load=1.66 k

So the load on frame are shown in figure

3. Static and kinematic indeterminacy:

Static indeterminacy:

S.I = 6-3

= 3°

Kinematic indeterminacy:

K.I = 3j-r-m

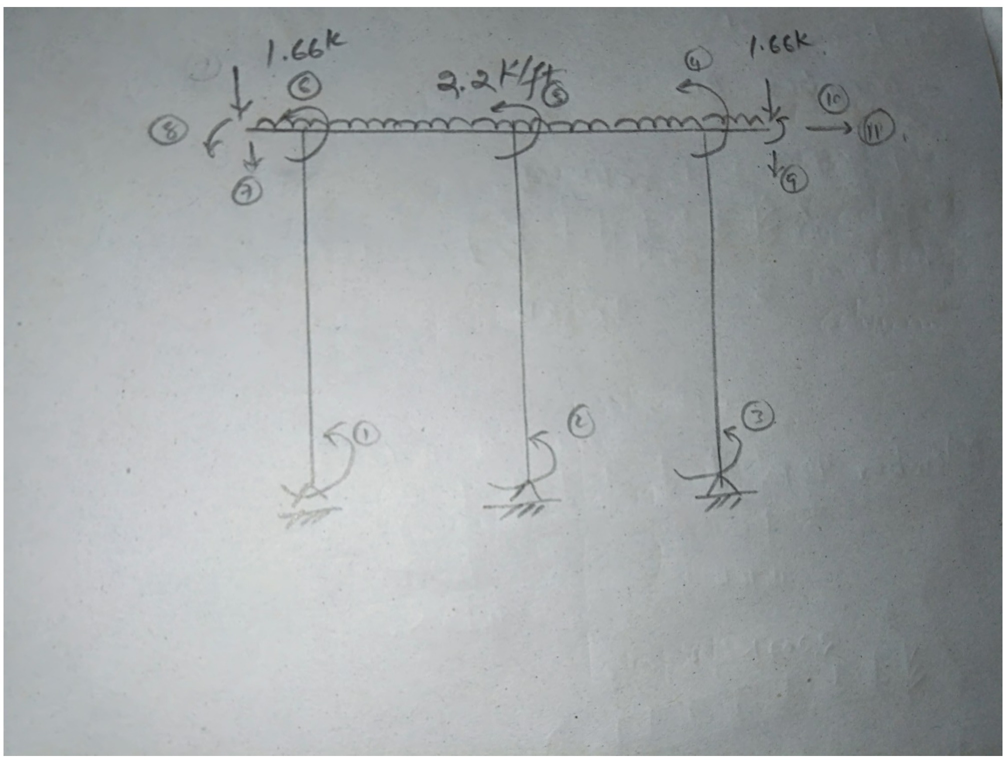
K.I = 3(8)-6-7

K.I = 11°

Note:

Six are rotations at each joints one is sway and 4 degree is for determinate cantilever portion.

Figure:



4. Analyze the frame model to determine support reactions and member end forces.

Step 1:

K.I = 6
End A , C and E can be modified as hinged end.

Step 2:

Determine stiffness factor:

I for beam= 1*(18/12)^3/12
= 0.28125 ft^3

I for column= 1*1^3/12
= 0.08333 Ft^3

Note end A,C and E are modified.

Kab= kba= ¾(I/L) = ¾(0.0833/9)
= 0.00694

Kbd = Kdf= I / L= 0.28125/10
= 0.028125

Kbg = Kfh= I/L = 0.28125/3.5
= 0.0804

Step 3:

Distribution factor:

DFba = DFfe = kba/(kba + kbg + kbd)

= 0.0069/(0.00694+.0801+0.082125)
= 0.0603

DFbd = DFfd=0.028125/(0.028125+0.00694+0.0801)
=0.244

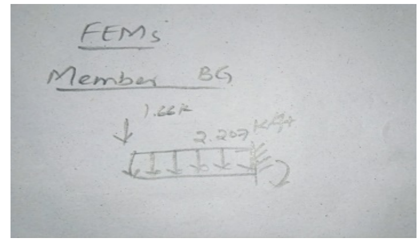
DFdf = DFdb =0.028125/(0.028125+0.028125+0.00694)

= 0.445

DFdc= 0.00694/(0.00694+0.028125+0.028125)
= 0.11

DFab = DFcd = DFef = 1 ; as rotatable end

Step 4:

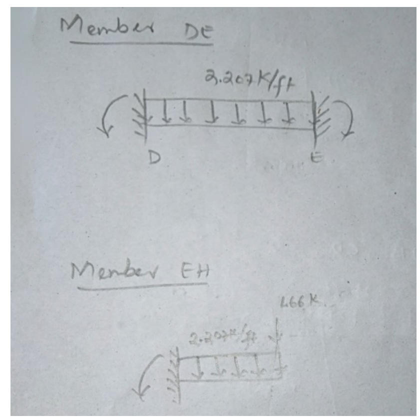


Fixed end moments:

FEMbg= 19.33 kft

FEMfh= -17.23Kft

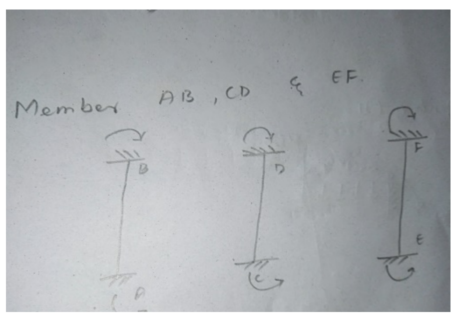
FEMab = FEMba = FEMcd = FEMdc = FEMef = FEMfe =0.

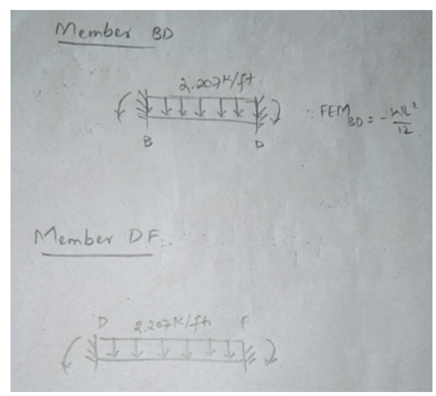


As no lateral force is applied at columns

FEMbd = FEMdf = -16.25 kft

FEMdb = FEMfd = 16.25 kft





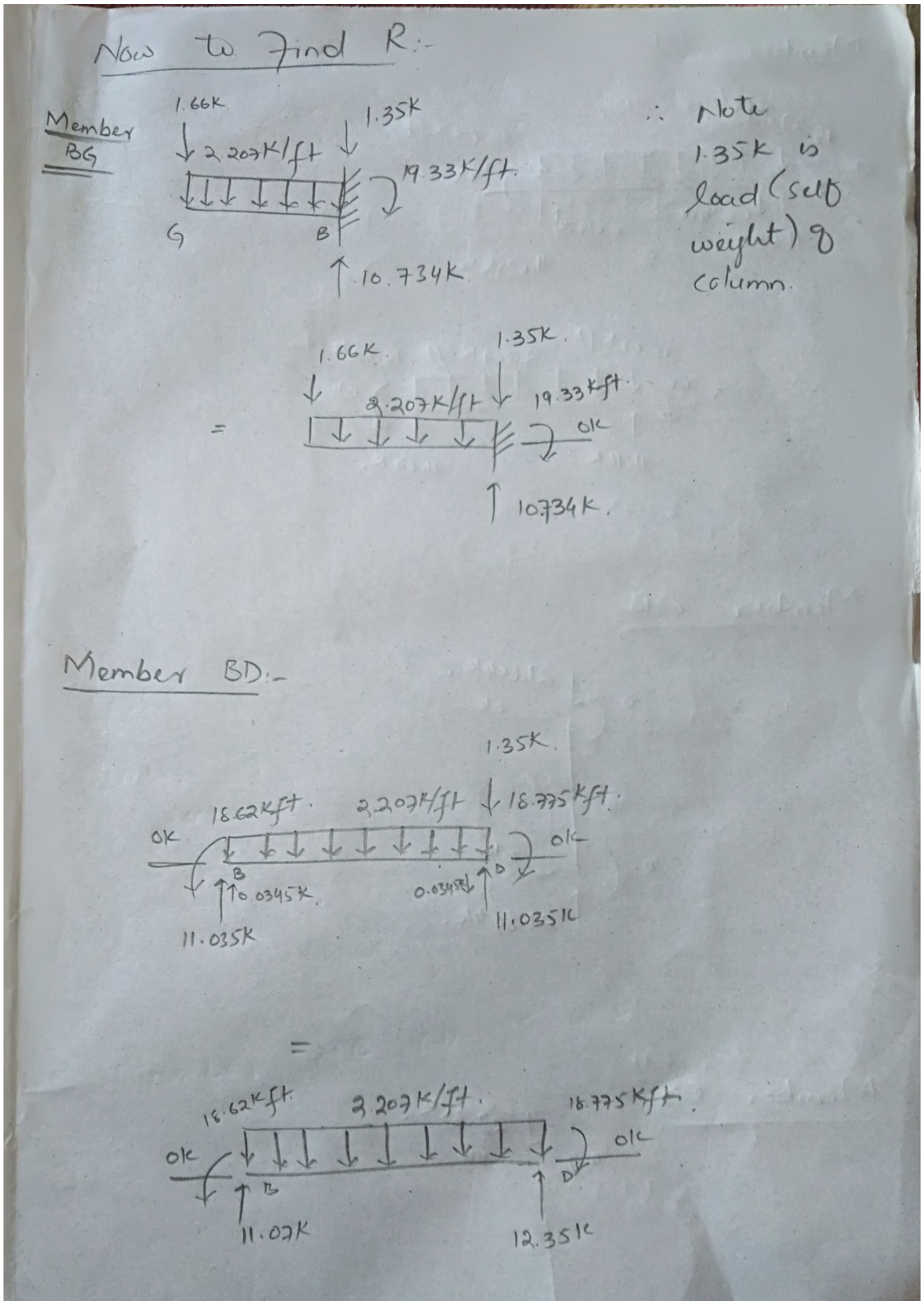
Step 5

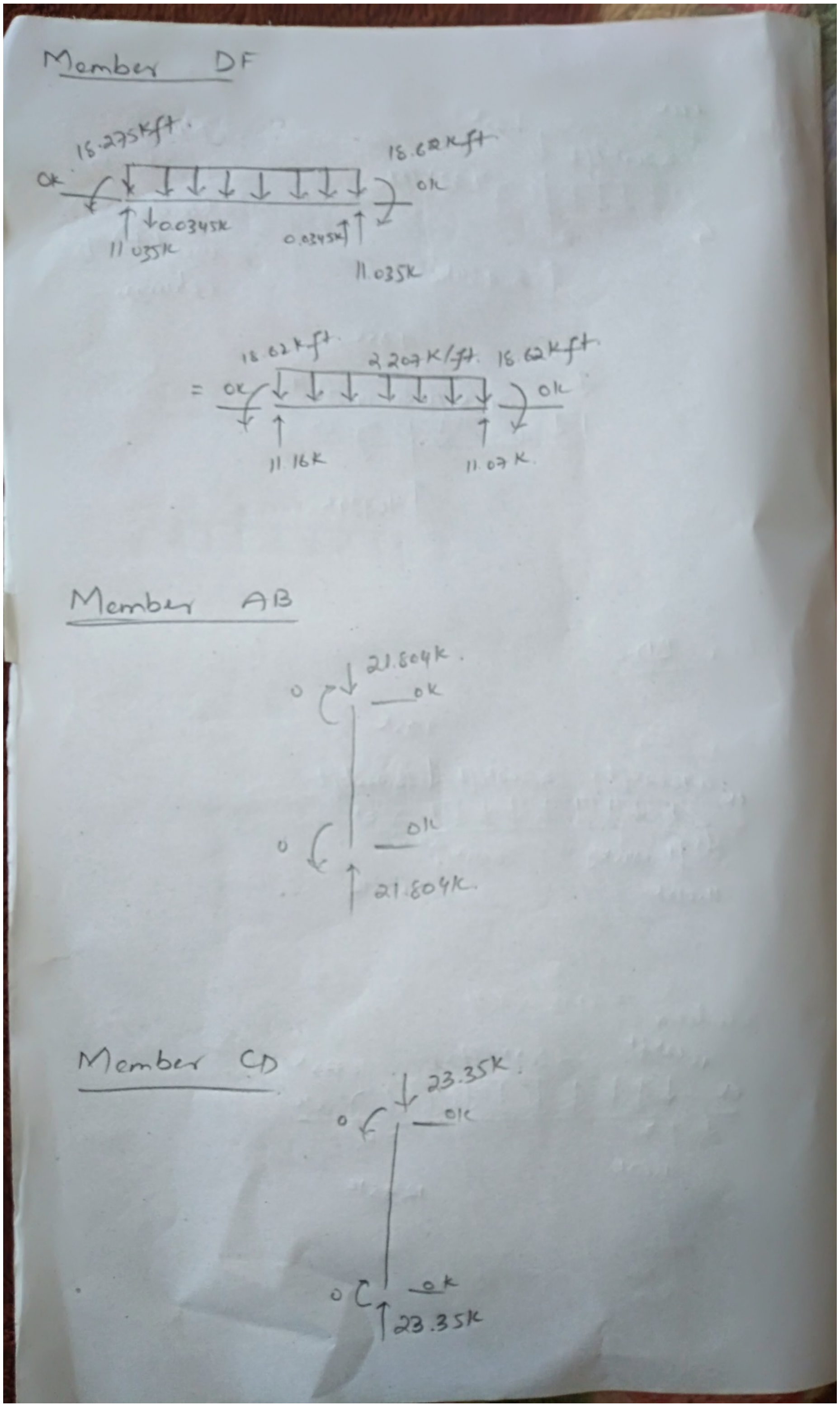
Moment distribution table for restrained frame subjected to real loads:

JOINT	B			D			F			A	C	E
MEMBERS	**BG**	**BA**	**BD**	**DB**	**DC**	**DF**	**FD**	**FE**	**FH**	**AB**	**CD**	**EF**
D.F	-	0.0603	0.244	0.445	0.11	0.445	0.244	0.0603	-	1	1	1
FEM	19.33	0	-18.39	18.39	0	-18.39	18.39	0	-19.33	0	0	0
BM	-	-0.0867	-0.23	0	0	0	0.23	0.0867	-	0	0	0
COM	-	0	0	-0.115	0	0.115	0	0	-			
BM	-	0	0	0	0	0	0	0	-			
COM	-	0	0	0	0	0	0	0	-			
M.	19.33	**-0.0567**	**18.62**	**18.275**	0	**-18.275**	**18.62**	**0.0567**	-19.33	**0**	**0**	**0**

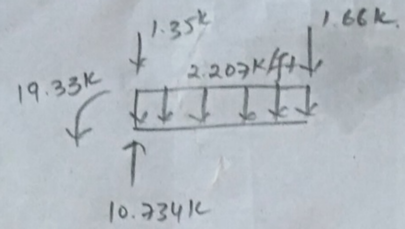
4. Analyze the frame model to determine support reactions and member end forces.

Calculating R:

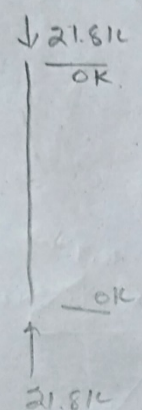



Member DF
15.275kft.
18.62kft
0k
0k
0.0345k
0.0345k
11.035k
11.035k
18.62kft.
2.207k/ft.
18.62kft
= 0k
0k
11.16k
11.07k.
Member AB
21.804k.
0
0k
0
0k
21.804k.
Member CD
23.35k.
0
0k
0
0k
23.35k

Member FH

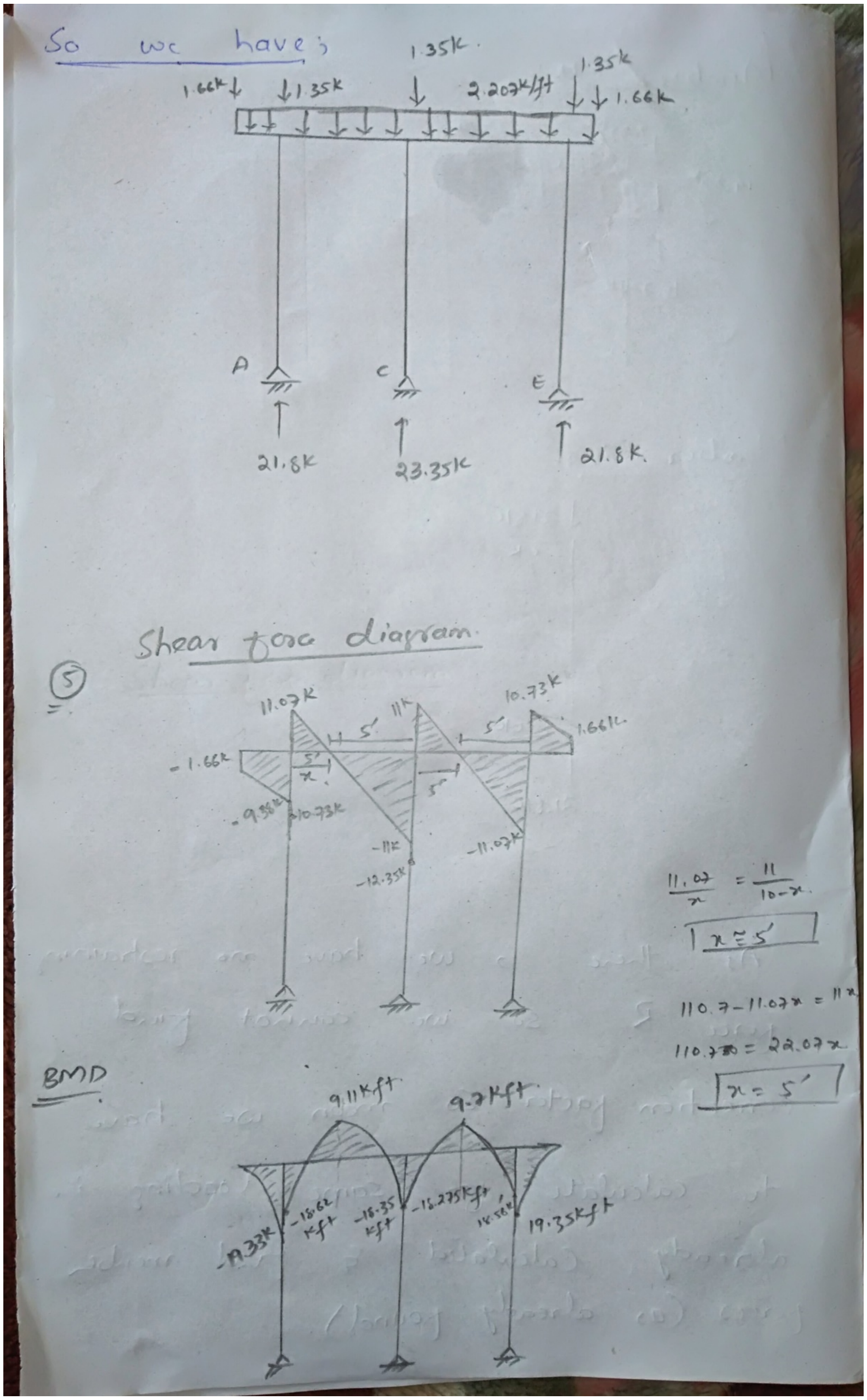


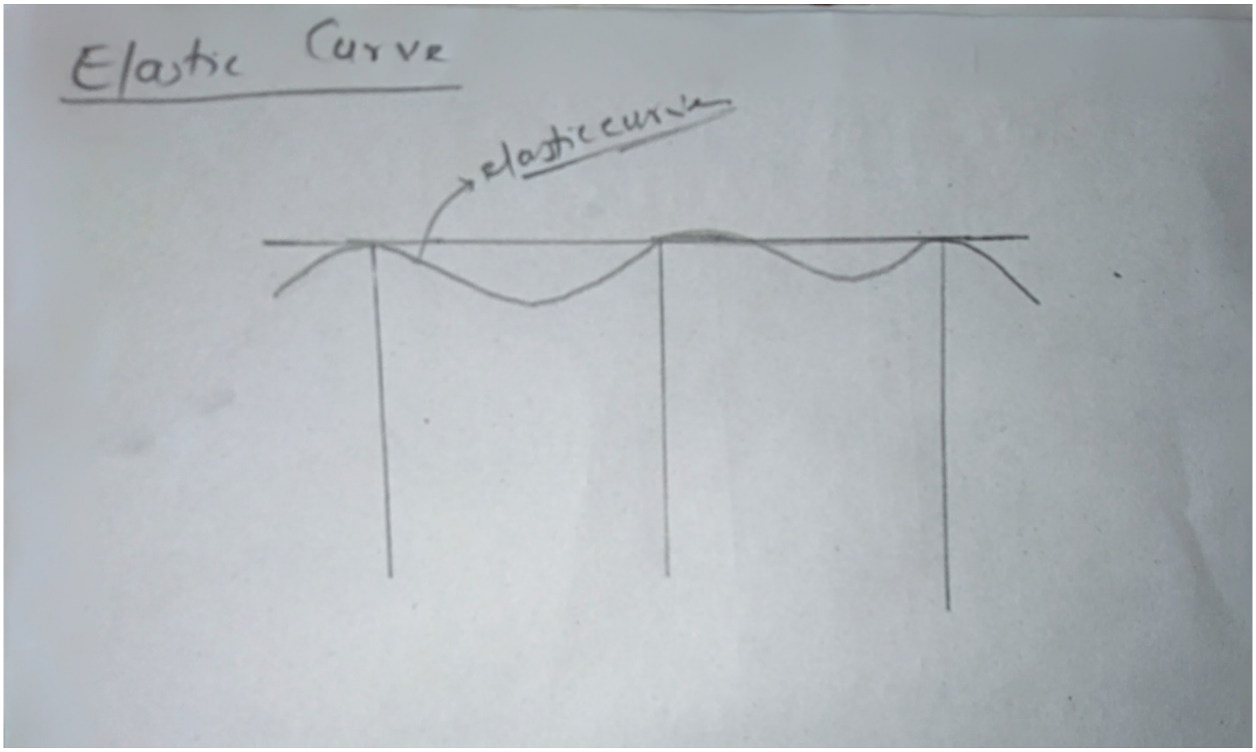
Member EF :-



As there is we have no restraining force R so we cannot find correction factor so mean we have to calculate for same loading i.e already calculated & find member forces (as already found)

5. Draw shear force and bending moment diagram of the frame. Also sketch the elastic curve.




Elastic Curve
elastic curve