Moment distribution method in analysis of frames with Sway :-

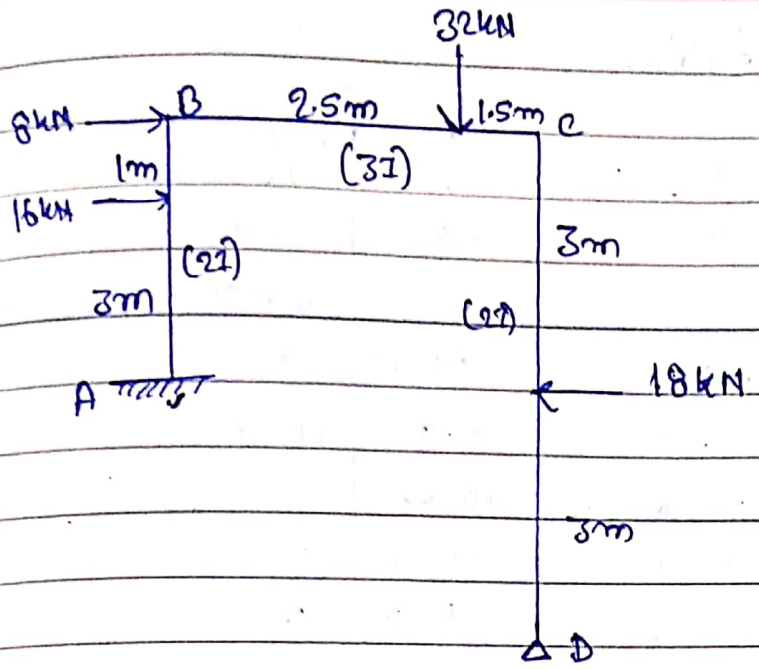
| (I) Non-Sway | (II) Sway-Analysis |
|---|---|
| 1. F.E.M | 1. Ratio |
| 2. D.F | 2. Sway M & D.M table |
| 3. M.DM table | 3. Column (Cr) |
| 4. Horizontal reaction at A and D | 4. Horizontal reaction at A and D |
| 5 Sway force = ~~left - right~~ | 5. Sway force = A+D |

grade - Small 6. Actual Sway moment

7. Reaction
Horizontal at A and D
Vertical at A and D

8. B.M.D diagram

Q.1




Solution

(1) NON- SWAY

A: Fixed End moment

$M_{ab} = -3\ kN\text{-}m$ $\quad M_{ba} = +9\ kN\text{-}m$

$M_{bc} = -11.25 kN\text{-}m$ $\quad M_{cb} = +18.75 kN\text{-}m$

$M_{cd} = -13.50 kN\text{-}m$ $\quad M_{dc} = +13.50\ kN\text{-}m$

(2) Distribution factor.

| Joint | member | R.S | T.R.S | D.F |
|---|---|---|---|---|
| B | BA | $\frac{2I}{4}$ | $\frac{5I}{4}$ | 2/5 |
| | BC | $\frac{3I}{4}$ | | 3/5 |
| C | CB | $3I/4$ | $\frac{4I}{4}$ | 3/4 |
| | CD | $\frac{3}{4}\cdot\frac{2I}{6} = \frac{I}{4}$ | | 1/4 |

(3) Moment Distribution table.

| A | B | | C | | D | |
|---|---|---|---|---|---|---|
| | 2/5 | 3/5 | 3/4 | 1/4 | | |
| -3 | +9 | -11.25 | +18.75 | -13.50 | +13.50 | |
| | | | | -6.750 | -1350 | |
| -3 | +9 | -11.25 | +18.75 | -20.25 | 0 | BD |
| 0 | +0.9 | +1.35 | +1.12 | +0.38 | 0 | BA |
| +0.45 | 0 | +0.56 | +0.67 | 0 | 0 | BC |
| 0 | -0.22 | -0.34 | -0.51 | -0.17 | 0 | |
| -0.11 | 0 | -0.26 | -0.17 | 0 | 0 | |
| 0 | +0.10 | +0.19 | +0.12 | +0.04 | 0 | |
| 0.05 | 0 | +0.06 | +0.09 | 0 | 0 | |
| 0 | -0.02 | -0.04 | -0.06 | 0.02 | 0 | |
| 0.01 | 0 | -0.03 | -0.02 | 0 | 0 | |
| -2.63 | +9.76 | -9.76 | +20.01 | -20.01 | 0 | |

Horizontal Reaction

at A $= \frac{-2.63 + 9.76 - 16 \times 1}{4}$

$= -2.2175$ KN ←

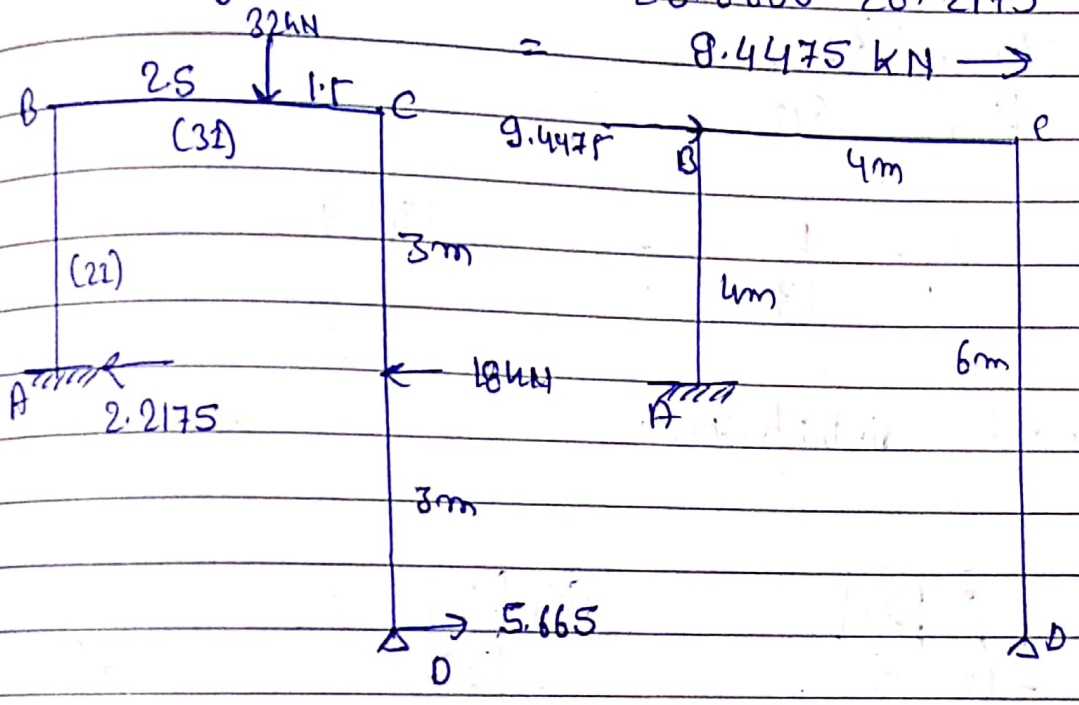
at D $= \frac{-20.01 + 0 + 18 \times 3}{6}$

$= 5.665$ KN →

Force Acting left to right = 8 + 16 + 5.665
= 29.6650 kN

Force Acting right to left = 18 + 2.2175
= 20.2175 kN

∴ Sway force = 29.6650 - 20.2175
= 8.4475 kN →




## Sway Analysis :-

Conditions: one end fixed and other is hinged

Ratio of the equivalent moment at the top of the Column

$$\frac{27}{l_1^2} : \frac{I_2}{l_2^2}$$

$$= \frac{2I_1}{l_1^2} : \frac{2I_2}{l_2^2}$$

$$= \frac{2(2I)}{4^2} : \frac{2I}{6^2}$$

$$= \frac{4I}{16} : \frac{2I}{36}$$

$$= \frac{1}{4} : \frac{1}{18} \Rightarrow 18 : 4$$

## Sway moment distribution:-

| | | 2/5 | 3/5 | | 3/4 | 1/4 | | |
|---|---|---|---|---|---|---|---|---|
| | -18 | -18 | 0 | | 0 | -4 | 0 | |
| | 0 | +7.2 | +10.8 | | +3 | +1 | 0 | B |
| | +3.6 | 0 | +1.5 | | +5.4 | 0 | 0 | C |
| | 0 | -0.6 | -0.9 | | -4.05 | -1.35 | 0 | B |
| | -0.3 | 0 | 2.02 | | -0.45 | 0 | 0 | C |
| | 0 | -0.80 | -1.21 | | +0.33 | +0.11 | 0 | B |
| | -0.4 | 0 | +0.16 | | -0.60 | 0 | 0 | C |
| Column | | | | | | | | |
| (a) | -14.28 | -10.58 | +10.58 | | +4.40 | -4.40 | 0 | |

Let the moments shown in Column (a) be due to a sway force S

Horizontal Reaction at A = $\frac{-14.28 - 10.58}{4}$

= $-6.215\,kN \leftarrow$

Horizontal Reaction at D = $\frac{-4.40 + 0}{6}$

= $-0.733\,kN \leftarrow$

Resolving Horizontally S = 6.215 + 0.733

= 6.948 kN

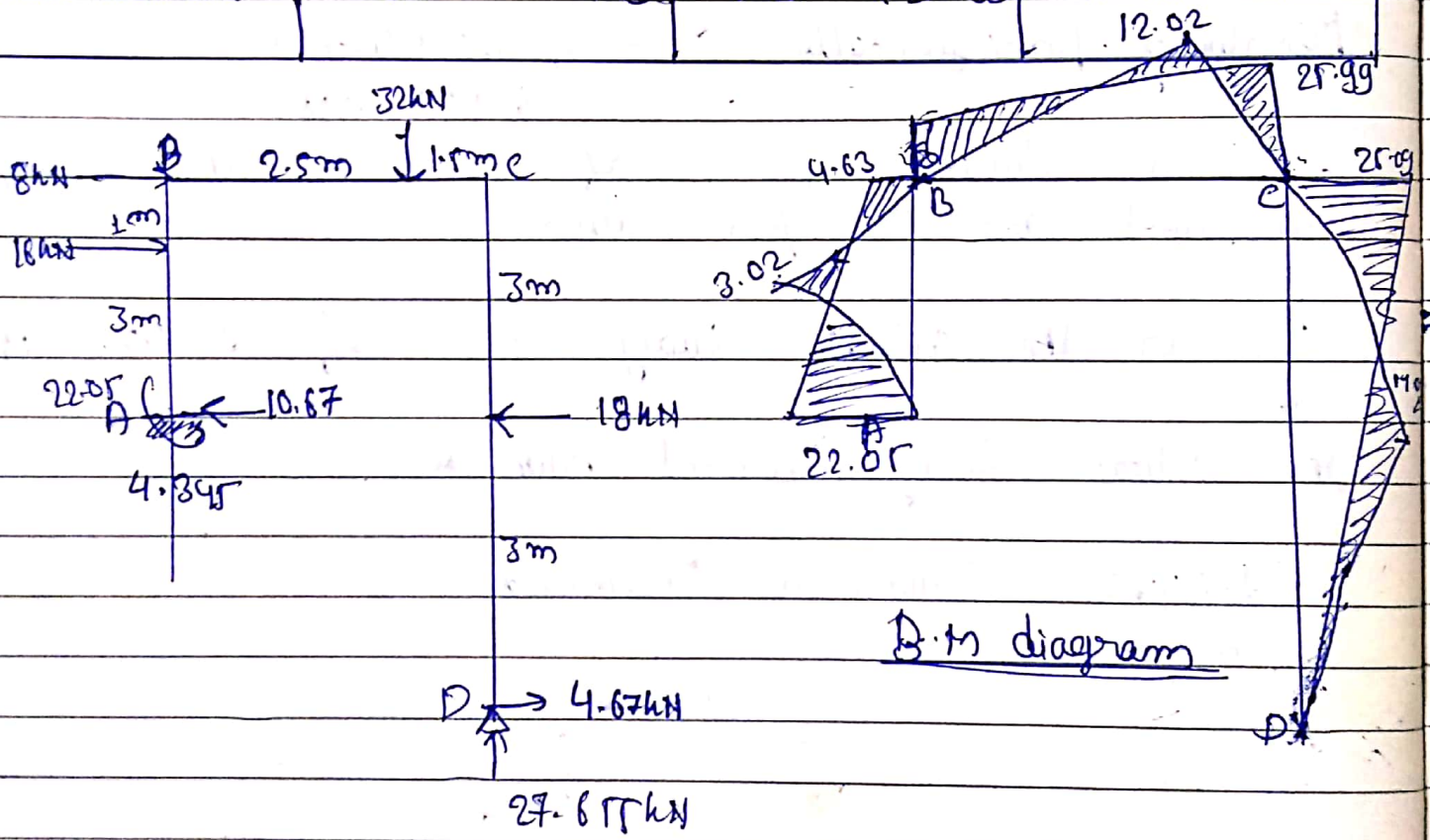
For a sway force of 6.948 kN the sway moment are as per Column (a)

∴ For the actual sway force of 9.4475 kN

the actual sway moment will be

$\frac{9.4475}{6.9480} \times$ Column (a) moments

| | A | B | | C | | D |
|---|---|---|---|---|---|---|
| Column (a) | −14.28 | −10.58 | +10.58 | +4.40 | −4.40 | 0 |
| Actual Sway moment $\frac{9.4475}{6.9480} \times$ (col (a)) | −19.42 | −14.39 | +14.39 | +5.98 | −5.98 | 0 |
| Non-Sway moment | −2.63 | +9.76 | −9.76 | +20.01 | −20.01 | 0 |
| Final moment | −22.05 | −4.63 | +4.63 | +25.99 | −25.99 | 0 |



Reaction

Horizontal Reaction at A $= \frac{-22.05 - 4.63 - 16 \times 1}{4}$

$= -10.67\ KN \leftarrow$

Horizontal Reaction at D $= \frac{-25.99 + 0 + 18 \times 3}{6}$

$= +4.67\ KN \rightarrow$

Vertical Reaction at D $\rightarrow V_d = \frac{+4.63 + 25.99 + 32 \times 2.5}{4}$

$= +27.655\ KN \uparrow$

Vertical Reaction at A $= 32 - 27.655$

$= +4.345\ KN \uparrow$