

16-12

F → Flex
M → mom
S →

T → theory

N → not mention

- | | | | | | |
|----------------|--------------|--------------|--------------|--------------|--------------|
| | <u>15-16</u> | <u>14-15</u> | <u>13-14</u> | <u>12-13</u> | <u>11-12</u> |
| 1 (a) → theory | 1 (a) → M | 1 (a) F | 1 (a) M | 1 (a) M | 1 (a) F |
| (b) → Flexi | (b) M | (b) F | (b) F | (b) S | (b) S |
| 2 (a) → T | 2 (a) S | 2 (a) F | 2 → F | 2 (a) S | 2 (a) F |
| (b) → F/N | (b) S | (b) F | 3 → M | 2 (a) M | (b) S |
| 3 (a) → F/N | 3 (a) S | 3 (a) S | 4 → F | (b) S | 2 (a) F |
| (b) → F | (b) M | (b) S | 5 → M | 3 (a) S | (b) S |
| 4 (a) → S | 4 (a) M | 4 (a) S | 6 → F | (b) S | 3 (a) N |
| 5 (a) → M | (b) S | (b) T | 7 → M | 4 (a) S | (b) S |
| (b) → M | 5 (a) F | 5 (a) T | 8 → S | 5 (a) F | 4 → S |
| 6 (a) → M | (b) F | (b) M | 9 → S | (b) F/T | 5 (a) M |
| (b) → M | 6 (a) F | 6 (a) M | 10 → S | 6 (a) F | (b) F |
| 7 (a) → M | (b) F | (b) M | 11 → S | (b) F | 6 (a) scope |
| (b) → S | 7 (a) F | 7 (a) S | 12 → S | 7 (a) F | (b) M |
| 8 (a) → S | (b) S | (b) F | 13 → S | 8 (a) F | 7 (a) M |
| (b) → S | 8 (a) N | 8 (a) S | 14 → F | (b) F | 8 (a) scope |
| | (b) S | (b) S | | 8 (a) F | (b) — |

S → 4
F → 4
M → 5

S → 5
F → 5
M → 4

S → 6
F → 5
M → 3

S → 6
F → 4
M → 4

S → 4
F → 6
M → 2

S → 4
F → 3
M → 3

13-14

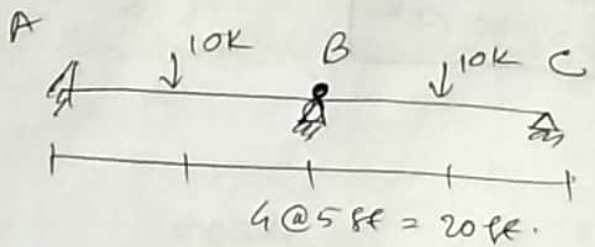
11 12
10 11
8 9

Nothing is certain.

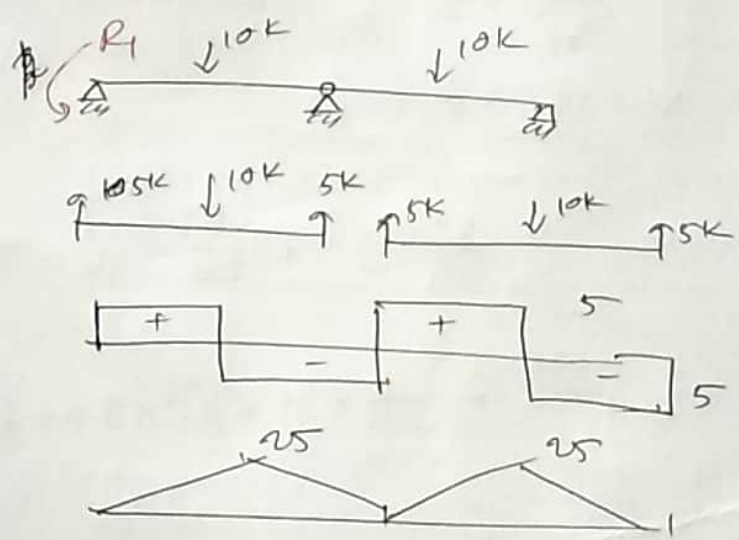
2016-17

1(b)

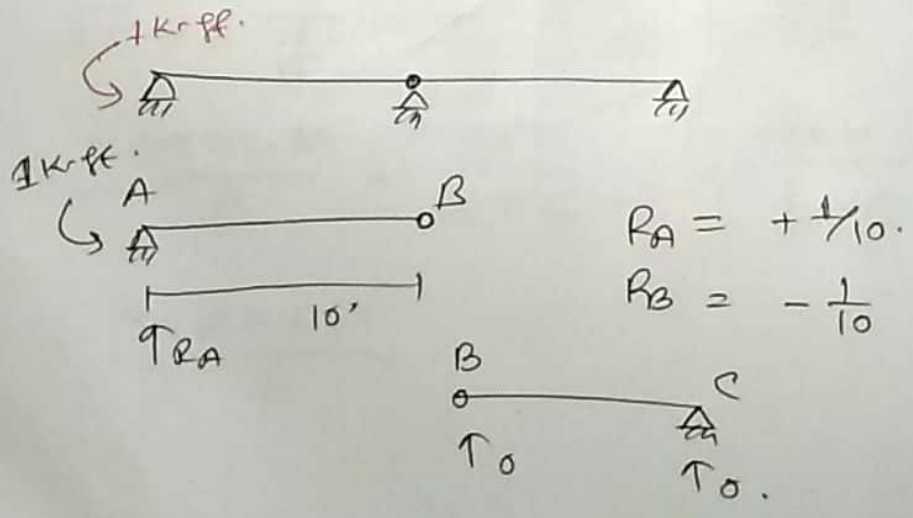
$DOF = 2 + 1 + 1 - 2 - 1 = 1^0$

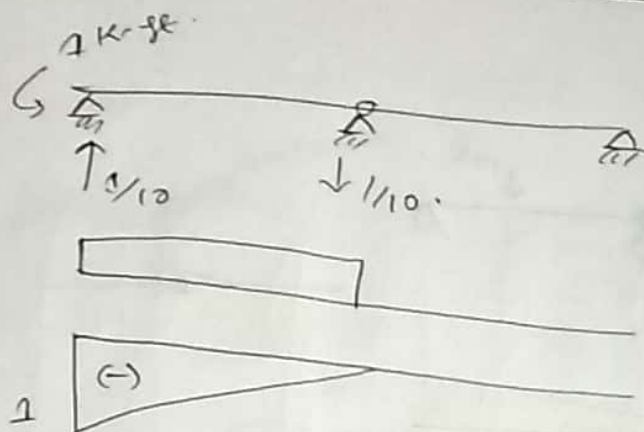


m0



m1





$$\Delta_{01} = \int \frac{m_0 m_1}{EI} dx = \frac{1}{6} \times (-1) \times 25 \times (10+5) \times \frac{1}{2EI}$$

$$= \frac{-31.25}{EI} \quad \hookrightarrow \frac{1}{6} m m' (L+a)$$

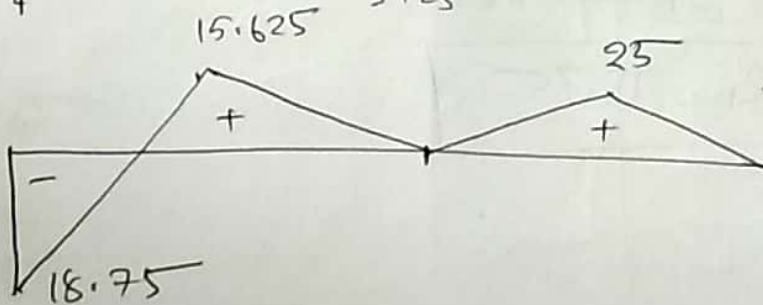
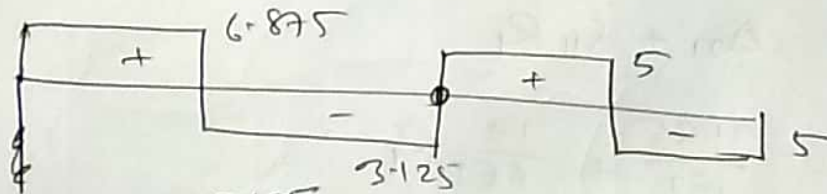
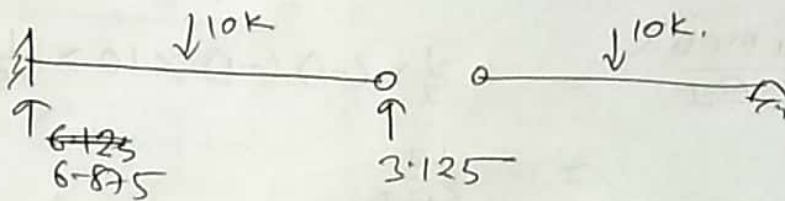
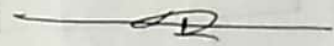
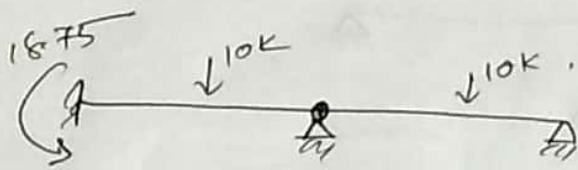
$$\delta_{11} = \int \frac{m_1 m_1}{EI} dx = \frac{1}{2} \times (-1) \times (-1) \times 10 \times \frac{1}{2EI}$$

$$= \frac{10}{6EI}$$

$$\Delta_1 = \Delta_{01} + \delta_{11} R_1$$

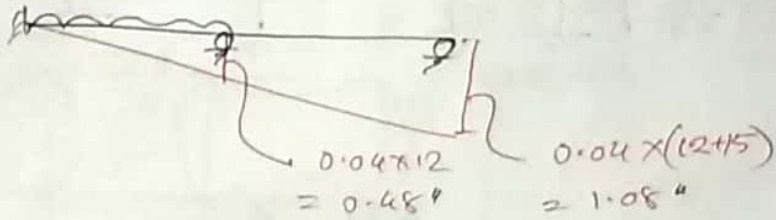
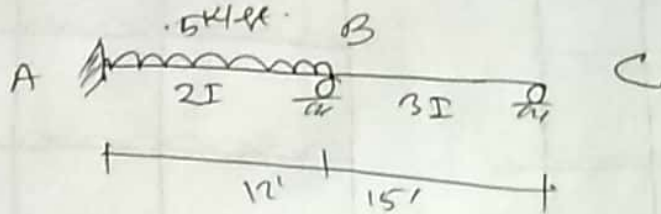
$$\Rightarrow 0 = -\frac{31.25}{EI} + \frac{10}{6EI} R_1$$

$$\Rightarrow R_1 = 18.75$$

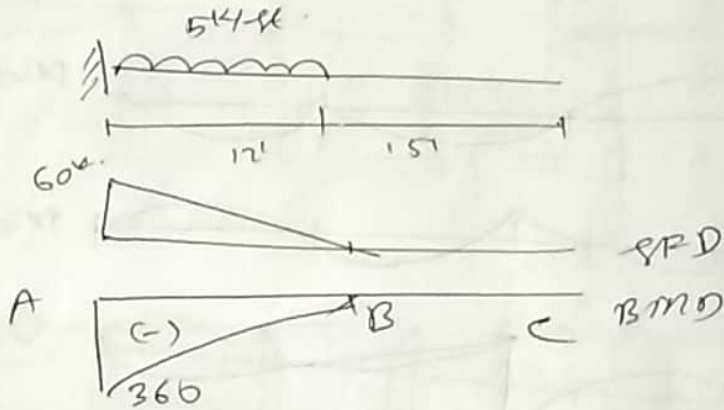


Beam + Composite

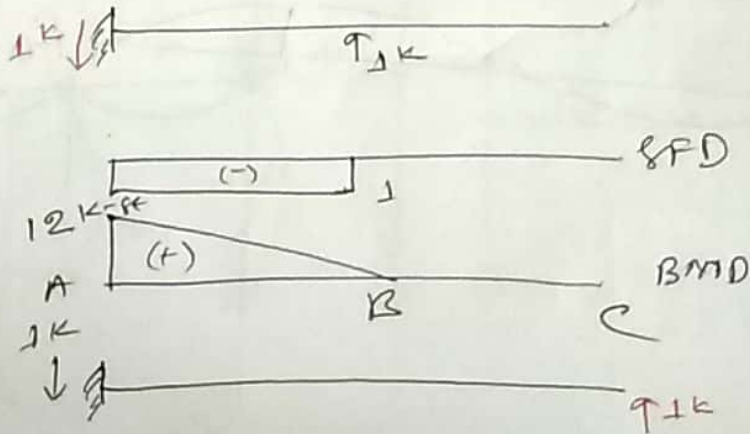
203-4
⑥



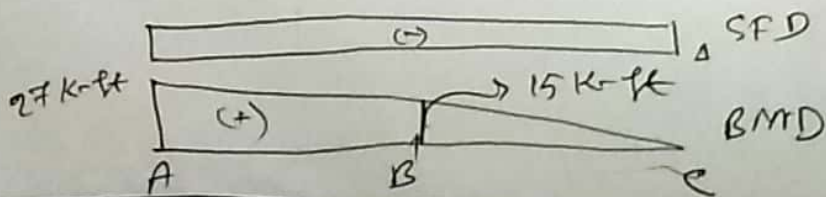
m0



m1



m2



$$\Delta_{01} = \int \frac{m_0 m_1}{EI} dx$$

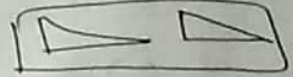
$$EI = 5000$$

$$2EI = 10000 \rightarrow AB$$

$$3EI = 15000 \rightarrow BC$$

$$= \frac{1}{4} \times (-360) \times (12) \times 12 \times \frac{1}{2EI} = \frac{1}{4} \text{ mm}'L \cdot \frac{1}{EI}$$

$$= \frac{-12960}{10000} = -1.296$$



$$\Delta_{02} = \int \frac{m_0 m_2}{EI} dx$$

$$= \frac{1}{12} (-360) \times (15 + 3 \times 27) \times 12 \times \frac{1}{2EI}$$

$$= -3.456$$



$$\delta_{11} = \int \frac{m_1^2}{EI} dx$$

$$= \frac{1}{3} \times 12 \times 12 \times 12 \times \frac{1}{2EI} = 0.0576$$

$$\delta_{12} = \delta_{21} = \int \frac{m_1 m_2}{EI} dx$$

$$= \frac{1}{6} \times 12 \times (15 + 2 \times 27) \times 12 \times \frac{1}{2EI}$$

$$= 0.1656$$

$$\delta_{22} = \int \frac{m_2^2}{EI} dx$$

$$= \left\{ \frac{1}{6} \times 27 (2 \times 27 + 15) + \frac{1}{6} \times 15 \times (2 \times (15 + 27))^2 \right\} \times 12 \times$$

$$+ \frac{1}{3} \times 15 \times 15 \times 15 \times \frac{1}{3EI}$$

$$= 0.5436 + 0.075 = 0.6186$$

$$\Delta_{15} = -\frac{0.48}{12} = -0.04'$$

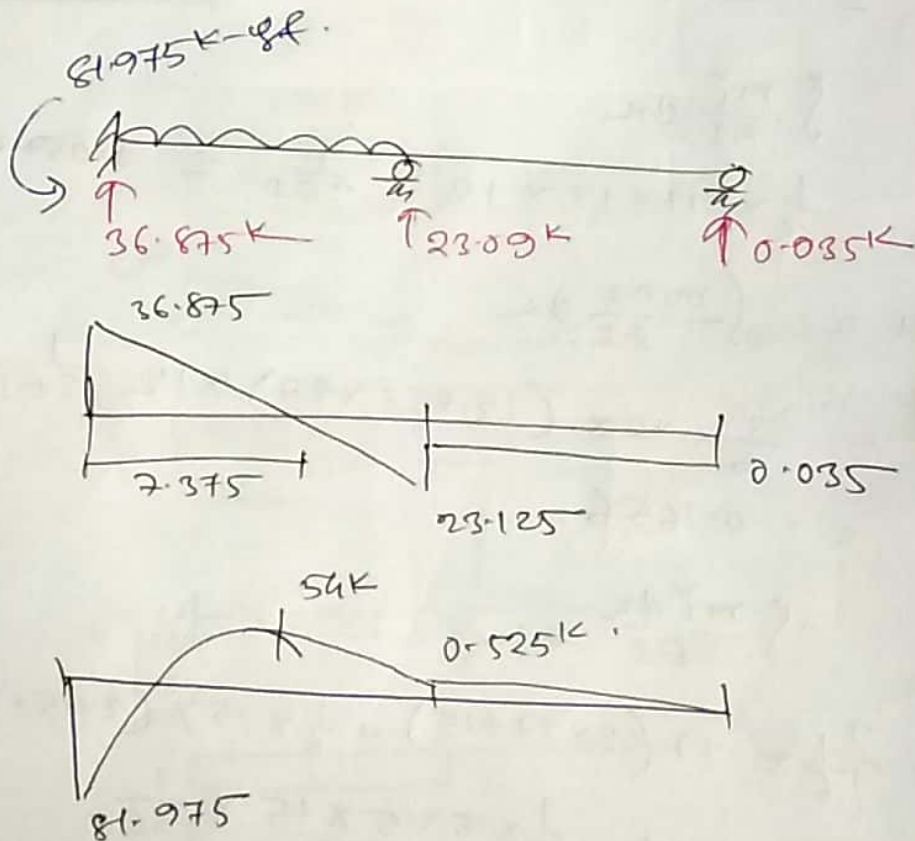
$$\Delta_{25} = -\frac{1.08''}{12} = -0.09'$$

$$\begin{pmatrix} \Delta_1 \\ \Delta_2 \end{pmatrix} = \begin{pmatrix} \Delta_{01} \\ \Delta_{02} \end{pmatrix} + \begin{pmatrix} \delta_{11} & \delta_{12} \\ \delta_{21} & \delta_{22} \end{pmatrix} \begin{pmatrix} R_1 \\ R_2 \end{pmatrix}$$

$$\Rightarrow \begin{pmatrix} 0 \\ 0.3 \end{pmatrix} = \begin{pmatrix} -1.296 - 0.04 \\ -3.456 - 0.09 \end{pmatrix} + \begin{pmatrix} 0.0576 & 0.1656 \\ 0.1656 & 0.6186 \end{pmatrix} \begin{pmatrix} R_1 \\ R_2 \end{pmatrix}$$

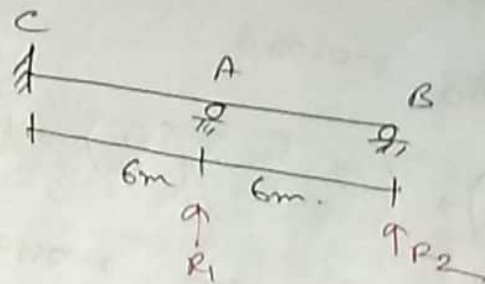
$$\Rightarrow R_1 = 23.09 \text{ K}$$

$$R_2 = 0.035 \text{ K}$$



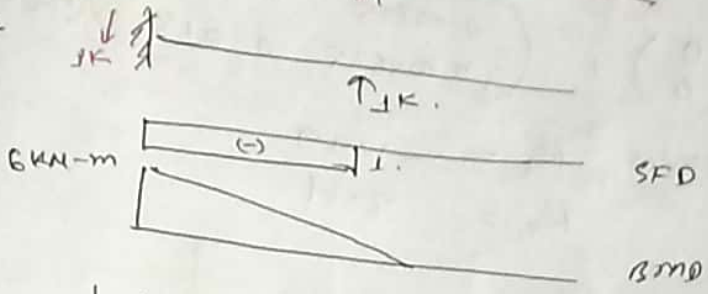
2012-13

60

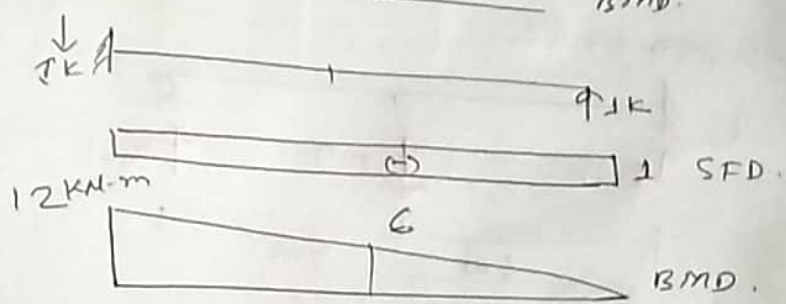


$E = 200 \times 10^6 \text{ KN/m}^2$
 $I = 160 \times 10^{-6} \text{ m}^4$
 $DOI = (3+1+1) - 3 = 2$

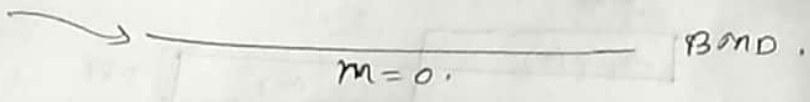
m1



m2



m0



$$\Delta_{01} = \int \frac{m_0 m_1}{EI} dx = 0$$

$$\Delta_{02} = \int \frac{m_0 m_2}{EI} dx = 0$$

$$\delta_{11} = \frac{1}{3} \times 6 \times 6 \times 6 \times \frac{1}{EI} = \frac{72}{200 \times 160} = 0.00225$$

$$\delta_{12} \delta_{21} = \frac{1}{6} \times 6 \times (2 \times 12 + 6) \times 6 \times \frac{1}{EI} = \int \frac{m_1 m_2}{EI} dx = 0.005625$$

$$\delta_{22} = \int \frac{m_2^2}{EI} dx = \int \frac{1}{3} \times 12 \times 12 \times 12 \times \frac{1}{EI} = 0.018$$

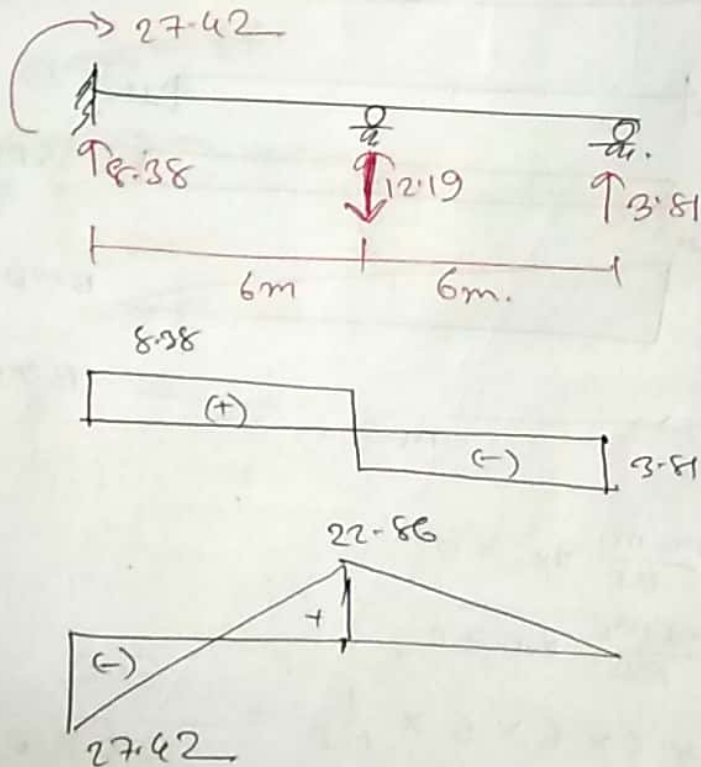
$$\Delta_1 = 6 \text{ mm } (\downarrow)$$

$$= -\frac{6}{1000} = -0.006$$

$$\begin{pmatrix} \Delta_{01} \\ \Delta_{02} \end{pmatrix} + \begin{pmatrix} \delta_{11} & \delta_{12} \\ \delta_{21} & \delta_{22} \end{pmatrix} \begin{pmatrix} R_1 \\ R_2 \end{pmatrix} = \begin{pmatrix} \Delta_1 \\ \Delta_2 \end{pmatrix}$$

$$\Rightarrow \begin{pmatrix} 0 \\ 0 \end{pmatrix} + \begin{pmatrix} 0.00225 & 0.005625 \\ 0.005625 & 0.018 \end{pmatrix} \begin{pmatrix} R_1 \\ R_2 \end{pmatrix} = \begin{pmatrix} -0.006 \\ 0 \end{pmatrix}$$

$$\Rightarrow \begin{aligned} R_1 &= -12.19 \\ R_2 &= 3.81 \end{aligned}$$

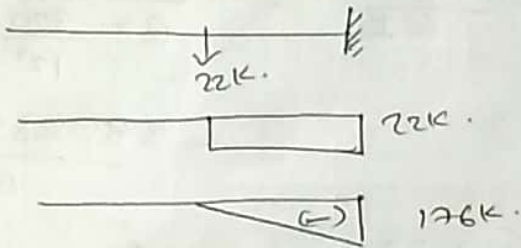
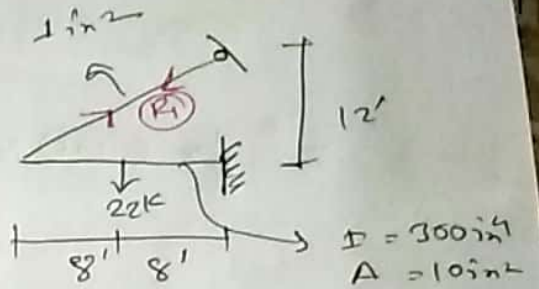


Composite beam

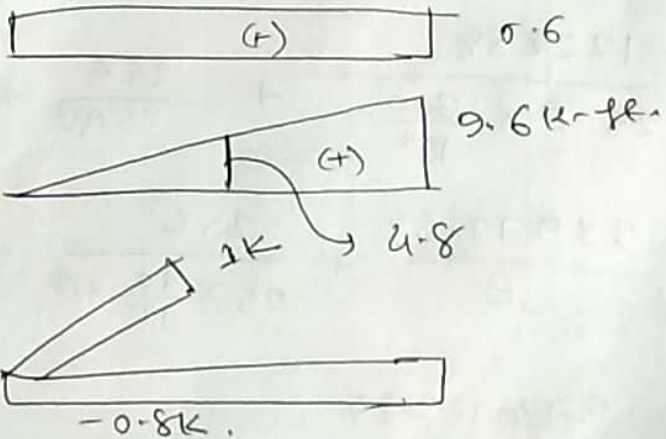
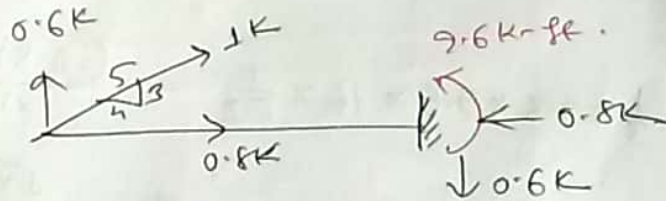
2012-13 7(a)

$$DOF = (3+1) - 3 = 1^{\circ}$$

no/no



mi ni



$$\Delta_{01} = \int \frac{m_0 m_1 dx}{EI} + \sum \frac{n_0 n_1}{AE} L$$

$$= \frac{1}{6} \times (-176) \times (2 \times 9.6 + 4.8) \times 8 \times \frac{1}{EI}$$

$$+ 0.$$

$$= -\frac{5632}{EI} = -\frac{5632}{E \times \frac{300}{12^4}}$$

$$= -\frac{389283.84}{E}$$

$$\delta_{11} = \int \frac{m_1^2 dx}{EI} + \sum \frac{n_1^2 L}{AE}$$

$$= \frac{1}{3} \times 9.6 \times 9.6 \times 16 \times \frac{1}{EI} + \frac{(-0.8)^2 \times 16}{AE}$$

$$+ \frac{1^2 \times 20}{AE} \rightarrow \text{inclined length.}$$

$$= \frac{12288}{25 E \times \frac{300}{12^4}} + \frac{256}{25 AE} + \frac{20}{AE}$$

$$= \frac{33973.86}{E} + \frac{256}{25 \times \frac{10}{12^2} \times E} + \frac{20}{\frac{1}{12^2} \times E}$$

$$= \frac{37001.3184}{E}$$

$$\Delta_1 = \Delta_{01} + \delta_{11} R_1$$

$$2) \quad 0 = - \frac{389283.89}{E} + \frac{37001.3189}{E} R_1$$

$$2) \quad \boxed{R_1 = 10.52 \text{ k}}$$