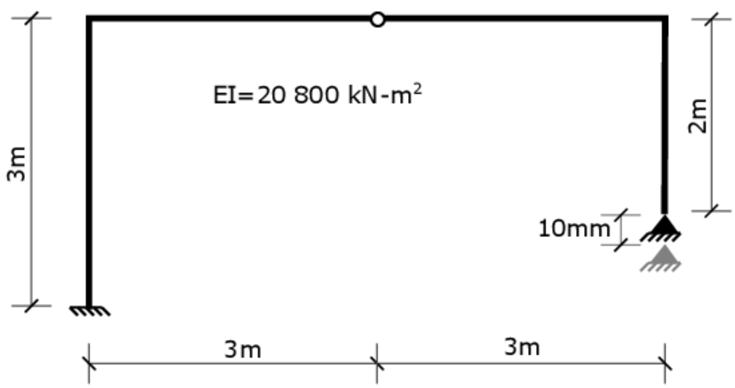
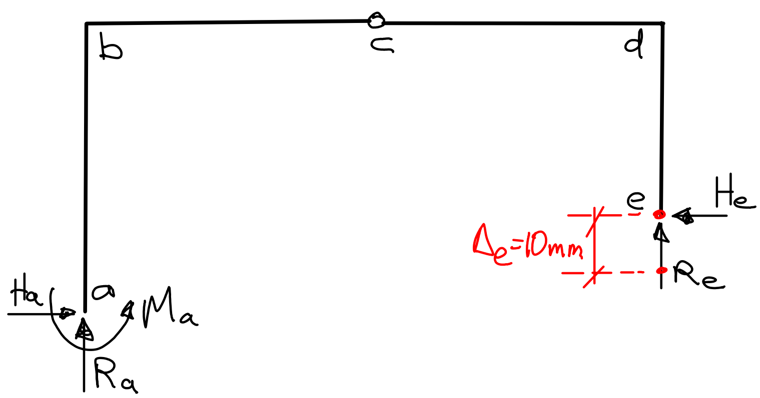
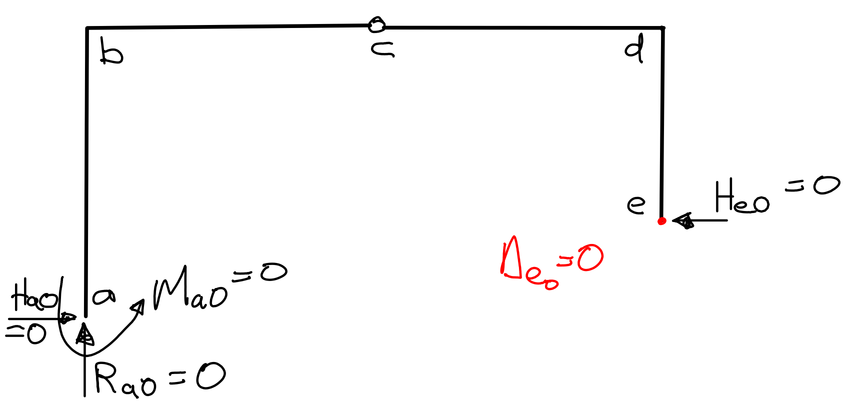


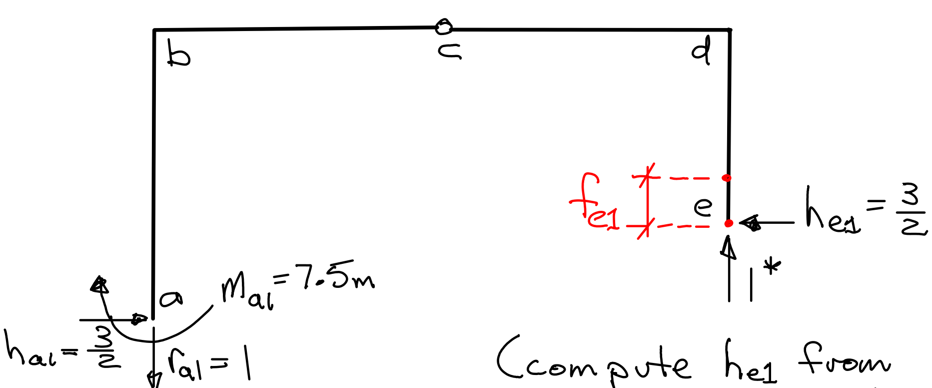


Real System

Must choose R_e as redundant (otherwise, calculating displacements will be much more difficult).



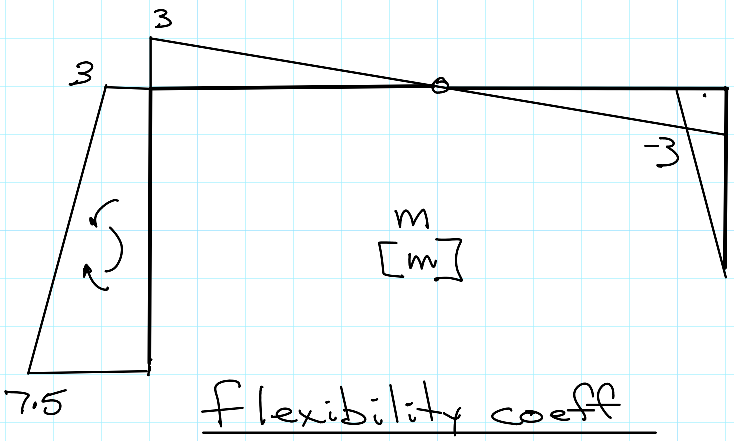
Primary System



(compute h_{e1} from FBD of c-d-e)

Unit Redundant (placed in the direction of assummed R_e above) (yes, I know its a questionable assumption)

This establishes upward displacements as +ive.

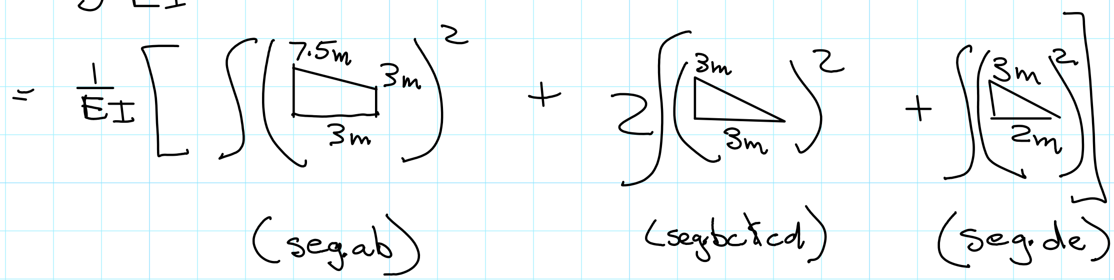


moment due to unit redundant

flexibility coeff

(displ. due to unit redundant)

$$f_{e1} = \int \frac{mm}{EI}$$



$$= \frac{1}{EI}\left[\frac{3m}{6}\left[7.5m(2\times7.5m+3m) + 3m(7.5m+2\times3m)\right] + 2\times\frac{3m}{3}\times3m\times3m + \frac{2m}{3}\times3m\times3m\right]$$

$$= \frac{120.75\ m^3}{EI}$$

Compatibility: Real System = Primary System + R_e × Unit Redundant

Vert. displacement @ e

$$\Delta_e = \Delta_{eo} + R_e f_{e1}$$

$$-0.01m = 0 + R_e \frac{120.75m^3}{EI}$$

(Δ_e -ive because +ive ↑ - see prev. page)

$$R_e = -82.82\times10^{-6}\ \frac{EI}{m^2}$$

$$= -82.82\times10^{-6}\times 20\,800\ \frac{kN-m^2}{m^2}$$

$$\underline{\underline{R_e = -1.72\ kN}} \quad (\therefore \downarrow)$$

Superposition

$H_a = H_{a0} + R_e h_{a1} = 0 + -1.72 \times \frac{3}{2} = -2.58\text{ kN} \; (\therefore \leftarrow)$

$R_a = R_{a0} - R_e r_{a1} = 0 - -1.72 \times 1 = 1.72\text{ kN} \; (\therefore \uparrow)$

$M_a = M_{a0} - R_e m_{a1} = 0 - -1.72 \times 7.5 = 12.9\text{ kNm} \; (\therefore \circlearrowleft)$

$H_e = H_{e0} + R_e h_{e1} = 0 + -1.72 \times \frac{3}{2} = -2.58\text{ kN} \; (\therefore \rightarrow)$

$M_{ba} = M_{bc} = -R_e \times 3 = -1.72 \times 3 = -5.16\text{ kN m}$

$M_{dc} = M_{de} = -R_e \times -3 = 5.16\text{ kN-m}$