Rigid Body Displacements in Frames

Draw I.L. for
horizontal reaction
at a.

4m

3m

6m

4m

c 0.706
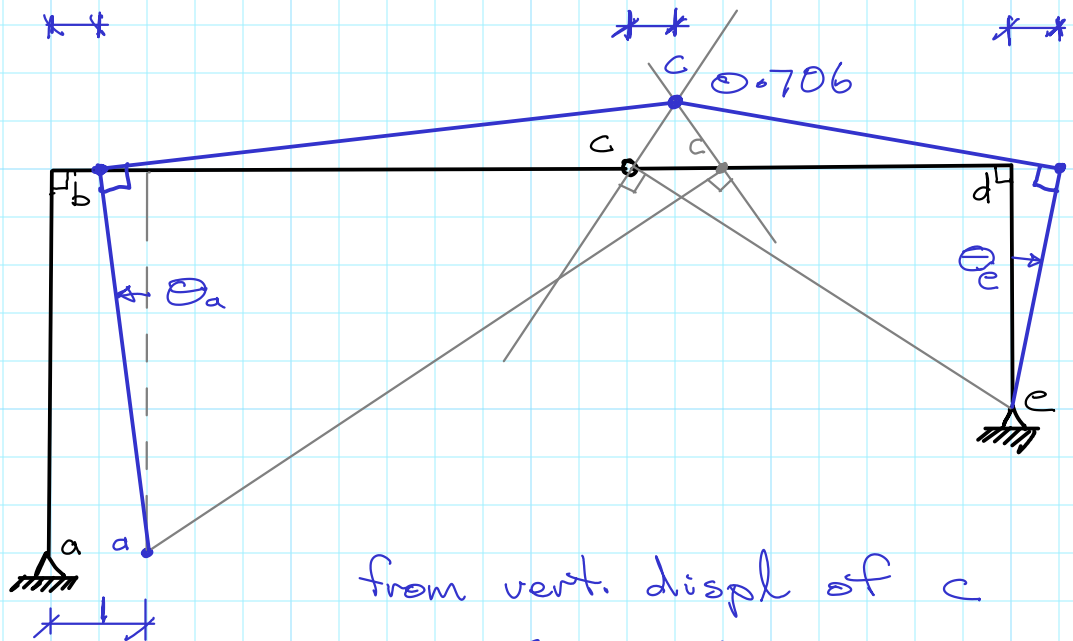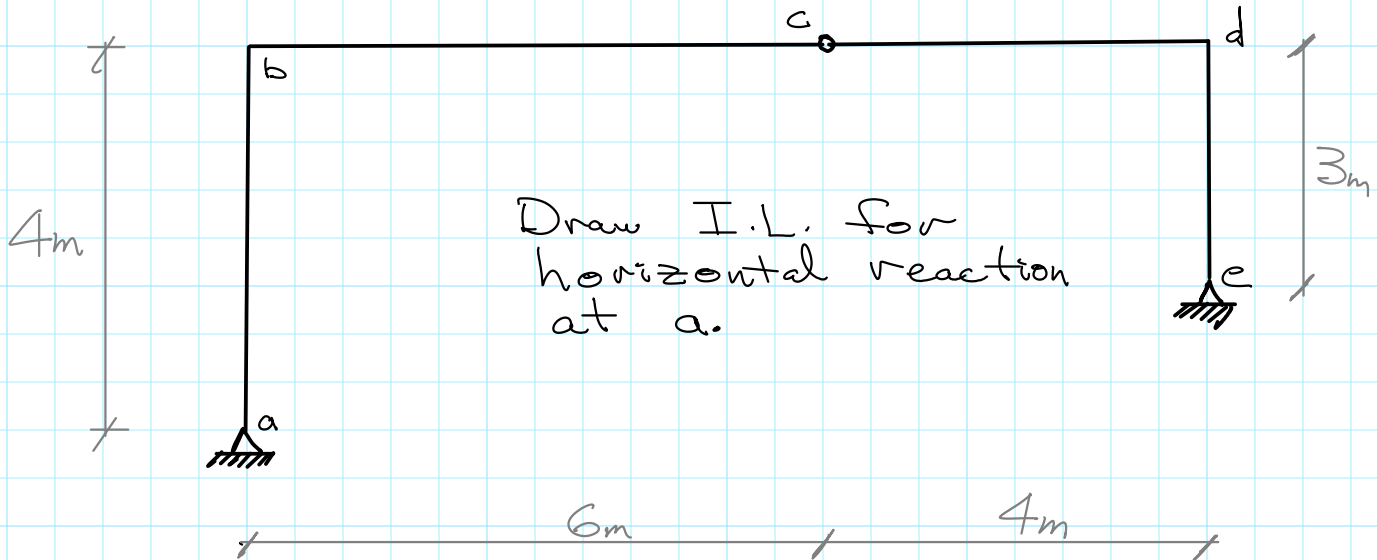
from vert. displ of c

$$6\theta_a = 4\theta_e$$

$$\theta_e = 1.5\theta_a$$

from horiz. displ of b & d

$$1 - 4\theta_a = 3\theta_e$$
$$1 - 4\theta_a = 4.5\theta_a$$
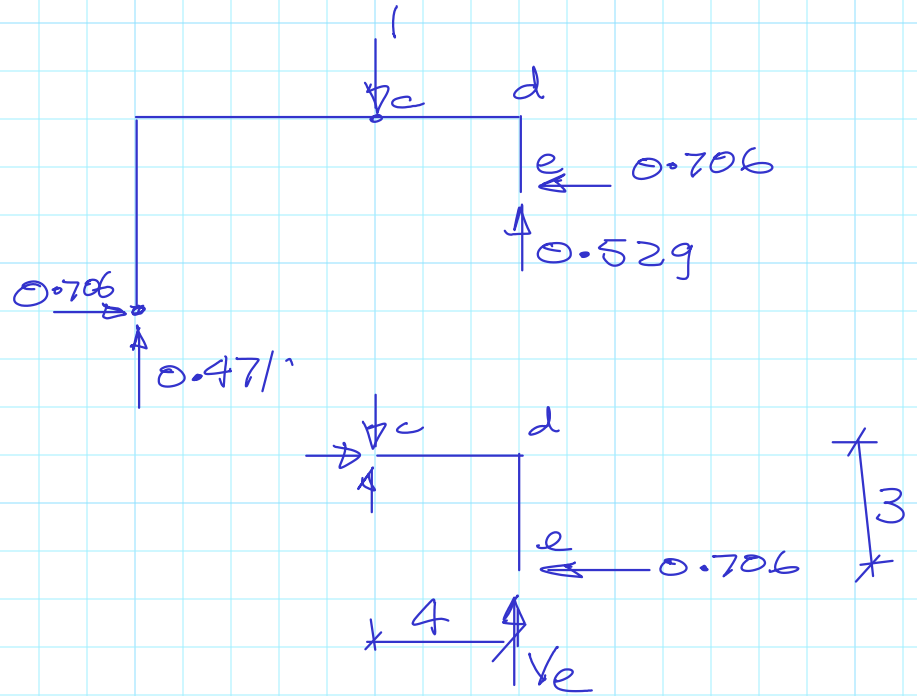$$8.5\theta_a = 1$$
$$\theta_a = \frac{1}{8.5}$$

vert. displ. of c

$$= 6\theta_a = \frac{6}{8.5}$$

$$= 0.706$$

Therefore — a vertical unit
load placed @ hinge c
will result in a horizontal
reaction of 0.706 at 'a'
(and 'e')

Check:

$$V_e = \frac{3 \times 0.706}{4} = 0.529$$

Check ΣM_a entire frame ↻

$$-1 \times 6 + 0.706 \times 1 + 0.529 \times 10$$
$$= -.004 \approx 0 \qquad OK$$

Equilibrium is satisfied.
I.L. ordinate is correct.