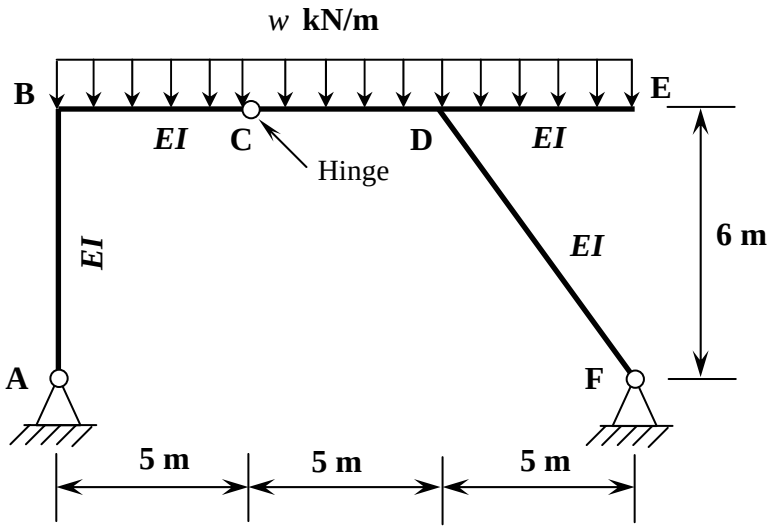
DEPARTMENT OF CIVIL ENGINEERING

CE-222 STRUCTURAL MECHANICS I

Quiz-2 28/3/11

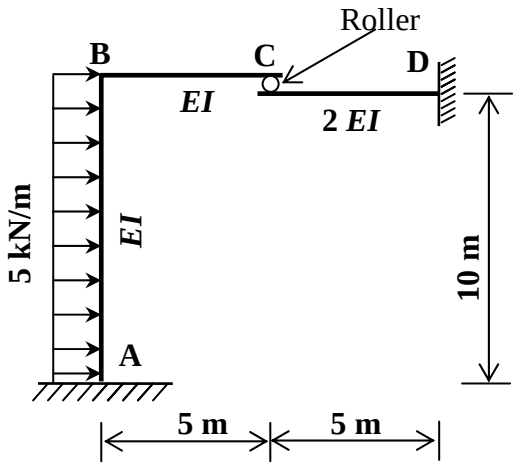
Problem 1

Determine the **rotation at *C* just to the right of the hinge** for the frame in **Fig. 1**, by using Castigliano's theorem only.

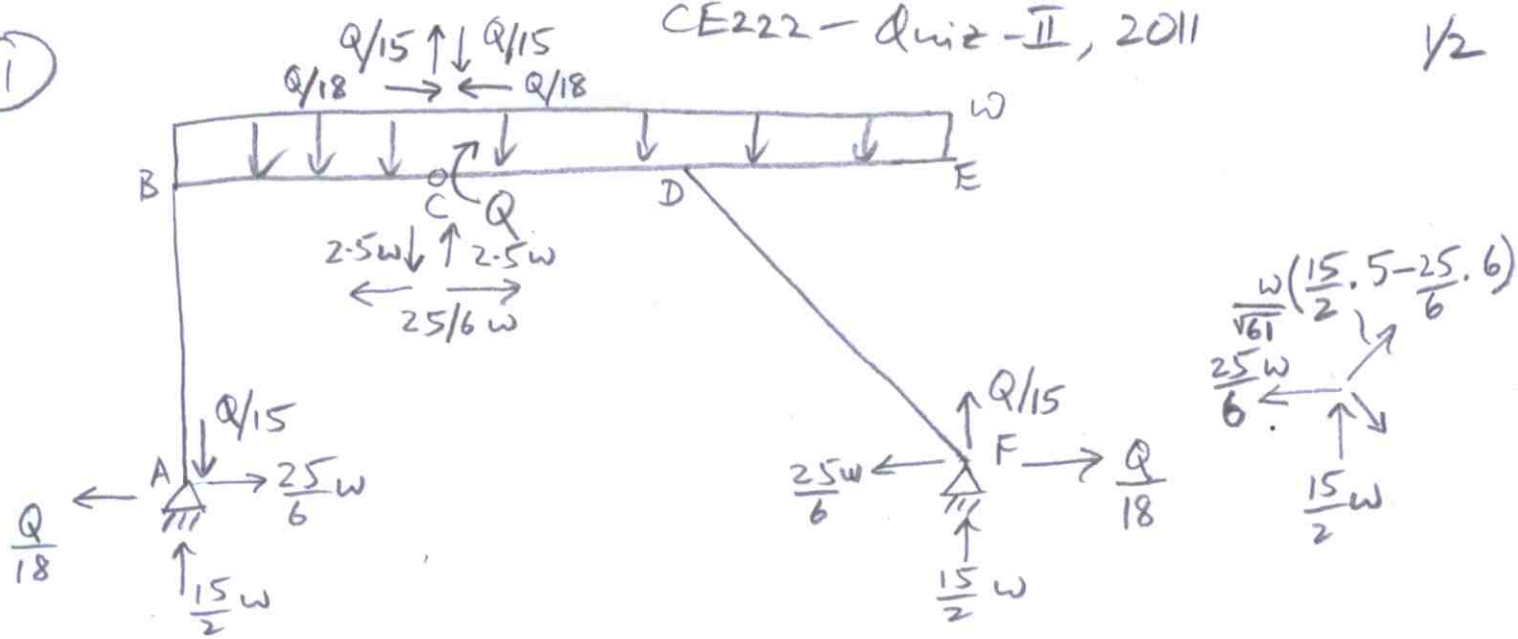


Problem 2

Determine the **support reactions** for the structure in **Fig. 2** by using the flexibility method only.



(1)



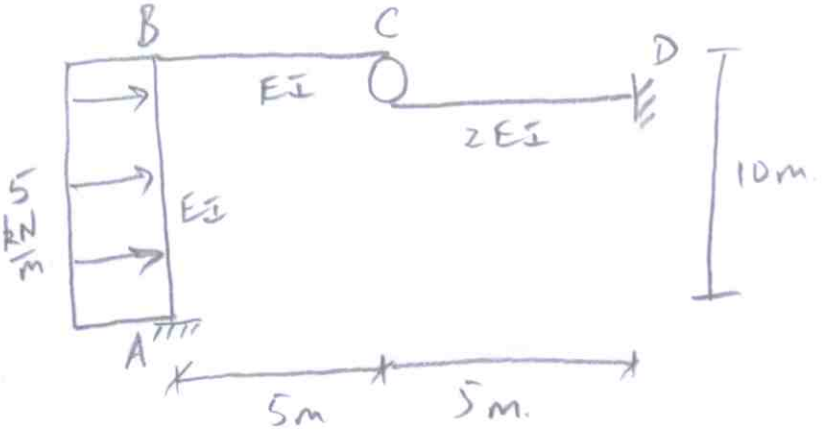
$$A_x \cdot 6 + w \cdot \frac{5^2}{2} - \frac{15w}{2} \cdot 5 = 0 \Rightarrow A_x = \frac{25}{6} w$$

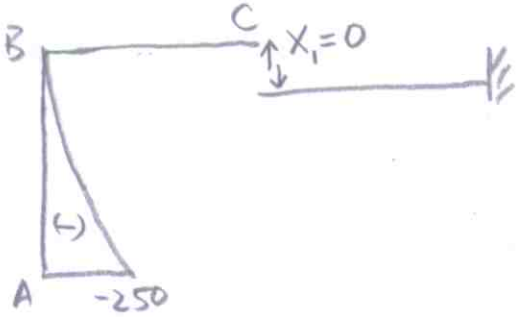
		$\frac{\partial M}{\partial Q}$
$M = -\frac{25}{6} wx + \frac{Q}{18} x$	, AB ,	$= \frac{x}{18}$
$= -2.5wx - w\frac{x^2}{2} + \frac{Q}{15} x$	, CB ,	$= \frac{x}{15}$
$= 2.5wx - w\frac{x^2}{2} - \frac{Q}{15} x + Q$	, CD ,	$= 1 - \frac{x}{15}$
$= -\frac{wx^2}{2}$	, ED ,	$= 0$
$= \frac{12.5wx}{\sqrt{61}} + \frac{2}{3}\frac{Q}{\sqrt{61}} x$	, FD ,	$= \frac{2}{3\sqrt{61}} x$

$$\theta_{C+} = \int M \frac{\partial M}{\partial Q} \frac{1}{EI} \Big|_{Q=0} dx = \frac{1}{EI}\Bigg[\int_0^6 \left(-\frac{25}{6} w \frac{x^2}{18}\right) dx + \int_0^5 \left(-\frac{2.5}{15} wx^2 - \frac{wx^3}{30}\right) dx + \int_0^5 \left(2.5wx - 2.5w\frac{x^2}{15} - \frac{wx^3}{2} + \frac{wx^3}{30}\right) dx + \int_0^{\sqrt{61}} \frac{25wx^2}{3 \cdot 61} dx \Bigg]$$

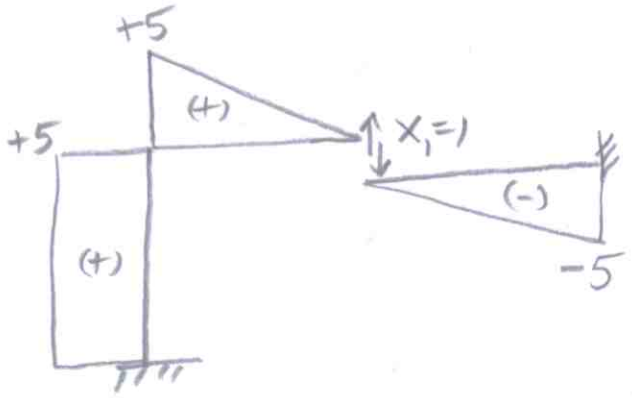
$$= \frac{w}{EI}\Bigg[-\frac{25}{6} \cdot \frac{1}{18} \cdot \frac{6^3}{3} - \frac{2.5}{15} \cdot \frac{5^3}{3} - \frac{1}{30} \cdot \frac{5^4}{4} + 2.5 \cdot \frac{5^2}{2} - \frac{2.5}{15} \cdot \frac{5^3}{3} - \frac{1}{2} \cdot \frac{5^3}{3} + \frac{1}{30} \cdot \frac{5^4}{4} + \frac{25}{3 \times 61} \cdot \frac{61\sqrt{61}}{3} \Bigg] = \frac{1.5562}{EI} w \blacktriangleleft$$

(2)





BM, applied load, $X_1 = 0$



BM, $X_1 = 1$ only, no appl loads

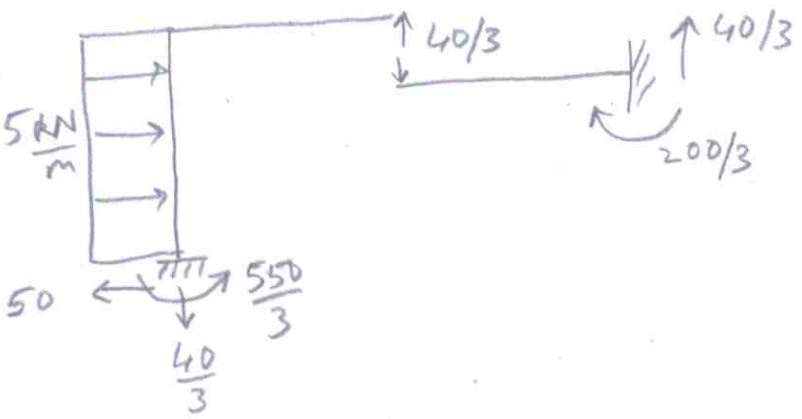
Δ_{10} = gap at C (measured ↑↓ +ve) due to applied loads only

$$= \left(\frac{2}{3}.250.5.10 - 250.5.10\right)\frac{1}{EI} = \frac{-12500}{3}$$

f_{11} = overlap at C (measured ↑↓ +ve) due to $X_1 = 1$ only

$$= \left(5.5.10 + \frac{1}{3}.5.5.5 + \frac{1}{3}.5.5.5.\frac{1}{2}\right).\frac{1}{EI} = \frac{312.5}{EI}$$

$$\Delta_{10} + X_1 f_{11} = 0 \Rightarrow X_1 = \frac{40}{3}\ kN$$



◀ Reactions at supports