DEPARTMENT OF CIVIL ENGINEERING

CE-222 STRUCTURAL MECHANICS I

Quiz-1 2/2/11

Problem 1

Draw the Axial Force, Shear Force, and Bending Moment Diagram for the frame shown in **Fig. 1.** Then, use this to sketch the Qualitative Deflected Shape.

Problem 2

The truss-beam bridge structure shown in **Fig. 2** comprises truss ***AGHBJI*** and three members ***BCD***, ***DF***, and ***CE***. The truss is connected to member ***BCD***. Members ***BCD*** and ***CE*** are connected by a pin/hinge at ***C***. Members ***BCD*** and ***DF*** are connected by a pin/hinge at ***D***. The load train shown passes over the bridge. Find:

(i) the maximum compressive force in member ***EC***

(ii) the maximum bending moment at ***C*** in member ***BCD***

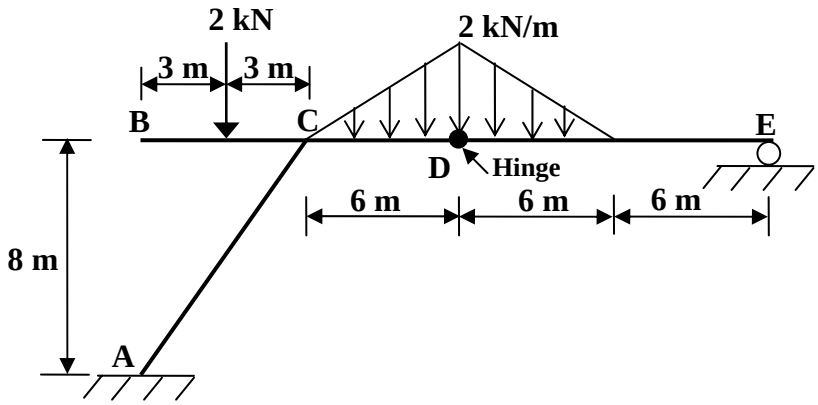

Figure 1

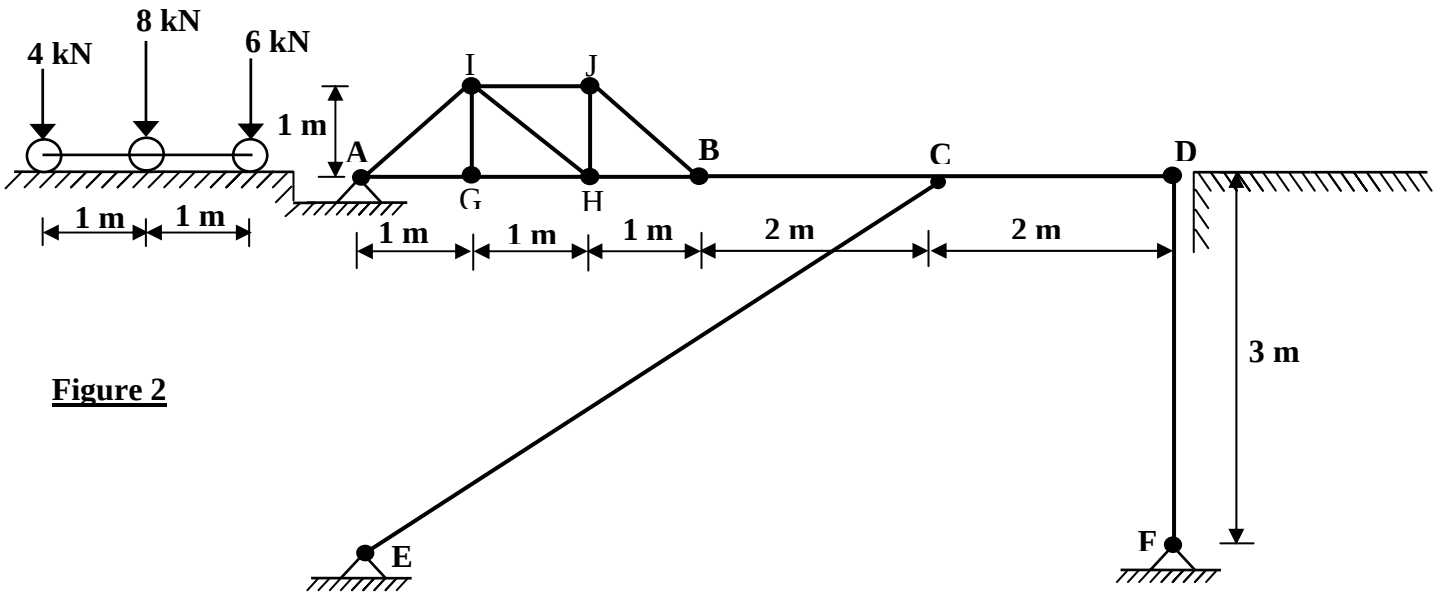

Figure 2

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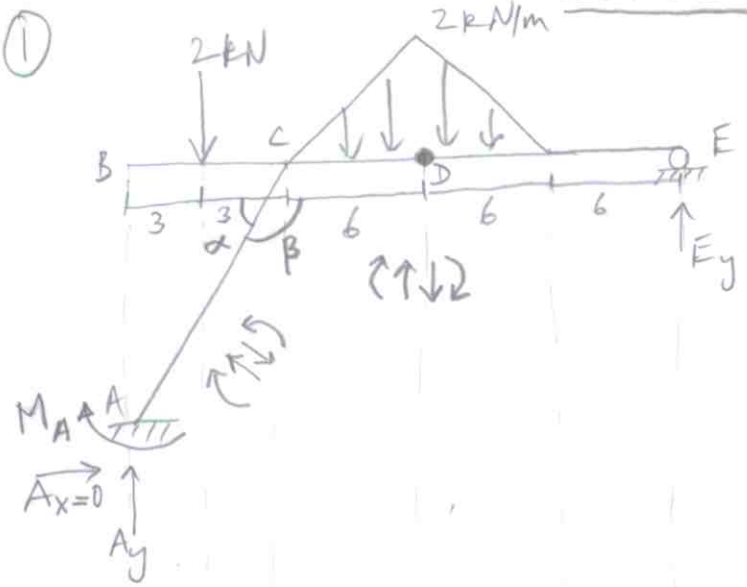
(1) (1)



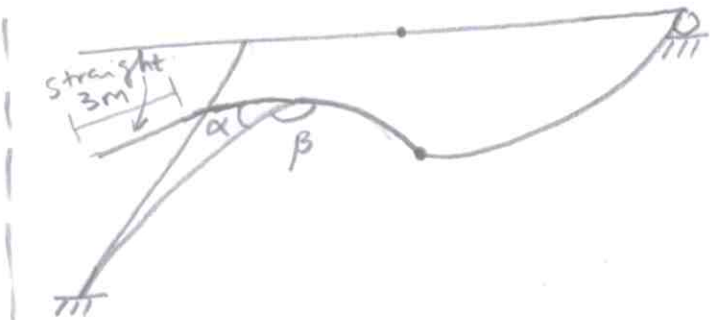
$\Sigma M_D = 0 \Rightarrow E_y = \frac{\frac{1}{2}.6.2.2}{12} = 1\ kN$

$\Rightarrow A_y = 2 + \frac{1}{2}.12.2 - 1 = 13\ kN$

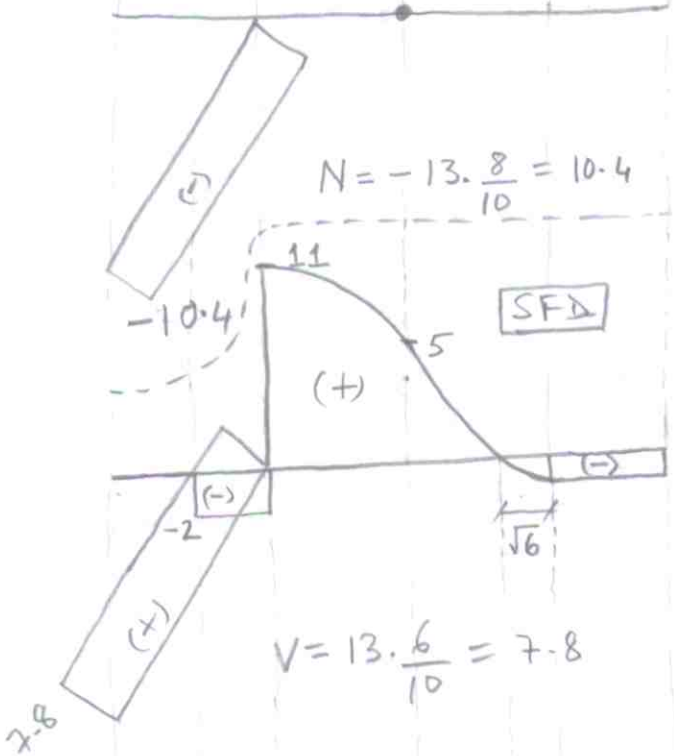
$M_A = -(2.3 + \frac{1}{2}.12.2.12 - 1.24)$

$= 126\ kN.m.$

DEFL SHAPE



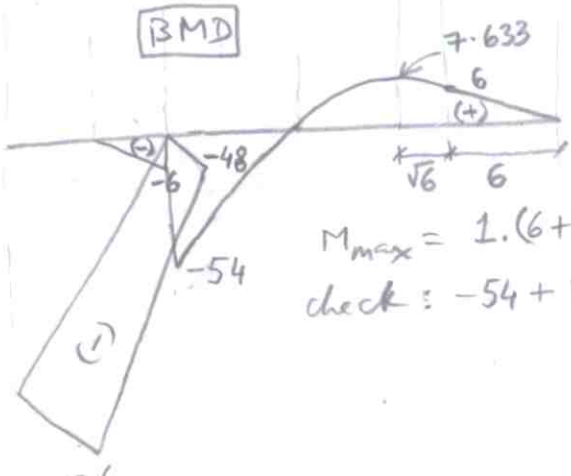
AFD



$\Leftarrow \frac{1}{2}x.\frac{1}{3}x = 1 \Rightarrow x = \sqrt{6} = 2.45$

$V = 13.\frac{6}{10} = 7.8$

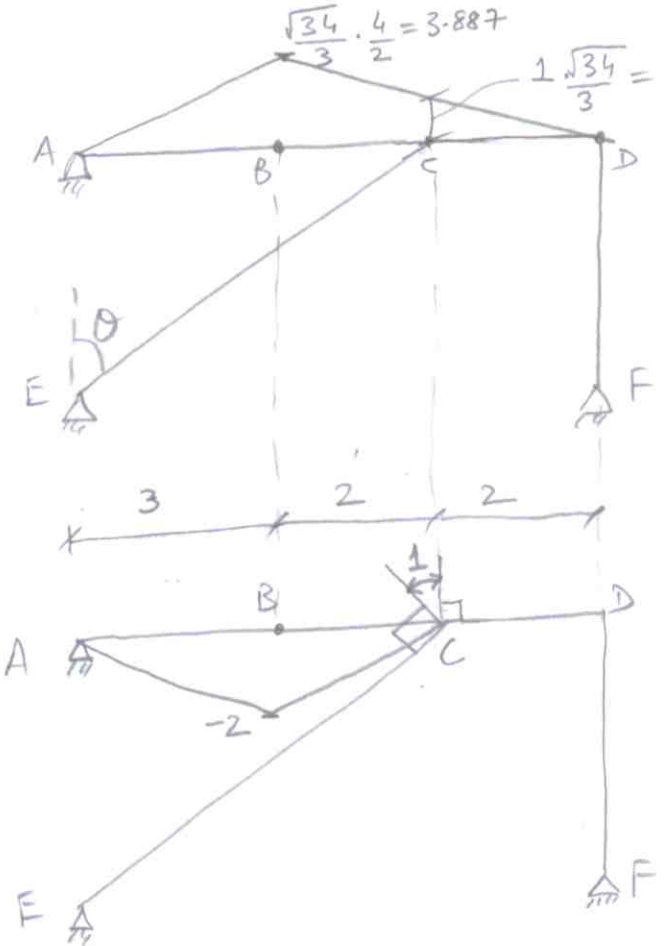
BMD



$M_{max} = 1.(6+\sqrt{6}) - \frac{1}{2}.\sqrt{6}.\frac{\sqrt{6}}{3}.\frac{\sqrt{6}}{3} = 7.633$

check: $-54 + 11.6 - \frac{1}{2}.2.6.\frac{1}{3}.6 = 0$ (at hinge)

(2)



IL – EC (compressive)

Best to use Muller Breslau. Release EC (≡ releasing its vertical component) and give unit (1) displ in vertical direction. Then IL-EC at C $= \frac{1}{\cos\theta} = \frac{\sqrt{34}}{3}$ (maintain support at A, D)

IL – M_c in BCD

Best to use Muller Breslau. Create hinge at C, give unit rotational displ, maintain support at A, C, D.

$(EC)_{max}$ when 8kN at B, train moving rightward so that 6kN on shallower slope

$$(EC)_{max} = \frac{\sqrt{34}}{3}\cdot\frac{4}{2}\left(8+6\cdot\frac{3}{4}+4\cdot\frac{2}{3}\right) = 58.96\,kN \blacktriangleleft$$

$(M_c)_{max}$ in BCD when 8kN at B, train moving leftward so that 6kN on shallower slope

$$(M_c)_{max \text{ in BCD}} = -2\left(8+6\cdot\frac{2}{3}+4\cdot\frac{1}{2}\right) = -28\,kN. \blacktriangleleft$$