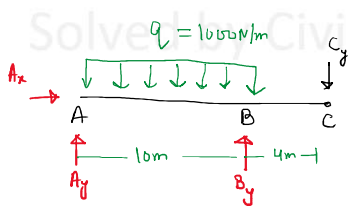
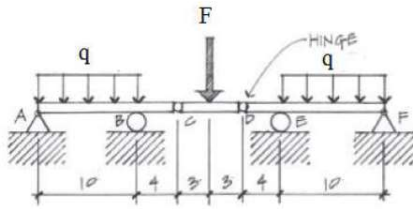
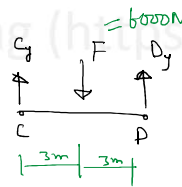


Shear and Moment Diagrams:

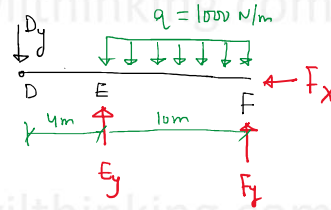
5. A compound beam with internal hinges is loaded as shown. Draw the load, shear, and moment diagrams of the figure show. $F=6000\text{N}$, $q=1000\text{N/m}$.



Part-1



Part-2



Part-3

$$\sum F_x = 0 \Rightarrow A_x = 0$$

$$\sum M_A = 0 :$$

$$-(C_y \times 14) + (B_y \times 10) - \left(q \times 10 \times \frac{10}{2} \right) = 0$$

$$C_y = 3000 \text{ N}$$

$$\Rightarrow -(3000 \times 14) + (B_y \times 10) - \left(1000 \times \frac{100}{2} \right) = 0$$

$$\Rightarrow B_y = (100 \times 50) + (3000 \times 14) = 9200 \text{ N}$$

$$\Rightarrow B_y = 9200 \text{ N}$$

\Downarrow
CD is symmetric

$$\Downarrow$$

$$C_y = D_y = \frac{F}{2} = \frac{6000}{2}$$

$$\Rightarrow C_y = D_y = 3000 \text{ N}$$

\Downarrow
Part-3 and Part-1 are similar

$$\Downarrow$$

$$F_x = A_x = 0$$

$$F_y = A_y = 800 \text{ N}$$

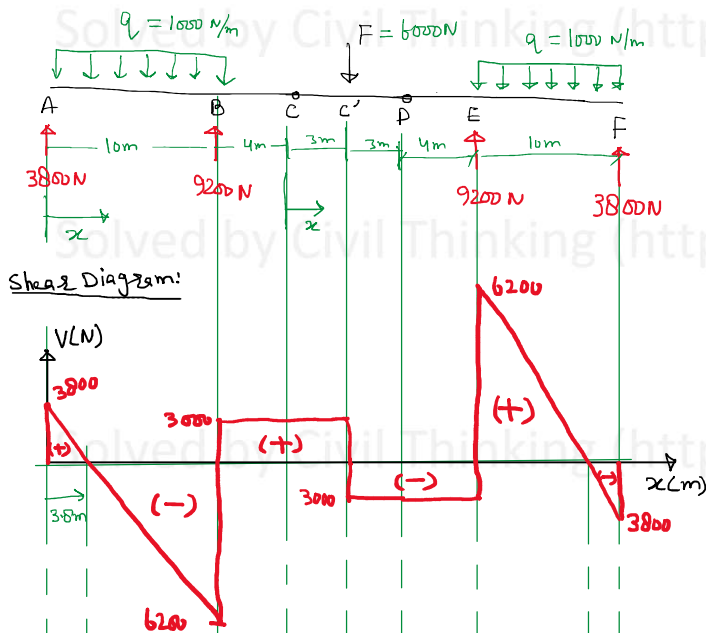
$$E_y = B_y = 9200 \text{ N}$$

$$\sum F_y = 0 :$$

$$A_y + B_y - (10q) - C_y = 0$$

$$\Rightarrow A_y = (10 \times 1000) - 9200 + 3000 \text{ N}$$

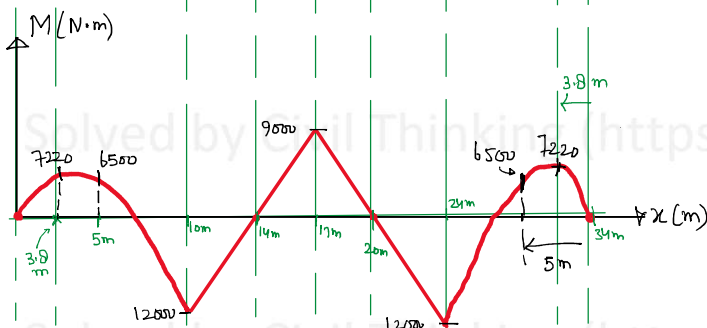
$$\Rightarrow A_y = 3800 \text{ N}$$



Shear Forces:

- $V_A = 3800$
- $V_B = 3800 - (1000 \times 10) = -6200$
- Zero Shear Force location between A and B:
 $V_x = 0$:
 $\Rightarrow 3800 - 1000x = 0 \Rightarrow x = 3.8 \text{ m}$
- $V_{B+} = V_B + 9200 = -6200 + 9200 = 3000 \text{ N}$
- $V_C = V_{B+} = 3000 \text{ N}$
- $V_{C-} = V_C - 6000 = 3000 - 6000 = -3000$
- $V_D = -3000$; $V_E = 6200$; $V_F = -3800$
- [∵ D, E, F are mirror images of C, B, A respectively]

Moment Diagram:



Moments:

- $M_A = M_F = 0$ [Hinge supports]
- $M_C = M_D = 0$ [internal Hinges]
- In AB:
 $M_x = 3800 \times x - (q \frac{x^2}{2})$ [parabolic]
 $\Rightarrow M_{5m} = 3800 \times 5 - (1000 \times \frac{5^2}{2}) = 6500 \text{ N.m}$
 $\Rightarrow M_{3.8m} = 3800 \times 3.8 - (1000 \times \frac{3.8^2}{2}) = 7220 \text{ N.m}$
- In BC:
 $M_B = (3800 \times 10) - (q \times 10 \times \frac{10}{2}) = -12000 \text{ N.m}$
 $M_C = 3800 \times (10 + 4) - (q \times 10 \times (\frac{10}{2} + 4)) + (9200 \times 4) = 0$
- In CD:
 $M_{max} = \frac{FL}{4} = \frac{6000 \times 6}{4} = 9000 \text{ N.m}$
- In EF:
 Same as AB because EF and AB are symmetric.

This problem was solved by Civil Thinking (<https://civilthinking.com>)

If you need solutions of **Strength of Materials** questions or any other **Civil Engineering** subject questions, contact us at:


solutions@civilthinking.com

Or submit your problem directly here:

 <https://civilthinking.com/getproblemsolutions>

Other Subjects We Cover:

- ☒ Structural Analysis
- ☒ Fluid Mechanics
- ☒ Geotechnical Engineering
- ☒ Transportation Engineering
- ☒ Construction Management
- ☒ Finite Element Analysis (FEA)
- ☒ Engineering Software (ANSYS, ETABS, MATLAB, Revit)

Let us help you solve your engineering challenges! 

NOTE:

The solution provided in this document is the intellectual property of Civil Thinking and is protected by copyright. Any reproduction, distribution, or publication of this content, in whole or in part, is strictly prohibited without prior written permission from <https://civilthinking.com>.