# POORNIMA
## COLLEGE OF ENGINEERING

# TUTORIAL SHEETS

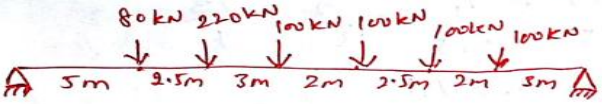
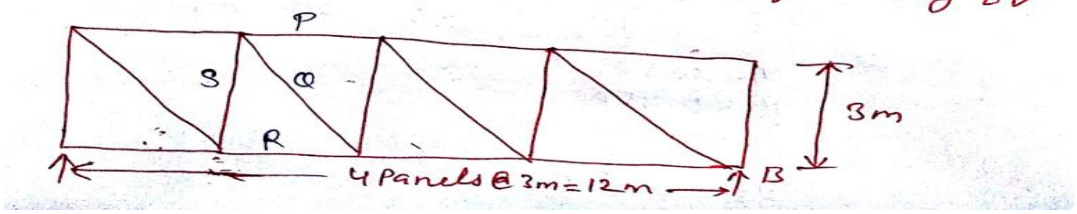
**TUTORIAL SHEET** — **SHEET No. 01**

**Campus: PCE Course: B.Tech** | **Class/Section: III Year** | **Date: 12/02/2019**

**Name of Faculty: Balwan** | **Name of Subject: TOS-II** | **Code: 6CE1A**

**Date of Tut. Sheet Preparation: 10/02/2019** **Scheduled Date of Tut. : 12/02/2019 Actual Date of Tut. : 12/02/2019**

**Name of Student:……..Scheduled & Actual Date of H.A. Submission:……&……**

| | | | |
|---|---|---|---|
| FIRST 20 MT. CLASS QUESTIONS | Q.1 The load system shown in fig moves from right to left on a girder of span 20 m. Find the maxi. shear force at a section 7.5 m from the left end.<br>  | CO 1 | PO 1 |
| 2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS | Q.2 Draw ILD for force in the members P, Q, R, S of truss shown in following fig:-<br>  | CO 2 | PO 2 |
| OTHER IMPORTANT QUESTIONS | **Q. 3**<br>A 3-hinged parabolic arch has a span of 30 m and a central rise of 6 m five wheel loads of 4, 5, 5, 3, 3 KN spaced at 3 m, 2m, 3m, and 2m in order to cross the arch from left to right with the 4 KN load leading. When the leading load is 20 m from the left hinge. Calculate the horizontal thrust in the arch. Also calculate the BM, normal thrust and shear force at the section under tail load. | CO 3 | PO 2 |

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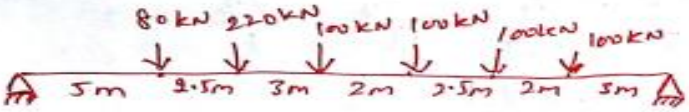
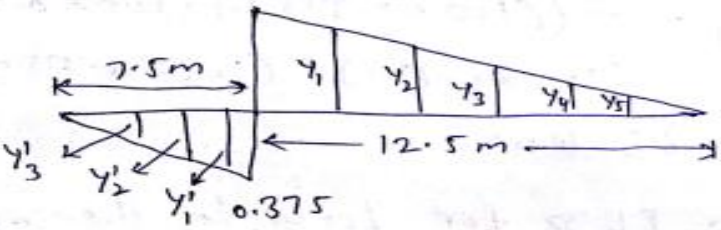
# Q.1 Solution

Q>1 The load system shown in fig moves from right to left on a girder of span 20 m. Find the maxi. shear force at a section 7.5 m from the left end.




Ans:- We need to draw ILD of shear force at that point.




$$\frac{0.625}{12.5} = \frac{y_1}{10} = \frac{y_2}{7} = \frac{y_3}{5} = \frac{y_4}{2.5} = \frac{y_5}{0.5}$$

So $y_1 = 0.50$
$y_2 = 0.350$
$y_3 = 0.250$
$y_4 = 0.125$
$y_5 = 0.025$

So the value of maxi. positive shear force at point C due to moving load set

$$F_{C(+ve)} = (80 \times 0.625) + (220 \times 0.50) + (100 \times 0.35) + (100 \times 0.25) + (100 \times 0.125) + (100 \times 0.025)$$

$$F_{C(+ve)} = 235 \text{ kN}$$

For maxi. Negative S.F. :-

$$\frac{0.375}{7.5} = \frac{y_1}{5.5} = \frac{y_2}{3} = \frac{y_3}{1}$$

So $y_1 = 0.275$
$y_2 = 0.150$
$y_3 = 0.050$

$$F_{C(-ve)} = -((100 \times 0.375) + (100 \times 0.275) + (100 \times 0.150) + (100 \times 0.050))$$

$$F_{C(-ve)} = -85 \text{ kN}$$

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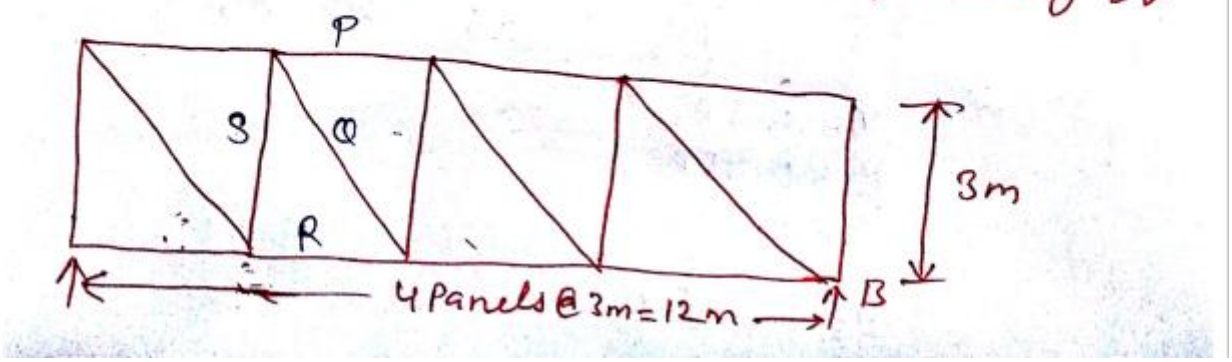
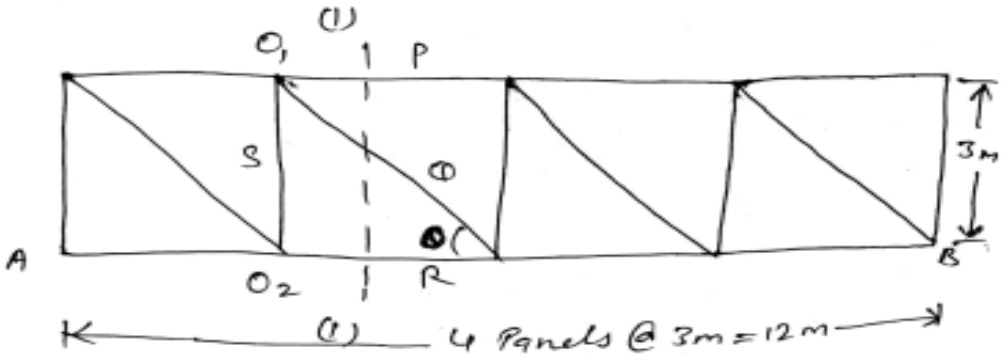
# Q.2 Solution

Q→2 Draw ILD for force in the members P, Q, R, S of truss shown in following fig:-




Ans:-




→ ILD for $P_P$

Take section (1)–(1)

$$P_P = \frac{M_T}{3}$$

$$M_T = \frac{6 \times 6}{12}$$

$$P_P = \frac{6 \times 6}{12 \times 3} = P_P = 1 \text{ (comp.)}$$

→ ILD for $P_Q$ = (S.f. in $O_2T$) / $\sin\theta$

$$\sin\theta = \frac{3}{\sqrt{3^2+3^2}} = \frac{1}{\sqrt{2}}$$

$$\theta = 45^\circ$$

$$P_Q = \frac{3}{12} / \sin 45^\circ$$

$$P_Q = 0.354 \text{ (comp.)}$$

Unit load at T

$$-P_Q \cos\theta + R_A = 0$$

$$R_A = \frac{1}{2}$$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$$\frac{1}{2} = \frac{Q}{\sqrt{2}}$$

$$Q = 0.707 \text{ (Ten.)}$$

→ ILD for the member R

To find ILD at $O_1$ or ($O_2$) keep a unit load at $O_2$

$$R_A = \frac{3}{4}$$

Take moment about $O_1$

$$R_A = \frac{3}{4} \text{ (Tension at } O_1\text{)}$$

Hence ILD for $R_A$ is a triangle having a maxi. ordinate at $O_2$ of 3/4

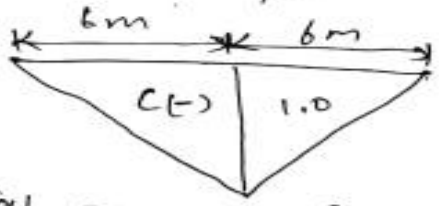
→ ILD for the member $P_S$

When load is at $O_2$

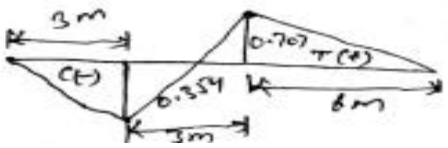
$$P_S = \frac{3}{12} = 0.25 \text{ (comp.)}$$

At T

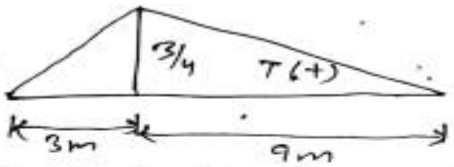
$$P_S = \frac{6}{12} = 0.5 \text{ (Ten.)}$$



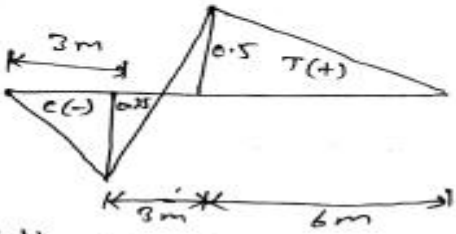

(a) ILD for $P_P$




(b) ILD for $P_Q$




(c) I.L.D for $P_R$




(d) ILD for $P_S$

# Q.3 Solution

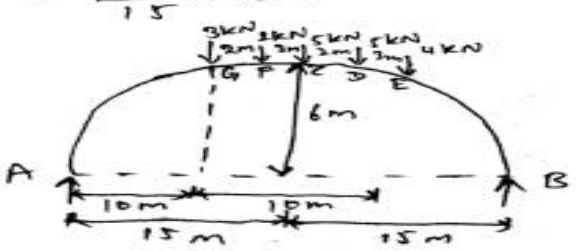
Q → 3

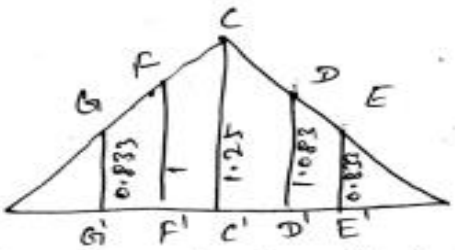
Ans :-

Horizontal thrust ordinates of ILD

$$CC' = \frac{l}{4r} = \frac{30}{4\times 6} = 1.25$$

$$DD' = \frac{1.25}{15} \times (15-2) = 1.083$$




ILD for horizontal thrust

$$EE' = \frac{1.25}{15}(15-5) = 0.833.$$

$$FF' = \frac{1.25}{15}(15-3) = 1$$

$$GG' = \frac{1.25}{15}(15-5) = 0.833$$

Horizontal thrust

$$= 4\times 0.833 + 5\times 1.083 + 5\times 1.25 + 3\times 1 + 3\times 0.833$$

$$H = 20.496 \text{ kN}$$

→ At the section under the tail load

considering the tail load slightly to the right side of the each

$$V_A = \frac{1}{30}((4\times 10)+(5\times 13)+(5\times 15)+(3\times 18)+(3\times 20))$$

$$= 9.8 \text{ kN}$$

The equation of Parabola is :-

$$y = \frac{4rx}{L^2}(L-x)$$

$$= \frac{4\times 6x}{30^2}(30-x)$$

$$= \frac{2x}{75}(30-x) = \frac{2\times 30x}{75} - \frac{2x^2}{75}$$

$$\frac{dy}{dx} = \tan\theta = \frac{2\times30}{75} - \frac{4x}{75}$$

At $x = 10\,m$, $\tan\theta = 0.267$

$\theta = 14.931°$

At $x = 10\,m$, $\tan\theta = 0.267$

$\theta = 14.931°$

$M = 9.8 \times 10 - 20.496 \times y$

As at $x = 10\,m$

$y = \frac{2\times10}{75}(30-10)$

$= 5.333\,m$

$M = 9.8 \times 10 - 20.496 \times 5.333$

$= -11.312\ kN-m$

$F = V_A \cos\theta - H\sin\theta$

$= 9.8\cos14.931 - 20.496\sin14.931°$

$= 4.188\ kN(\downarrow\uparrow)$

$N = H\cos\theta + V_A\sin\theta$

$= 20.496\cos14.931 + 9.8\sin14.931$

$N = 22.329\ kN$

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