Ans

Q No 1

Dead load

Dead loads are basically static in nature, is constant for a long period of time. This loads also includes the own weight of the structure. Such kind of immovable structural load is like weight of the walls, plasterboard, carpet, flooring material, roofing material etc.

Live Load

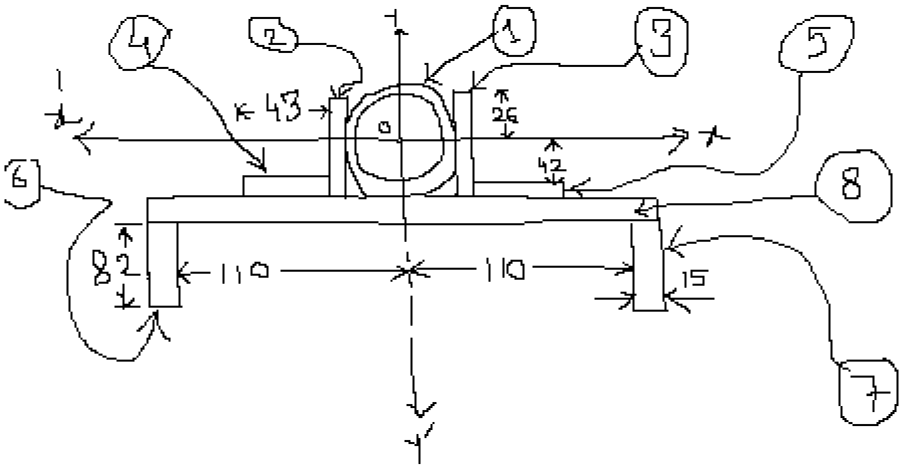
Live load is dynamic in nature, can change over a time period. This kind of load is very unstable. Impact, momentum, vibration are under this category of loading. The perfect example of the live load is vehicle moving over the bridge. Roof and floor live loads are produced during maintenance by workers, equipment and materials, and during the life of the structure by movable objects, such as planters and people.

In conclusion it can be said that dead load is permanent kind of loading where as the live load is temporary variable loading. So dead load can be calculated precisely but live load can't calculate exactly. Therefore, live loads required greater safety factor with respect to dead load.

2.

Let us assume that the beam can carry a load of w kN/m.
Total load = (3 x 0.15 x 25 + w) kN/m = 11.25 + w kN/m
Factored load = 1.5 x (11.25 + w) kN/m
M = wl x l / 8
Assuming, Friction between slab and top flange will provide continuous lateral support to the whole of the top (compression) flange, there is no possibility of lateral buckling, so The effective length over which the compression flange can buckle = 0. Thus, L = 10 m (Considering span = 10m) and bending failure can only occur by yielding so Mb = Ms.

Therefore, M = 1.5 x (11.25 + w) x 100/8 = 18.75 x (11.25 + w) kN-m
phi = 0.9 AS 4100 Table 3.4
phi x Mb = 0.9 x Mb = 0.9 x Ms
Ms = fy x Ze AS 4100 Cl.5.2.1
Ms = 300 x 86.4 x 10^6/10^12/(304/2) kN-m
Now,
18.75 x (11.25 + w) = 300 x 86.4 x 10^6/10^12/(0.304/2)
Hance, design load, w = 888.75 kN/m



3. (a) $C_1 \equiv (0,0)$, $C_2 \equiv (-54,-12)$,
$C_3 \equiv (54,-12)$, $C_4 \equiv (-79.5,-46)$
$C_5 \equiv (79.5,-46)$, $C_6 \equiv (-117.5,-99)$
$C_7 \equiv (117.5,-99)$, $C_8 \equiv (0,-54)$

$A_1 = \pi(50^2-45^2)$, $A_2 = 76\times 8 = A_3$

$A_4 = 43\times 8 = A_5$

$A_6 = 82\times 15 = A_7$

$A_8 = 250\times 8$

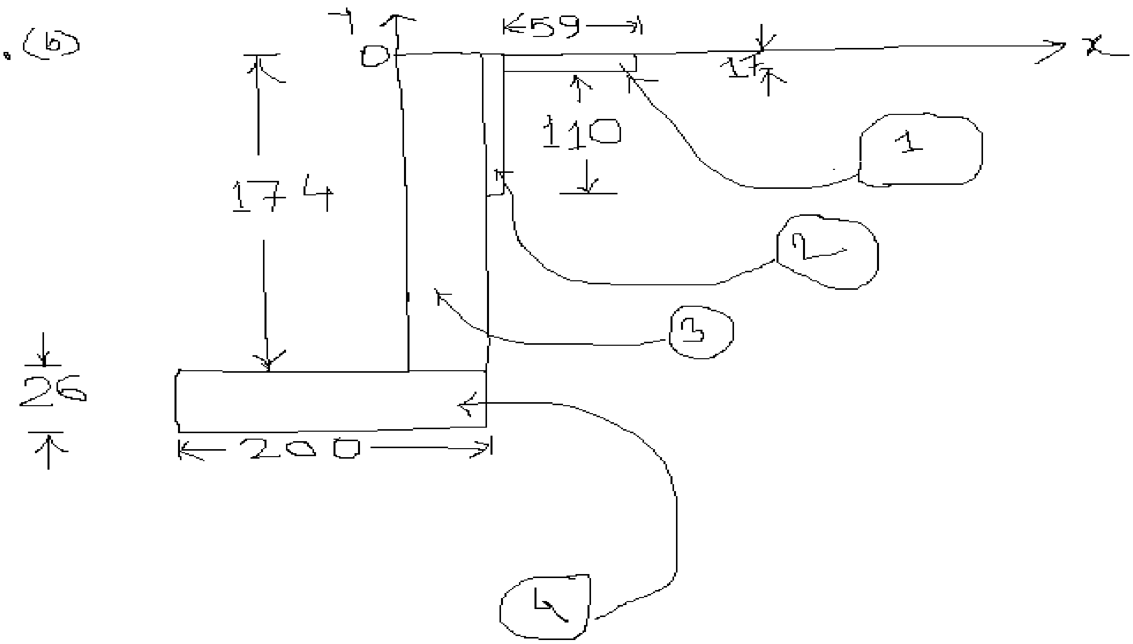
From symmetry we can say that c.g. lies on the y axix.

$\therefore x_{CG} = 0$

$$y_{CG} = \frac{A1*(0)+(A2+A3)*(-12)+(A4+A5)*(-46)+(A6+A7)*(-99)+A8}{A1+A2+A3+A4+A5+A6+A7+A8}$$

the cg is at x=0 and y=-45.07

3.(b)



3.(b) $C_1 \equiv (72.5, -8.5)$, $C_2 \equiv (34.5, -63.5)$

$C_3 \equiv (13, -87)$, $C_4 \equiv (-74, -187)$,

$A_1 = 59 \times 17$, $A_2 = 127 \times 17$

$A_3 = 174 \times 26$, $A_4 = 200 \times 25$

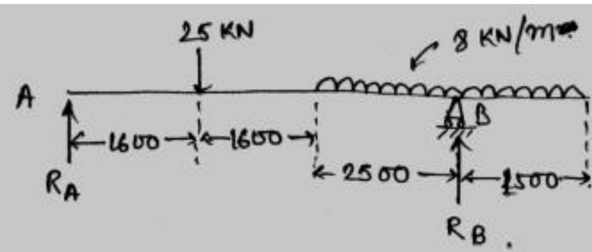
$$\therefore C.G. = \frac{A_1 \times C_1 + A_2 C_2 + A_3 C_3 + A_4 C_4}{A_1 + A_2 + A_3 + A_4}$$

Here, A_i = Area of i-th figure

C_i = C.G. of i-th figure

the cg is at x=-14.10 and y=-117.57

Ans :Q no 4 a



Solution → $R_A + R_B = \left[25 + 8 \times \frac{2500 + 1500}{1000}\right]$ KN

$= (25 + 8 \times 4)$ KN $=$ 57KN .

$\Sigma M_B = 0,$

$$R_A \times (1.6 + 1.6 + 2.5) = 25 \times 4.1 + 8 \times 2.5 \times \frac{2.5}{2} + 8 \times 1.5 \times \frac{1.5}{2}$$

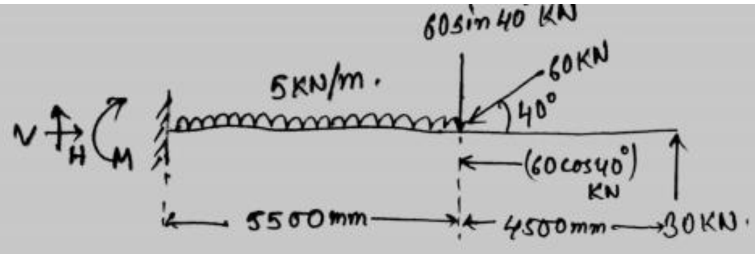
$$\Rightarrow R_A = \frac{136.5}{5.7}$$

$$= 23.94 \text{ KN}$$

$$\therefore R_B = (57 - 23.94) = 33.052 \text{ KN}.$$

$$\boxed{R_A = 23.94 \text{ KN}; \quad R_B = 33.052 \text{ KN}}$$

Ans 4 b



Solution –

$$H = 60\cos 40 = 45.9626\text{ KN.}$$

$\Sigma V = 0$,

$$V + 30 = 5 \times 5.5 + 60\sin 40 = 66.067\text{ KN.}$$

$$\Rightarrow V = 36.067\text{ KN.}$$

$$M = 5 \times 5.5 \times \frac{5.5}{2} + 60\sin 40 \times 5.5 - 30 \times (5.5+4.5)$$

$$= 75.625 + 212.1199 - 300$$

$$= 287.7449 - 300$$

$$= -12.255\text{ KN-m.}$$

5. $\vec{F_1} = 100\cos 30^\circ\,\hat{i} + 100\sin 30^\circ\,\hat{j}$
$= 86.6\,\hat{i} + 50\,\hat{j}$

$\vec{F_2} = 180\cos 90^\circ\,\hat{i} + 180\sin 90^\circ\,\hat{j} = 180\,\hat{j}$

$\vec{F_3} = 60\cos 135^\circ\,\hat{i} + 60\sin 135^\circ\,\hat{j}$
$= -42.43\,\hat{i} + 42.43\,\hat{j}$

$\vec{F_4} = 200\cos 210^\circ\,\hat{i} + 200\sin 210^\circ\,\hat{j}$
$= -173.2\,\hat{i} - 100\,\hat{j}$

$\therefore \vec{F_{net}} = \vec{F_1} + \vec{F_2} + \vec{F_3} + \vec{F_4}$
$= -129.03\,\hat{i} + 172.43\,\hat{j}$

$\therefore |\vec{F_{net}}| = \sqrt{(F_{net,x})^2 + (F_{net,y})^2}$
$= \sqrt{(-129.03)^2 + (172.43)^2} = 215.36$

$\theta = \tan^{-1}\left|\frac{y}{x}\right| = \tan^{-1}\left|\frac{172.43}{-129.03}\right| = 53^\circ$

so the angle is $180^\circ - 53^\circ = 127^\circ$, as $\vec{F_{net}}$ lies in 2nd quadrant.

$\therefore \vec{F_{net}} = (215.36, 127^\circ) = 215.36\ \underline{|127^\circ}$

Ans Q.No 5:

If we take I and j as unit vectors along X and Y

1st : 100 along 30 deg = 100*Cos(30)*I + 100*Sin(30)*j = 50*$\sqrt{3}$ *I + 50 *j

2nd : 180 along 90 deg = 180*Cos(90)*I + 180*Sin(90)*j= 180*j

3rd : 60 along 135 deg =60*Cos(135)*I + 60*Sin(135)*j= -60/$\sqrt{2}$* I + 60/$\sqrt{2}$* j

4th : 200 along 210 deg =200*Cos(210)*I + 200*Sin(210)*j= -100*$\sqrt{3}$ * I - 100*j

Resultant of sum of all four vectors = (50*$\sqrt{3}$+0- 60/$\sqrt{2}$ -100*$\sqrt{3}$)*I + (50+180+60/$\sqrt{2}$ −100) ∗ j

= -129 *I + 172 *j = 215.36 at 126.87 deg

6. Summation of Horizontal Force = (1200 + 900 cos 50 - 800) kN = 978.7 kN

Summation of Vertical Force = (2400 - 900 sin 50) kN = 1710.6 kN

Position of Resultant about bottom left corner = ((1200 + 900 cos 50 - 800) x 4 + 2400 x 4 - 900 sin 50 x 6)/(978.7+1710.6) = 3.49 m

7. Universal Columns (UC) and Universal Beams (UB) are refered to as "I Sections" or "H Sections". The differenciation in UB and UC lies in their Depth to With ratio. The depth of UB is greater than its width and difference is quite big, making it easy to spot. Unlike a universal beam, the UC's width is roughly equal to their depth.

The increased depth in case of UB results in higher loading capabilities than UCs, however there is not always enough space to use a UB. An example is a 203 x 133 UB 30. The first number is the depth of the beam, the second is the width and the last number is the weight (in this case 30) per metre in kilograms. Again, by multiplying the total beam length in metres by the weight per metre we can quickly work out what is the total weight of the beam.

Universal columns are the most often used section for structural steel purposes. A 152 UC 23 is 152 mm wide and 152 mm deep. The last number (23 in this example) is the weight per metre in kilograms. Universal columns are mainly used for columns, however their small depth compared to universal beams make them ideal load bearing members when height is limited (which is quite often the case in residential projects).