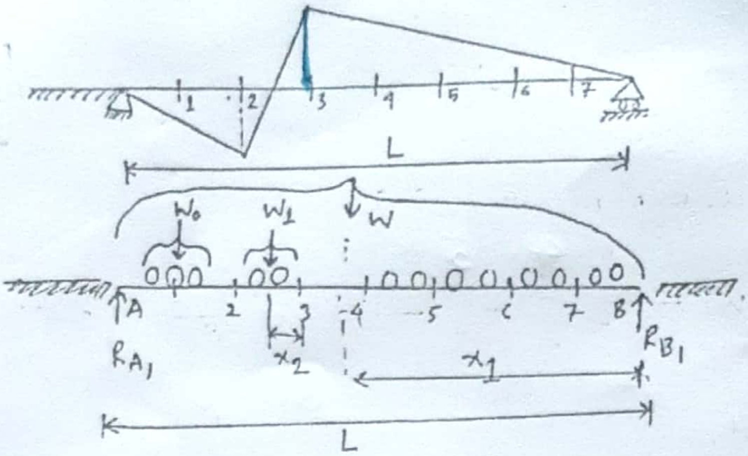
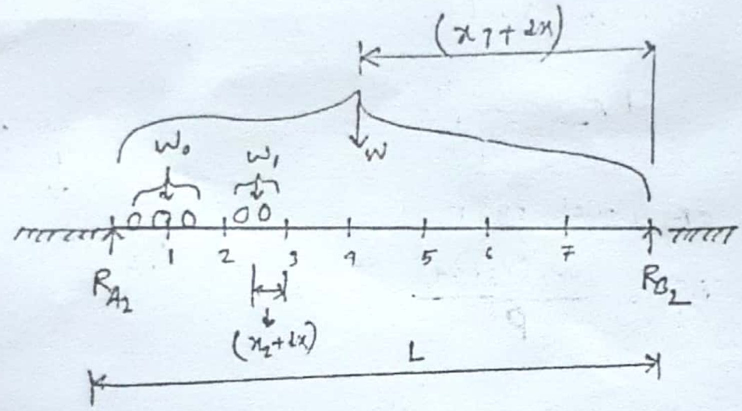
(A)

16,15,08

Panel Load

□ Criteria for the maximum shear of a floor beam subjected to series of concentrated loads move right to left.





Here, W = the sum of all of loads on the span

W_0 = The sum of all of loads left of the panel.

W_1 = The sum of all of loads in the panel.

x_1 = The distance of center of gravity, all the loads (W) to right support (B)

x_2 = The distance of center of gravity all the loads within panel to right point of panel.

L = span length of beam.

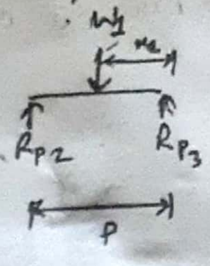
(a)

Before movement,

$\Sigma M_B = 0$ $\quad W x_1 - R_{A_1} L = 0 \quad \Rightarrow R_{A_1} = \frac{W x_1}{L}$

Also reaction at panel point 2,

$R_{P_2} = \frac{W_1 x_2}{P}$



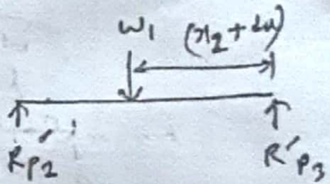
Now, shear force with in panel (2-3),

$V_1 = R_{A_1} - W_0 - R_{P_2} = \frac{Wx}{L} - W_0 - \frac{W_1 x_2}{P}$ .... ①

After movement,

$\Sigma M_B = 0$ $\quad W(x_1 + dx) - R_{A_2} L = 0$

$\Rightarrow R_{A_2} = \frac{W(x_1+dx)}{L}$



Also, reaction at panel point 2,

$R'_{P_2} = \frac{W_1(x_2+dx)}{P}$

Now, shear force with in panel (2-3)

$V_2 = R_{A_2} - W_0 - R'_{P_2} = \frac{W(x_1+dx)}{L} - W_0 - \frac{W_1(x_2+dx)}{P}$ ...... ②

Now, From ① - ② we obtain.

$dV = V_2 - V_1 = \frac{W(x_1+dx)}{L} - W_0 - \frac{W_1(x_2+dx)}{P} - \frac{Wx}{L} + W_0 + \frac{W_1 x_2}{P}$

$\Rightarrow dv = \frac{W\,dx}{L} - \frac{W_1\,dx}{P} = 0$

$\therefore \frac{dv}{dx} = \frac{W}{L} - \frac{W_1}{P}$

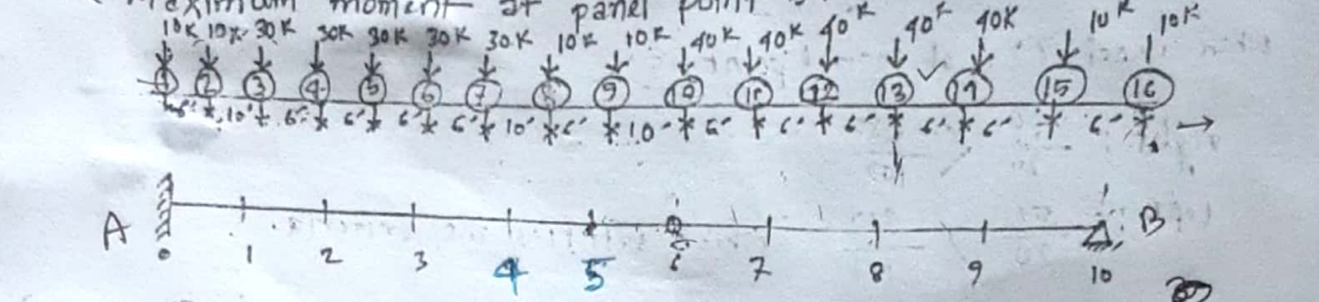
Now, For maximum, $\frac{dv}{dx} = 0$

$\frac{dv}{dx} = \frac{W}{L} - \frac{W_1}{P} = 0$

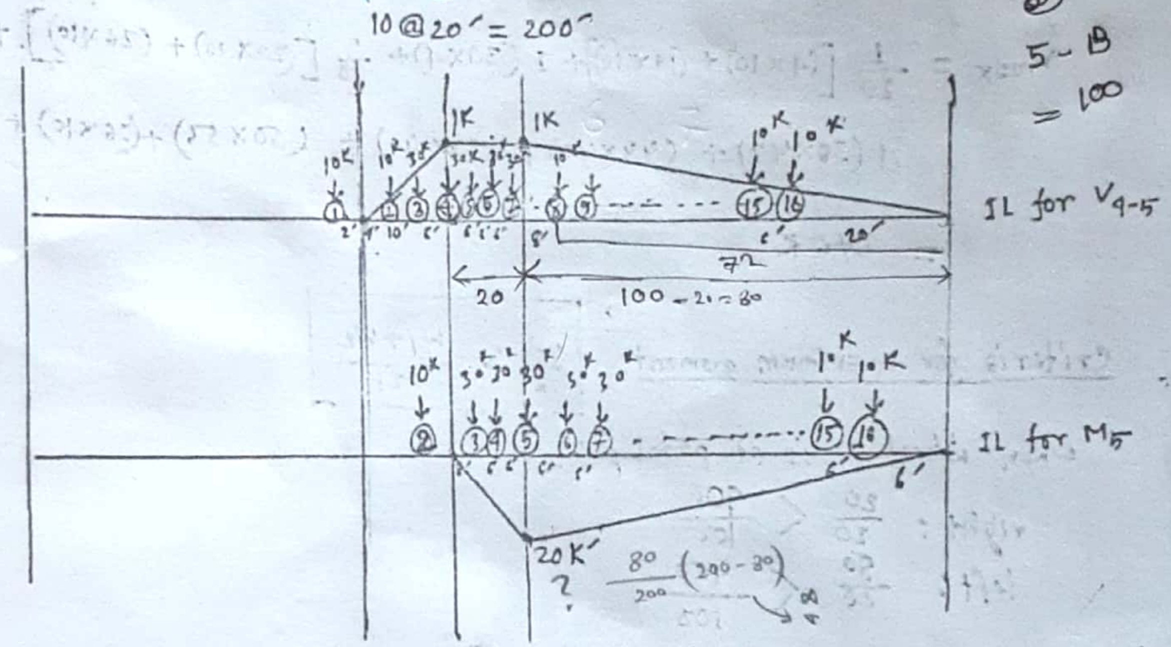
$$\boxed{\therefore \frac{W}{L} = \frac{W_1}{P}}$$

2006

using proper criteria to obtain the position of moving loads and hence calculate the maximum shear in the panel 4-5 and the maximum moment at panel point 5.



5 - B = 100



Here,

Criteria for maximum shear: $\boxed{\dfrac{W_1}{a} = \dfrac{W_1 + W_2}{a+b}}$ (IL is similiar to Moment IL)

When wheel ① is at panel point ⑤

Right: $\frac{0}{20} < \frac{350}{100}$

left: $\frac{10}{20} < \frac{360}{100}$

when wheel ② is at panel point ⑤

Right: $\frac{10}{20} < \frac{340}{100}$

Left: $\frac{20}{20} < \frac{350}{100}$

①-⑬ = 6 + 10 + 6×4 + 10 + 6 + 10 + 6×3 = 84' + 6×3 = 102

When wheel-③ is at panel point-⑤,

right: $\frac{20}{20} < \frac{290}{100}$

left: $\frac{50}{20} < \frac{320}{100}$

when wheel-④ is at panel point-⑤,

right: $\frac{40}{20} < \frac{280}{100}$

left: $\frac{70}{20} > \frac{310}{100}$ which satisfies the criteria.

$$V_{max} = \frac{1}{20}[(4\times10)+(14\times30)] + 1(30\times4) + \frac{1}{80}[(20\times10)+(26\times10)+(32\times40)$$
$$+(38\times40)+(44\times40)+(50\times40)+(50\times56)+(66\times10)+(72\times10)]$$
$$= 276\text{ K}$$

Criteria for maximum moment: $\boxed{\frac{W_1}{a} = \frac{W_1+W_2}{a+b}}$

when wheel ③ is at panel point ⑥.

right: $\frac{20}{20} < \frac{390}{100}$

left: $\frac{50}{20} < \frac{400}{100}$

when wheel ④ is at panel point ⑥

right: $\frac{40}{20} < \frac{390}{100}$

left: $\frac{70}{20} < \frac{400}{100}$ → 5-B

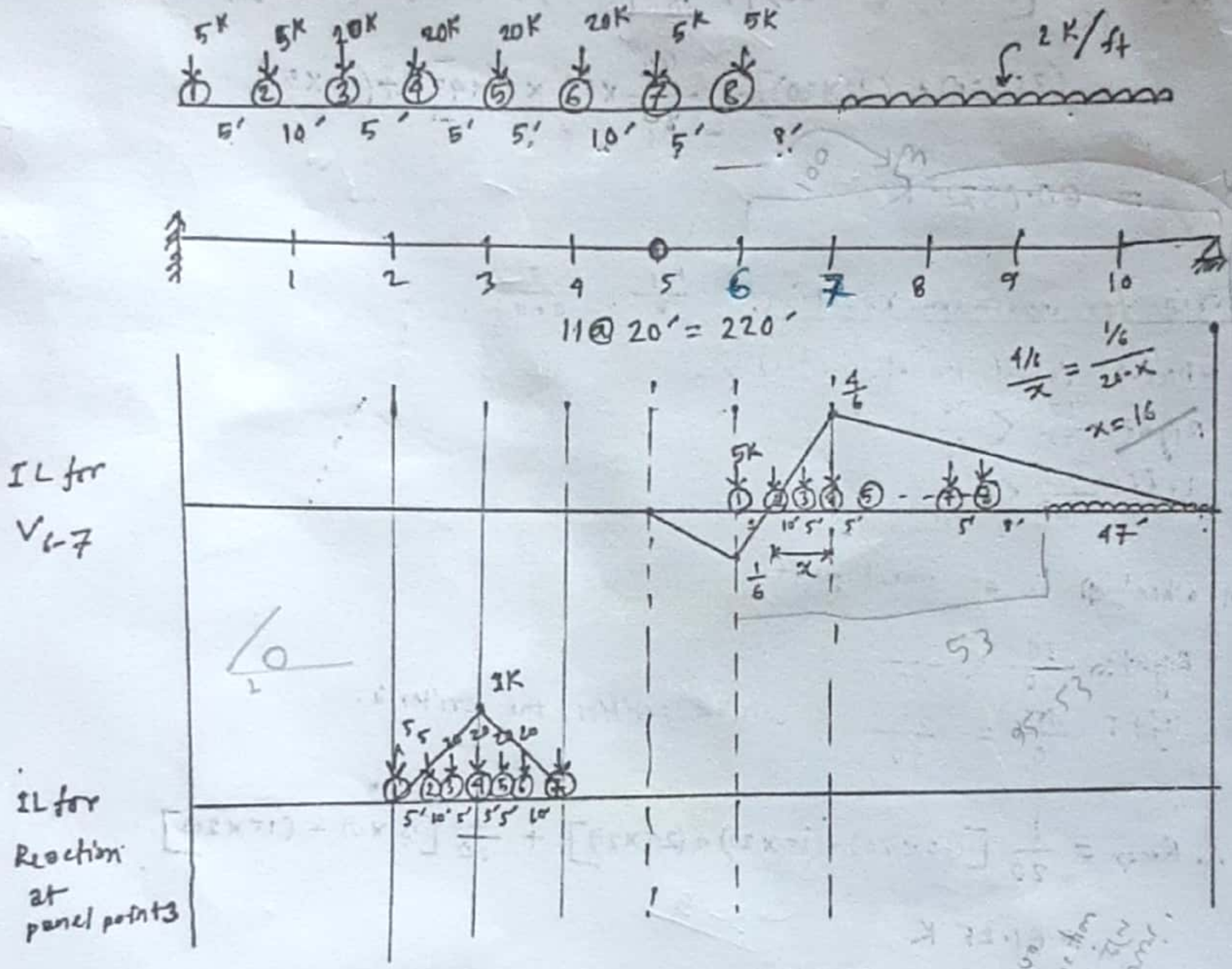
when wheel ⑤ is at panel point ⑥

right: $\frac{60}{20} < \frac{390}{100}$

left: $\frac{90}{20} > \frac{390}{100}$ which satisfies the criteria.

$$M_{max} = \frac{20}{20}[(8\times30)+(14\times30)+(20\times30)] + \frac{20}{80}[(6\times10)+(12\times10)+$$
$$(18\times40)+(24\times40)+(30\times40)+(36\times40)+(42\times40)+$$
$$(52\times10)+(58\times10)+(68\times30)+(74\times30)] = 4145\text{ K}$$

Problem: using proper criteria to determine the maximum shear in panel 6-7 and maximum floor beam reaction at panel point 3 due to the series of moving concentrated loads shown in figure below:



criteria for maximum shear: $\frac{W_1}{P} = \frac{W}{L}$

Now,

when wheel ③ at panel point ⑦,

(5×2 + 20×4 + 5×2 + 2×42)

right: $\frac{10}{20} < \frac{184}{120}$

Left: $\frac{30}{20} < \frac{184}{120}$

6-7 = 100

When wheel-④ is at panel point-⑦

right: $\frac{30}{20} < \frac{194}{120}$

Left: $\frac{45}{20} > \frac{187}{120}$ which satisfies the criteria.

$$V_{max} = \frac{4/6}{16}\left[(1\times5)+(11\times20)\right] + \frac{1/6}{80}\left[(55\times5)+(60\times5)+(70\times20)+(75\times20)+(80\times20)\right] + \left[\left(\frac{4/6}{80}\times97\right)\times\frac{1}{2}\times47\right]\times2-\left(\frac{1}{6}\times5\right)$$

$= 69.242$ K

$\frac{W_1}{a} = \frac{W_1+W_2}{a+b}$

criteria for maximum reaction:

when wheel-① is at panel point-③,

Right: $\frac{10}{20} < \frac{90}{40}$

Left: $\frac{30}{20} < \frac{90}{40}$

when wheel-④ is at panel point-③

Right: $\frac{30}{20} < \frac{90}{40}$

left: $\frac{45}{20} = \frac{90}{40}$ which satisfies the criteria.

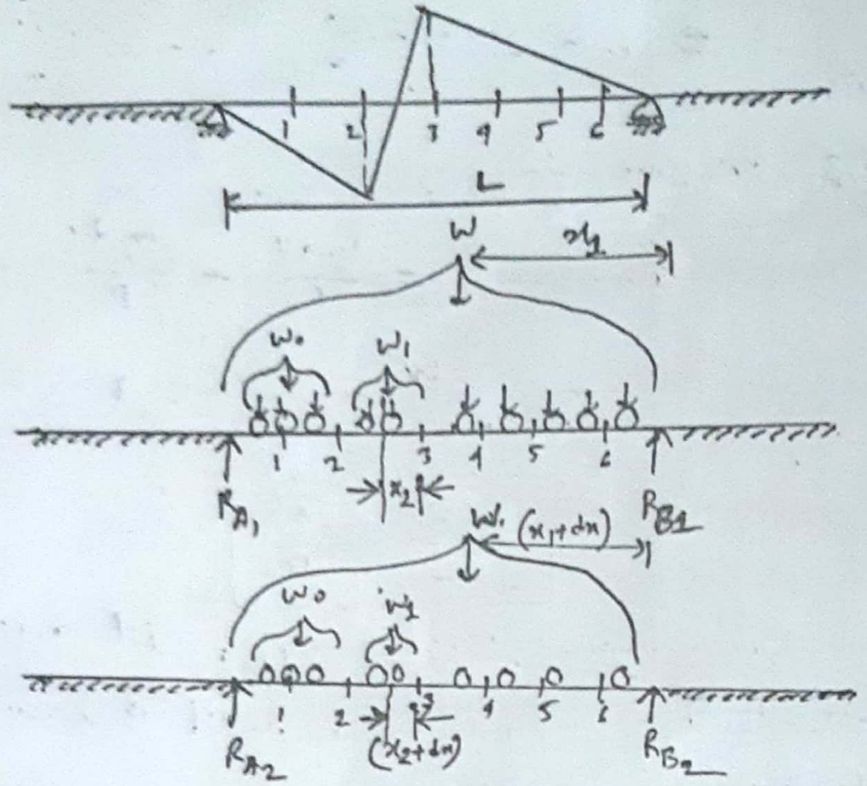
$$\therefore R_{max} = \frac{1}{20}\left[(10\times20)+(15\times20)+(20\times20)\right] + \frac{1}{20}\left[(5\times5)+(15\times20)\right]$$

$= 61.25$ K

(Ans.)

16.15.08

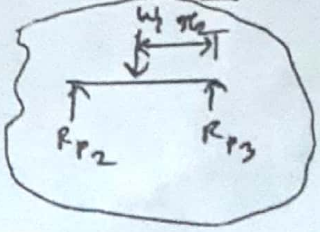
Criteria for the maximum shear of a floor beam subjected to series of concentrated loads move from right to left.



Before movement,

$$\Sigma M_B = 0 \Rightarrow R_{A_1} \times L - W x_1 = 0 \Rightarrow R_{A_1} = \frac{W x_1}{L}$$

Reaction at pand 2, $R_{P_2} = \frac{W_1 x_2}{P}$



Now, Shear force in panel (2-3),

$$V_1 = R_{A_1} - W_0 - R_{P_2} = \frac{Wx}{L} - W_0 - \frac{W_1 x_2}{P} \quad \text{......(1)}$$

After movement,

$$\Sigma M_B = 0 \Rightarrow R_{A_2} = \frac{W(x_1+dx)}{L}$$

and, $R'_{P_2} = \frac{W_1(x_2+dx)}{L}$

Now, shear force in panel (2-3),

$$V_2 = R_{A_2} - W_0 - R'_{P_2}$$

$$\Rightarrow V_2 = \frac{W(x_1+dx)}{L} - W_0 - \frac{W_1(x_2+dx)}{P} \quad \text{......(ii)}$$

From (i) & (ii)

∴ The change in shear force,

$$dV = V_2 - V_1 = \frac{W\,dx}{L} - \frac{W_1\,dx}{P}$$

$$\Rightarrow \frac{dV}{dx} = \frac{W}{L} - \frac{W_1}{P} = 0$$

$$\therefore \boxed{\frac{W}{L} = \frac{W_1}{P}}$$

Therefore, The maximum shear force will occur within panel when the average load in the panel is equal to average load in the span of the beam.