MOVING LOAD

In civil engineering structures loads can change their positions. in such a case & certain load positions can be critical to certain parts or components of the structure. Shifting of load positions is common enough in buildings. But they are more prolonged in bridges over which vehicles keeps rding

certain beam positions can be crusial are should be able to identify such positions and their influence on the structure.

Load categories for simply supported beams:

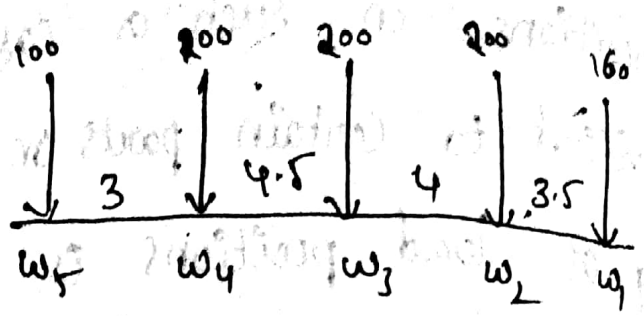
1. Single concentrated load.
2. UDC longer than the span.
3. UDC shorter than the span.
4. Two point loads suported by a fixed distance.
5. multiple point loads.

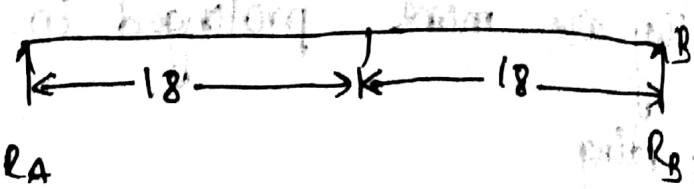
1. Single concentrated load:

consider a load w, i.e. single concentrated load over the span AB of length l. In order to find max +ve shear and -ve shear we are taking one section x. Take the distance A to the load a.

i, Max +ve shear at X

$R_A + R_B = W$





ii Resultant of loads:

$760\bar{x} = 100 \times 3 + 200 \times 7.5 + 200 \times 11.5 + 160 \times 15$

$= 6500$

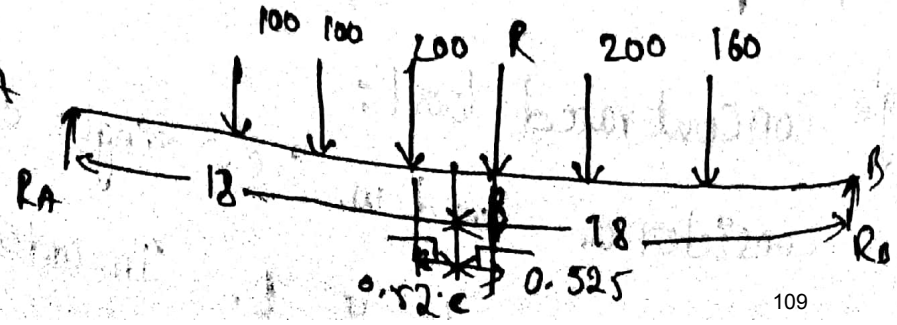
$\bar{x} = 8.55$

2) Max BM:

Max BM occurs at under the load w_3. w_3 is near to the resultant force

D is b/w C & w_3 = D is b/w C & R

$\frac{1}{2} \times 1.05 = 0.525$



MOVING LOAD

In civil Engineering structures loads can change their positions. in such a case & certain load positions can be critical to certain parts or components of the structure. Shifting of load positions is common enough in buildings. But they are more prolonged in bridges over which vehicles keeps rding

certain beam positions can be crusial are should be able to identify such positions and their influence on the structure.

Load categories for simply supported beams:

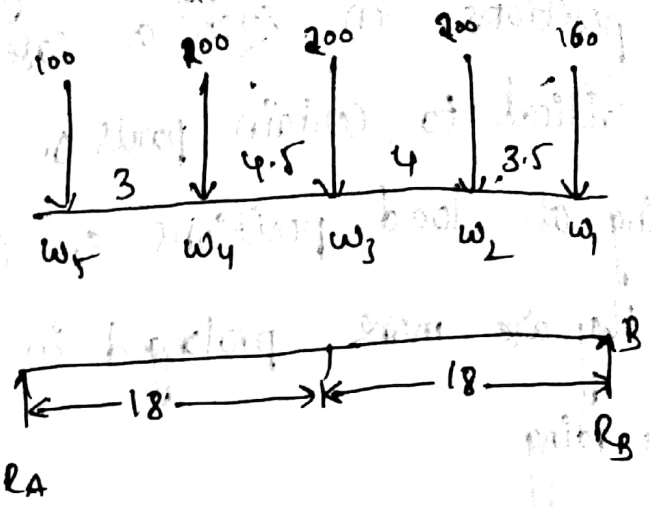
1. Single concentrated load.
2. UDC longer than the span.
3. UDC shorter than the span.
4. Two point loads suported by a fixed distance.
5. multiple point loads.

1. Single concentrated load:

consider a load w, i.e. single concentrated load over the span AB of length l. In order to find max +ve shear and -ve shear we are taking one section x. Take the distance A to the load a.

i, Max +ve shear at X

$R_A + R_B = W$



ii, Resultant of loads:

$760\bar{x} = 100\times3 + 200\times7.5 + 200\times11.5 + 160\times15$

$= 6500$

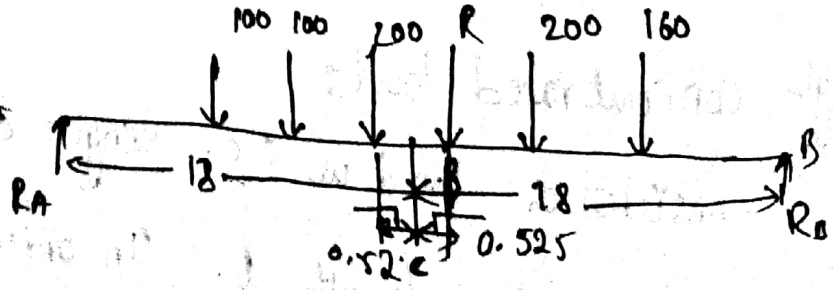
$\bar{x} = 8.55$

2) Max BM:

Max BM occurs at under the load w_3. w_3 is near to the resultant force

D is b/w C & w_3 = D is b/w C & R

$\frac{1}{2} \times 1.05 = 0.525$



UNIT-7

INFLUENCE LINES

An influence lines for any beam locus are frame is a graph on curve, showing the variation of S.F and B.M reactions, tension. deflection for various positions of a moving unit along the span of the structure.

uses of influence lines:

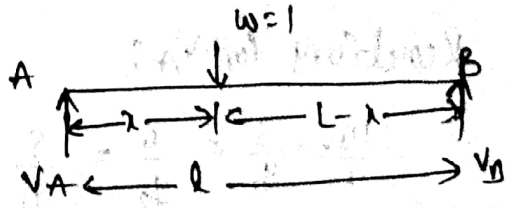
1. They are used to find the position of line load which will load to a max value of particular stress function.

2. To calculate the value of particular stress function with the critical load condition.

simply supported beams:

1. Determine the reactions and influence line diagram reaction for to a simply support beam of span lm. with a point load xm from the left end.

Ans:



$$V_A + V_B = 1$$

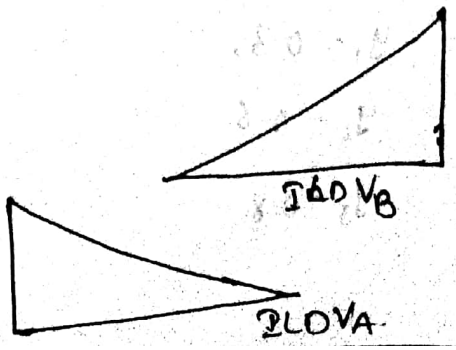
$$\Sigma M_A = 0$$

$$-V_B \times l + w' \times x = 0$$

$$l V_B = x$$

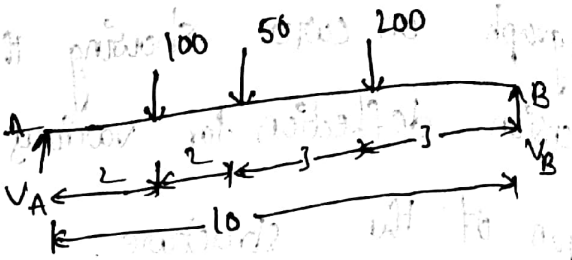
$$V_B = x/l$$

$$V_A = l - x/l$$



when $x=0$, $V_A=1$, $V_B=0$

2. Construct the influence line diagram for the simply supported beam of span 10m. carrying 3 point loads 100 KN, 50 KN, 200 KN respectively as shown in fig. find the V.C. reaction at A and B.



Any: $V_A + V_B = 350$

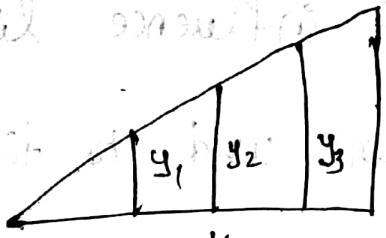
$\Sigma M_A = 0$

$-V_B \times 10 + 100 \times 2 + 50 \times 4 + 200 \times 7 = 0$

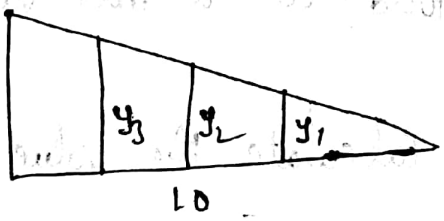
$10V_B = 1800$

$V_B = 180 KN$

$V_A = 170 KN$



Reactions for V_B:



$\frac{10}{1} = \frac{2}{y_1} = \frac{4}{y_2} = \frac{7}{y_3}$

$y_1 = 0.2,$

$y_2 = 0.4,$

$y_3 = 0.7.$

$V_B = 100 y_1 + 50 y_2 + 200 y_3 = 180 KN$

~~$V_A = 100 y_3 + 50$~~

Reactions for V_A:

$\frac{10}{1} = \frac{3}{y_1} = \frac{6}{y_2} = \frac{8}{y_3}$

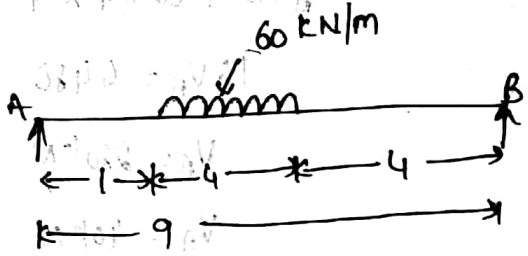
$y_1 = 0.3,$

$y_2 = 0.6$

$y_3 = 0.8$

$V_A = 100y_3 + 50y_2 + 200y_1 = 170kN$

3. Construct the influence line diagram for the simply supported beam of span 9m. carry in UDC 1m from the left end. find the V.C. reactions at A and B.



Ans: $V_A + V_B = 240$

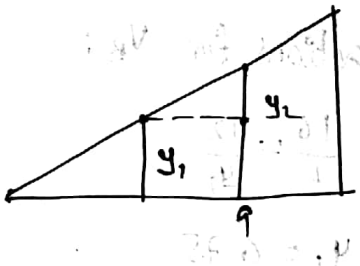
$\Sigma M_A = 0$

$-V_B \times 9 + 60 \times 4 \times 1 = 0$

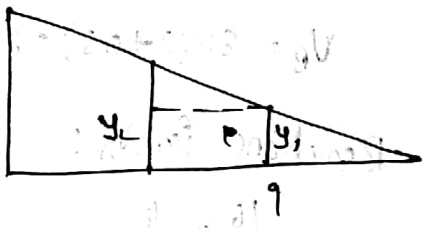
$9V_B = 720$

$V_B = 80$

$V_A = 160$



Reactions for V_B:



$$\frac{9}{1} = \frac{1}{y_1} = \frac{5}{y_2}$$

$y_1 = 0.11$

$y_2 = 0.56$

V_B = load (area) = $60\ (0.44 + 0.9) = 80.4 \cong 80kN$

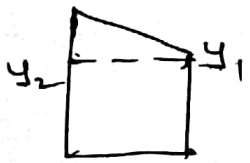
Reactions for V_A:

$$\frac{9}{1} = \frac{4}{y_1} = \frac{8}{y_2}$$

$y_1 = 0.44$

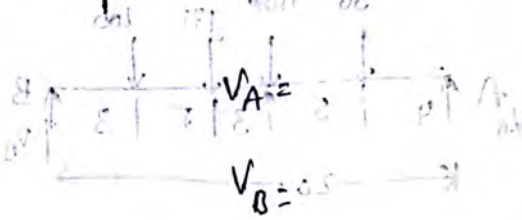
$y_2 = 0.89$

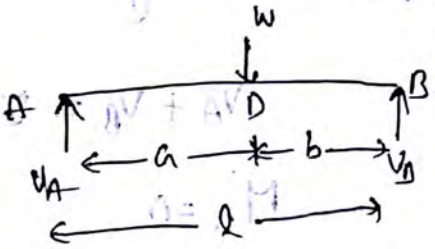
$V_A = 60(1.76 + 0.9) = 159.6 \cong 160kN$

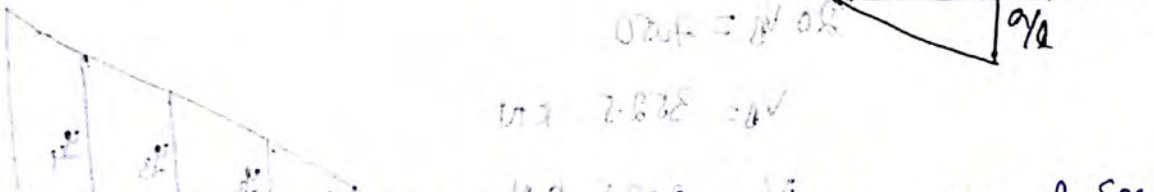


Influence line diagram for shear force:

1. A simply supported beam of span lm, loaded by a point load at the centre of the beam.







2. Find the S.F. at a section K for a beam AB of span 12m loaded with the moving loads 70kN, 60kN and 50kN from left to right. 70kN from 2m from the left end. 60kN, 5m from left end 50kN, 4m from right end. Find S.F. by influence line method.

Ans:

$$V_A + V_B = 180\,kN$$

$$\Sigma M_A = 0$$

$$-V_B \times 12 + 50 \times 8 + 60 \times 5 + 70 \times 2 = 0$$

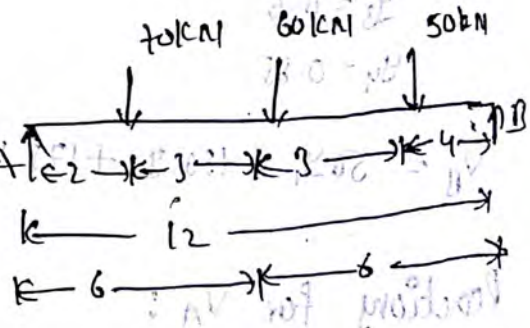
$$12 V_B = 840$$

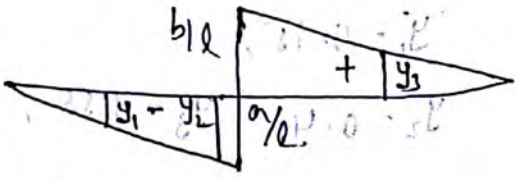
$$V_B = 70\,kN$$

$$V_A = 40\,kN$$

$$\frac{a}{l} = \frac{6}{12} = 0.5$$

$$\frac{b}{l} = \frac{6}{12} = 0.5$$





$$\frac{6}{0.5} = \frac{2}{y_1} = \frac{5}{y_2}$$

$$y_1 = 0.166$$

$$y_2 = 0.416$$

$$\frac{6}{0.5} = \frac{4}{y_3}$$

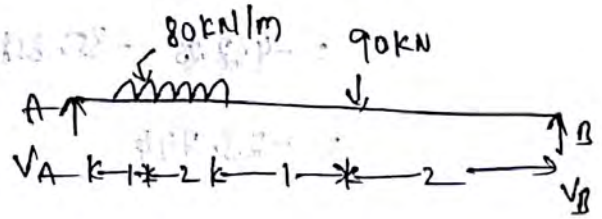
$$y_3 = 0.333$$

$$S.F.\ (V_k) = 70(-y_1) + 60(-y_2) + 50\,y_3$$

$$= -11.62 - 24.96 + 16.65$$

$$= -20.6\ kN$$

3. Find the S.F. at the section K for the loaded suranded shown in fig by influence the line method. A beam of Span 6m loaded with the point load of 90kN 2m from the right support and an UDL of 80kN/m, 1m from the left end of span 2m.



Ans:

$$V_A + V_B = 160 + 90$$

$$\frac{a}{l} = \frac{3}{6} = 0.5$$

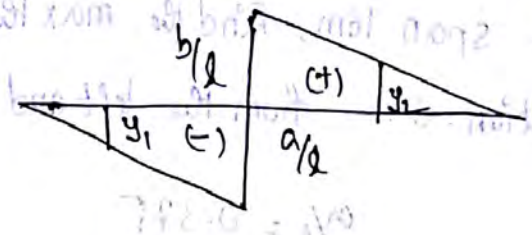
$$b/l = 3/6 = 0.5$$

$$\frac{3}{0.5} = \frac{1}{y_1}$$

$$y_1 = 0.166$$

$$\frac{3}{0.5} = \frac{2}{y_2}$$

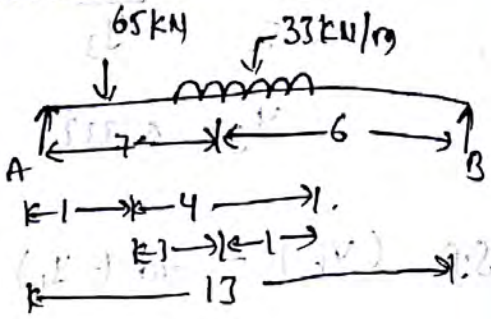
$$y_2 = 0.33$$



S.F $(V_k) = -80(0.332 + 0.334) + 90 \times 0.33$

$= -23.58$ kN.

3. Find the S.F. at the section k for the loaded beam as shown in fig by influence line method.



Ans: $a/l = 0.538$

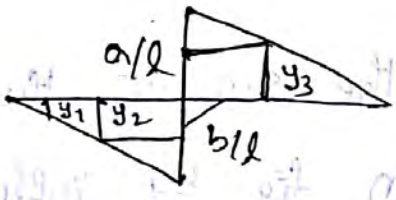
$b/l = 0.461$

$\frac{7}{0.461} = \frac{1}{y_1} = \frac{4}{y_2}$

$y_1 = 0.065$

$y_2 = 0.263$

$\frac{6}{0.538} = \frac{1}{y_3}$



S.F $(V_k) = -65 \times 0.065 - 33\left(\frac{0.263 + 0.461}{2}\right) \times 3$

$+33\left(\frac{0.448 + 0.538}{2}\right) \times 1$

$= -4.225 - 35.831 + 16.269$

$= -23.794$

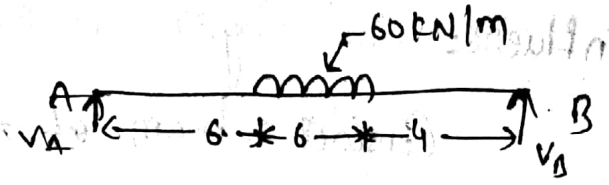
4. An UDL of 60kN/m of length 6m moves on sourended of span 16m, Find the max the S.F. and max -ve S.F. at a section 6m. from the left end.

Ans: $a/l = 0.375$

$b/l = 0.625$

$$\frac{10}{0.375} = \frac{4}{y_1}$$

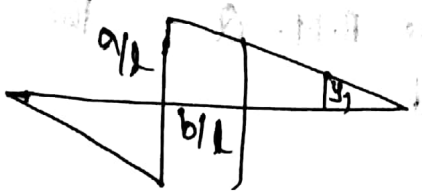
$$y_1 = 0.15$$



max +ve

S.F = 60 (0.9 + 0.675)

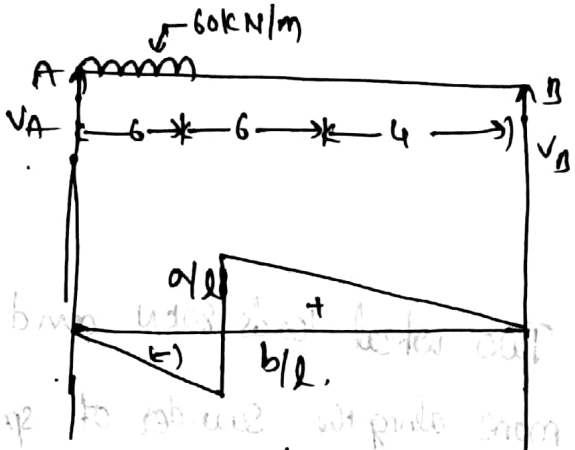
= 94.5 KN



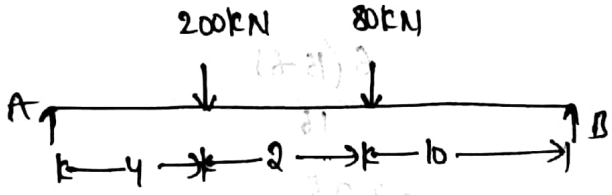
max -ve

$$S.F = -60\left(\frac{6 \times 0.625}{2}\right)$$

= −112.5 KN



5. Two wheel loads 80KN and 200KN spaced 2m apart move on a girder of span 16m find the max +ve S.F. and -ve SF at a section 4m from the left end.



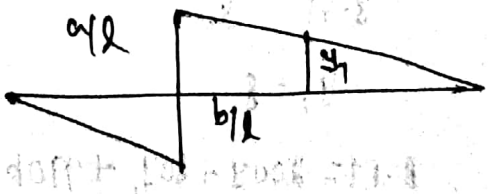
Ans:

$$\frac{a}{l} = 0.25$$

$$\frac{b}{l} = 0.75$$

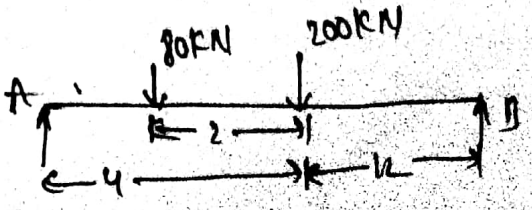
$$\frac{12}{0.25} = \frac{10}{y_1}$$

$$y_1 = 0.208$$



max +ve

S.F = 80 y_1 = 16.64 KN



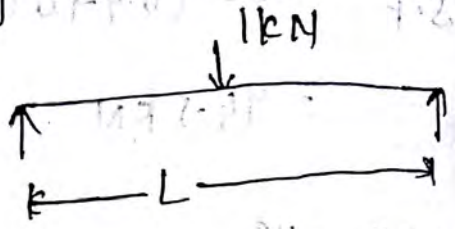
max -ve

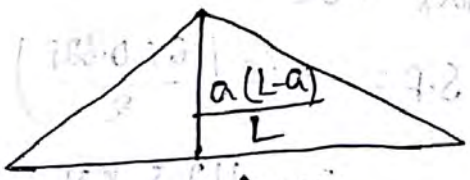
$$= \frac{2}{y_1}$$

$y_1 = 0.375$

Influence line diagram for B.M:

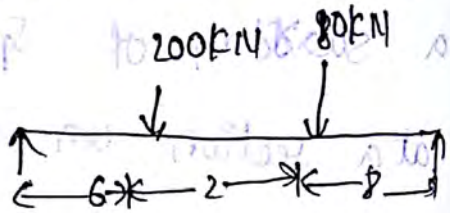
Consider a beam AB of span 'L' m loaded with the point load of 1kN at the centre of the beam, Find the B.M. @ the load by influence line method.





ICD for BM

1. Two wheal loads 80kN and 200kN. Spaced at 2m apart move along the Suander of span 16m. find the max B.M. that can occur at a section 6m from the left end.

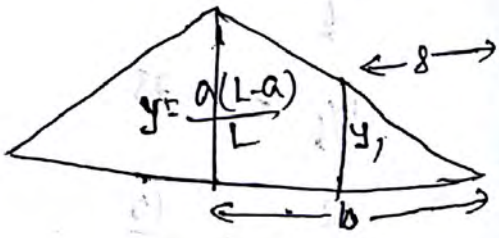


Ans: $y = \frac{a(L-a)}{L}$

$= \frac{6(16-6)}{16}$

$= 3.75$

$a = 6$ $\quad b = 10$



$\frac{10}{3.75} = \frac{8}{y_1}$

$y_1 = 8$

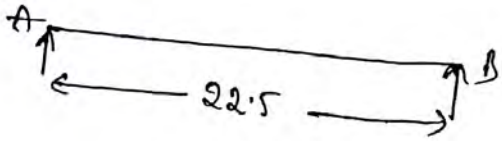
B.M $= 200y + 80y_1 = 1040 \text{ kN/m}$.

2. A Train of 5 wheel loads crosses, a simply supported beam of span 22.5 m using influence lines. Calculate the max the +ve S.F. and -ve S.F. at the mid span and absolute B.M. in the span.

Ans: For max +ve S.F, the head of the wheel load placed at a given section (mid span C).

$$a/l = \frac{11.25}{22.5} = 0.5m$$

$$b/l = \frac{11.25}{22.5} = 0.5m$$



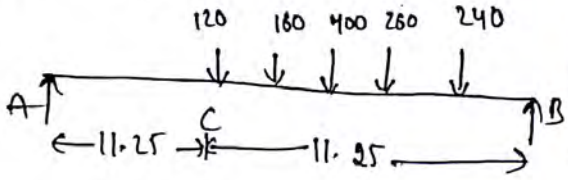
$$\frac{11.25}{0.5} = \frac{1.25}{y_1} = \frac{3.75}{y_2} = \frac{6.25}{y_3} = \frac{8.75}{y_4}$$

$y_1 = 0.056$

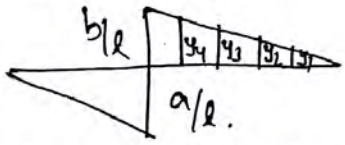
$y_2 = 0.167$

$y_3 = 0.278$

$y_4 = 0.389$



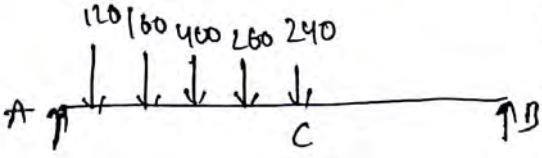
(+) $S.F_{max} = 240y_1 + 260y_2 + 400y_3 + 160y_4 + 120 \times b/l$



$= 290.3 kN$

max -ve S.F. will occur when the tail end of the load is placed at a given section i.e. at the mid span of C.

$$\frac{11.25}{0.5} = \frac{1.25}{y_1} = \frac{3.75}{y_2} = \frac{6.25}{y_3} = \frac{8.75}{y_4}$$

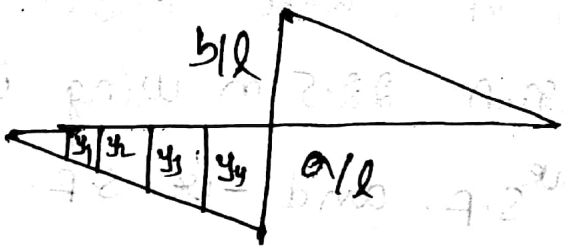


$y_1 = 0.056$

$y_2 = 0.167$

$y_3 = 0.278$

$y_4 = 0.389$



$(-)\ S.F_{max} = -120y_1 - 160y_2 - 400y_3 - 260y_4 - 240\,a/l.$

$= -365.78\ kN.$