1.2 INFLUENCE LINES FOR SHEAR FORCE AND BENDING MOMENT

Location of maximum shear force

In a simple beam with any kind of load, the maximum positive shear force occurs at the left hand support and maximum negative shear force occurs at right hand support.

Maximum shear force diagram

Due to a given system of rolling loads the maximum shear force for every section of the girder can be worked out by placing the loads in appropriate positions. When these are plotted for all the sections of the girder, the diagram that we obtain is the maximum shear force diagram. This diagram yields the 'design shear' for each cross section.

Bending moment diagram

Bending moment diagram represents variation of bending moment. Bending moment diagrams are drawn for only bending moments. If span longer than UDL for a maximum BM, the load on left side is equal to the load on right side in case of bending moment diagram.

Several point loads

The maximum bending moment for a series of moving loads is obtained when the average load on the left of the section is equal to the average load on the right of the section.

The above statement exists in a system of moving point loads. In such cases, each load is passed over the section and average load on each side is calculated. The load, when the crosses the section makes the heavier side lighter and lighter side heavier and gives the maximum bending moment at the section.

Example:

A train of 5 wheel loads crosses a ss beam of span 22.5m.using influence lines, calculate the max positive and negative shear forces at mid span and absolute max bending moment anywhere in the span.

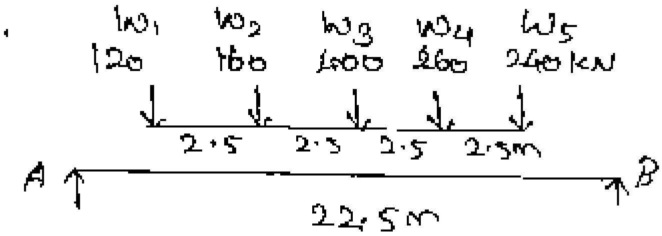

Fig. 1.2.1

Solution:

a)max shear force

find shear increment

w =1180KN

c =2.5

Si =Wc/l -W1

=(1180×2.5)/(22.5)-120

=11.11(+)

Si =Wc/l -W1

=(1180×2.5)/(22.5)-160

=- 28.8(-)

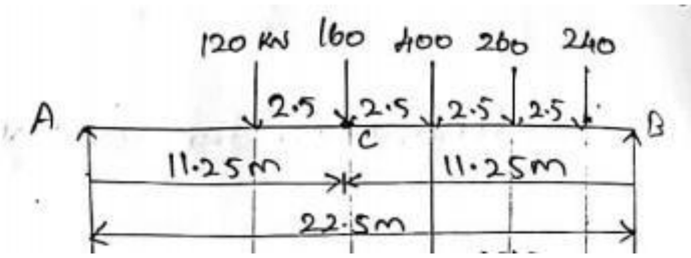

Fig. 1.2.2

Ordinate under C

right side =l-x/l

=11.25/22.5

=0.5

left side =x/l

=11.25/22.5

= 0.5

Ordinate under 400KN

=0.5/11.25 × 8.75

=0.38

Ordinate under 260KN

=0.5/11.25 ×3.75

= 0.16

Ordinate under 120KN

=-0.5/11.25 ×8.75

= -0.38(-)

Max positive shear force

= (-120×0.38)+(400×0.38)+(260×0.27)+(240×0.16)+(160×0.5)

=295 KN

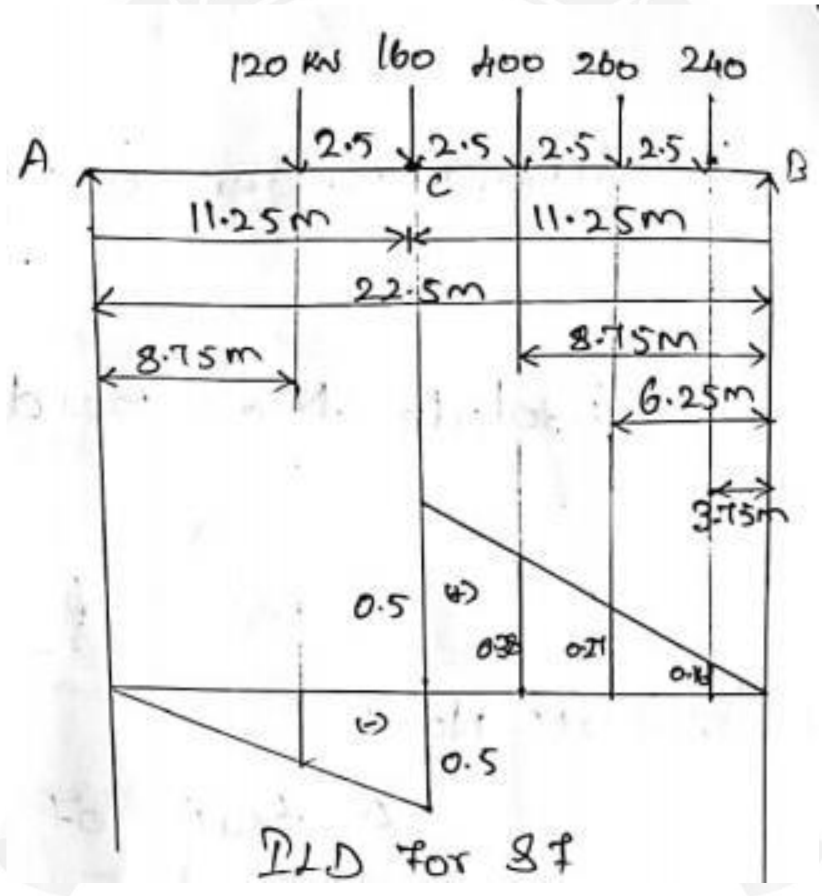

Fig. 1.2.3 Influence Line Diagram For Positive Shear Force

ii) Negative shear force

Find shear increment

Si =Wc/l - W1

=(1180×2.5)/(22.5) - 240

= -108.89(-)

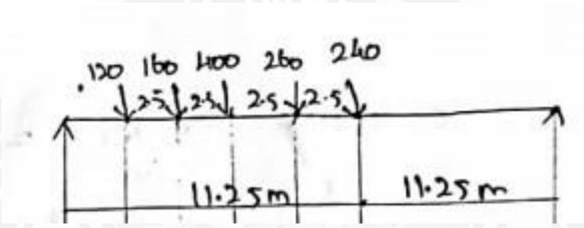

Fig. 1.2.4

Ordinate under 400KN

=0.5/11.25 × 6.25

=0.27

Ordinate under 260KN

=0.5/11.25 ×8.75

= 0.39

Ordinate under 160KN

=0.5/11.25 × 3.75

=0.167

Ordinate under 120KN

=0.5/11.25 ×1.25

= 0.056

Max negative shear force

=(240×-0.5)+(260×-0.39)+(400×- 0.27)+(160×0.167)+(120×0.056)

=-366.04 KN (-ve)

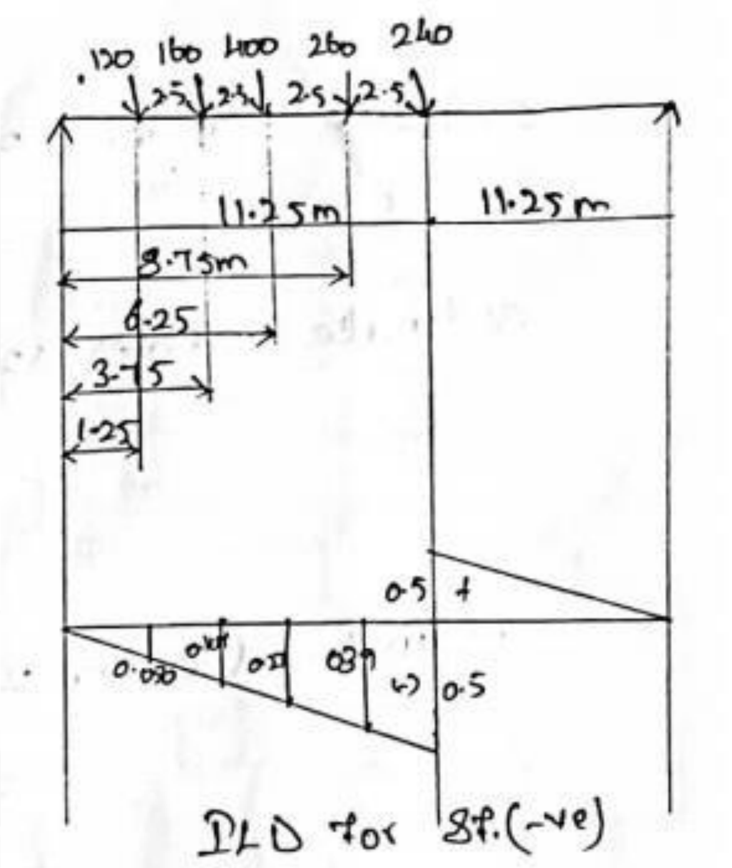

Fig. 1.2.5 Influence Line Diagram For Negative Shear Force

b) Absolute max bending moment

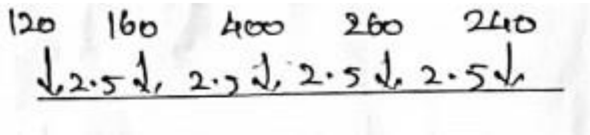

Fig. 1.2.4

Taking moment about 120KN

$(160\times2.5)+(400\times5)+(260\times7.5)+(240\times10) = R.x$

$6750 = 1180x$

$\bar{x} = 5.72$ m

Max ordinate of lLD

$= x(l-x)/l$

$= 10.89(22.5-10.39)/22.5$

$= 5.62$

Ordinate under 160KN

$= 5.62/10.89 \times 8.39$

$= 4.33$

Ordinate under 120KN

$= 5.62/10.89 \times 5.39$

$= 3.04$

Ordinate under 160KN

=5.62/10.89 × 9.11

=4,41

Ordinate under 160KN

=5.62/10.89 × 6.61

=3.20

Absolute maximum bending moment

=120(3.04)+160(4.33)+400(5.62)+260(4.41)+(240×3.2)

=5220.2 KNm

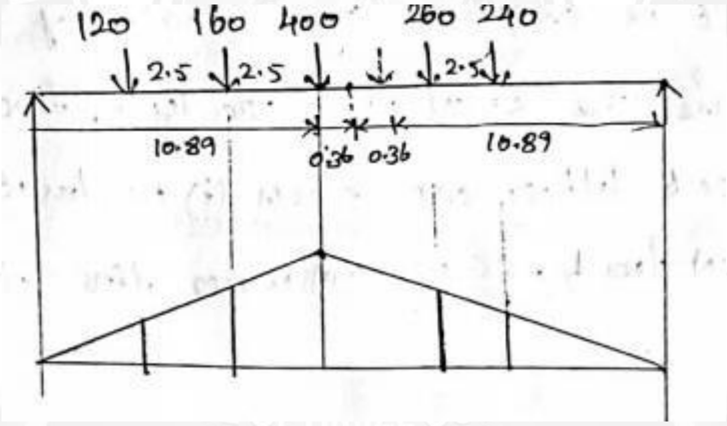

Fig. 1.2.4 Absolute Maximum Bending Moment