1.3 CALCULATION OF CRITICAL STRESS RESULTANTS DUE TO CONCENTRATED AND DISTRIBUTED MOVING LOADS

Equivalent uniformly distributed load

A girder with live load system is consider, in which the system is replaced by an equivalent uniformly distributed load over the total span so that the shear force at any section due to UDL is equal to or more than the maximum shear force due to live load system or bending moment at any section due to UDL is equal to or maximum bending moment at the section due to live load system. The equivalent uniformly distributed load can be determined for different live load system such as Single wheel load, Uniformly distributed live load shorter than the span, Two wheel loads W1 and W2 spaced apart.

Moving loads

The load moving across the span changes the magnitude of shear force and bending moment at every cross section of the girder. Such loads are known as moving loads or rolling loads.

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.

Example:

Two point load of 100KN and 200KN span 3m apart cross a girder of span 15m from the left to right with the 100KN load. Draw the influence for the shear force and bending moment and find the value of max shear force and bending moment at a section D,6m from the left hand support. Also find the absolute max bending moment due to the given load system.

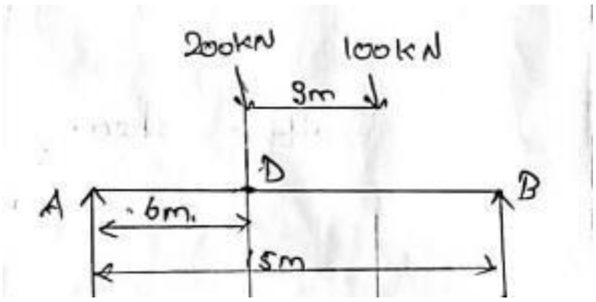

Fig. 1.3.1

Solution:

a) Find the max shear force

shear increament

Si =Wc/l -W1

=300/15 -200

=-180

i) positive shear force

l-x/l =15-6/15

= 0.6

x/l =6/15

= 0.4

ordinate under 200KN

= 0.6

ordinate under 100KN

0.6/9 ×6 = 0.4

max positive shear force

= (200×0.6)+(100×0.4)

=160KN

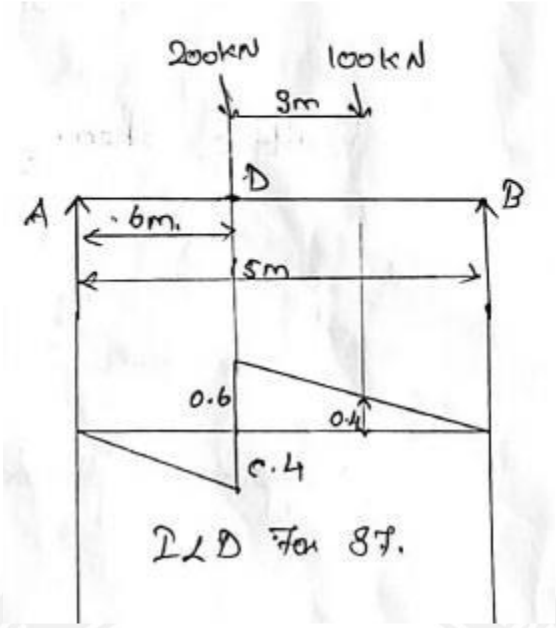

Fig. 1.3.2 ILD For Positive Shear Force

ii) Negative shear force

shear increament

Si =wl/l -w1

=300×3/15 -100

= -40

Ordinate under 200KN

=0.4/6 ×3

=0.2

max negative shear force

=(200×0.2)+(100×0.4)

=80KN(neg)

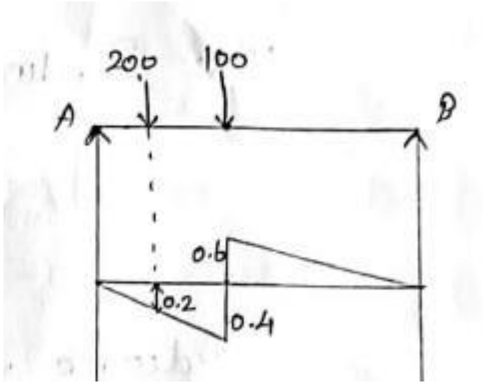

Fig. 1.3.3 ILD For Negative Shear Force

b)max bending moment

find critical load

loading rate Lr = W leff/x -W right/(l-x)

=200/6 -100/9

= 22 (+)

Loading rate Lr =0/6 - 300/9

= - 33.33 (_ve)

ordinate under 100KN

=3.6/9 × 6

=2.4 m

max bending moment

= load × ordinate

=(200×3.6)+(100×2.4)

= 960 KNm

ordinate of ILD =x(l-x)/l

= 9× 6/ 15

= 3.6 m

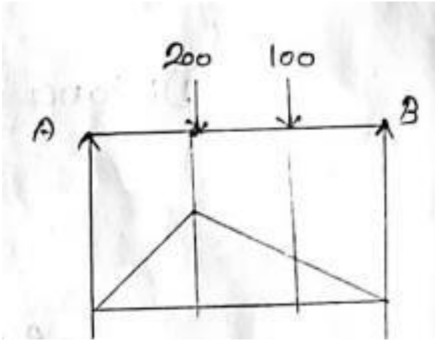

Fig. 1.3.4 ILD For Max Bending Moment

C) Absolute max bending moment

Fig. 1.3.5

Taking moment about 200KN

$100\times3 = R.x$

$300 = 300\,x$

$\bar{x} = 1\text{ m}$

Distance of this 200KN from C

$=\bar{x}/2$

$=1/2$

$=0.5$

Max ordinate under 200KN

$=(l-x)x/l$

$=8\times7/15$

$=3.73\text{ m}$

Ordinate under 100KN

=3.73/8 × 5

=2.33 m

Absolute max bending moment

= (200×3.73) +(100×2.33)

=979.3 KNm.

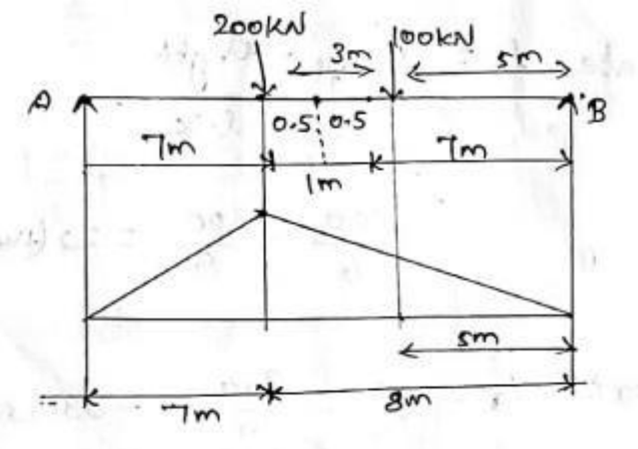

Fig. 1.3.5 ILD For Absolute Max Bending Moment