1.5 INFLUENCE LINES FOR MEMBER FORCES IN PIN JOINTED PLANE FRAMES

Forces in the members of truss

Based on the loading conditions the members of truss experience torsion and compression. The diagonal members are in tension and vertical members are in compression. When the unit load is transmitted along the bottom chord members the influence l9ine diagrams will be drawn for different chord members.

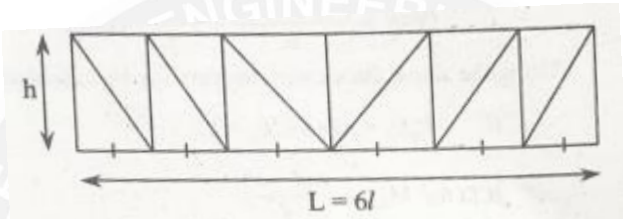

Fig. 1.5.1 Truss

Top chord members

Consider a top chord member U1, U2 Let the support reactions be RA and RB. When a unit load is taken, three conditions are taken into considerations which are as follows

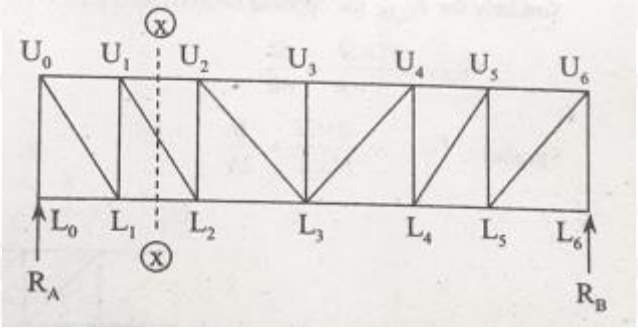

Fig. 1.5.2 Top Chord Members

I. When unit load is on the left side off L1
II. When unit load is on the right side off L2
III. When unit load is between L1 and L2

Rolling loads

Shifting of load positions is common enough in buildings. But they are more pronounced in bridges and in gantry girders over which vehicles keep rolling.

Reversal of stresses

In certain long trusses the web members can develop either tension or compression depending upon the position of live loads. This tendency to change the nature of stresses is called reversal of stresses.

Example :

Draw the influence line diagram for forces in the member of warren truss as shown below

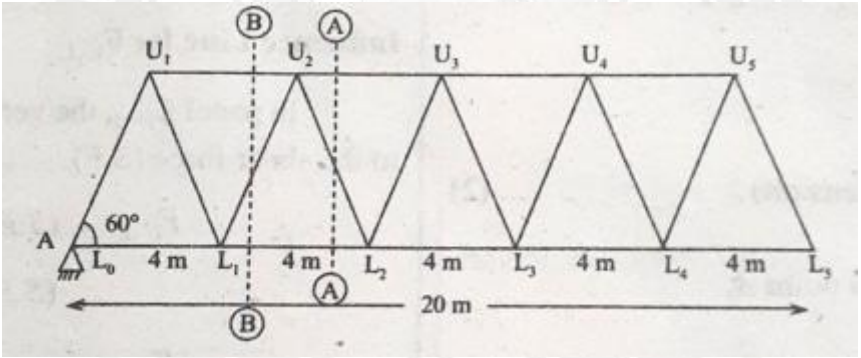

Fig. 1.5.3

Solution

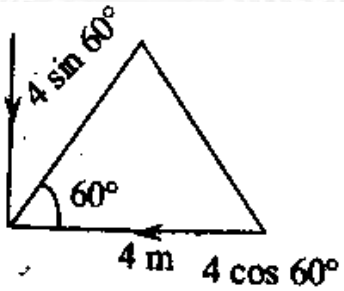

Fig. 1.5.4

The truss height 'h' is

$$h = 4 \sin 60$$

h =3.464 m

Influence line for F U_2 U_3

considering a section AA

$P_{U2\ U3} = Ml_2 / h$

$P_{U2\ U3} = Ml_2 /3.464$ (compression)

=1/3.464 (8×12/20)

=1.386 (under point L2)

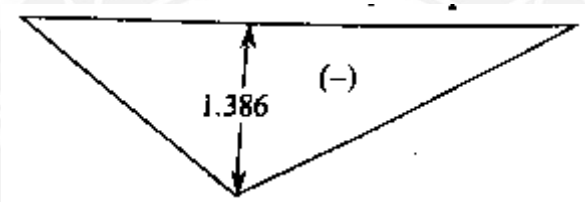

Fig. 1.5.5 ILD for F U_2 U_3

Influence line for the Force in member L_1 L_2 (F L_1 L_2)

F L_1 L_2 $=M_{U2}/h$

F L_1 L_2 $=M_{U2}/3.464$ (Tension) __2

When the load is acting on point A

RB =0

M_{U2} and F L_1 L_2 = 0

When the load is acting on point L_1

RB = 1×4 / 20

= 1/5

M_{U2} = RB × 14

M_{U2} = 1/5 × 14

=2.8 KN-m

sub the value of M_{U2} in eqn 2

F L_1 L_2 = 1 /3.464(1/5 ×14)

F L_1 L_2 = 0.808 (Tension)

When the load is acting on point L2 then

RA = 1×12/ 20

= 3/5

M_{U2} = RA ×6

M_{U2} = 3/5 ×6

sub the value of M_{U2} in eqn 2

F L_1 L_2 =M_{U2} /3.464

= 1/3.464 (3/5 ×6)

F L_1 L_2 =1.039 (tension)

when the load is acting on point B then

RA =0

and

M_{U2} and F L_1 L_2 =0

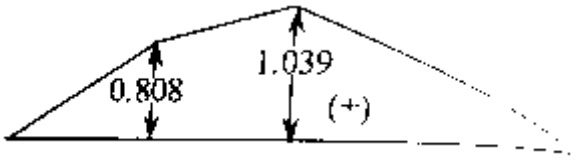

Fig. 1.5.6 ILD for L_1L_2 ($F\ L_1L_2$)

Influence line for $F\ U_2L_2$

$=(s.f)\ L_1L_2\ \text{Cosec}\ Ø$

$=(s.f)\ L_1L_2\ \text{Cosec}\ 60$

$F\ U_2L_2 = 1.155\ (s.f)\ L_1L_2$

When the load is acting on point A

$RA = 1$

$(s.f)\ L_1L_2$ and

$F\ U_2L_2 = 0$

when the load is acting on point load L1

$F\ U_2L_2 = \text{cosec}\ Ø \times m/n$

$= \text{cosec}\ 60 \times 1/5$

$F\ U_2L_2 = 0.231$(compression)

$F\ U_2L_2 = 1.155 \times n\text{-}m\text{-}1 / n$

$= 1.155 \times 5\text{-}1\text{-}1/5$

$F\ U_2L_2 = 0.693$ (tension)

When the load is acting on point B

$RA = 0$

and

$(s.f)\ L_1L_2$ and

$F\ U_2L_2 = 0$

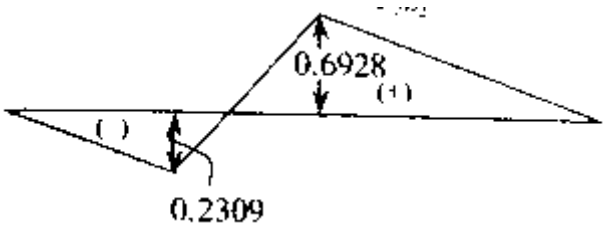

Fig. 1.5.7 Influence line for F U_2 L_2

Influence line for F U_2 L_1

F U_2 L_2 =(s.f) L_1 L_2

Cosec Ø =(s.f) L_1 L_2 Cosec 60

=1.155 (s.f) L_1 L_2

When the load is acting on point L1

F U_2 L_1 = tensile

F U_2 L_1 = compressive

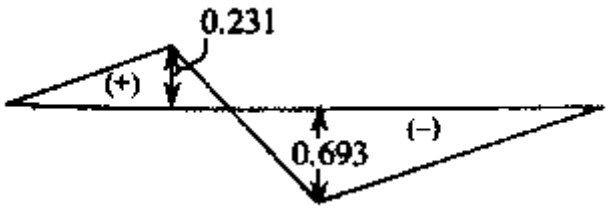

Fig. 1.5.8 Influence line for F U_2 L_1

Example:

Draw the IL for force in member BC and CI for the truss shown in figure, the of the height truss is 8m and each segments is 8m long

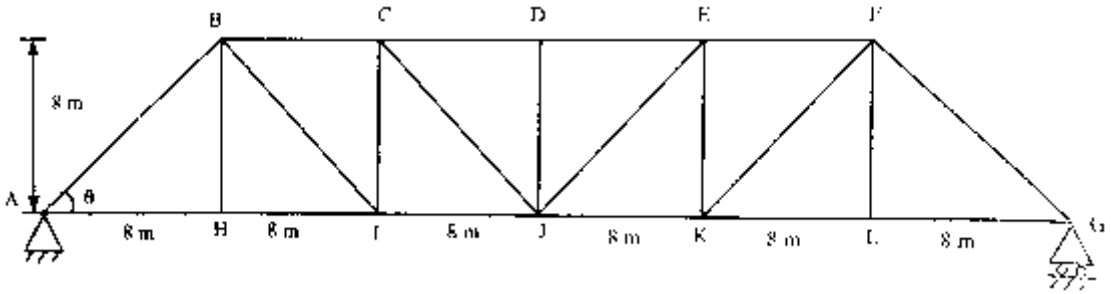

Fig. 1.5.9

Solution

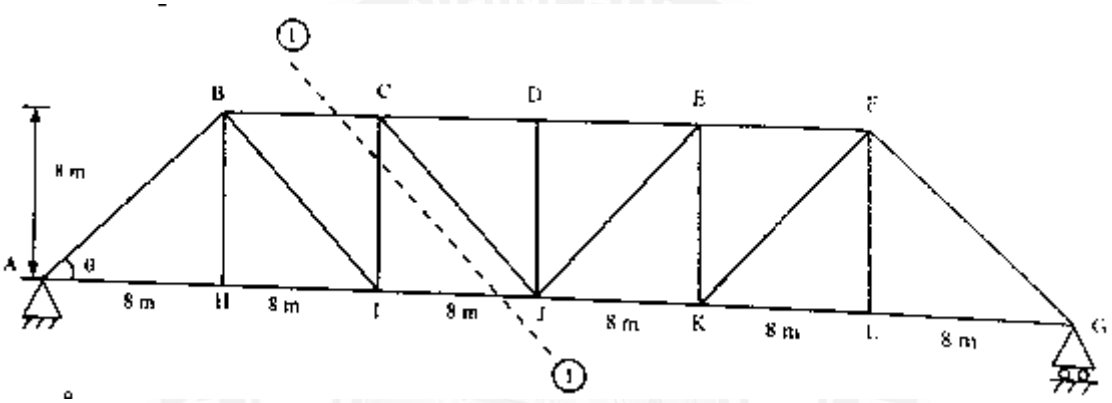

Fig. 1.5.10

height of the truss = 8m

length = 8m

$\tan Ø = 8/8$

$= 1$

$Ø = 45$

$\text{Sin } Ø = \sin 45$

$= 1/\sqrt{2}$

$\cos Ø = \cos 45$

$= 1/\sqrt{2}$

Influence line for force in the Member BC (P_{Bc})

$P_{Bc} = M_I/9$

Moment at I = a(l - a) /l

=16 (48-16) / 48

= 16×32 / 48

= 10.46

Force in member BC

= 10.66/8

= 1.33 KN

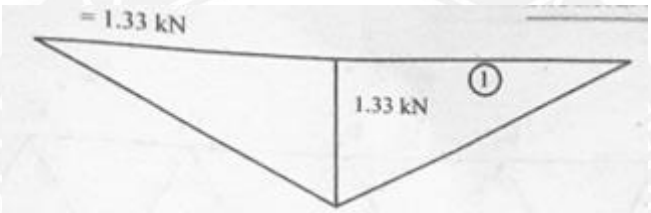

Fig. 1.5.11 Influence line for force in the Member BC (P_{Bc})

Influence line Diagram for force in Member CI (P_{CI})

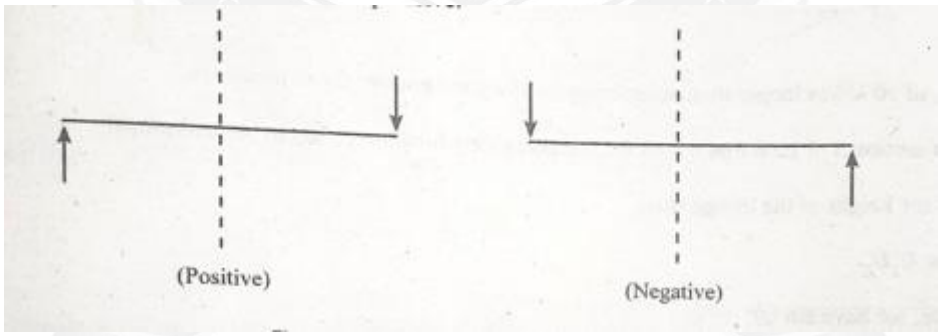

Fig. 1.5.12 Influence line for force in the Member CI (P_{CI})

At point I ordinate of I.LD

= a/l

= 16 /48

= 1/3

At point J ,ordinate of I.L.D

= - a/ l (Compressive)

= -24/48

= -1 /2

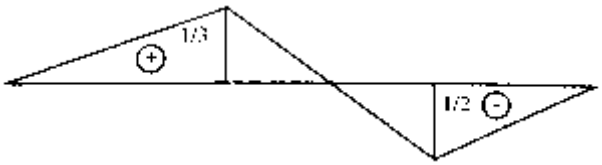

Fig. 1.5.13 Influence line for force in the Member CI (P_{CI})