Prepared by

- **Dr. S. M. ZAHURUL ISLAM**
- **PhD, The University Of Hong Kong, HONG KONG)**
- **M.Sc Engineering, Universiti Putra Malaysia, Malaysia**
- **B Sc. Engineering, Rajshahi University of Engineering & Technology (RUET)**
- **&**
- **Head, Department of Architecture, RUET &**
- **Professor**
- **Department of Civil Engineering**
- **Rajshahi University of Engineering & Technology (RUET), Rajshahi – 6204, BANGLADESH**

Course Title : Structural Analysis and Design-I

Course Code: CE 3111

Lecture: 3 hrs/ week , Credit: 3.00

Prereq. CE 2111

- **Content of Course:**
- Stability and determinacy of structures, analysis of statically determinate arches. Influence lines for statically determinate structure: moving loads on beams, frames and trusses. Cable supported structures and space trusses..

Reference Books

- 1. Theory of Simple Structures by T.C. Shedd and J.Vawter (2^{nd} Edition)
- 2. Elementary Structural Analysis by Utku, Norris & Wilber (4^{th} Edition)
- 3. Analysis of structures by V N Vazirani (Vol. 1) ,   M M Ratwani
- 4. Indeterminate Structural Analysis by J. Sterling Kinney

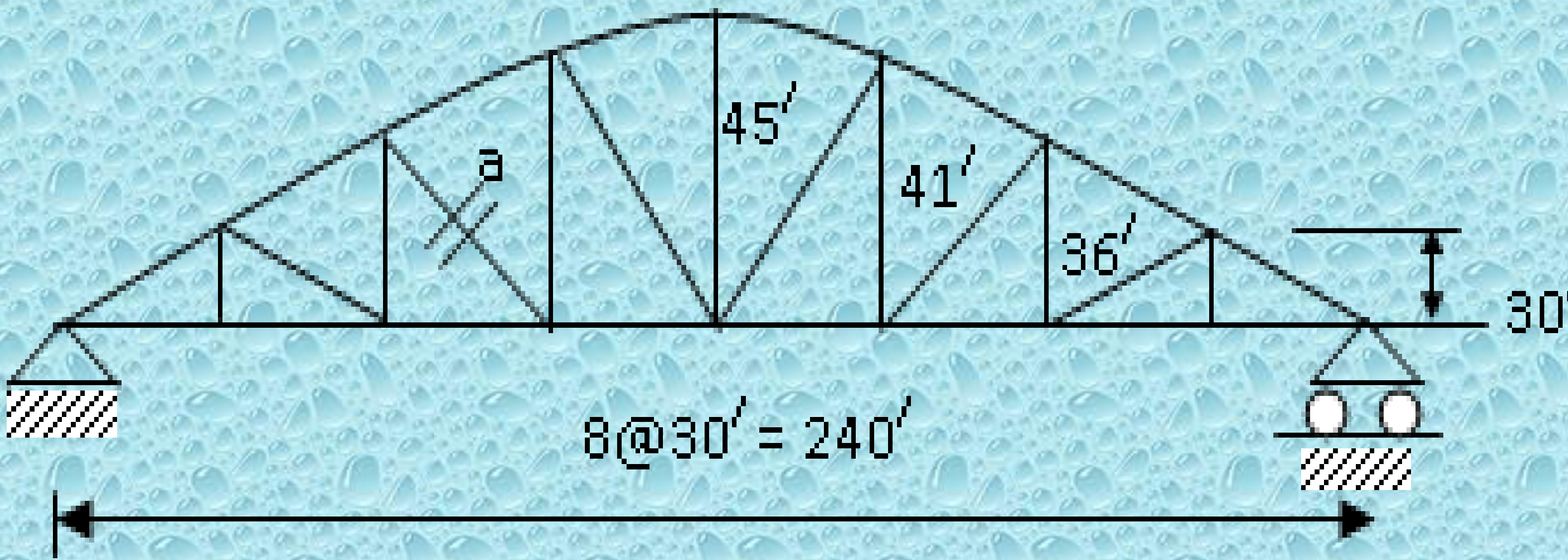
Topics:

Lane load on Trusses

Topics to be Covered

- Introduction
- Define Suspension Bridges
- Example of Suspension Bridges Advantages and disadvantages of Suspension Bridges
- Derive Formula for Analysis of Suspension Bridges
- Sample Example to Analysis and Design of Suspension Bridges

Introduction



Truss

The truss or framed structure are composed of interconnecting members and are supported in such a manner that they are capable of holding applied external force in static equilibrium. It must hold in equilibrium gravity forces that are applied as a consequence of its own weight.

1.2 DEFINETION OF TRUSS

A truss is a configuration, which is designed to sustain inclined, vertical, horizontal loads accruing at or between its points of support.

1.3 CHARACTERISTIC OF A TRUSS

a) The general configuration of a truss is triangle.
b) The members are connected of their end by frictionless pin.
c) The loads are applied only at joints and not at the intermediate points of a member.

ADVANTAGES OF TRUSS OVER BEAM

Manufactured roof trusses provide a structurally efficient alternative to beams. They place greater emphasis on axial loading of members and less on bending. Associated advantages of trusses include:

- Strong but light to erect
- Can be made to suit most roof shapes
- Less onsite fabrication, therefore less site labour and less effected by bad weather
- Factory production allows automated production Better quality control is possible
- Trusses make maximum structural use of the timber
- Trusses are capable of long spans Internal walls are usually non-load bearing therefore lighter weight internal walls are possible

1. TYPES OF TRUSS

They are mainly three types

a) Simple,

b) Compound,

c) Complex.

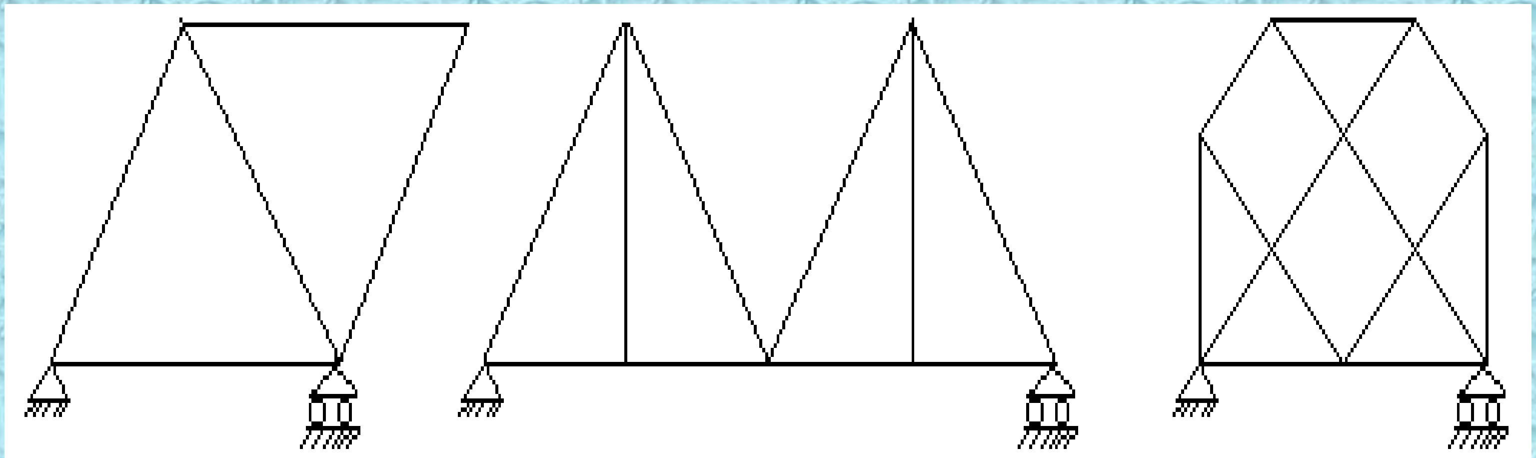
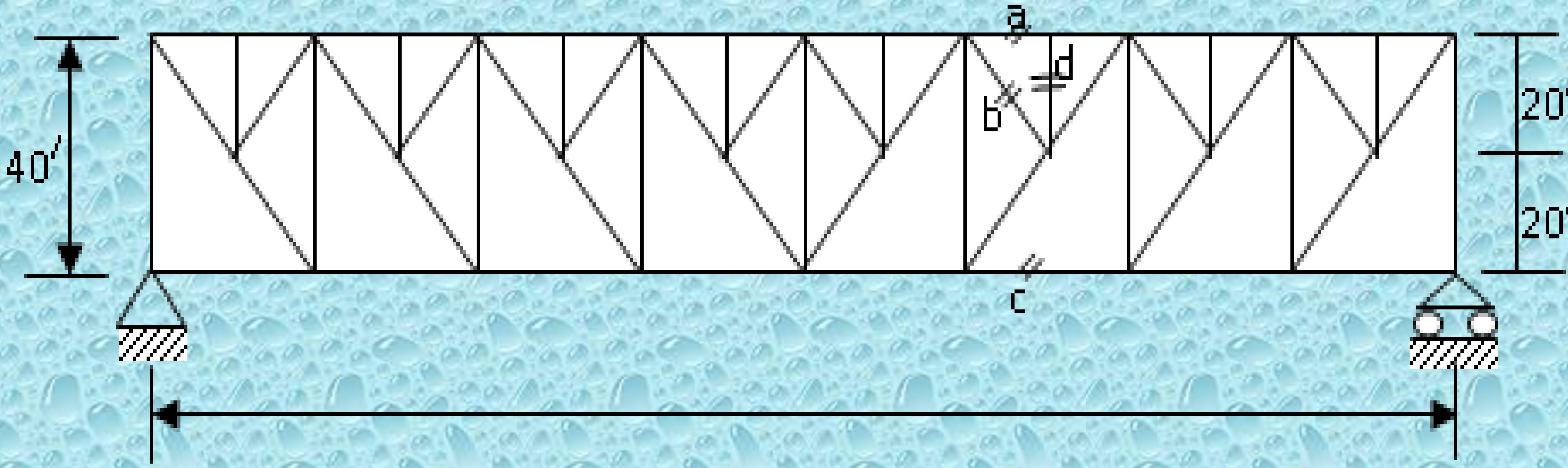
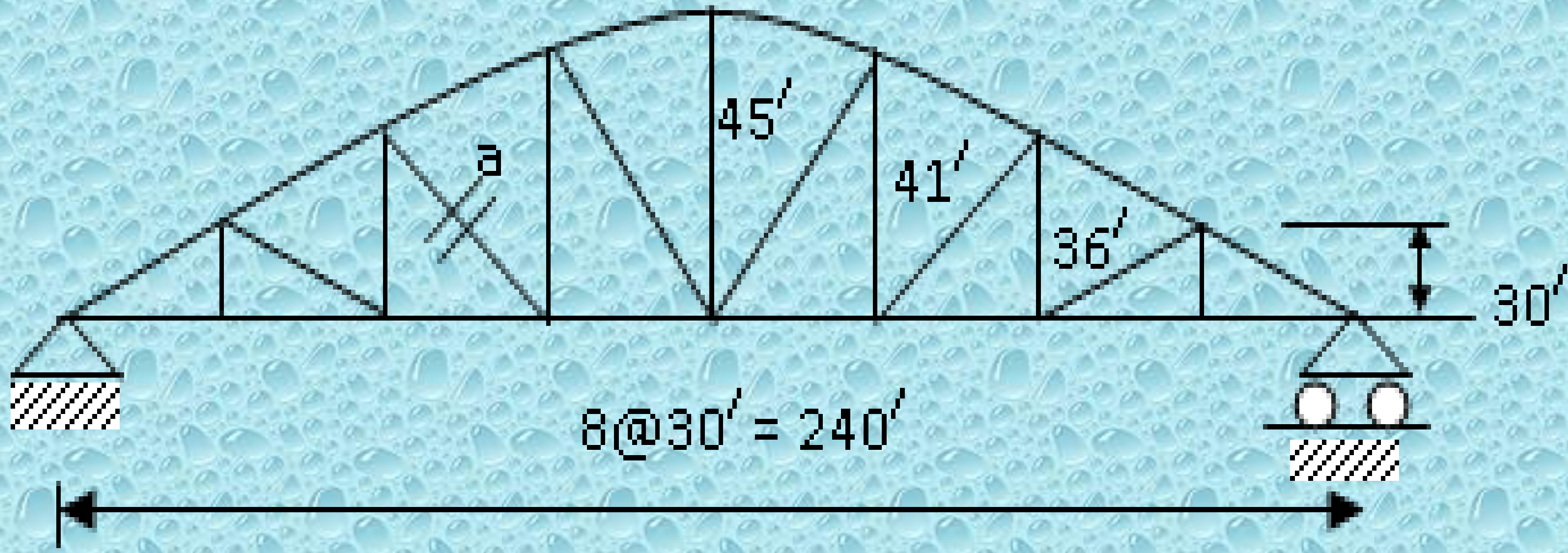


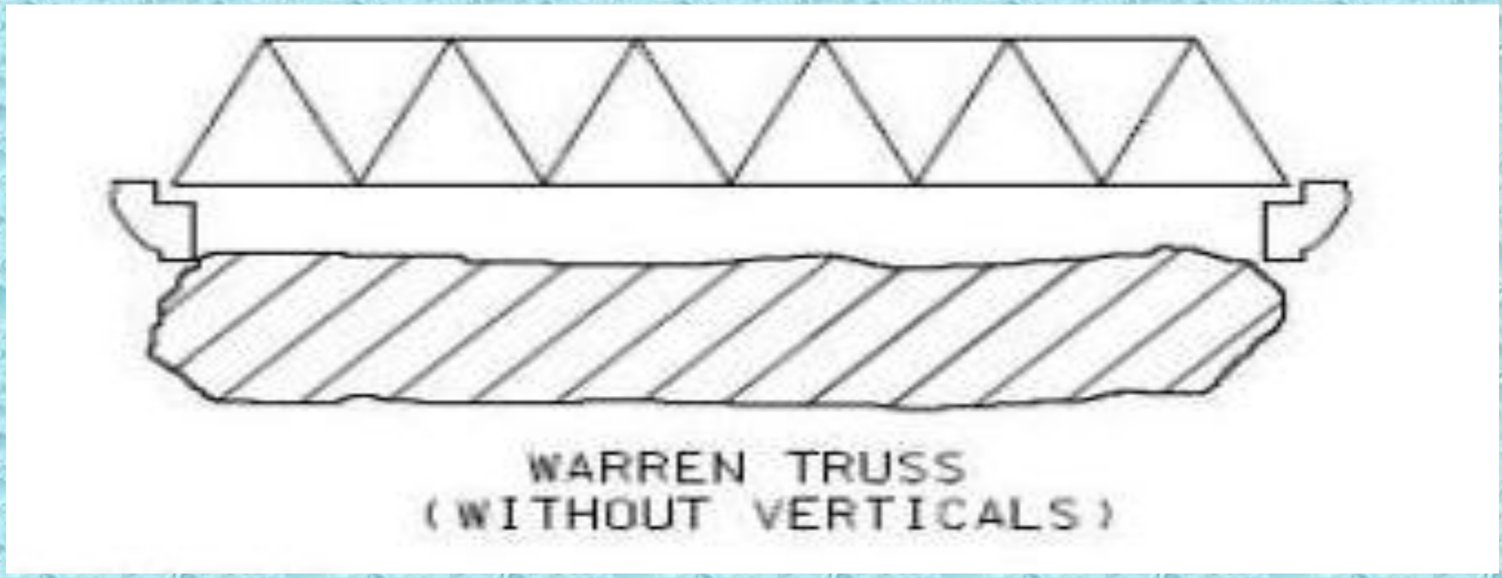
Fig. 1.1(a) simple truss Fig. 1.1(b) Compound truss Fig. 1.1(c) Complex truss

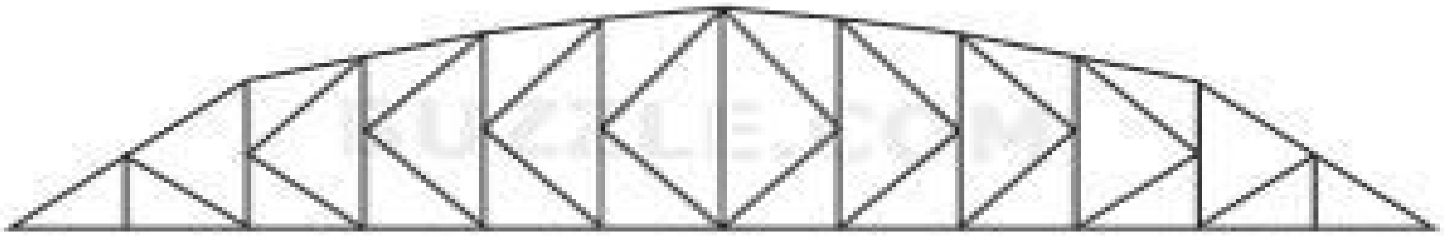
Equivalent loading for loaded lengths exceeding 60 ft.

1. Subdivided Trusses
2. Non-parallel Truss
3. Truss without vertical Truss
4. K-Truss



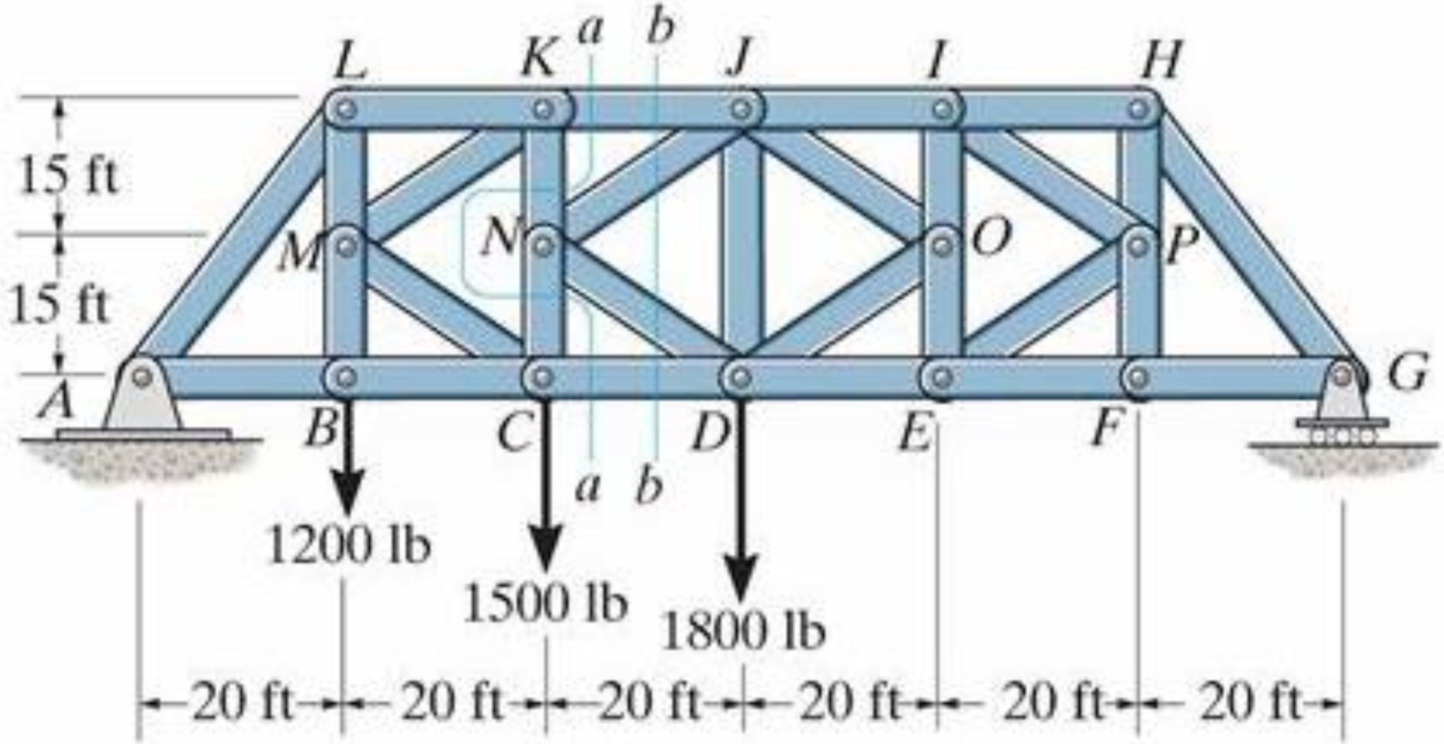

45′
41′
36′
30′
a
8@30′ = 240′


WARREN TRUSS
(WITHOUT VERTICALS)



KUZZLE.COM

K truss



L
K
a
b
J
I
H
15 ft
15 ft
M
N
O
P
A
B
C
D
E
F
G
a
b
1200 lb
1500 lb
1800 lb
20 ft
20 ft
20 ft
20 ft
20 ft
20 ft

Lane Loading:

Concentrated load

1. 18000 for moment
2. 26000 for shear

Uniform load 640 lbs. per linear foot of lane

H_{20} Loading

Lane Loading:

Concentrated load

1. 13500 for moment
2. 19500 for shear

Uniform load 480 lbs. per linear foot of lane

H_{15} Loading

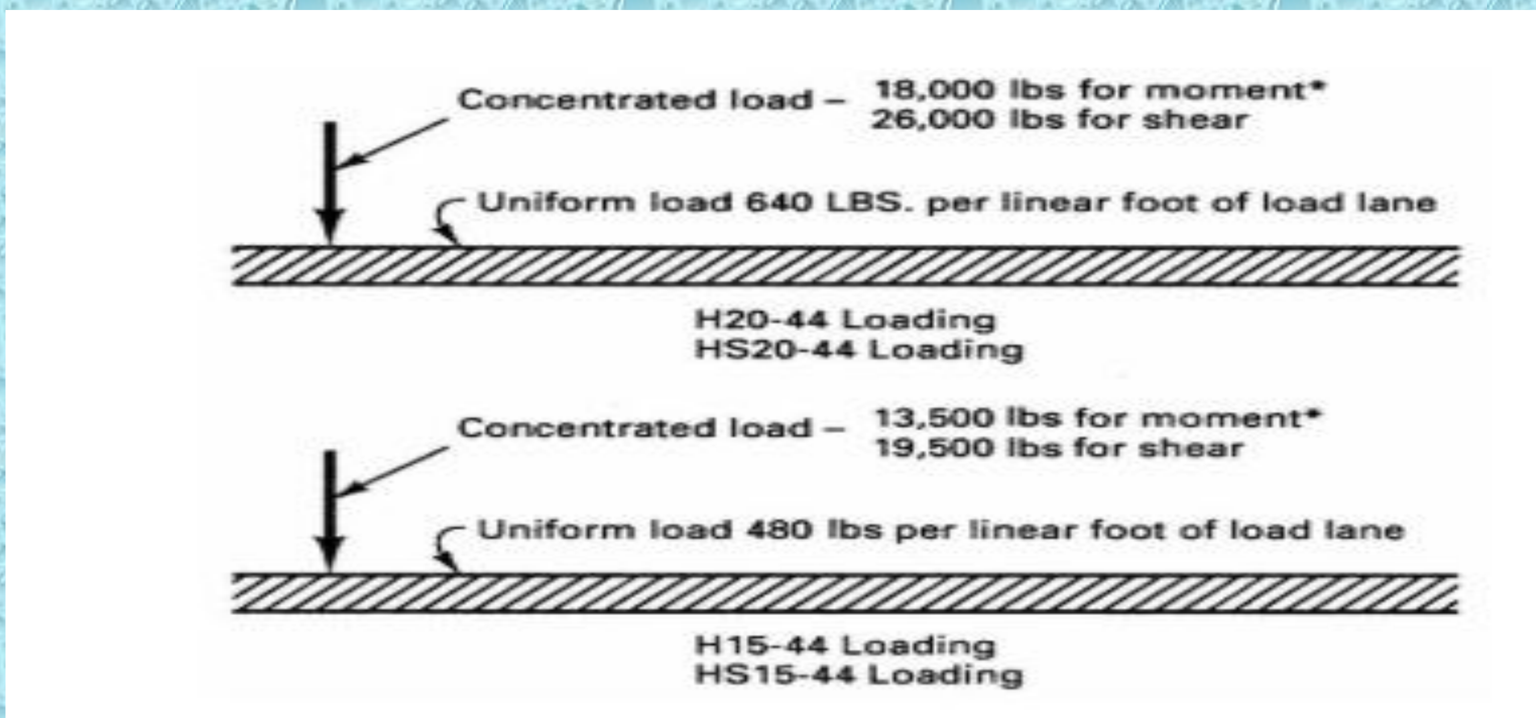
Lane Loading:

Concentrated load

1. 9000 for moment
2. 13000 for shear

Uniform load 320 lbs. per linear foot of lane

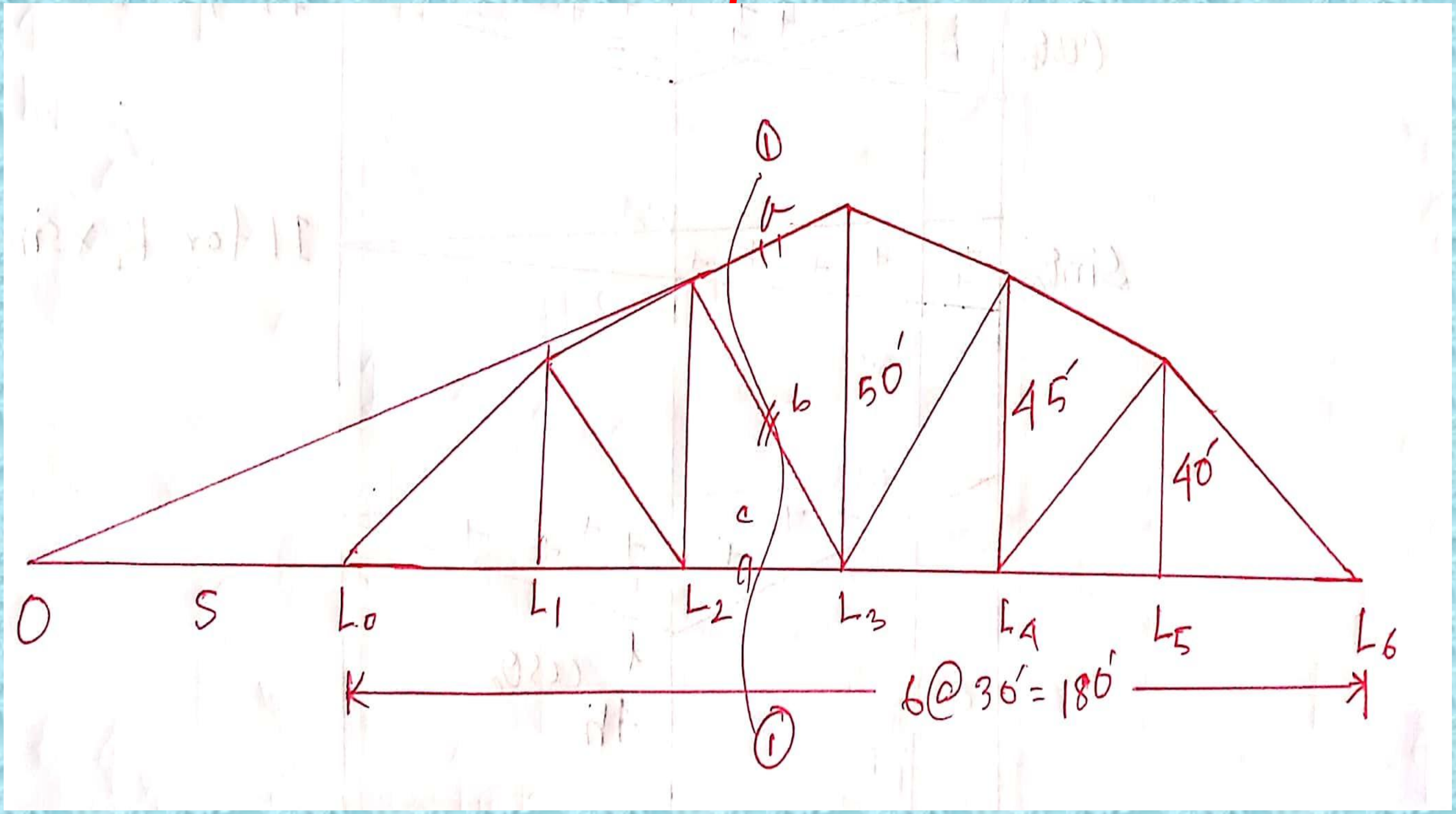
H10 Loading



Harding Bridges

Harding Bridges with train loading (Lane Loading:)

Draw the IL diagram for a, b, c, of the following structure.



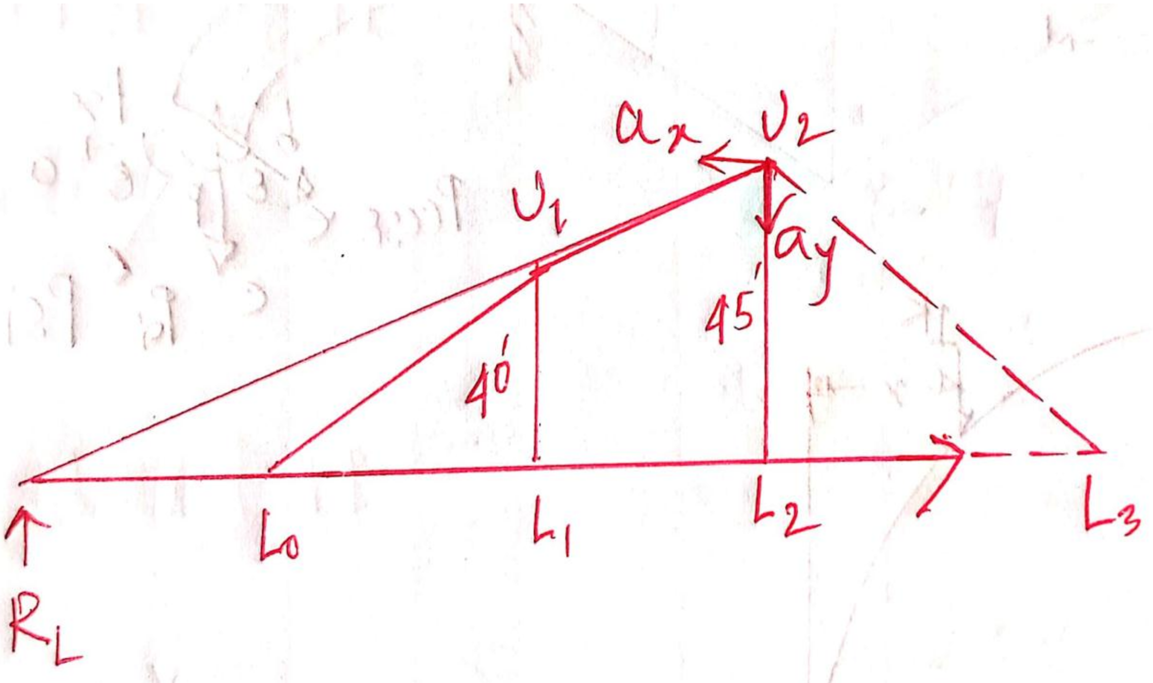
When the unit load at Lo,

R_L=1, R_R=0, a=b=c=0

When the unit load at L2,

R_{L}= 4/6 =.67

R_R =.33



$$\sum Mu2 = 0$$

C$\times 45 = .67 \times 60$

C=0.89

Similar triagle

$$\frac{50}{90+s} = \frac{45}{60+s}$$

S= 210

$$\sum Mu2 = 0$$

$$C\times 45 = .33 \times 120$$

C=0.88

$$\sum ML2 = 0$$

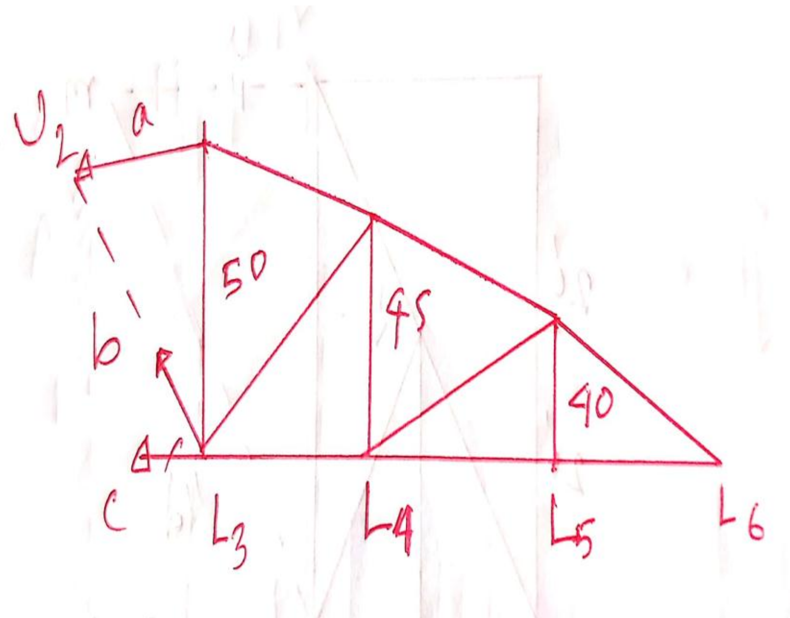
$$a\times 50 + .33 \times 90 = 0$$

50×.986×a+.33×90=0

A= - .60

$$\sum Fx = 0$$

-ax –bx-c=0



$-.986\times .60 - .55b - .88 = 0$

b=-.52

When unit load at L3

R_R=.5

$$\sum Mu2 = 0$$

C×45+1× 30=.5×120

C=.67

$$\sum ML3 = 0$$

50×.986a+.50×90=0

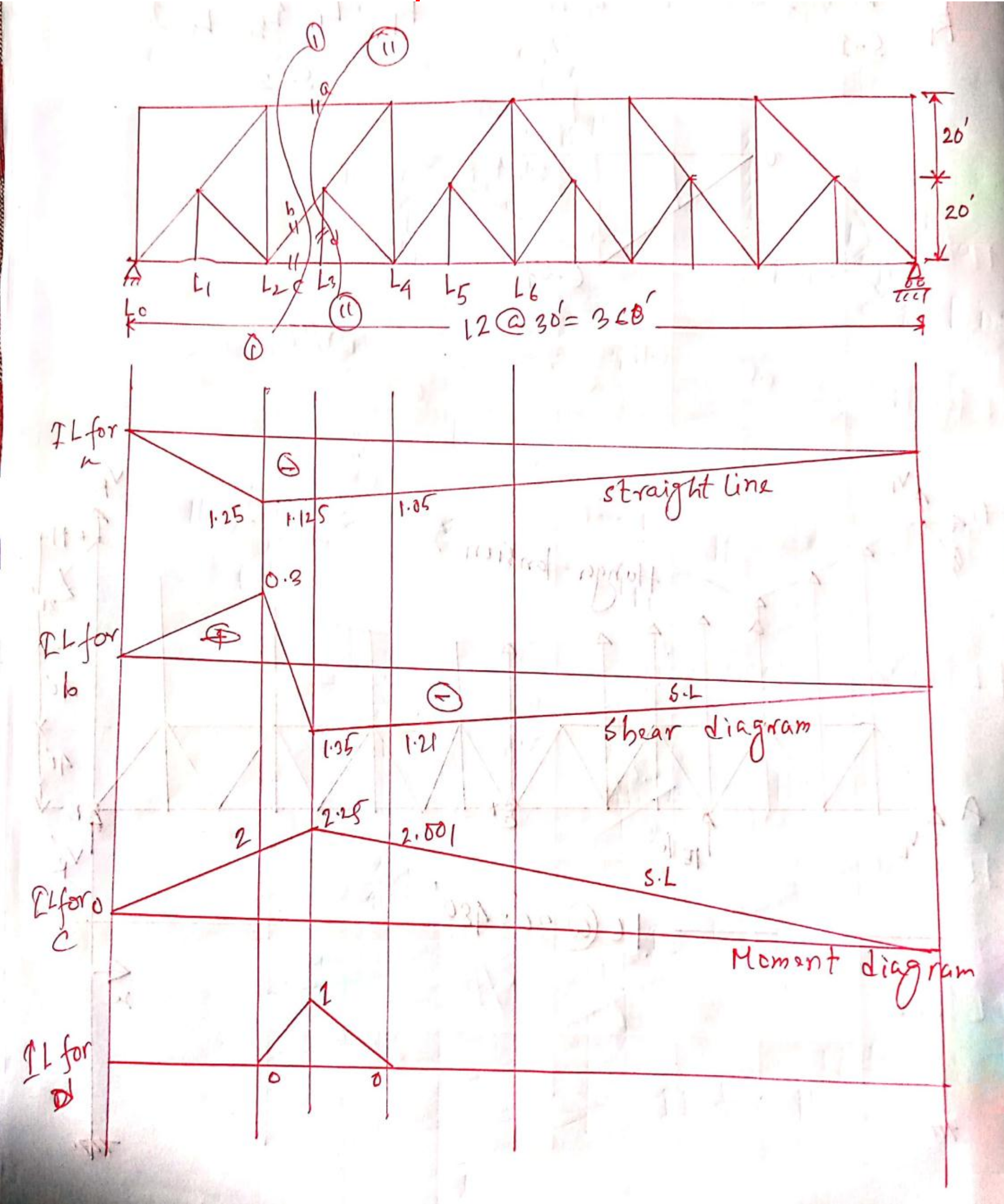
a=.91

$$\sum Fx = 0$$

$-.986\times (-.91) - .555\text{b} - .67 = 0$

b=.41

Draw IL diagram for member a, b, c, d also calculate minimum stress due to H20 loading of the same structures



Calculation:
When the unit load at Lo,
R=0, RR=0,
a=0 , b=0 ,c=0, d=0
When the unit load at L2,
RL=10/12=.83
RR=1/6
S-1,

$$\sum ML2 = 0$$

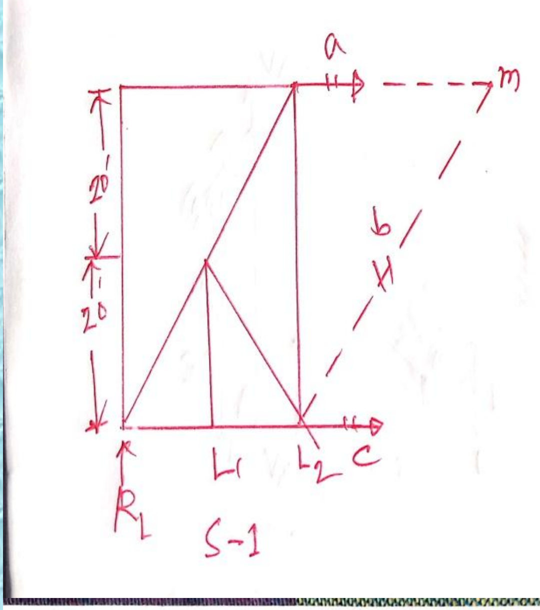
a* 40+$\frac{5}{6}$*60=0
a= -1.25

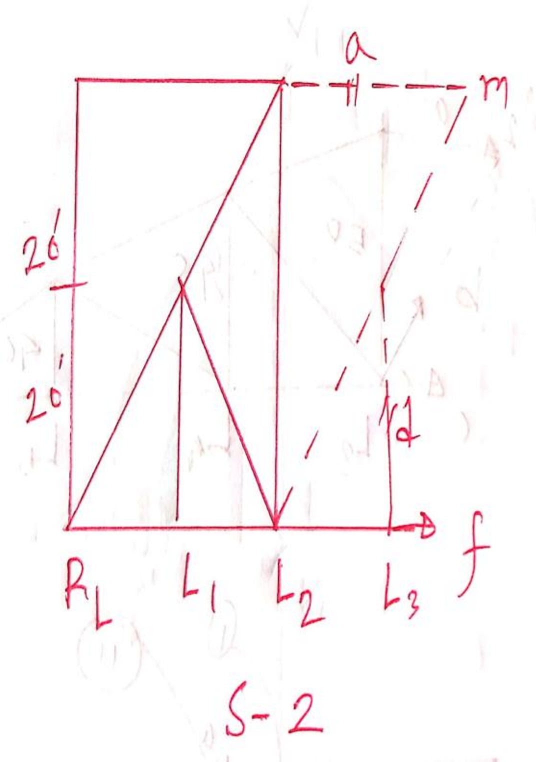
$$\sum Mm = 0$$

1*60+C*40= $\frac{5}{6}$*120
C=1

$$\sum Fy = 0$$

0.83+bsin33.70-1=0
b=.30





S-2

$$\sum ML2 = 0$$

.83*60-1.25*40= $d * 30$

d=0

When unit load at L3

RL=9/12= .75

RR=.25

S-1

$$\sum ML2 = 0$$

a*40+.75*60= 0

a= -1.125

$$\sum Mm = 0$$

C*40=.75*120

C=2.25

.75+bsin33.70-1=0

b= -1.35

S-2

$$\sum ML2 = 0$$

.75*60+1*30-1.125*40= $d * 30$

d=1

When unit load at L4,

RL=8/12=.67

RR=.33

S-1

$$\sum ML2 = 0$$

a*40+.67*60= 0

a= -1.005

$$\sum Mm = 0$$

C*40=.67*120

C=2.01

$$\sum Fy = 0$$

.67+bsin33.70-1=0

b= -1.21

S-2

$$\sum ML2 = 0$$

.67*60-1.005*40= $d * 30$

d=0

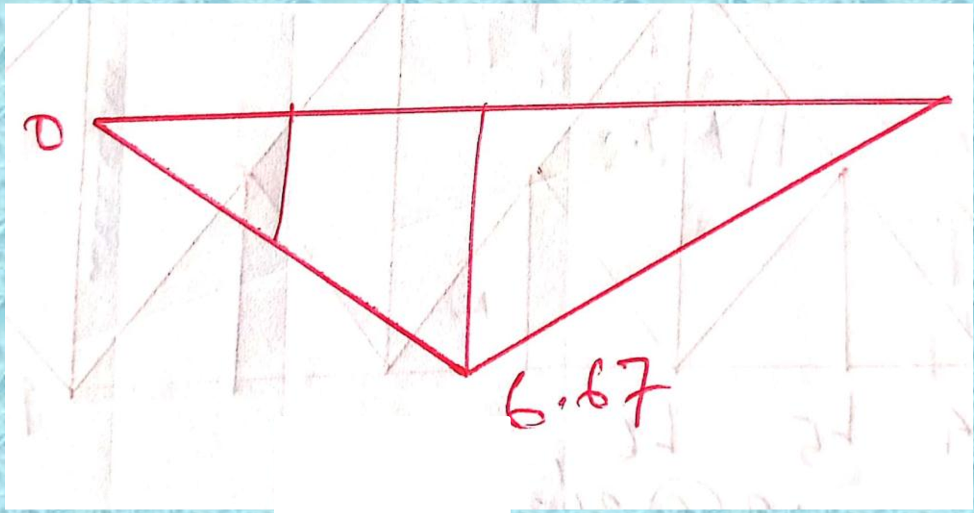
Maximum stress at member a=[.5*360*1.25]*.64+ 1.25*18
=310.5kips

Maximum stress at member b(-ve stress)=[.5*270*1.35+.5*24.54*1.35]*.64+ 1.35*26
=162.34kips

Maximum stress at member b(+ve stress)=[.5*60*.3+.5*5.45*.3]*.64+ .3*26
=14.08kips

Maximum stress at member c=[.5*360*2.25]*.64+ 2.25*18
=299.7kips

Maximum stress at member d=[.5*60*1]*.64+ 1*18
=37.2kips



6.67/10=
x/2
X=1.334

6.67/10=
x/5
X=3.335

Thanks All