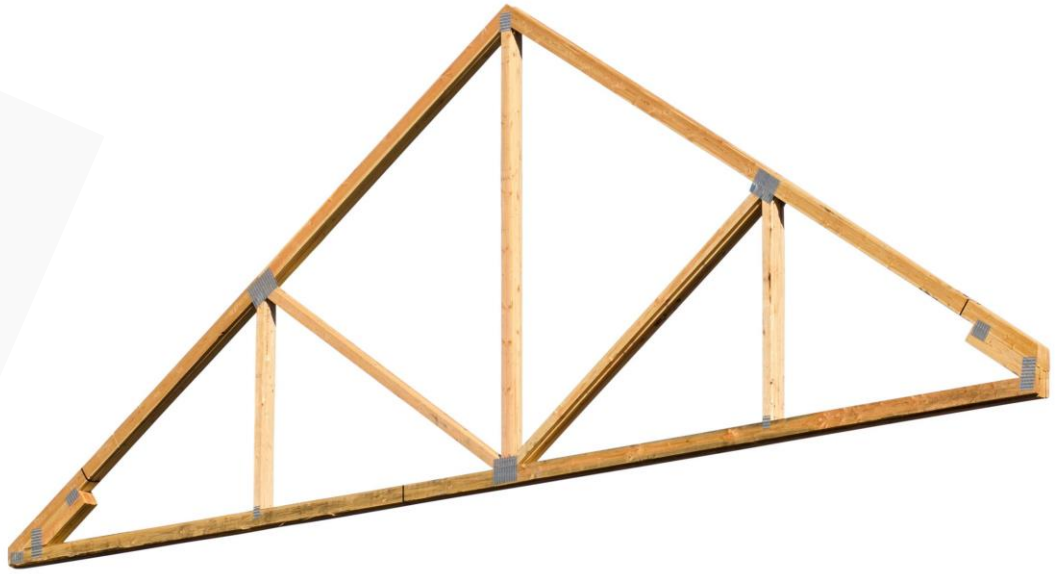
المحاضرة رقم / 9+10

مادة الميكانيك / المرحلة الأولى

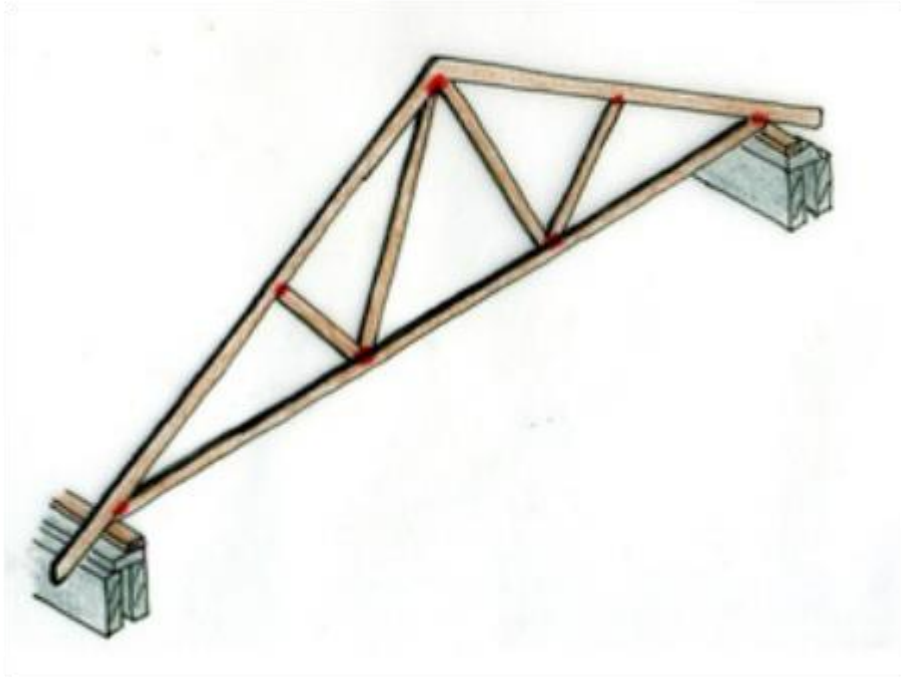
م.م. ميس خالد محمد

TRUSS ANALYSIS

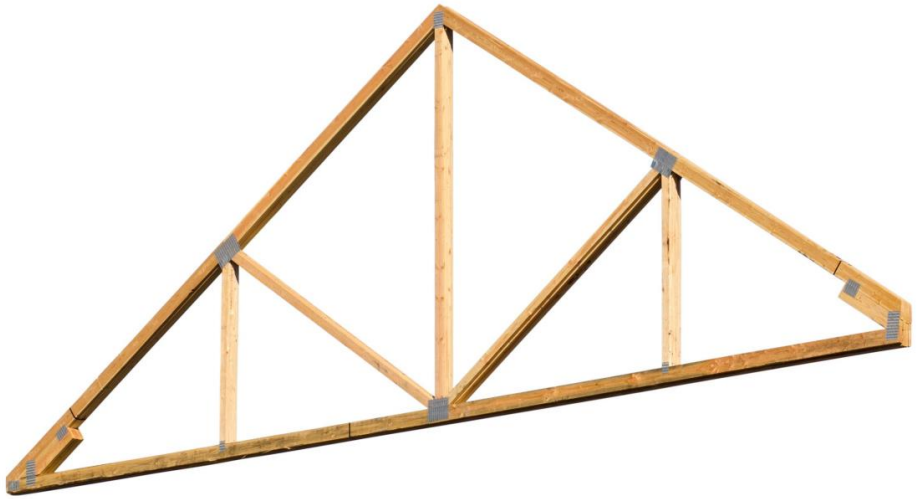


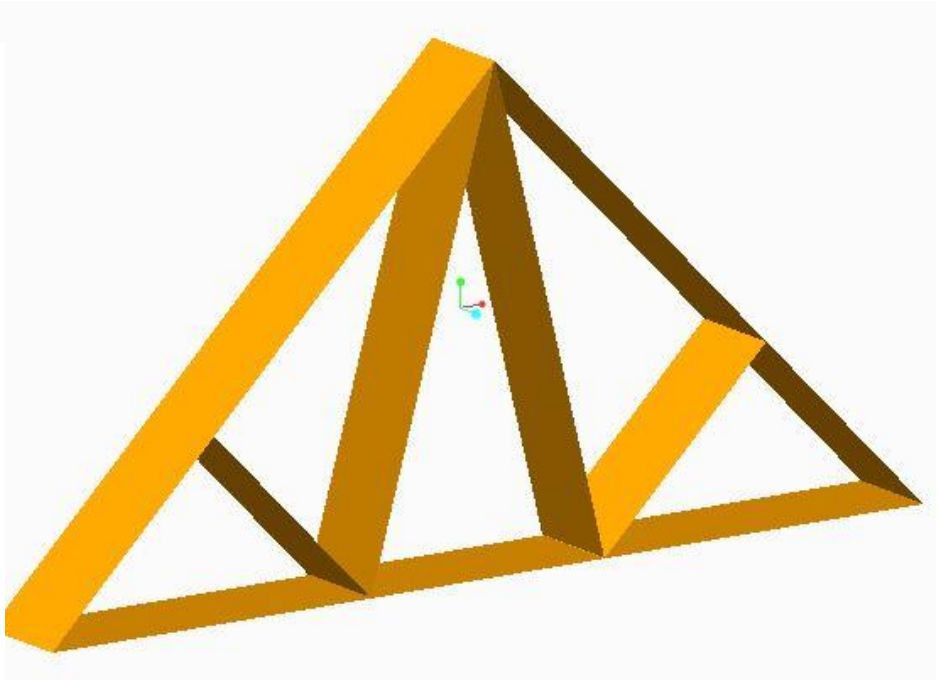
Introduction

- A truss is a structure that consists of members organized into connected triangles so that the overall assembly behaves as a single object. Trusses are most commonly used in bridges, roofs and towers.

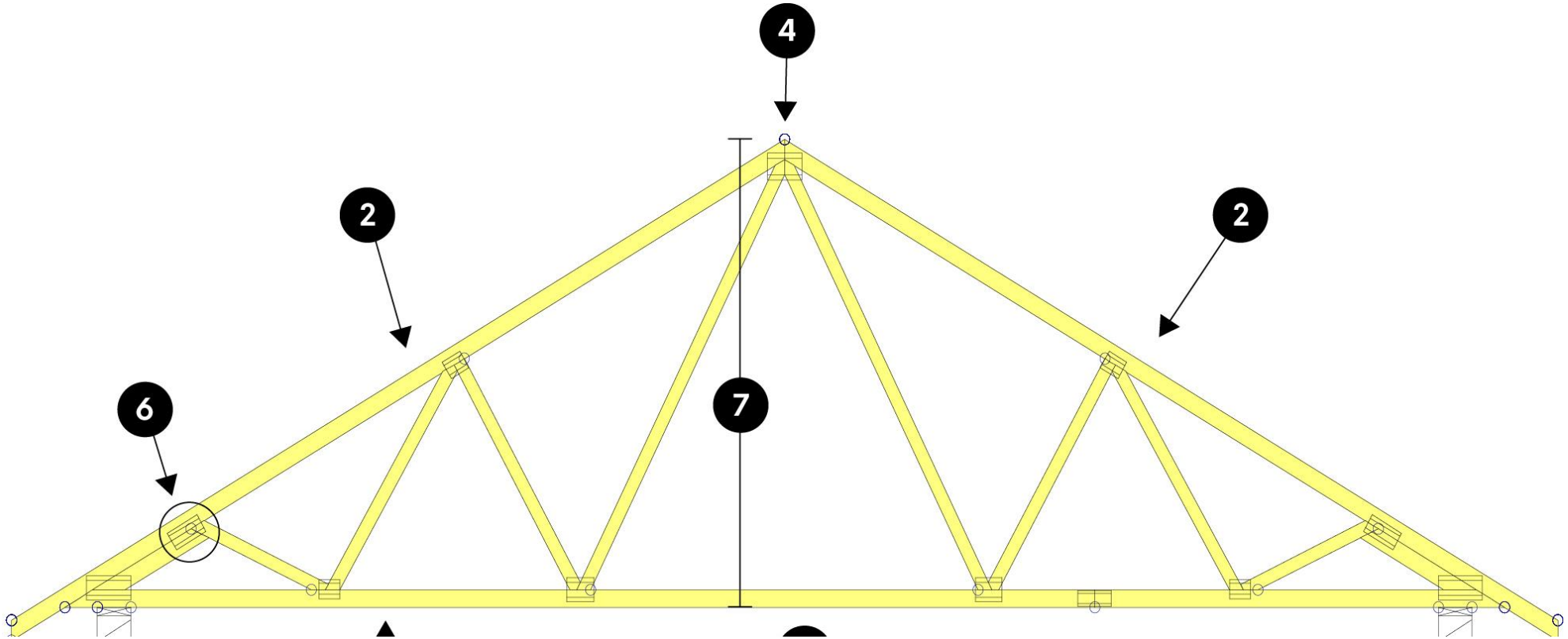


- A truss is made up of a web of **triangles** joined together to enable the even **distribution of weight and the handling of changing tension and compression without bending or shearing**. The triangle is **geometrically stable** when compared to a four (or more) -sided shape which requires that the corner joints are fixed to prevent shearing.





- Trusses consist of triangular units constructed with straight members. **The ends** of these members are **connected** at **joints**, known as nodes. They are able to carry significant loads, transferring them to supporting structures such as load-bearing beams, walls or the ground.

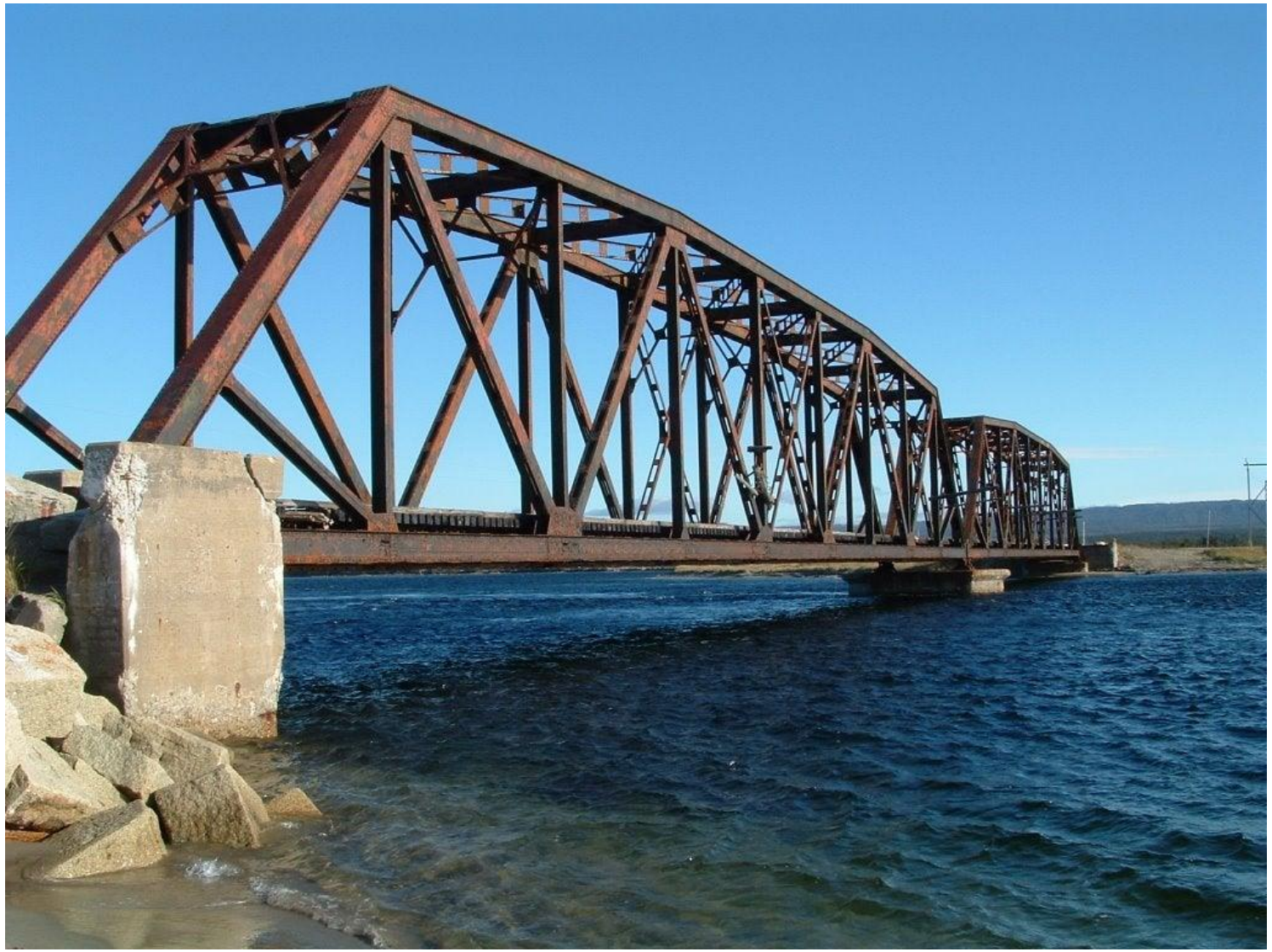


Truss – Assumptions

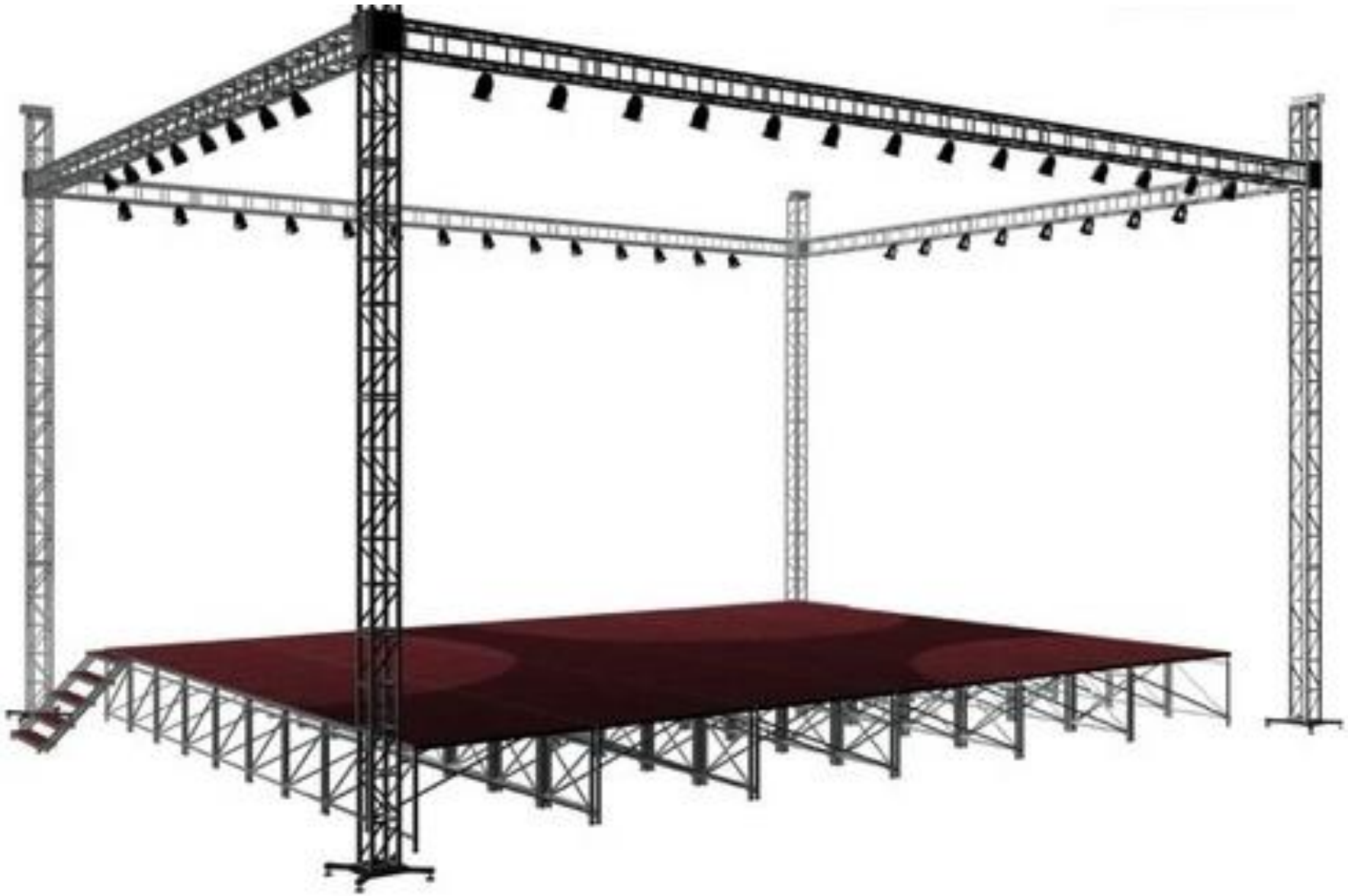
There are four main assumptions made in the analysis of truss

1. Truss members are connected together at their ends only.
2. Truss are connected together by frictionless pins.
3. The truss structure is loaded only at the joints.
4. The weights of the members may be neglected.

Truss examples



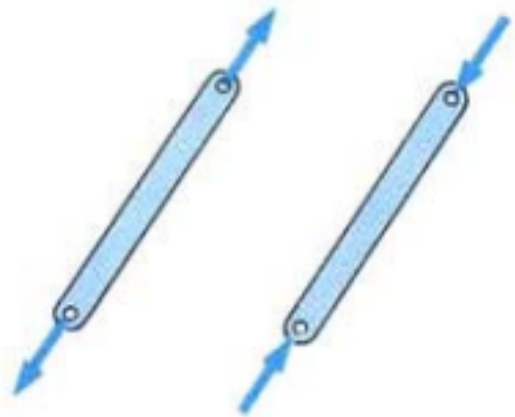

MOBILE HEALTH



Method of Joints -Truss

The method of joints uses the summation of forces at a joint to solve the force in the members. It does not use the moment equilibrium equation to solve the problem. In a two dimensional set of equations,

$$\sum F_x = 0 \qquad \sum F_y = 0$$

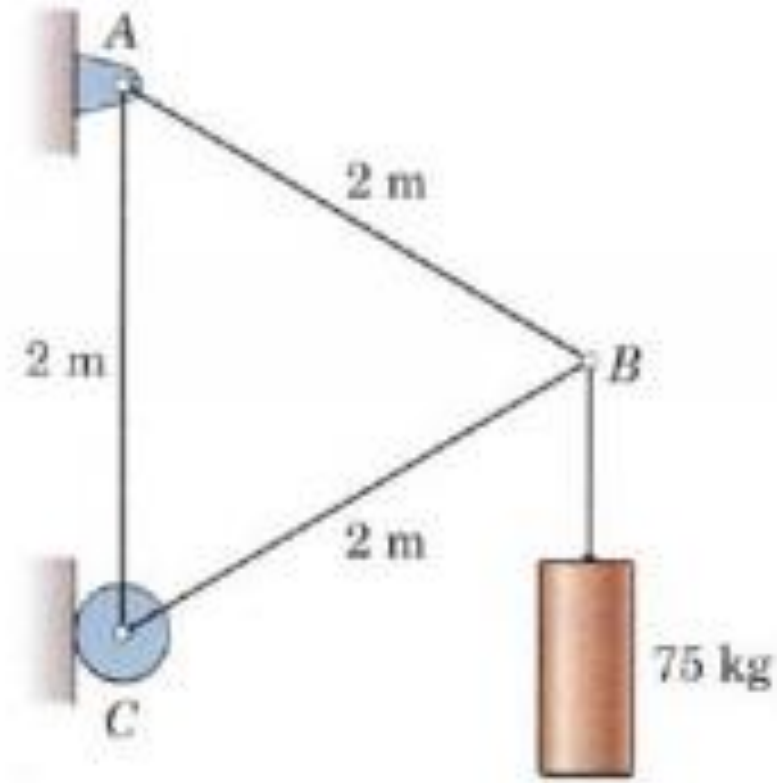


In three dimensions,

$$\sum F_z = 0$$

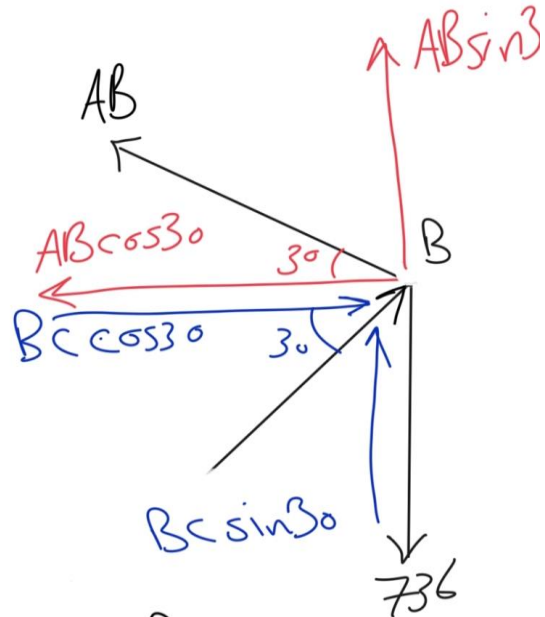
Determine the force in each member of the simple equilateral truss.

Ans. $AB = 736$ N T, $AC = 368$ N T, $BC = 736$ N C



Solution

at joint B //



$\Sigma F_x = 0$, $-AB\cos 30 + BC\cos 30 = 0$

$AB\cancel{\cos 30} = BC\cancel{\cos 30}$

$\therefore AB = BC$ ——①

$\Sigma F_y = 0$, $AB\sin 30 + BC\sin 30 - 736 = 0$ ——②

Sub ① in ②

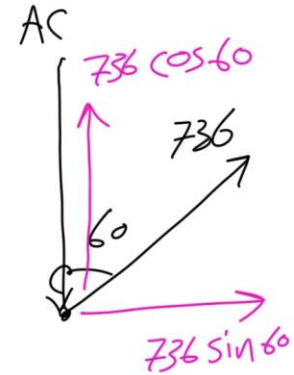
$AB\sin 30 + AB\sin 30 = 736$

$2AB\sin 30 = 736$

$AB = \frac{736}{2\times \sin 30}$

$\therefore AB = BC = 736\ N$.

at joint C //



$\Sigma F_y = 0$,

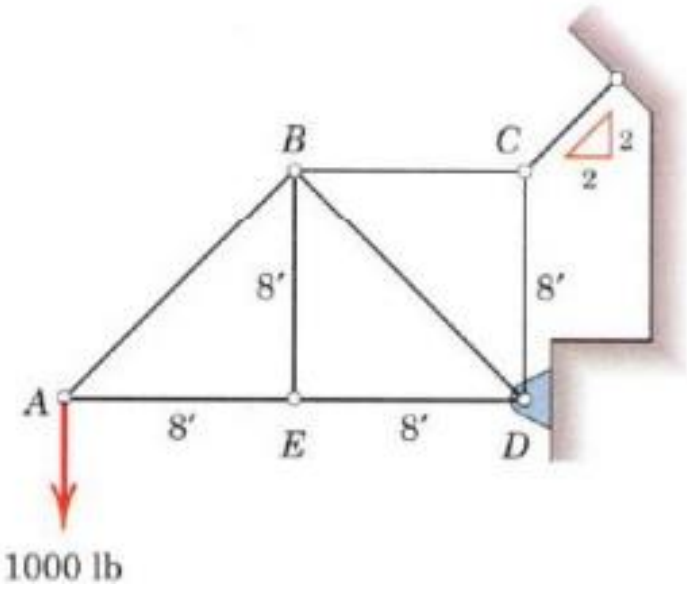
$736\cos 60 - AC = 0$

$AC = 736\cos 60$

$AC = 736 \times \frac{1}{2}$

$= 368\ N$

4/4 Calculate the forces in members *BE* and *BD* of the loaded truss.



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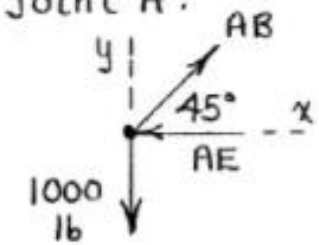
Joint A:



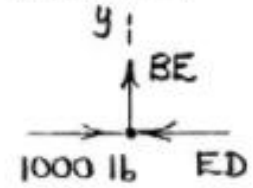
$\Sigma F_y = 0$: $AB \sin 45° - 1000 = 0$

$AB = 1414$ lb T

$\Sigma F_x = 0$: $1414 \cos 45° - AE = 0$

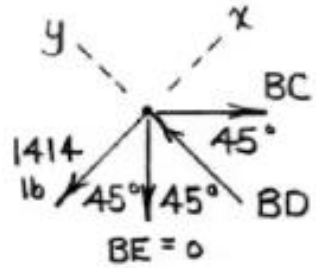
$AE = 1000$ lb C

Joint E:



$\Sigma F_y = 0$: $\underline{BE = 0}$

Joint B:



$\Sigma F_x = 0$: $BC \cos 45° - 1414 = 0$

$BC = 2000$ lb T

$\Sigma F_y = 0$: $BD - 2000 \cos 45° = 0$

$\underline{BD = 1414 \text{ lb C}}$

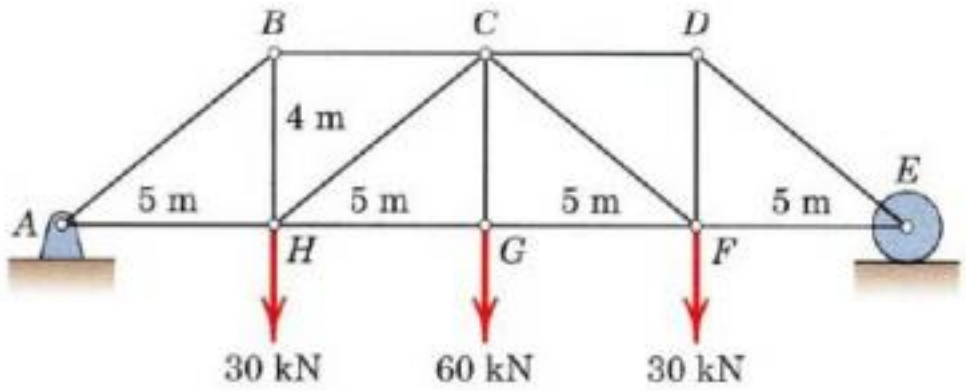
4/7 Determine the force in each member of the loaded truss. Make use of the symmetry of the truss and of the loading.

Ans. $AB = DE = 96.0$ kN C

$AH = EF = 75$ kN T, $BC = CD = 75$ kN C

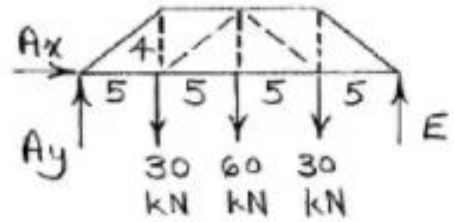
$BH = CG = DF = 60$ kN T

$CH = CF = 48.0$ kN C, $GH = FG = 112.5$ kN T

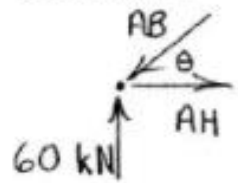


4/7 As a whole: $\Sigma F_x = 0 \Rightarrow A_x = 0$

(Dim. in m) $A_y = E = 60$ kN by $\Sigma F_y = 0$ and symmetry.



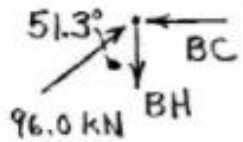
Joint A: $(\theta = \tan^{-1}(\frac{4}{5}) = 38.7°)$



$\Sigma F_y = 0$: $60 - AB\sin\theta = 0$, $AB = 96.0$ kN C

$\Sigma F_x = 0$: $AH - 96.0\cos\theta = 0$, $AH = 75$ kN T

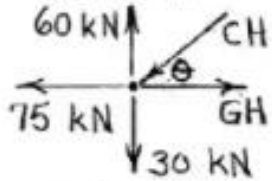
Joint B:



$\Sigma F_x = 0$: $-BC + 96.0\sin 51.3° = 0$, $BC = 75$ kN C

$\Sigma F_y = 0$: $-BH + 96.0\cos 51.3° = 0$, $BH = 60$ kN T

Joint H:



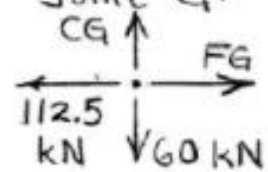
$\Sigma F_y = 0$: $-CH\sin\theta + 30 = 0$, $CH = 48.0$ kN C

$\Sigma F_x = 0$: $-48.0\cos\theta + GH - 75 = 0$

$GH = 112.5$ kN T

$\Sigma F_y = 0 \Rightarrow CG = 60$ kN T

Joint G:



By symmetry:

FG = 112.5 kN T, CF = 48.0 kN C

CD = 75 kN C, DF = 60 kN T

EF = 75 kN T, DE = 96.0 kN C