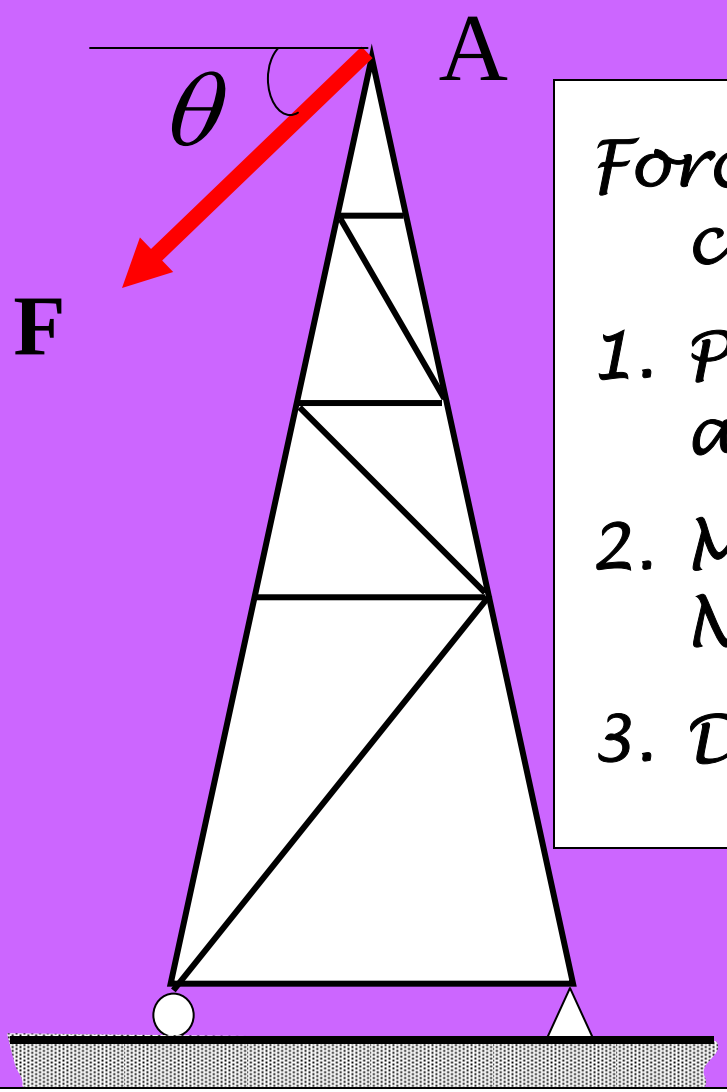
3.FORCE SYSTEMS

FORCE SYSTEMS

Characteristics of a Force

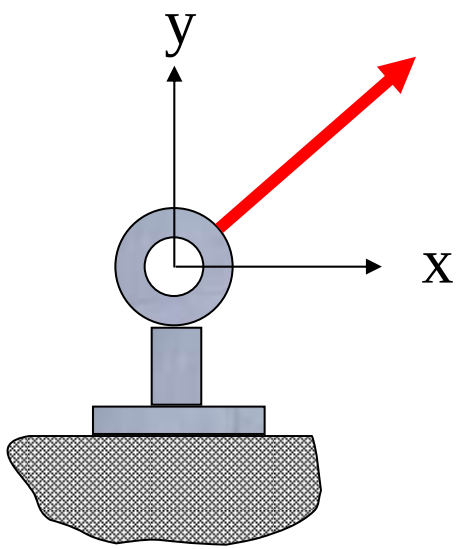


Force is characterized by

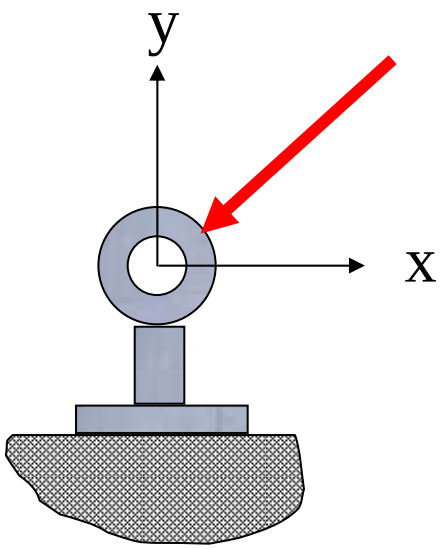
1. Point of application (A)
2. Magnitude (100 N)
3. Direction (from x-axis)

Objective: To bring out the characteristics of a Force as applied in Statics

Sense of Force



Tension

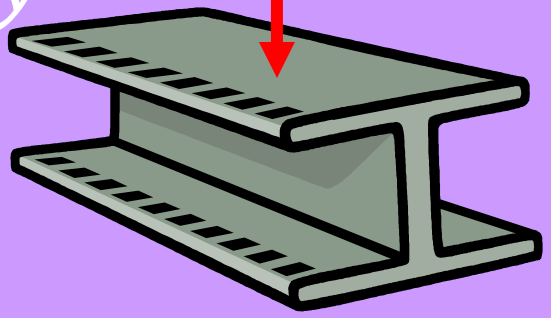


Compression

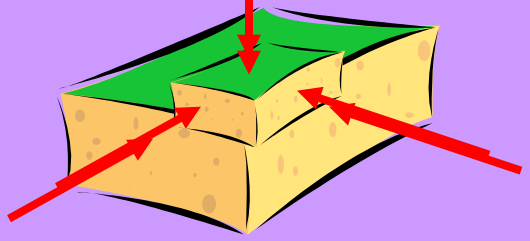
Objective: To bring out the two senses in which a Force can act

RIGID BODIES AND FLEXIBLE BODIES

Rigid Body



Steel, Wood, Concrete, Stone are rigid bodies, we neglect their deformation in Statics



Flexible Body

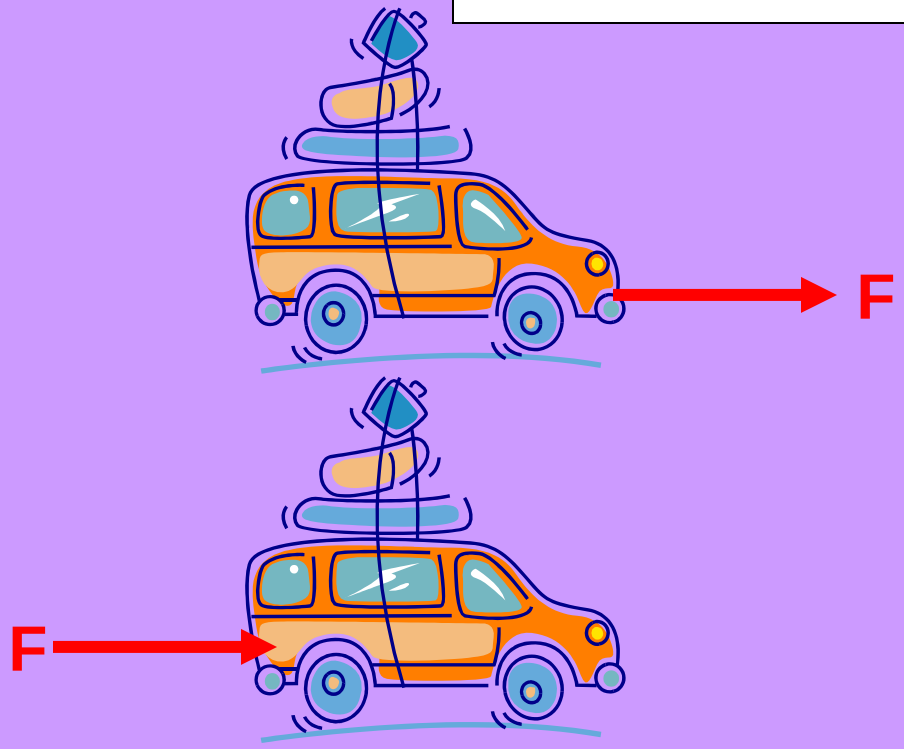
In Statics we deal with

Rigid bodies alone

Foam is Flexible material, which undergoes large deformations under loading

Objective: To bring out the difference between a Rigid Body and a Flexible Body

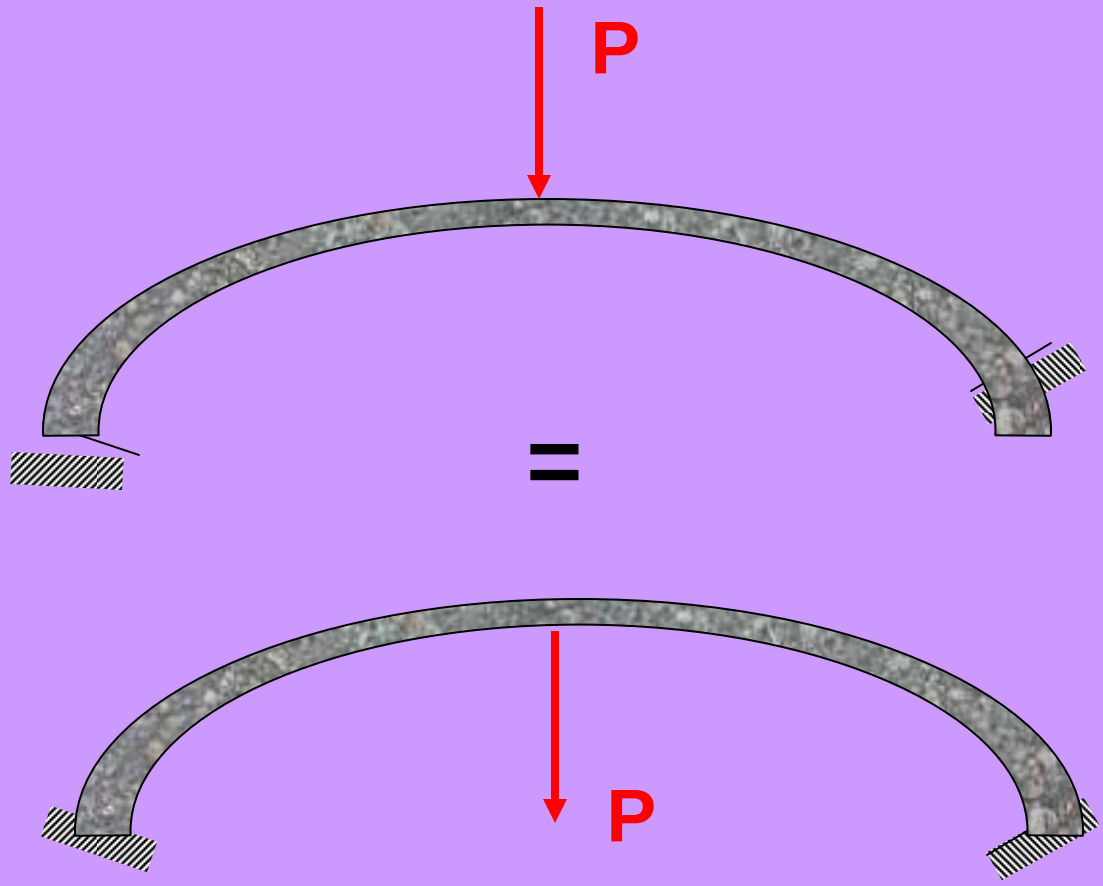
Transmissibility



Hence Pulling is equal to Pushing, provided the Forces are on the same horizontal line (same line of action)

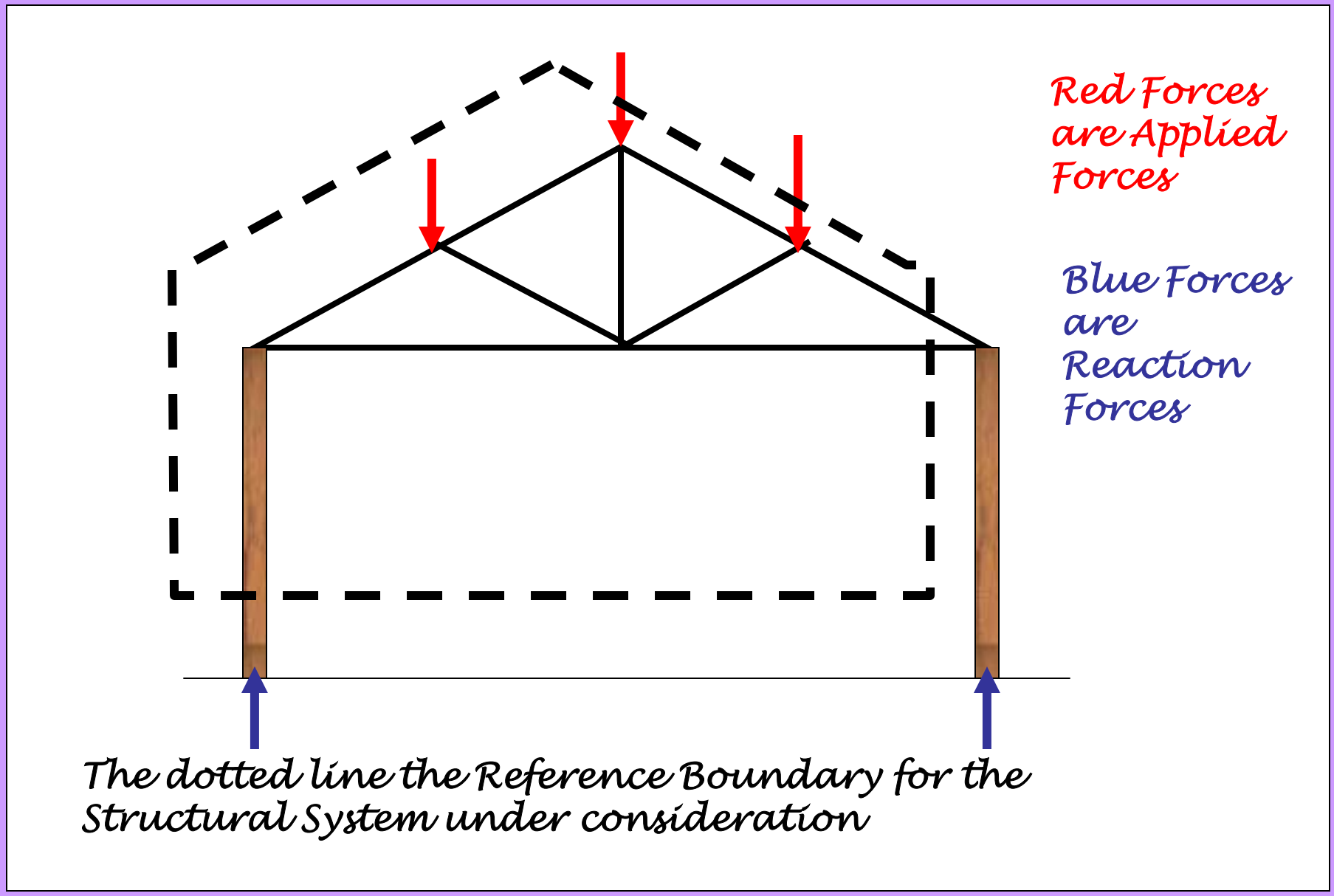
This is known as the Principle of Transmissibility

Objective: To explain the concept of Transmissibility

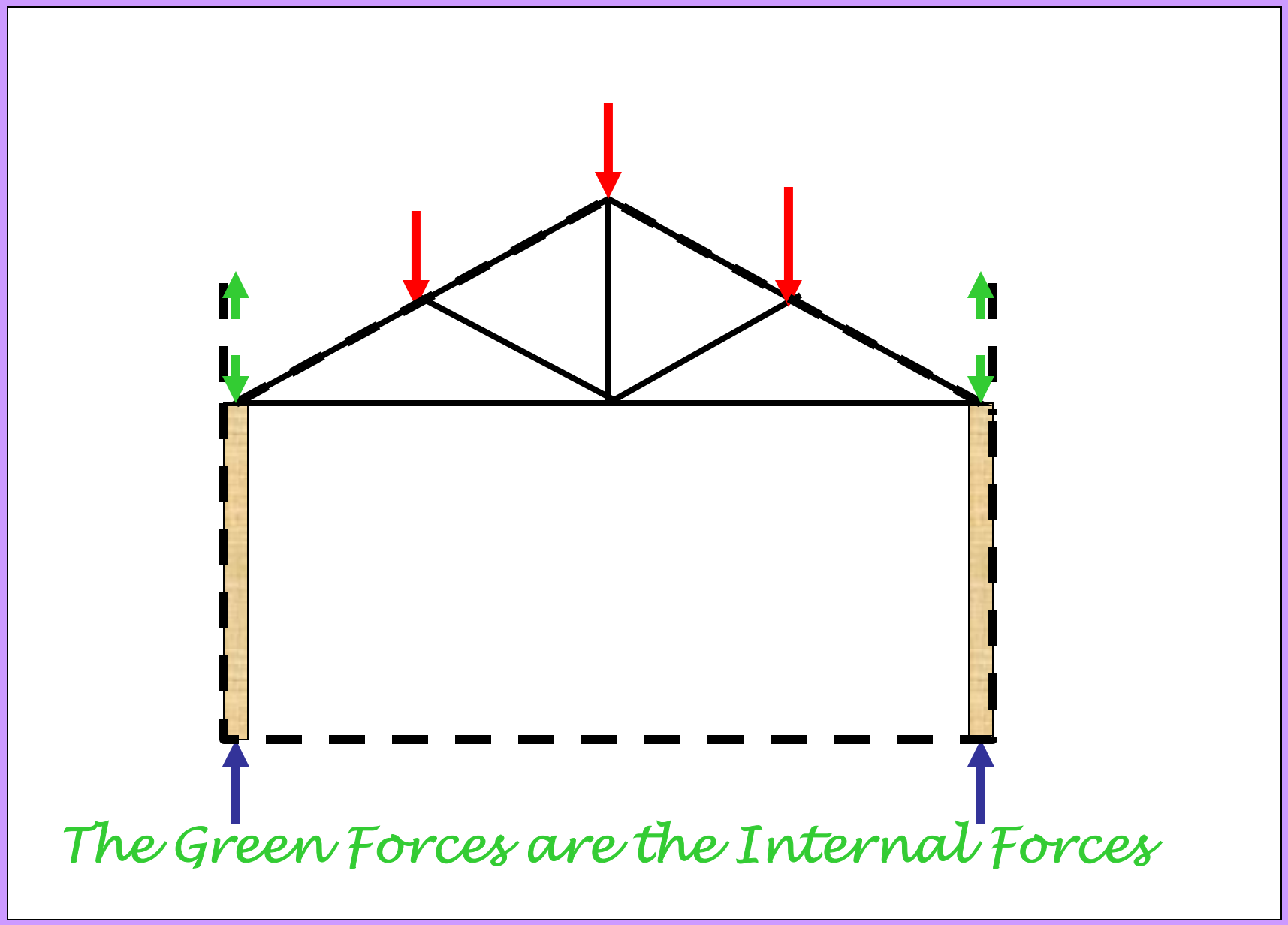


From the viewpoint of Statics, the Arch which is loaded on the top is equivalent top the arch which is loaded from beneath - this is an application of the principle of Transmissibility

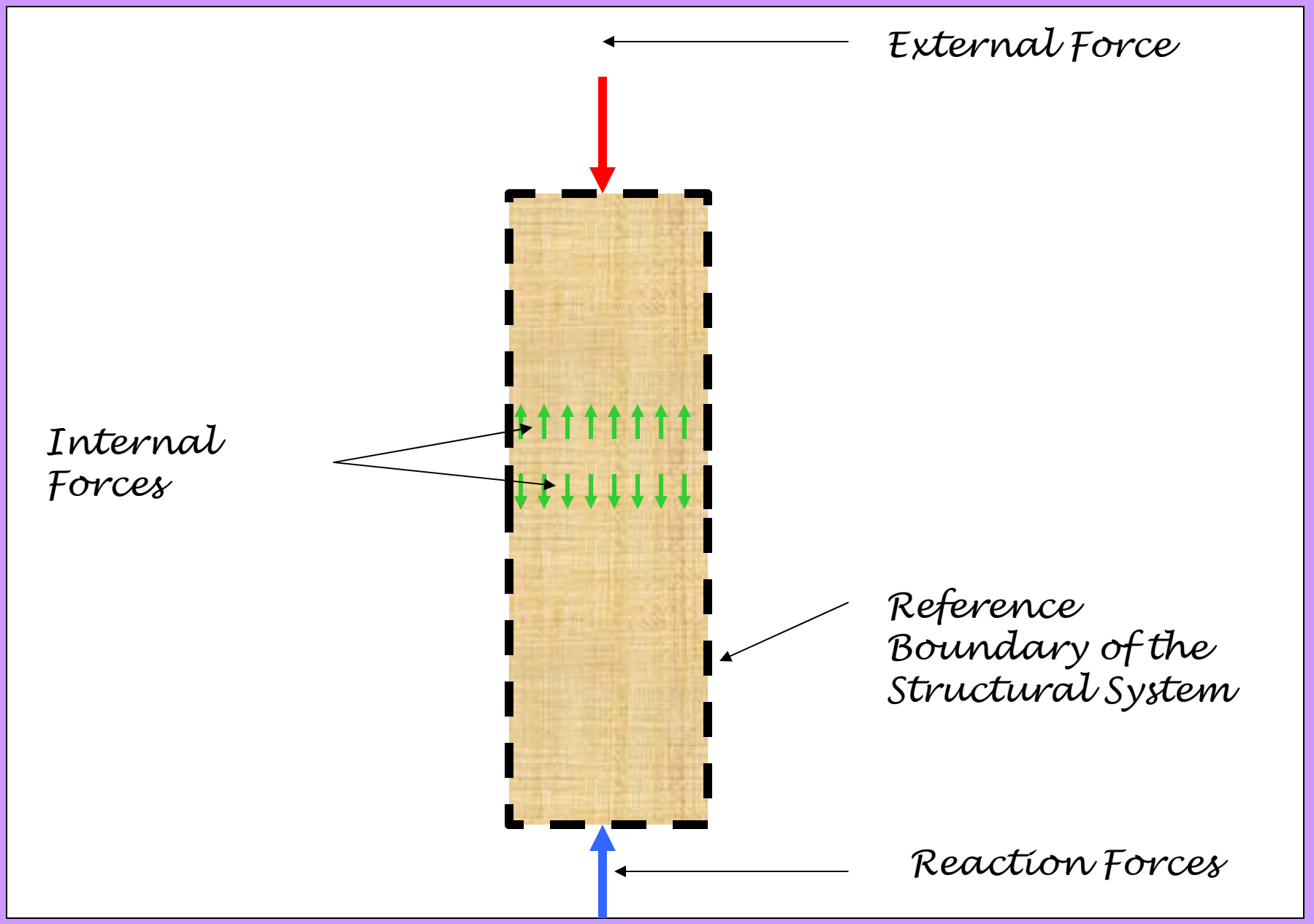
Objective: An example which illustrates the principle of Transmissibility



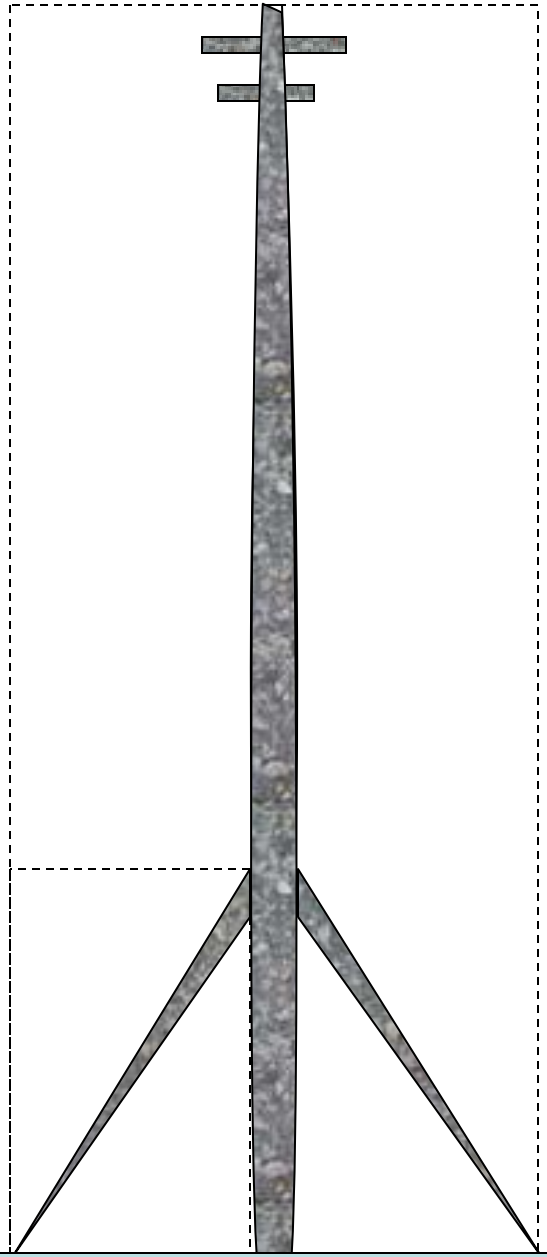
Objective: To describe, System Boundary, Applied Forces and Reaction Forces



Objective: To describe Internal Forces



Objective: An example to illustrate: System Boundary, External ,Reaction & Internal Forces



CONCLUSIONS

1. The System boundaries can be defined arbitrarily
2. What the Applied Forces, the Reaction Forces and the Internal Forces are, will be clarified accordingly

Objective: To explain the idea that the System Boundary is defined, depending on the portion of the structure one wishes to focus on

Vector Addition

Characteristics of a Vector

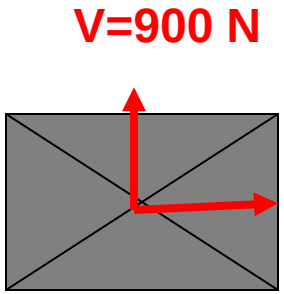
An important characteristic of vectors is that they must be added according to the parallelogram law . This is necessary because vectors have both magnitude and direction .

Using parallelogram law, we may add vectors graphically or by trigonometric relationships.

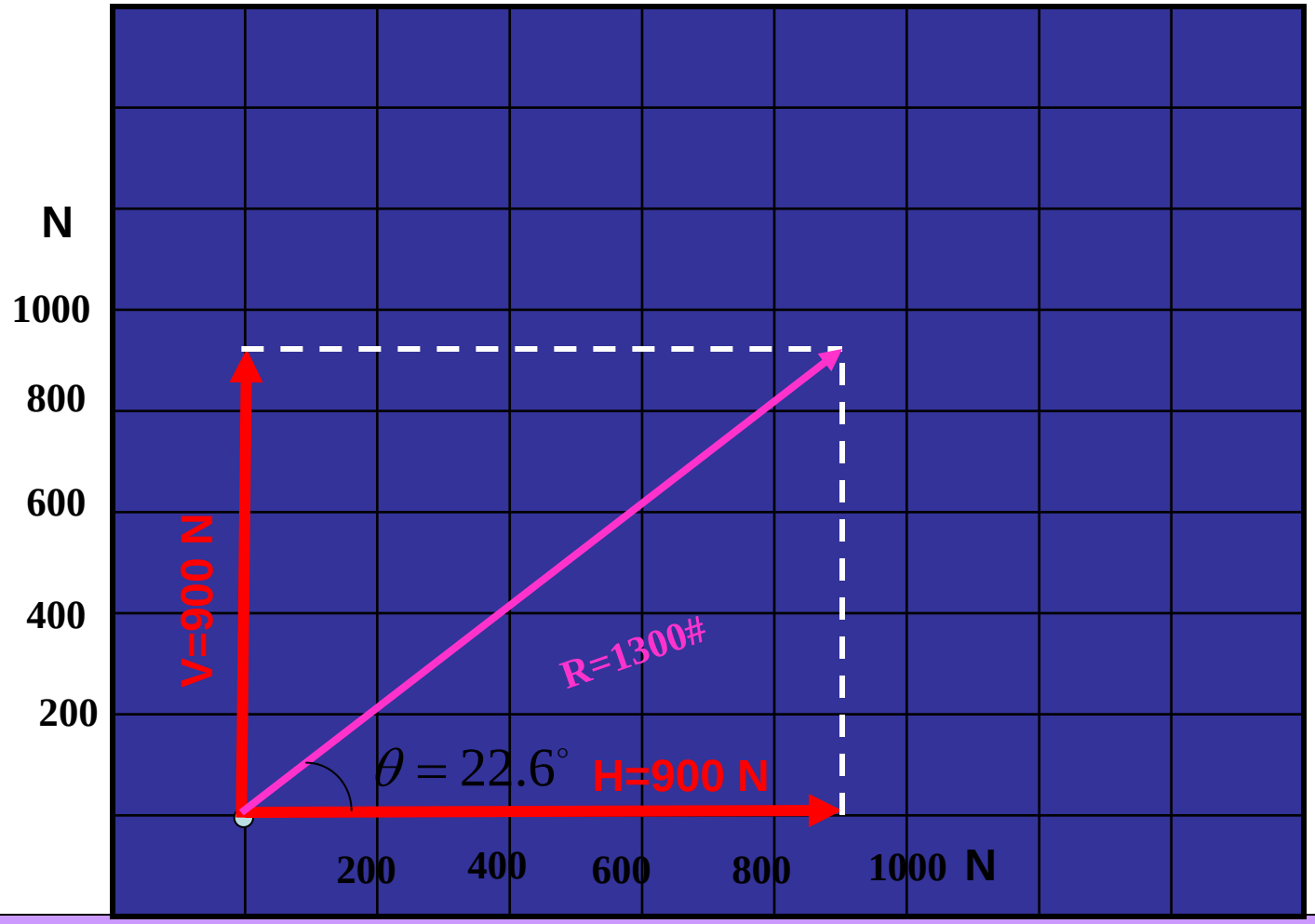
First we will see the graphical method and then the trigonometric method.

Objective: To explain how Vectors can be added graphically

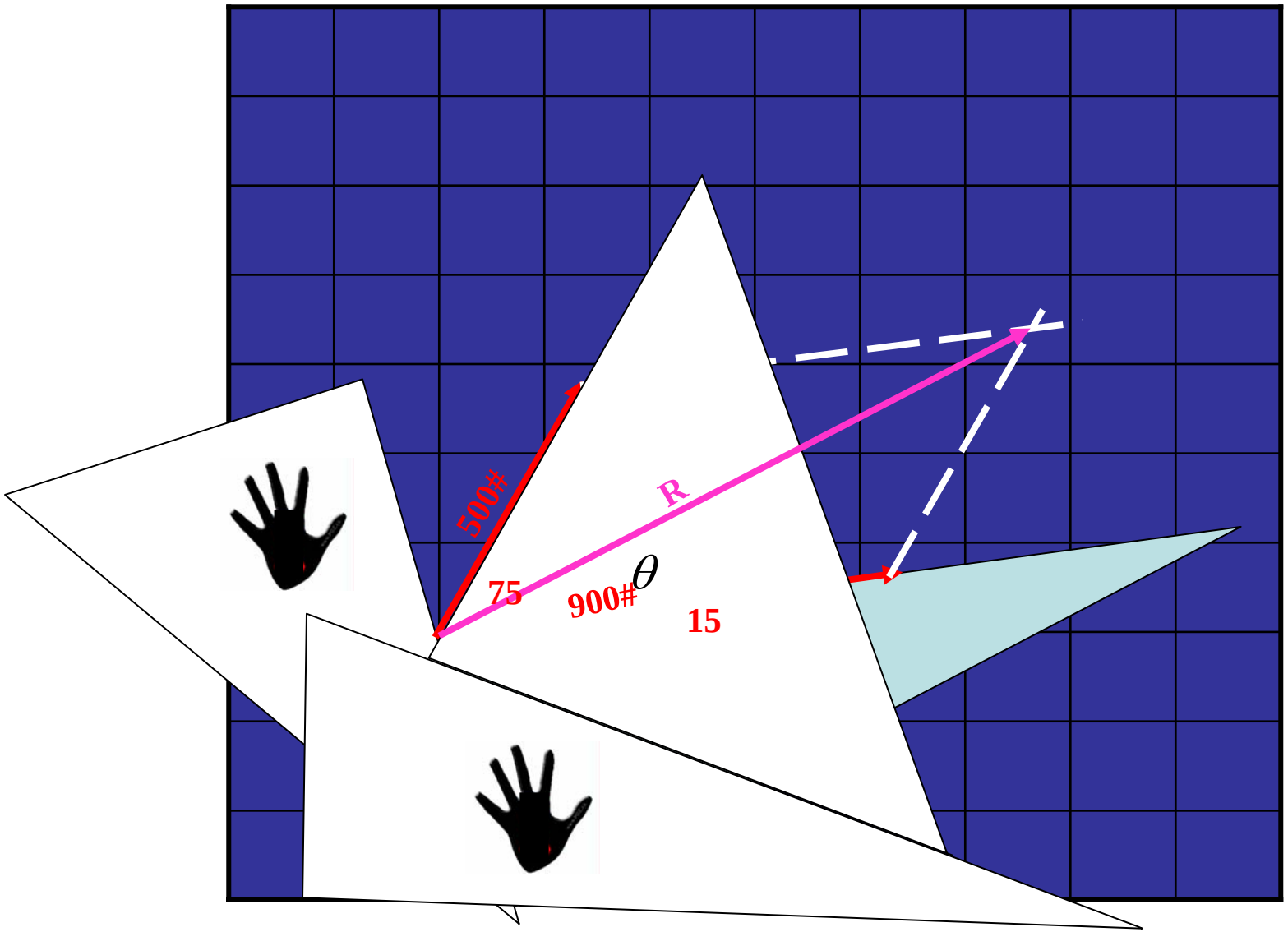
PARALLELOGRAM LAW OF VECTOR ADDITION



A box is being pulled up by a Force of 900 N and pulled to the right with a Force of 900 N. We want to know the Resultant.



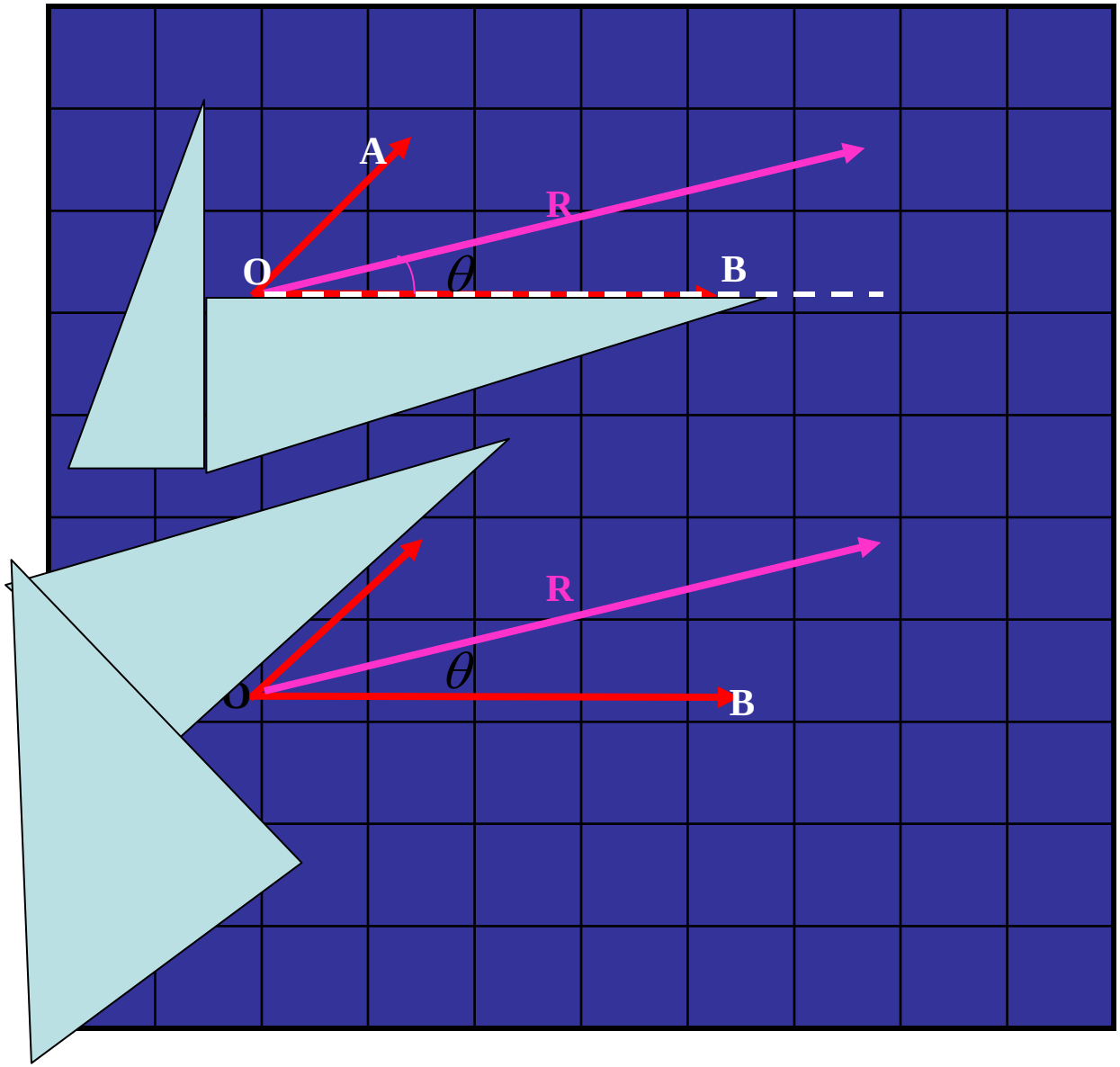
PARALLELOGRAM LAW OF ADDITION OF VECTORS



Objective: To illustrate the parallelogram method of addition of vectors using triangles

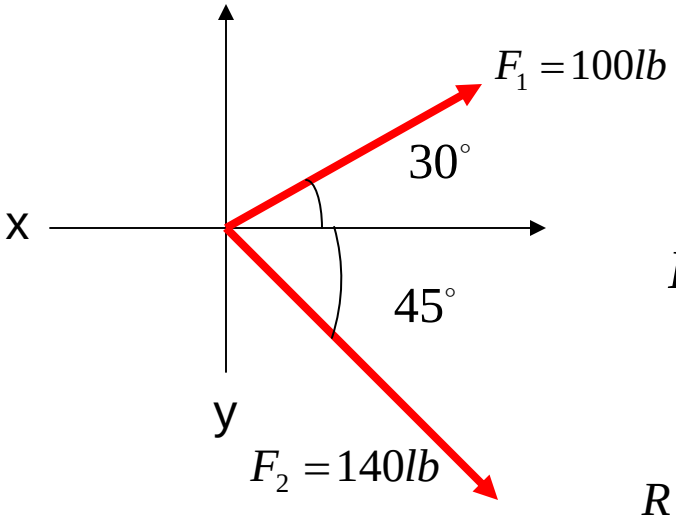
TIP –TO – TAIL METHOD

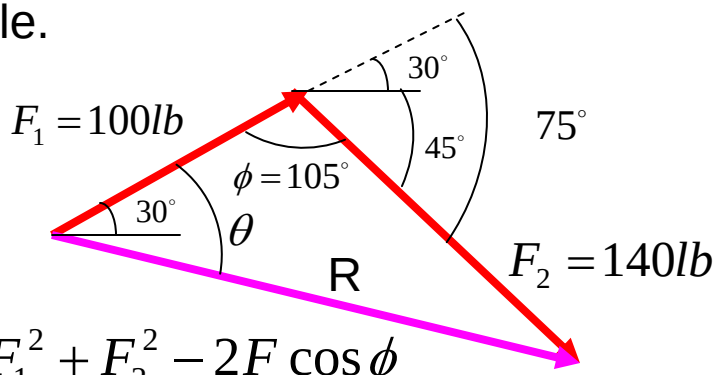
Another Method of Vector Addition



Determining the Resultant by Analytical Method.

Sometimes it is more convenient to determine the Resultant by using the cosine law as shown in the following example.





$$R^2 = F_1^2 + F_2^2 - 2F\cos\phi$$

$$= 100^2 + 140^2 - 2(100)(140)(-0.259)$$

$$= 192lb$$

$$\frac{R}{\sin 105^\circ} = \frac{F_2}{\sin\theta}$$

$$\sin\theta = \frac{F_2 \sin 105^\circ}{R}$$

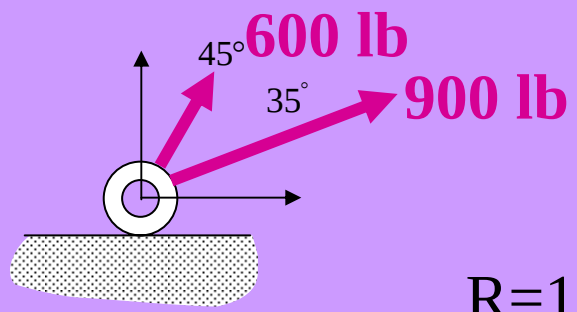
$$= \frac{140 \times 0.966}{192}$$

$$= 0.704$$

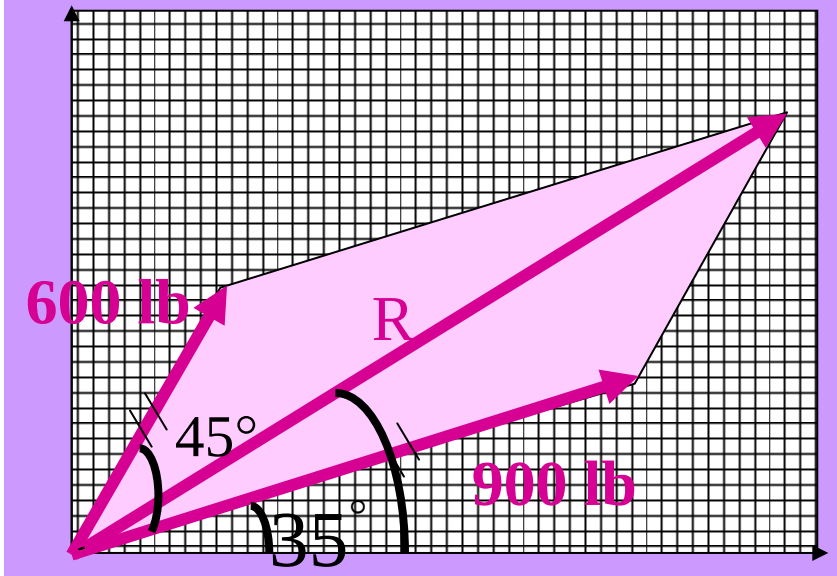
$$\theta = \sin^{-1}(0.704)$$

$$= 44.8^\circ$$

VECTOR ADDITION

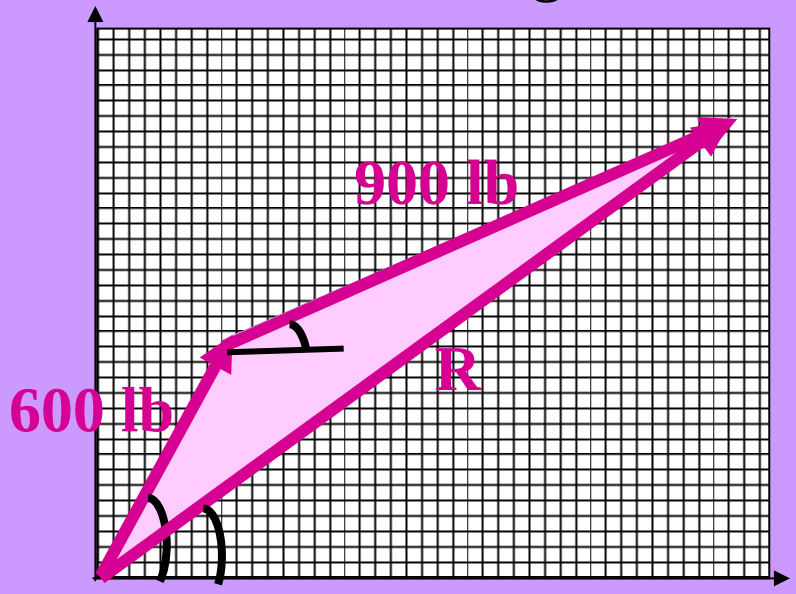


R= 1413 lb, Angle=50.8



Parallelogram Method

R=1413 lb, Angle=50.8



Tip-to-tail method

Graphical addition of Three or More Vectors