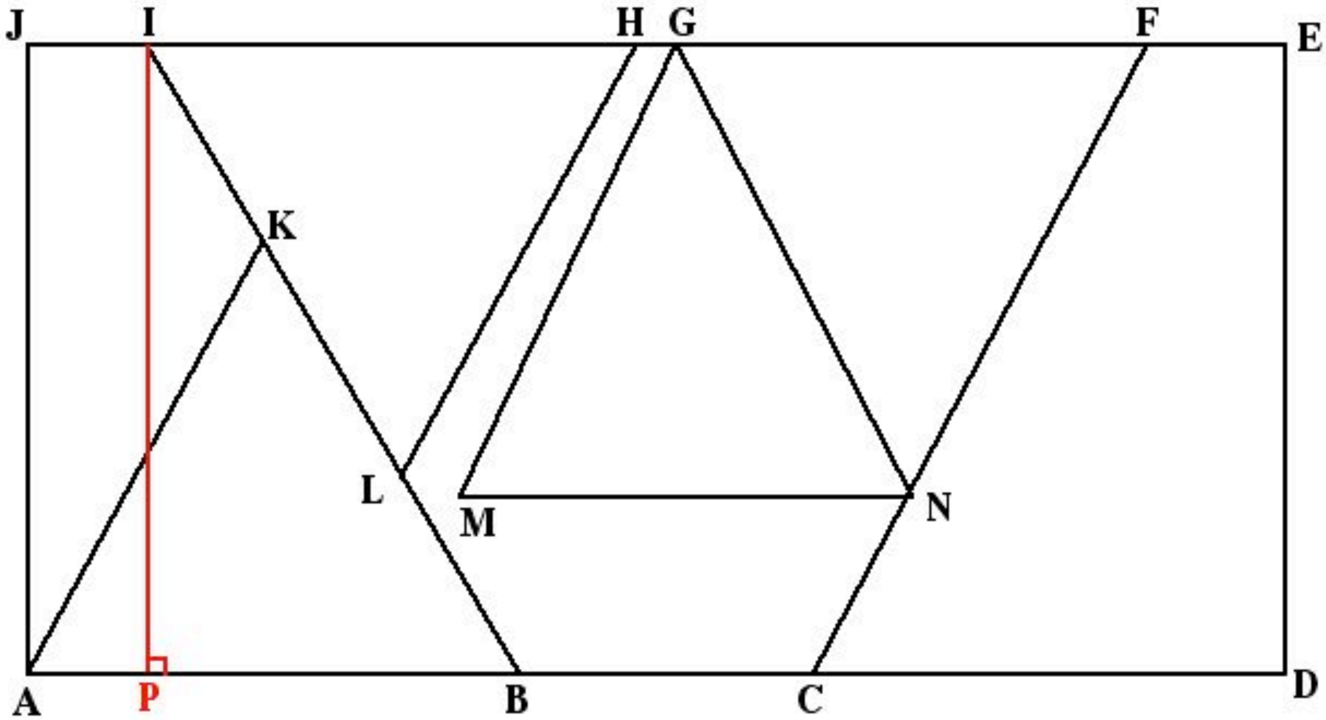
<u>Using Trigonometry in Construction</u>

Below is a diagram that I was working with yesterday. It shows a sheet of 4 ft by 8 ft plywood and five equal isosceles triangles that I wanted to cut from it.



What I was interested in was the distance JI. I knew AK = BK = 3.093 ft (3 ft 1 1/8 in) and AB = 3.026 ft (3 ft 0 5/16 in). First of all I found ∠KBA using the law of the cosines, and then I formed the right triangle BIP and using trigonometry of the right triangle I found distance PB. Subtracting this from distance AB gave me the same distance as JI. Here is the working:

$$AK^2 = BK^2 + AB^2 - 2(BK)(AB)\cos\angle KBA$$

$$\frac{AK^2 - BK^2 - AB^2}{-2(BK)(AB)} = \cos\angle KBA$$

$$\frac{3.093^2 - 3.093^2 - 3.026^2}{-2(3.093)(3.026)} = \cos\angle KBA$$

$$0.489169015 = \cos\angle KBA$$

$$\angle KBA = \cos^{-1}(0.489169015) = 60.714^\circ$$

$$\frac{IP}{PB} = \tan 60.714^\circ$$

$$\frac{4}{x} = 2.243408748$$

$$x = \frac{4}{2.243408748} = 2.243 \text{ ft}$$

$$AB - PB = 3.026 - 2.243 = 0.78591252 \text{ ft}$$

$$\text{AP = JI} = 9\ \frac{3}{8} \text{ in}$$

Thus I could Measure JI as 9 3/8 inches and AB as 3 5/16 inches and make one cut BI to form the first two triangles. Doing the same at the right hand end of the plywood allows me to make one cut CF to form those two triangles.

The Law of the Cosines is so useful in that it will allow you to find the 3rd side of any triangle as long as you know two sides ant the included angle (the angle in between them). Think of it as a "Pythagorean Extended" theorem. It is also used, as I have above, if you know all three sides, but want to find any of the angles.