The Focus of this Lesson is:

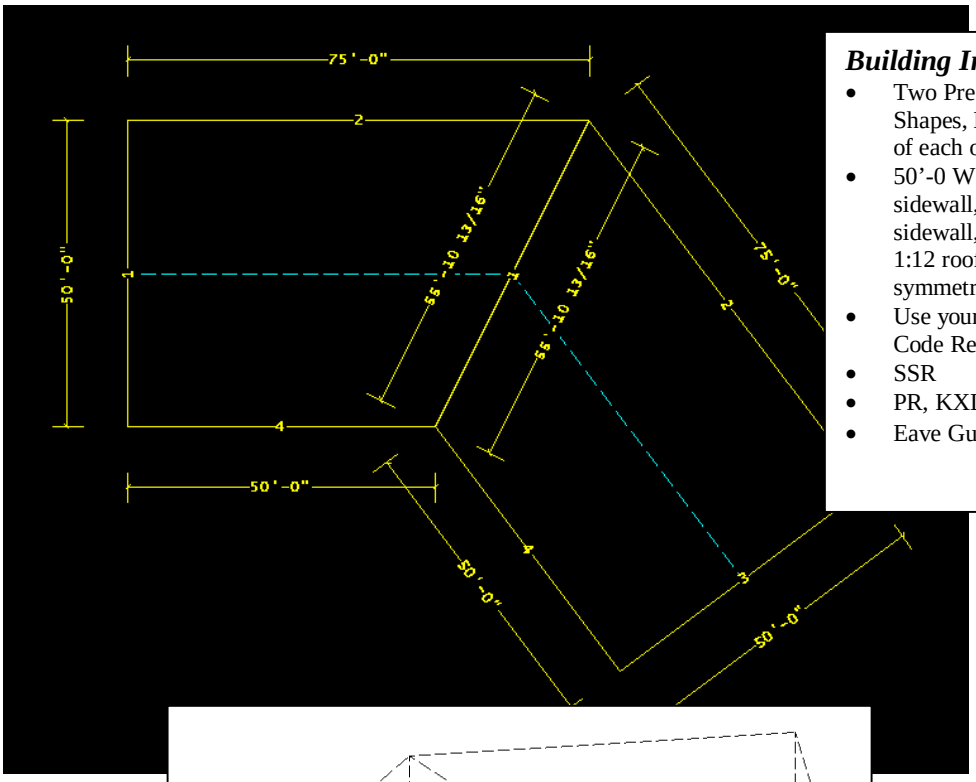
- *Locating and Rotating Shapes*
- *Calculating angles for locating multiple building shapes and angled frames*

Lesson Comments:

In this lesson you will be combining multiple shapes that connect at a common wall at an angle other than 90 degrees. The first part of the lesson will consist of a discussion of the Location and Rotation functions of VPCommand. The last part of the lesson will be more instructions to complete the frame input.

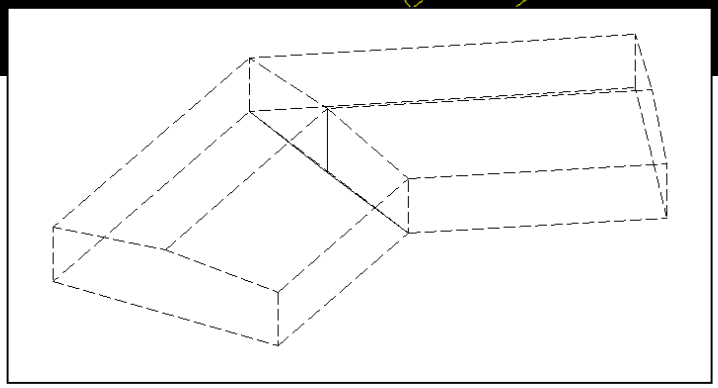
Below is a floor plan and 3-D view of the shapes you will be inputting. It is a good idea to sketch out your buildings in order to better visualize what is required for input.

Complete all General Information, Loading, etc. as required for your needs.



Building Information:

- Two Pre-Defined Shapes, Mirror images of each other
- 50'-0 W x 75'-0 Long sidewall, 50'-0 shorter sidewall, 12'-0 EH, 1:12 roof pitch, symmetrical ridge
- Use your Building Code Requirements
- SSR
- PR, KXL
- Eave Gutter

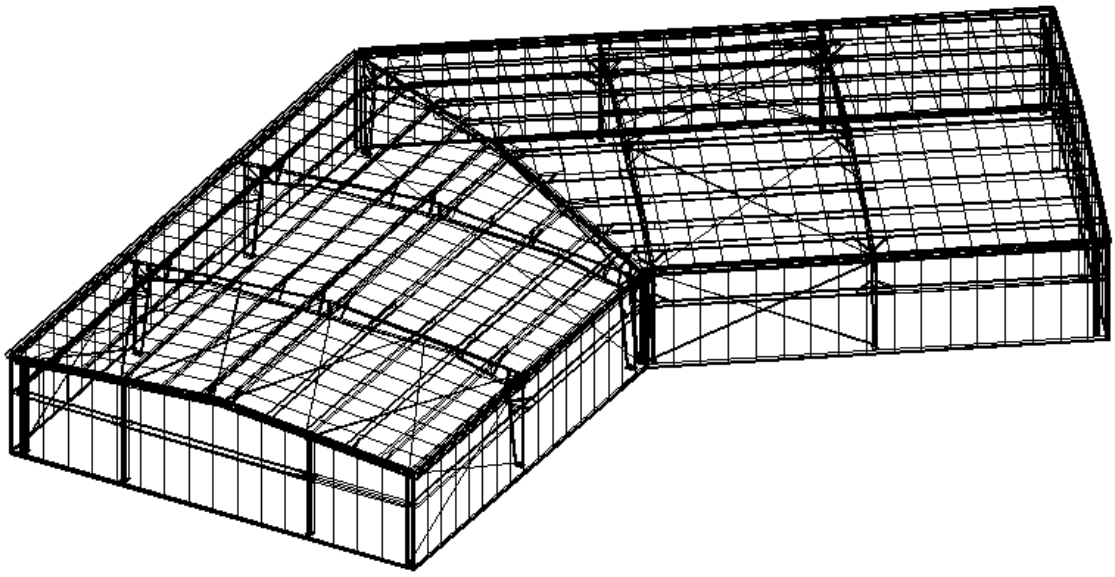


Shape Location and Rotation

There will be times when you will have the need to combine more than one VPCommand building shape to create your final desired result; and at times these shapes will need to be located at angles that are not easily discernable. The following should remove any trial-and-error-guesswork and help you to understand how VPCommand works in this regard. We will look at a specific example, which is attaching two shapes that are not at an easily definable angle between the two shapes.

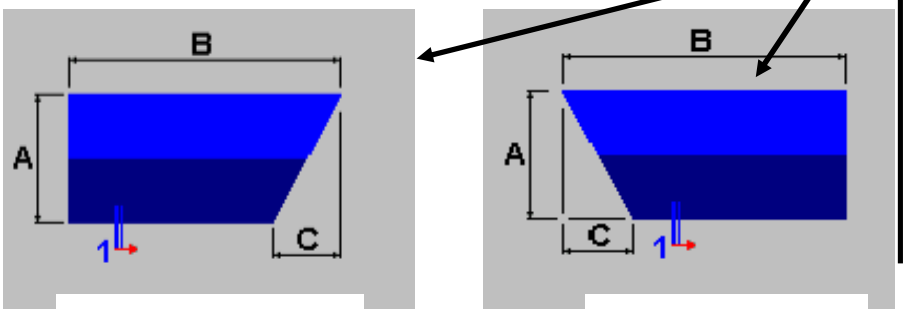
This lesson will consist of a discussion and working example of the location and rotation features and the actual instructions will begin on page 9.

The picture below shows the final result. First, let's look at the "*Location*" function.



Shape Location

Keep in mind that when locating a shape using the "X-Y" fields, VPCommand will be locating the "*Least-X*" point on a shape. Note that the "least-x" point on a shape may change if a shape is "rotated". With this said, when combining multiple shapes, you should begin with a sketch so that you know which point on a shape you will be locating. Let's give our shapes some dimensions so that we can begin to attach them. The pre-defined shapes shown below have been selected as the best representation of our final desired result.



Left shape

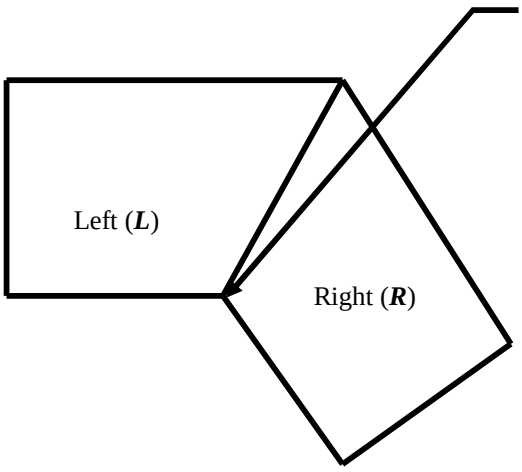
Right shape

1. Select the Pre-Defined shaped shown.

2. Locate the "Right" shape at an x dimension of 50.

Dim "A" = 50'-0
Dim "B" = 75'-0
Dim "C" = 25'-0

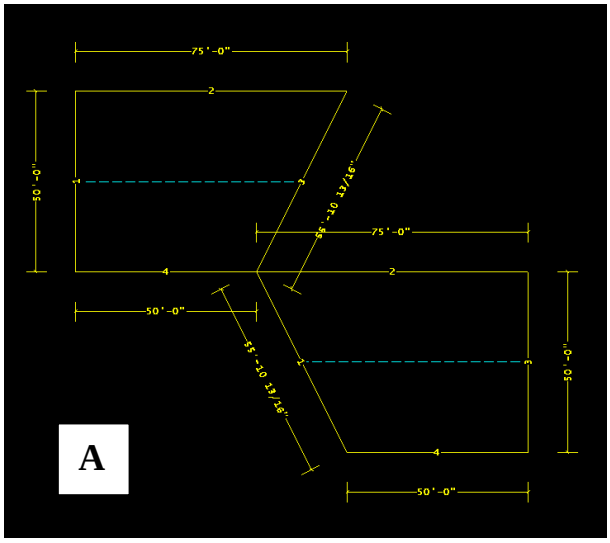
Making our sketch as follows:

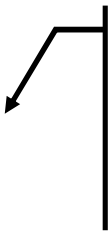


Location point / Least "X" of shape AFTER it is rotated. *Note that the "Least-X" point on a shape may change dependant upon its rotation.*

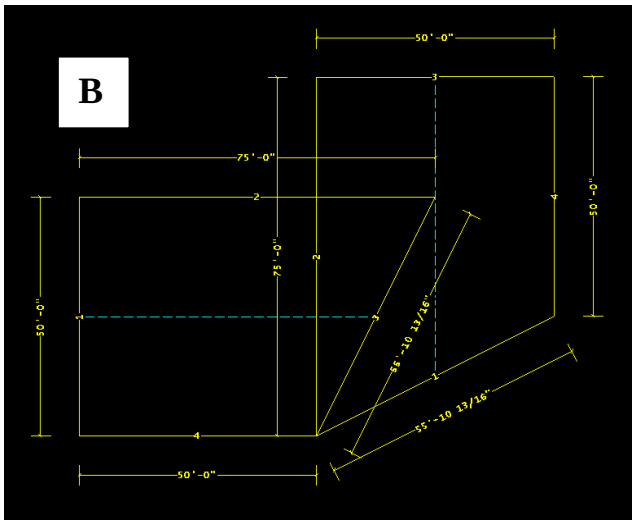
Shape Rotation

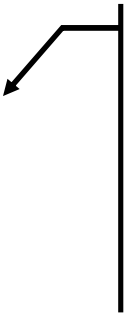
We have noted that the *"Least-X" / Location point* may change on a shape dependant upon its *rotation*. Let's look at how this may change. In the two shapes we know that the first shape we locate is the base shape from which all additional shapes are referenced from in an X-Y relationship. Thus, the Left shape has a shorter sidewall of 50'-0 in the "X" direction. Therefore, our X-dimension of the second shape Right (R) is 50. Let's look at the progression of how the least X may change in regard to the rotation point. We will use 50 as our X dimension and vary the Rotation angle.



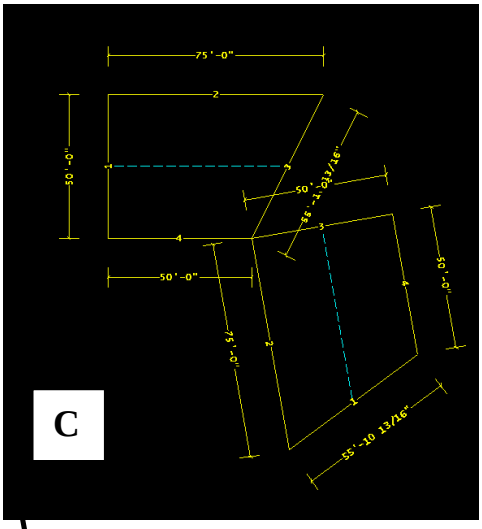


- The Left shape is the base shape; the Right shape is the shape being located.
- X = 50, Y = 0, Rotation = 0

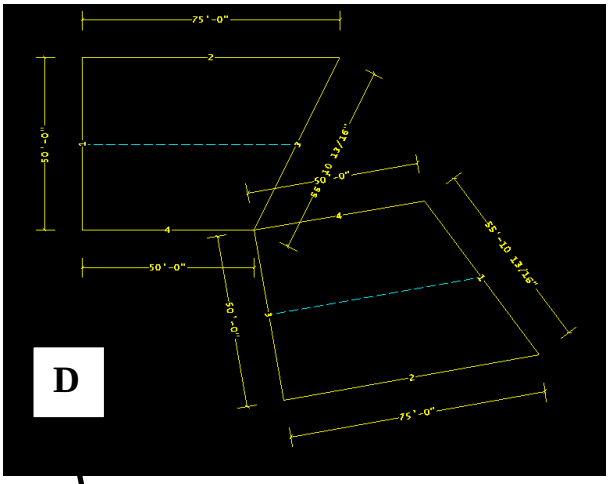




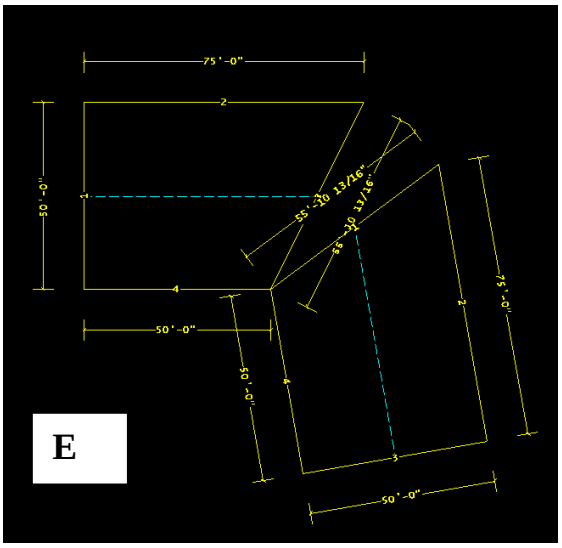
- X = 50, Y = 0, Rotation = 90
- Note that at 90 degrees, the shape has two points with the same X. The point with the Least X, and least Y is the location point.
- Watch as the Right shape exceeds 90 degrees. See Picture "C".



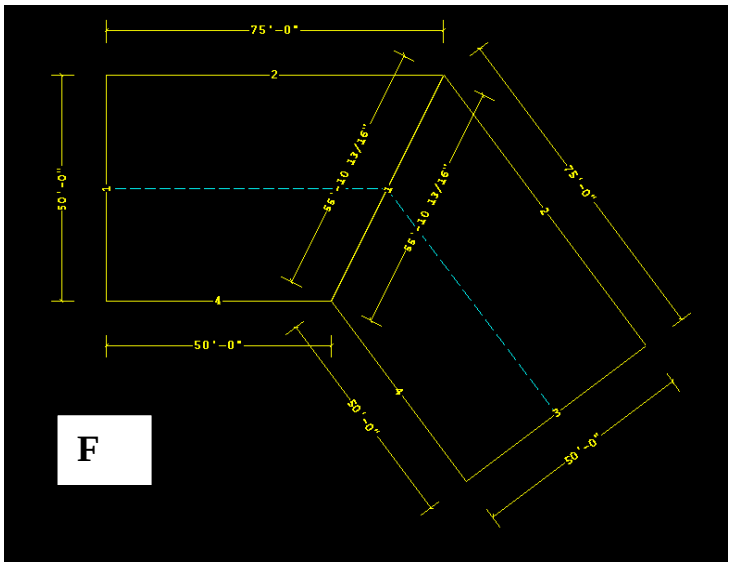
- At X = 50, Y = 0, Rotation = 100, the Least X point changes.
- This point will remain the least X, until the rotation exceeds 180 degrees. (See picture "D" at right).



- At exactly 180 degrees, this shape would have two points with the same X-value. Again, the point with the least X and Y values becomes the location point.
- This point will remain the least X, until the rotation exceeds 270 degrees. (See picture "E", below, left).

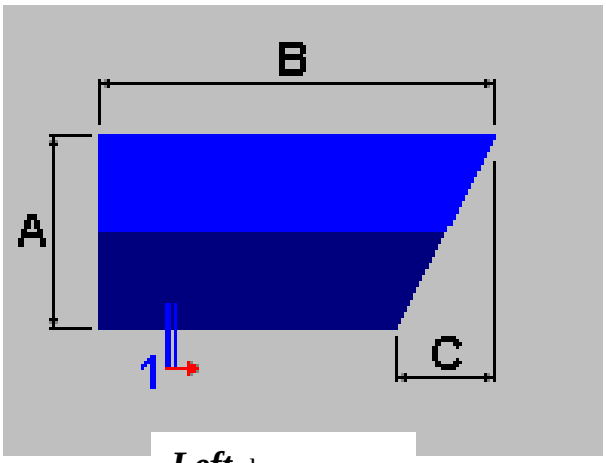


- At X=50, Y=0, Rot=280, the location point is desired point on our Right shape. We are approaching the required angle.
- See picture F, for final result.

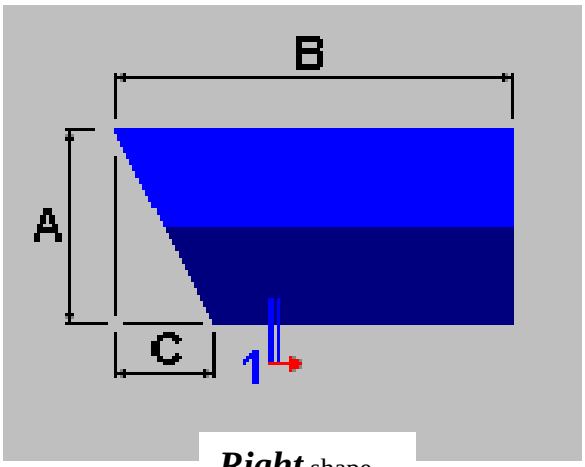


- Increasing the Rotation angle we find that ***306.8698*** degrees is the required rotation angle to connect the two shapes. You should carry the angle to at least 4 decimal places to insure accuracy.
- The good news is that you do not have to stumble upon that exact angle. It is calculated as explained below.

Calculating the Shape Rotation Angle: Below are the Pre-Defined shapes you selected for this example.

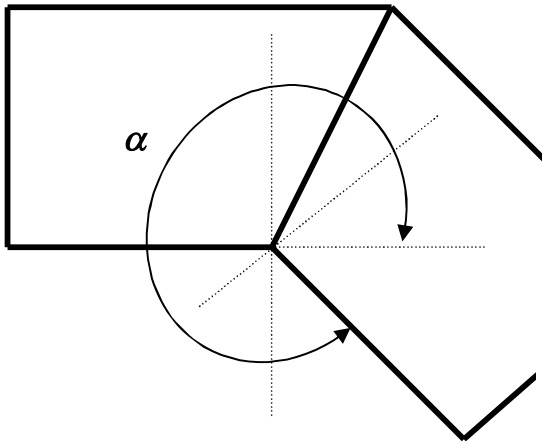


Left shape



Right shape

Calculating the angles necessary to be used in the formula for the "Angle of Rotation" in the VPCommand Geometry field: In this example, the shapes are similar in geometry (mirror images), thus the angles ($\theta 1$ and $\theta 2$) are equal. If they are not in similar in geometry, calculate the angles in the same manner shown below.



α, Rotation angle for VPC

$\alpha = 360 - (\theta 1 + \theta 2)$

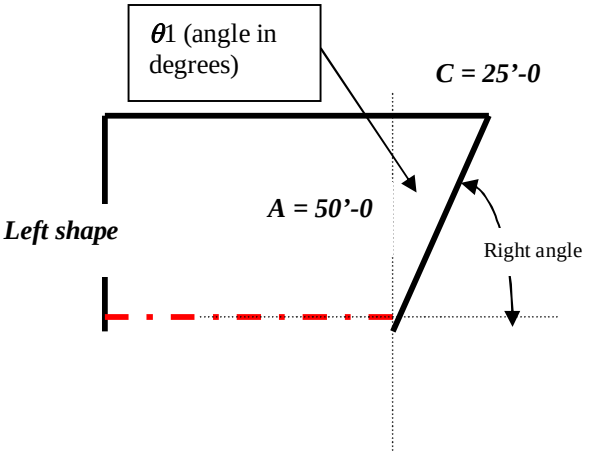
$\alpha = 360 - (26.5651 + 26.5651)$

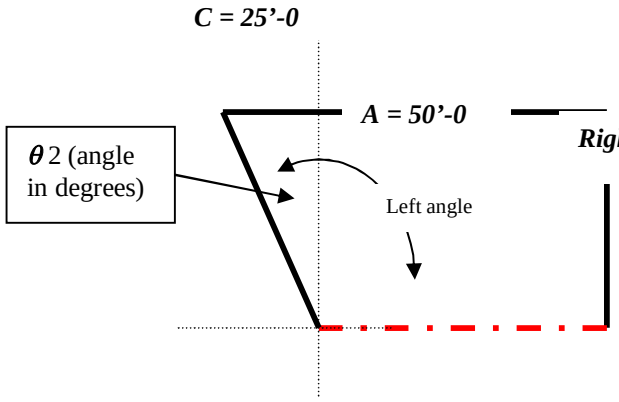
$\alpha = 360 - 53.1302$

$\alpha = 306.8698$ degrees

To find the above "*angle of rotation*" we add the acute angles (angle less than 90 degrees) where the shapes connect together and subtract this sum from 360 degrees (total degrees in a complete circle). We can easily find these acute angle(s) below on the left shape by subtracting the "*right angle*" found in the frame locations window for the wall (63.4349) from 90 degrees. The result is 26.5651.

The acute angle for the right shape can be found by subtracting 90 degrees from the "*left angle*" (116.5650). The result is also 26.5651 as these two shapes are symmetrical. Inserting these values in the above formula for rotation angle yields the VPC rotation input of *306.8698*.





$$\tan \theta_{1,2} = \frac{C}{A}$$

$$\tan \theta_{1,2} = \frac{25}{50}$$

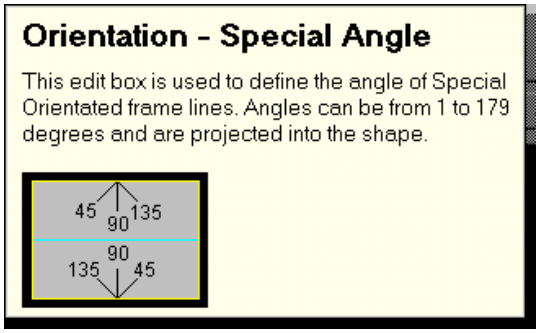
$$\tan \theta_{1,2} = 0.5$$

$$\theta_{1,2} = \arctan(0.5)$$

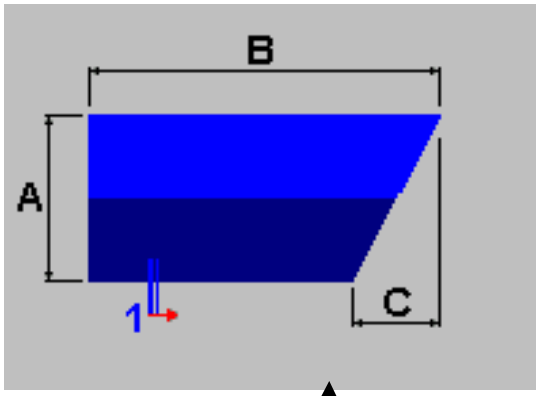
$$\theta_{1,2} = 26.5651 \text{ deg}.$$

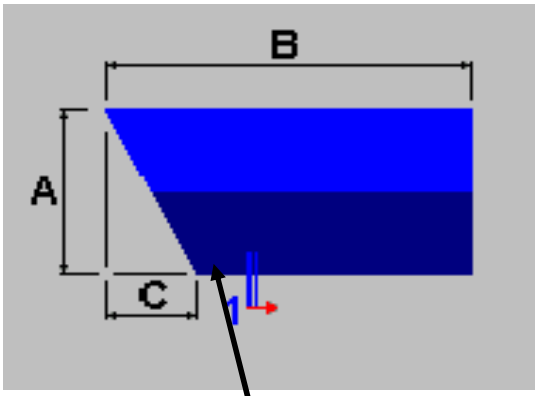
Using Trigonometry formulas, the acute angles are calculated as shown at left.

Locating Angled Frames:
Now that the shapes are correctly attached, you can further verify that they are positioned correctly by checking the "Openings" that have been created at the common wall. If the openings do not appear as they should when the common walls touch, you will need to adjust your rotation angle. Adding the angled frame along the common wall is simply a matter of inputting the angle, left or right as displayed on the frame locations window of the wall you are locating this frame along. Locate this skewed frame as follows:



- The "*F1-Help Screen*" for the Special Angle field at the Frame Location window, shows the expected VPC input. The angle will vary dependant upon which wall you select as your "Along" wall to locate this frame.
- Angle input is from greater than zero to less than 180 degrees.





If you select the short sidewall on the Left shape, the right angle is <u>*63.4349*</u>, this is the *right angle* shown on the frame location screen.

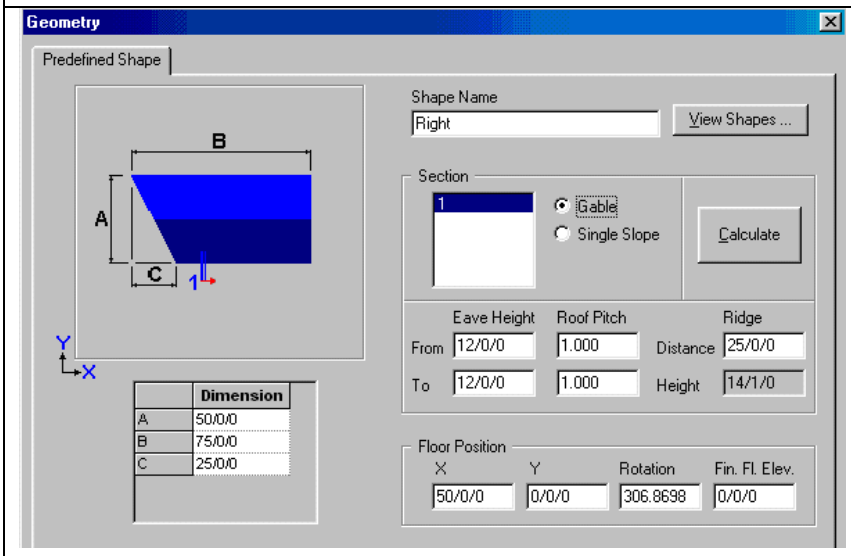
- The frame "*Location*" would be the wall

If you select the short sidewall on the Right shape, the left angle is <u>*116.5651*</u>, this is the *left angle* shown on the frame location screen

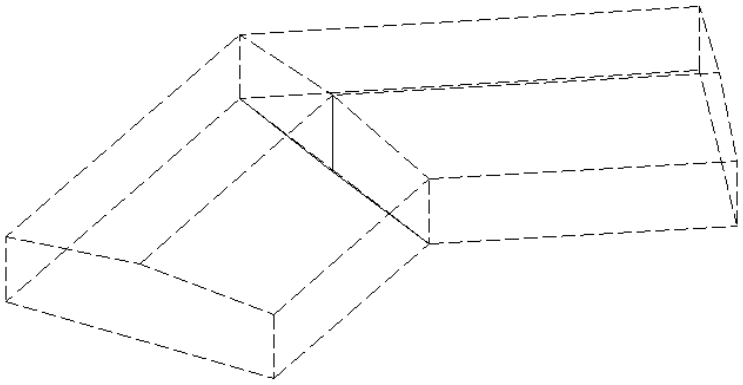
The frame "*Location*" would be 0 (zero). Note that if you try to input a "*Space*" of 0 (zero), you will receive an error message as the Space field tries to place the next frame at the input Space and in this example would indicate that zero is invalid. Therefore, use the *Location* field.

Beginning of Instructions:

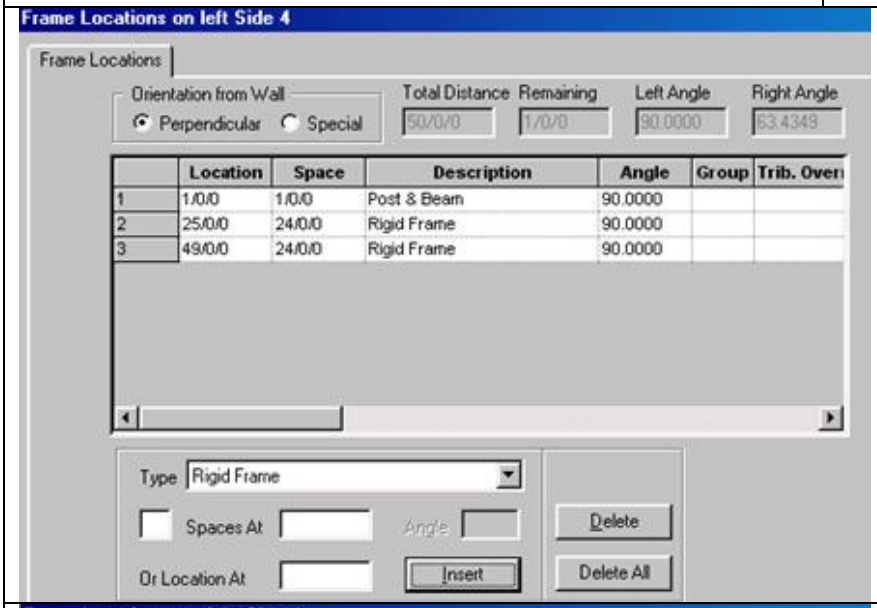
1. *Input first shape (Left):*
   - Choose "Skew Right Endwall 1" as your first pre-defined shape. Input dimensions of A= 50, B = 75, C = 25. Eave Height to be 12'-0 with 1:12 roof pitch, symmetrical ridge.
   - *Note that this first shape becomes the base shape from which all additional shapes are referenced from.*



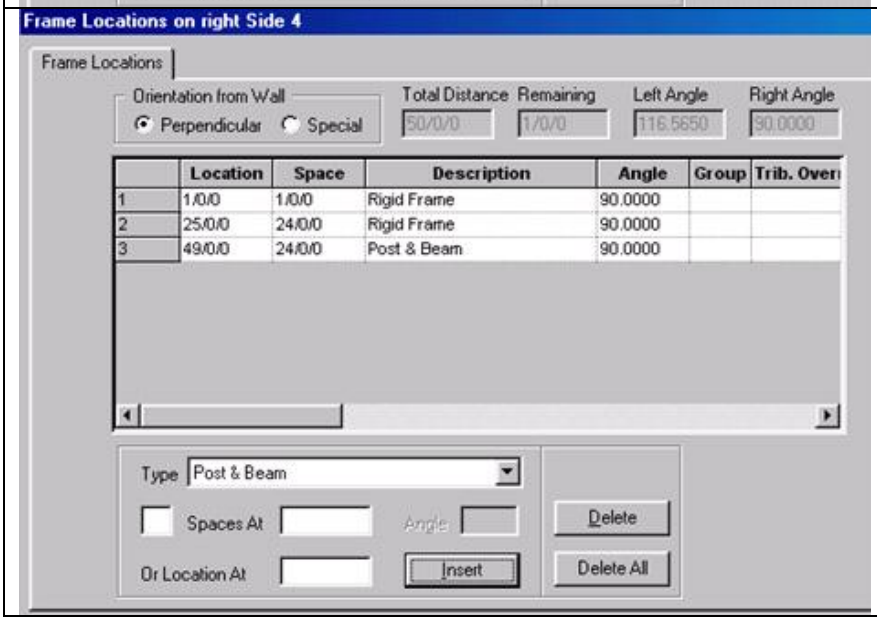
2. *Input second shape (to the right of first shape):*
   - Choose "Skew Left Endwall 2" as your second pre-defined shape. Input same dimensions as above. A = 50, B = 75, C = 25. Eave Height to 12'-0 with a 1:12 roof pitch, symmetrical ridge.
   - Input the floor Position dimensions to be referenced from the Origin of the First Pre-Defined shape. X= =50, Y = 0, Rotation = 306.8698 (from previous calculations). Your screen should look like the following if your input is correct.



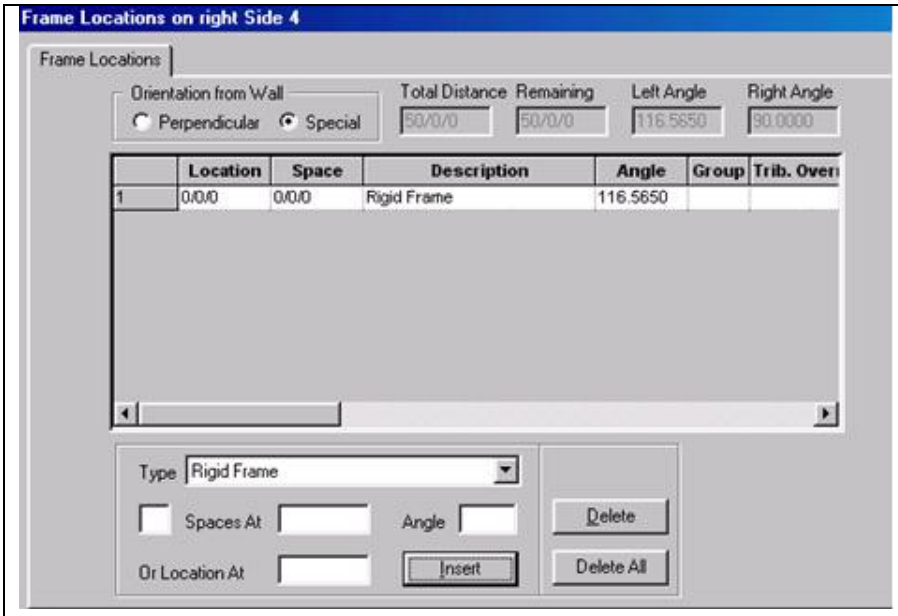
- Note: It is recommended to go to your "*Openings*" folder and visually see if the openings appear to have generated correctly at the common wall.

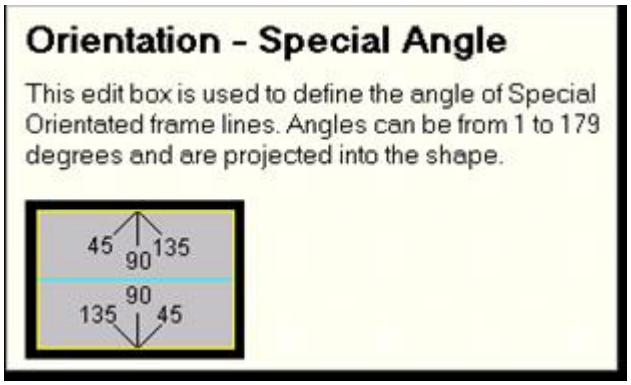


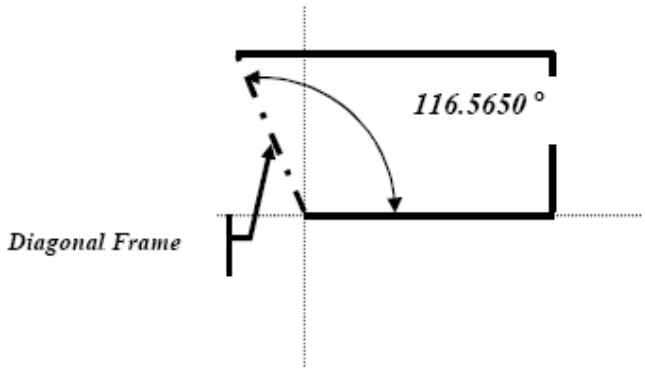
3. Locating Frames at the first shape: Locate frames in the Left (first) shape as shown below. Note that *Wall 4* has been chosen as the along wall. If you choose Wall 2, your locations will differ. You will locate the diagonal frame at the Right (second) shape.



4. Locating Perpendicular Frames at the second shape: Locate the *perpendicular frames* as shown below. Note that *Wall 4* has been chosen as the along wall. If you choose Wall 2, your locations will differ.



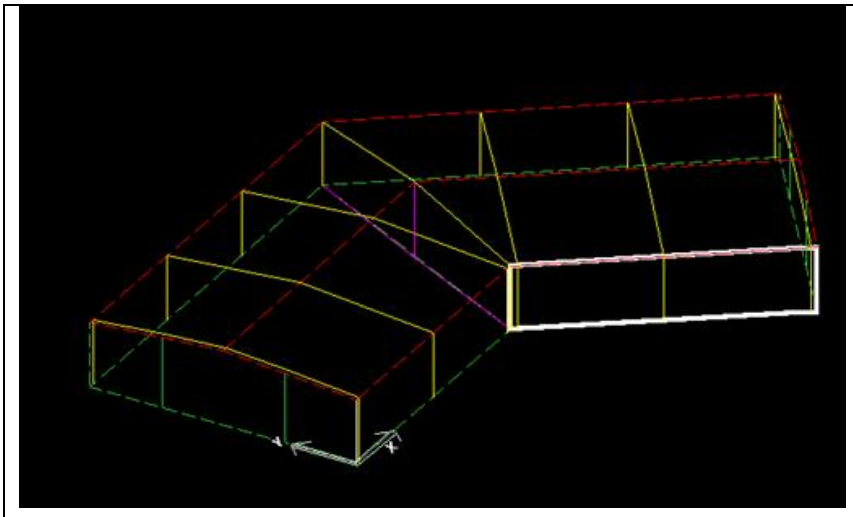




5. Locate the Diagonal Frame at the second shape: Using the angles you have previously calculated, you can calculate the angle of rotation for the diagonal frame as follows:

Angle = 90 + 26.5650
Angle = 116.5650

Input the Special angled frame as follows: Note that you type in the entire 116.5650, and the display will only show 6 characters, but the entire dimension has been accepted. You need to be as accurate as possible when inputting angles. Round to at least four decimal places.



- After all frames are located, your screen should resemble this.
- For this example, we located three columns close together at the inside corner of the building. You may also use lean-to type frames and vary the location to allow them to attach to the rafter of the diagonal frame.

6. Run any desired reports, and/or drawings.

Summary: This lesson showed you how to calculate and input numbers for the "Rotation" field in the Geometry window. Using this feature you can create almost any building condition.