



# Constructing a Wedge Die

*Using Graphite™*

# Constructing a Wedge Die

This exercise introduces the third dimension. Discover how easy it is to use. All of the tools used in 2D space are used in 3D.

In this chapter, construct a Wedge Die part and then create a 2D drawing with four views (Top, Front, Right and Trimetric).

Since working in Graphite is a smooth transition from 2D to 3D, start the drawing in 2D.

## Creating the Wireframe Geometry

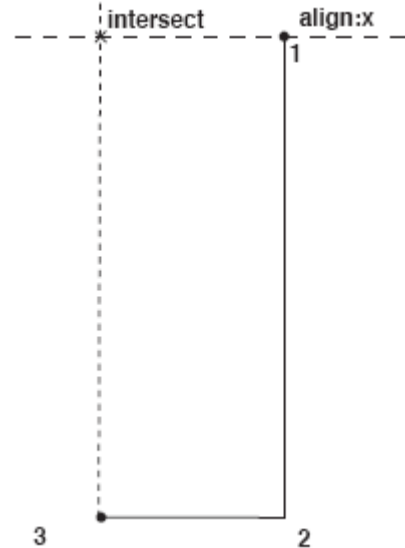
1. Begin with a new document and draw a rectangle. Make the rectangle about four times as tall as it is wide. It should be almost as tall as the screen.
  - Select the **Connected Lines** tool.



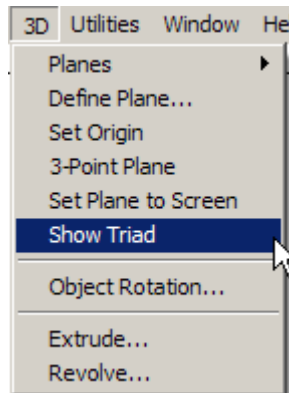
- Draw the first two lines by clicking at points 1, 2 and 3.

*The Drafting Assistant gives the alignments to complete the shape.*

Move up and show the intersect, but don't click this point yet.

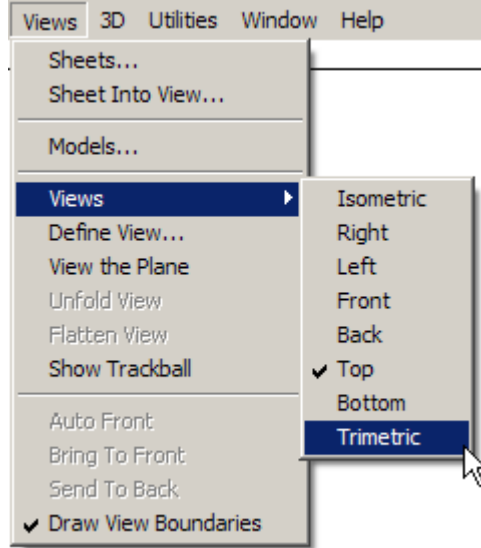


2. Display the Triad and change to a Trimetric view.
  - Choose **3D>Show Triad**.

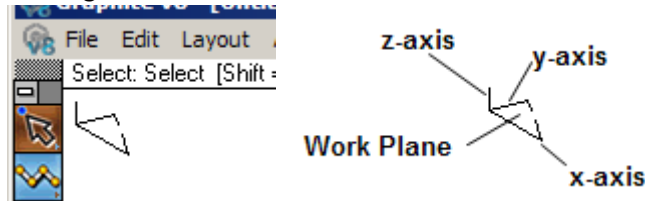


This command displays an orientation marker in the corner of the screen.

- Choose **Views>Views>Trimetric**.



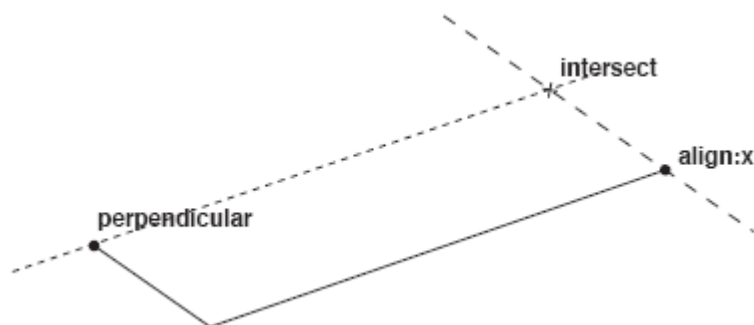
When starting Graphite, the Top view is automatically selected. Now, the triad has changed to show a new orientation.



The longest of the three lines is always the x-axis, the next longest is always the y-axis and the shortest line is always the z-axis.

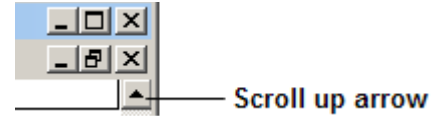
The broken line forms a triangle that indicates where the work plane is. In this case, it is flat on the bottom, between the x- and y-axis. The rectangle has tilted down to match the triad.

Now line up the same *intersect* point as before, but looking at it from a 3D orientation.



- Click the final two points, to close the rectangle but **don't** double-click at the last point. Continue with the **Connected Lines** tool, and the rectangle remains highlighted so the Drafting Assistant can align with it as you continue.

- Now click on the Scroll Up arrow a few times to move the rectangle near the bottom of the screen.

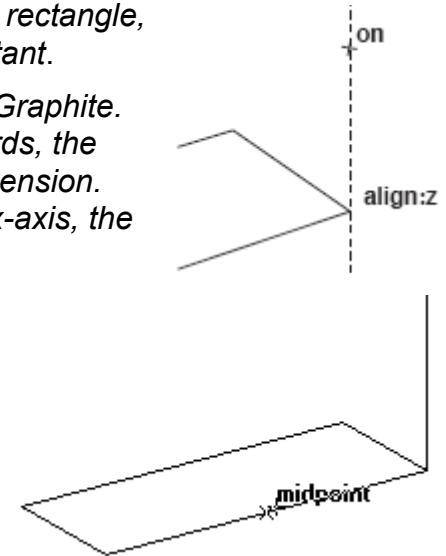


3. Use the Z-Drafting Assistant to draw in the Trimetric view.

- *Position the cursor above the first point of the rectangle, without clicking, to show the Z-Drafting Assistant.*

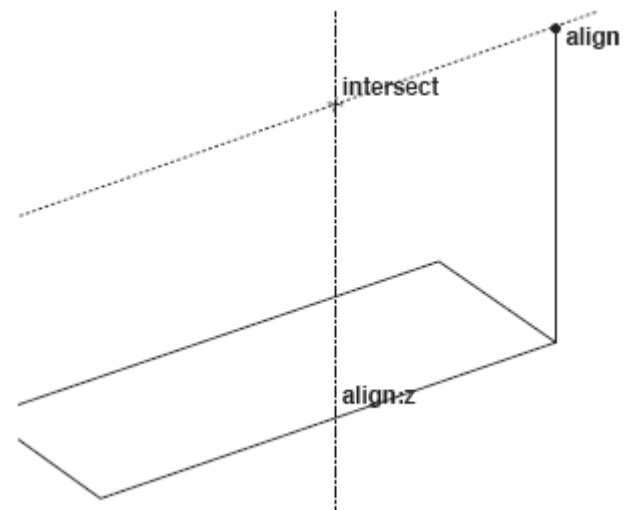
*Here is the first of many unique features of Graphite. This is the Z-Drafting Assistant. In other words, the Drafting Assistant is working in the third dimension. This provides automatic alignments off the x-axis, the y-axis and the z-axis.*

- Move up along the z-construction line and click the end point so the line is about 2/3 as tall as the rectangle is long. Then, without clicking, go down and touch the midpoint of the line, as shown in the following graphic.

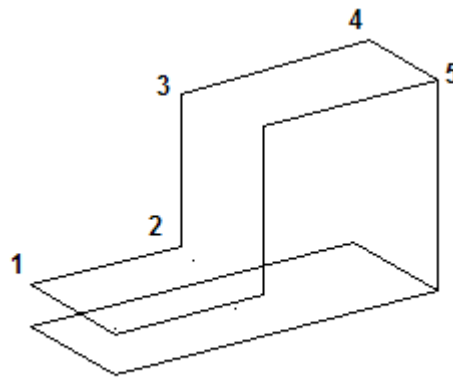
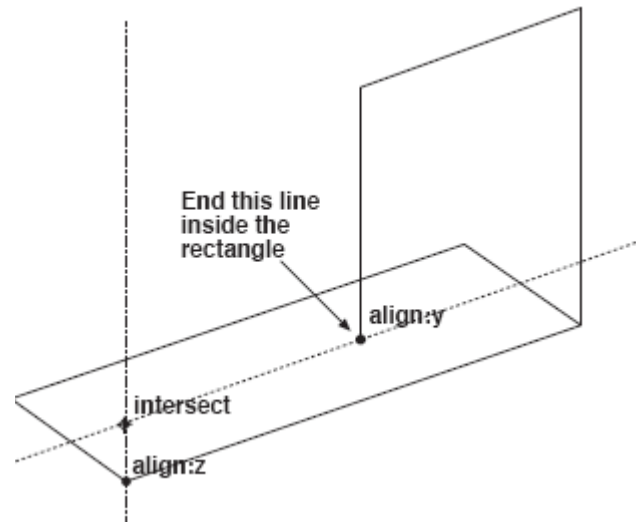


- Come up the z-construction line, and locate the *intersect* shown below.

*After the Drafting Assistant displays the intersect, begin moving around in 3D space and create this block by just sketching, and letting the Drafting Assistant find the alignments.*



- Click the *intersect* shown above. Then, move down along the z-axis, and end this line somewhere inside the rectangle as shown. Then move to the left along the y-axis and locate the *intersect* shown here. Click this point.
- Continue with the **Connected Lines** tool, and pick the five points shown here. Use the Drafting Assistant construction lines to get the proper alignments. At point 5, double-click this point to end the line.



*As each of these points is picked, notice how the Drafting Assistant senses where you are and what other geometry is near. It automatically provides all the alignment construction lines necessary to draw this part.*

What is shown here is one of the unique features of Graphite; the ability to move around freely in 3D space and just pick points, almost like in sketching. But having those points end up precisely aligned in all three axes is something that really sets Graphite apart.

4. Complete the shape of the wedge by moving copies of the selected lines.
  - Select the **Single Line** tool.



- Draw a single line from point 1 to point 2.

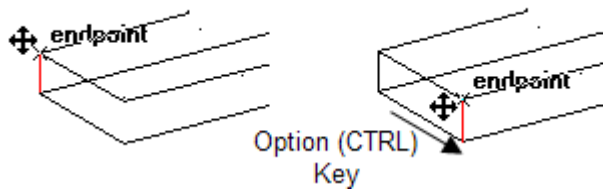


- Select the **Selection** tool.



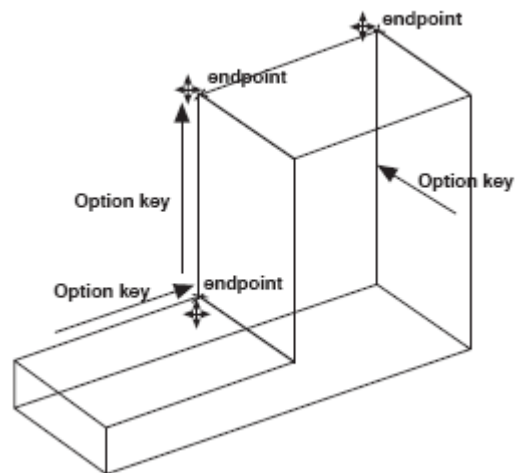
- With the line still selected, place the pointer at point 1. Hold down the CTRL (Windows) or OPTION (Macintosh) key and drag a copy of that line to the endpoint of the top line, as shown on the next page.

The Drafting Assistant automatically snaps to the endpoints at the start and the end of the move.



*Notice that when the pointer gets near the selected line, it changes from the **Selection** tool to the 4-Way Move symbol. This moves the selected item(s), as well as make copies while move.*

- With the **Selection** tool, select the line shown below.
- As before, while the line is still selected, place the pointer at one endpoint, hold down the CTRL (Windows) or the OPTION (Macintosh) key and drag a copy of the line in the y-direction, placing it at the corner of the L. Drag another copy in the z-direction and drop it at the top of the block. Select the long vertical line on the far right side of the part and move a copy of it, as shown. Now, all the lines of the L block should be drawn.



*The same thing can be done with some of the other lines. It is also possible to draw these lines using the **Single Line** tool, but sometimes it's easier to copy existing lines.*

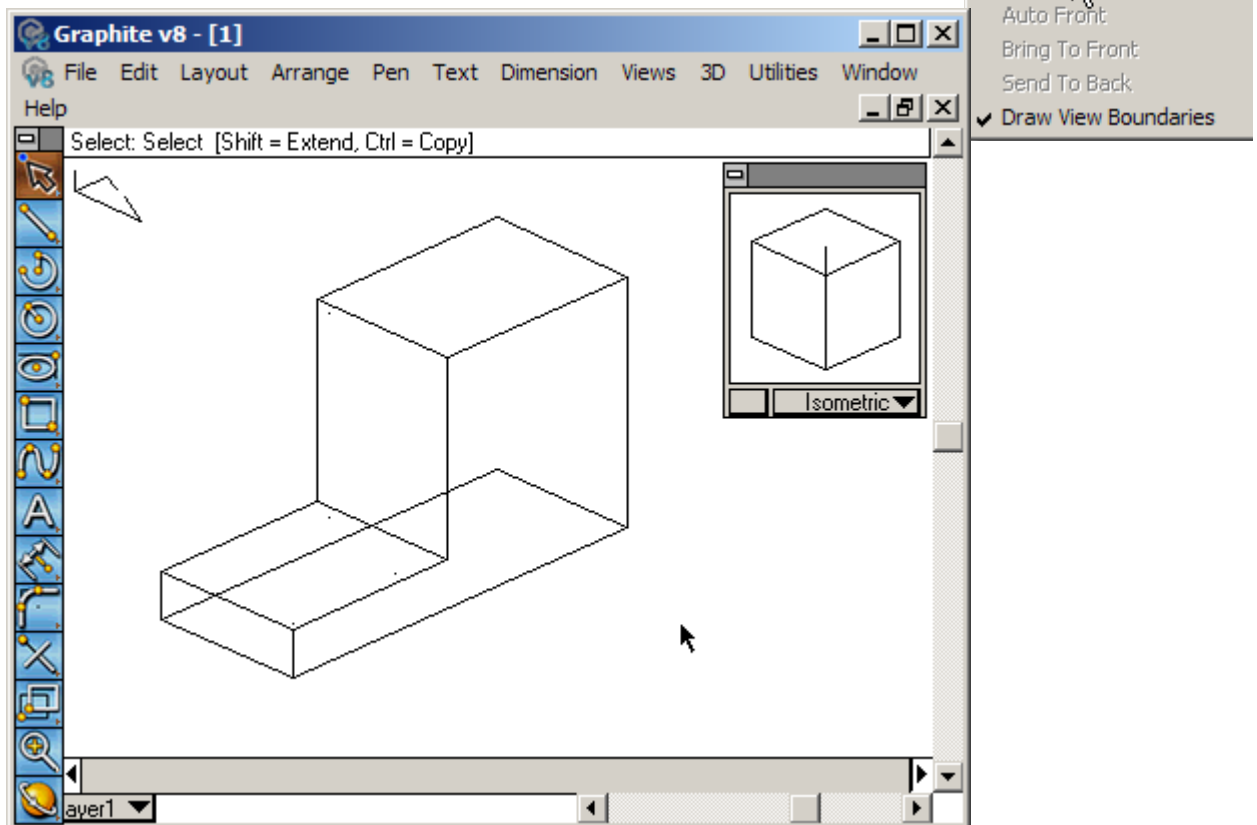
Now the outline of the Wedge Die is completed. Because of the Drafting Assistant, this process was fast and accurate.

5. Rotate the Wedge Die with the Trackball to make sure it is truly a 3D object.

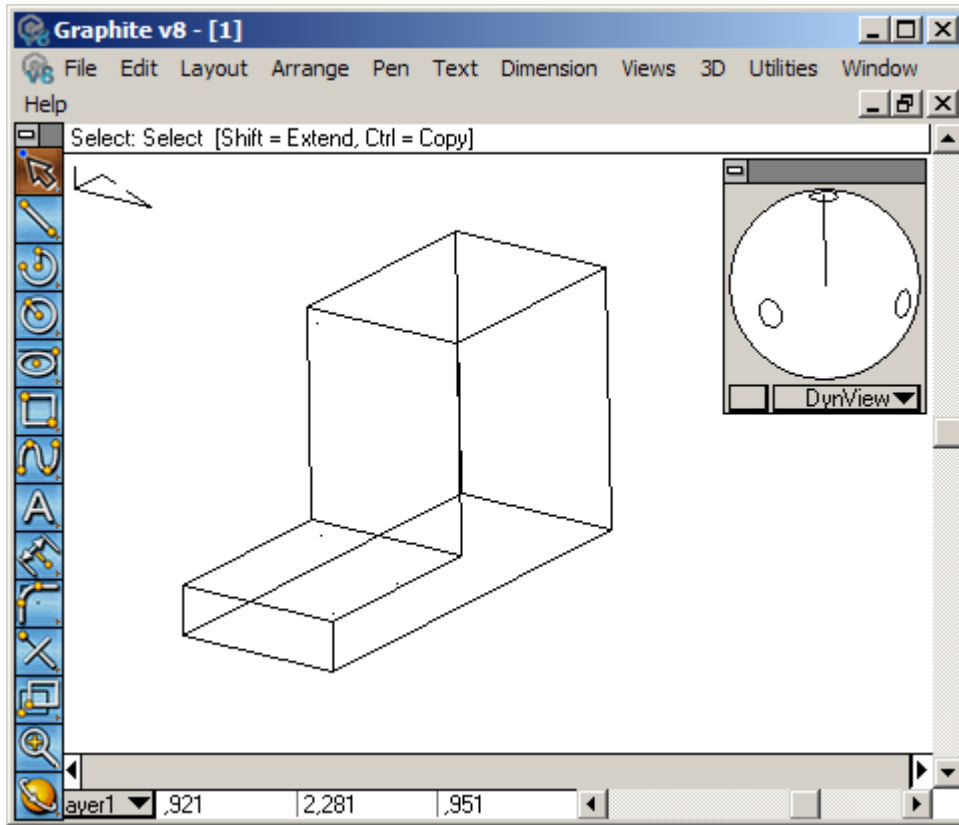
- Choose **Views>Show Trackball**.

The Trackball/TrackCube comes up on the left side of the screen. For the purposes of this tutorial, it works best to have it on the right, so grab it by its title bar, and move it over to the right.

*With the Trackball/Track-Cube, rotate the model just by clicking and rolling the ball. The model rotates in real time. Keep in mind, however, that point of view changes; the geometry itself remains fixed in model space.*



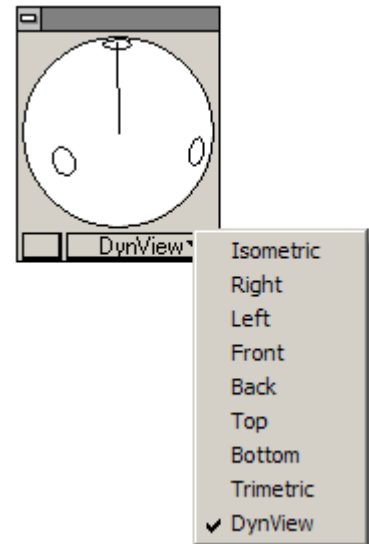
- Rotate the model using the Trackball/TrackCube. Notice that the Triad appears at the center of rotation and shows the orientation of the axes as the model is turning.



6. Change the view orientation.
  - Choose any view, such as Right or Top, by selecting each view from the pull-down menu on the bottom panel of the Trackball.

To continue with the tutorial, select Trimetric from the pop-up menu on the Trackball.

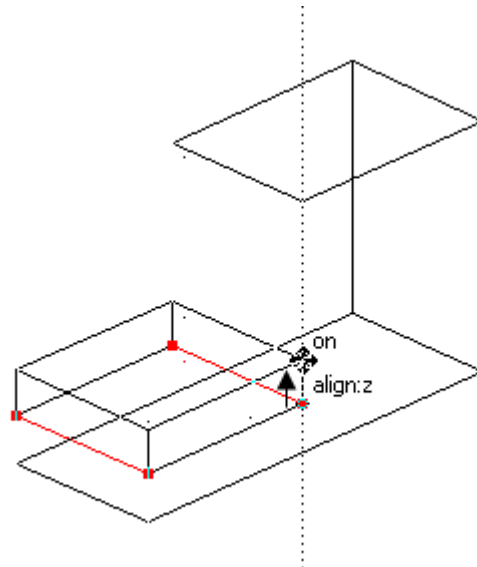
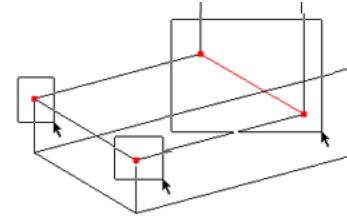
7. Modify the design intuitively in 3D.
  - Hold down the SHIFT key and drag three selection fences around the four points shown to select these points. (The one short line in the big fence will also be selected.)





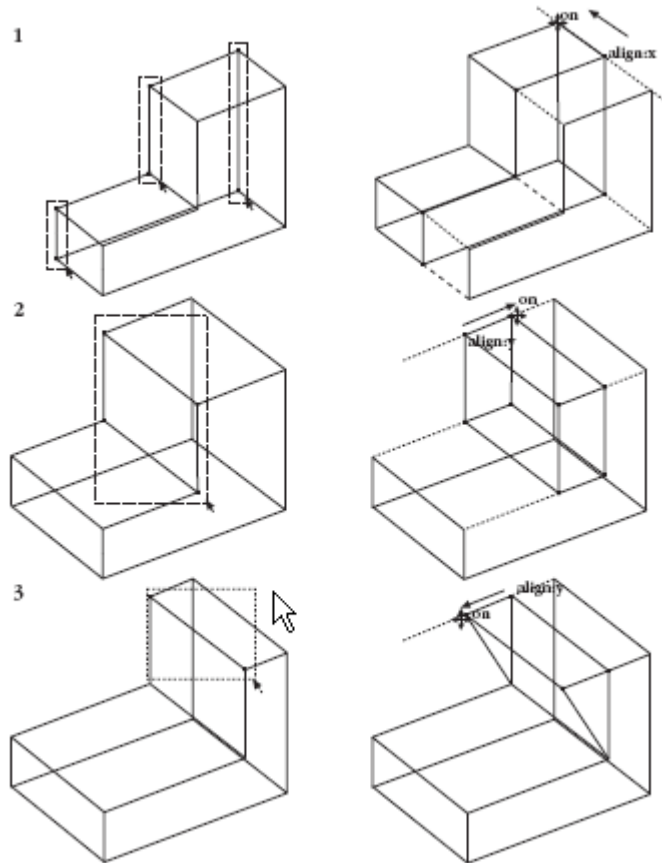
- Release the SHIFT key. Grab one of the points (the pointer will change to the Four Way Move cursor) and drag it vertically. Make sure there are the words *align:z* at the bottom point as you start to move upward.

Make the bottom block approximately twice as thick as it was originally.



*One of the great features of Graphite is the ability to modify the design easily in 3D. For example, to make this bottom area about twice as thick as it is now. Select these points, and then move this face straight up until it is where necessary. The Drafting Assistant allows constraining this movement along the z-axis.*

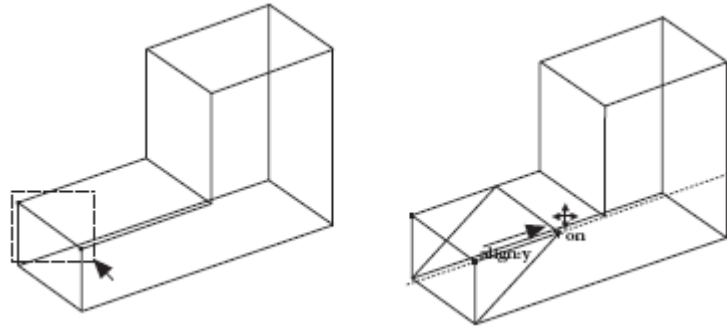
- In each of the examples below, use the SHIFT key and drag the selection fences shown to select the appropriate points. Then drag one of the points to stretch the part. (This exercise can be skipped.)



- Choose *Undo* three times to get the part back to how it looked before the stretch exercises above (Skip this if those exercises were skipped.) The bottom of the block should be twice as thick as when it was originally drawn.

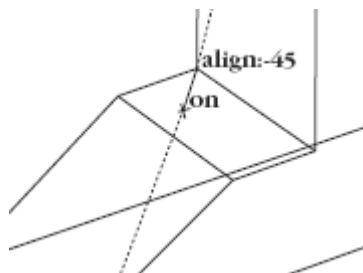
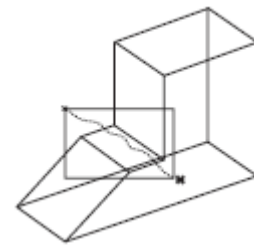
*Graphite has unlimited levels of Undo. Specify the number of Undos using a mouse click in empty screen space, select Undo... and specify the necessary number.*

- Regardless of whether the steps on the previous page were done, make sure to do the next one. This step is part of the actual shape of the finished part. Select the two points shown in the graphic and stretch the shelf back along the y-axis. (Stretch it two-thirds of the way back as pictured here.) As part of the design, create a wedge-shaped front.



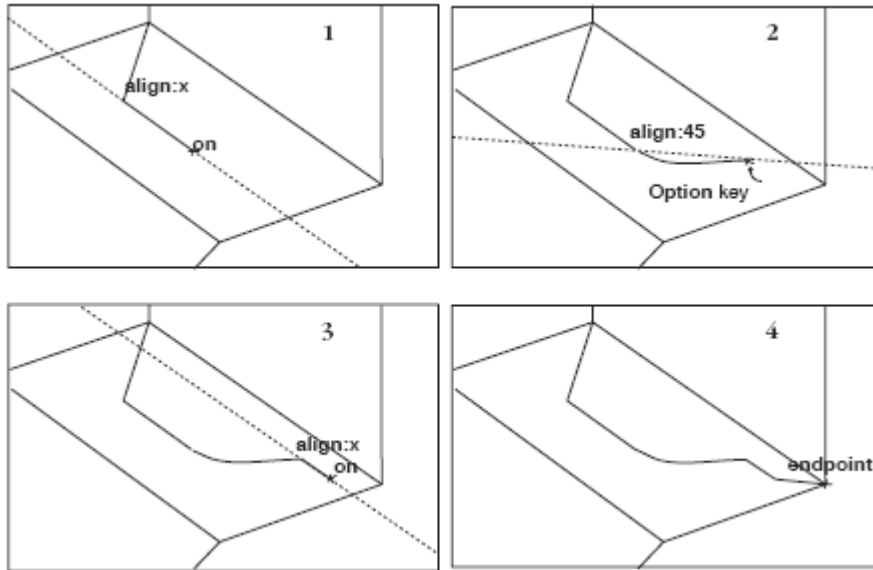
8. Put a molded face on the front.

- Do a Stroke-Zoom. Hold down the CTRL + SHIFT keys (Windows) or the ⌘ key (Macintosh), and drag the rectangle shown, from upper left to lower right.
- Pick the **Connected Lines** tool and draw the line shown, going about two-thirds of the way across the width of the face. Make sure there are the words *align:-45* and *on* before clicking the second point.



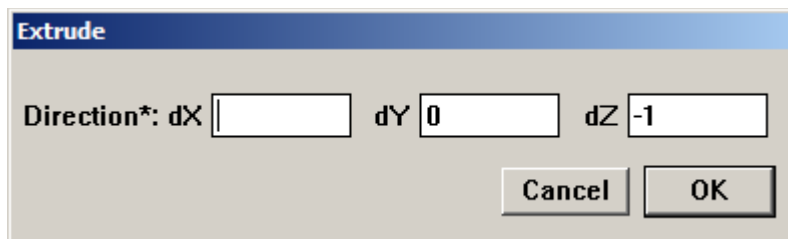
- Finish the contour by drawing the lines and the arc, as shown. In frame 2, hold down the CTRL (Windows) or OPTION (Macintosh) key to temporarily get the **Arc** tool. Make sure there are the words *align:45* and *on* before clicking the second point.

By using the Drafting Assistant construction lines, these lines are easily drawn. By holding the CTRL (Windows) or OPTION (Macintosh) key, temporarily get the Arc tool.



9. Finish the contour by first extruding it up, then by revolving it around the corner of the block, and finally by extruding it along the top face of the block.
  - Select **Arrange>Zoom All**.
  - Select **Views>Hide Trackball**.
  - Select the five lines of the just drawn contour (if they are not already selected).
  - Select **3D>Extrude**.

The Extrude dialog box appears.



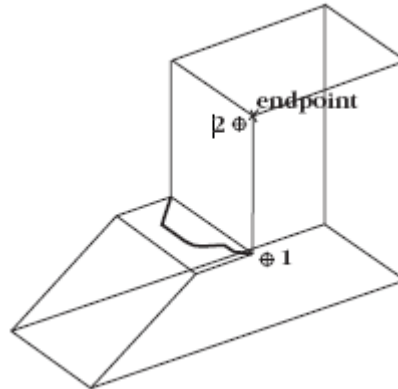
*The Extrude dialog box can be moved by grabbing its title bar and dragging it to a new location.*

You will now see one of the most important features in Graphite. Enter a set of numbers in the three data fields. It is necessary to extrude along the vertical line of the face, but how far and in what direction is unknown.

With Graphite, this is easy. Notice the asterisk in the dialog box. It means, “the cursor can be used to enter values.”

- Put the bulls-eye cursor on the bottom of the vertical line of the face and drag up to the top of the line, then release.

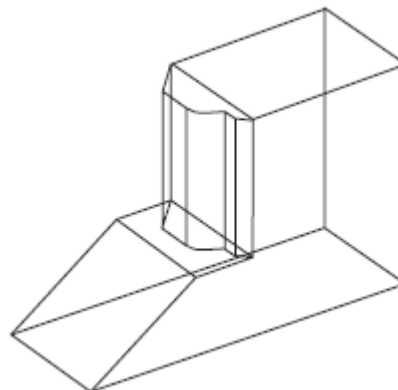
*One of the unique Graphite features is the ability to drag from one point to another, and have the values appear in the right data fields.*



A number equal to the distance of that drag will appear in the *dz* data field, replacing the  $-1$  that was there.

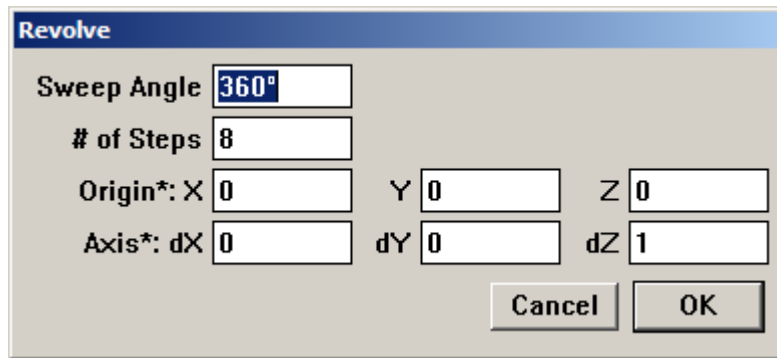
- Click OK.

The extruded objects appear.



- Now select the same five contour objects, but select the ones at the top of the extrusion. It is possible to revolve these objects around the corner of the block.
- Select **3D>Revolve**.

The Revolve dialog box appears.



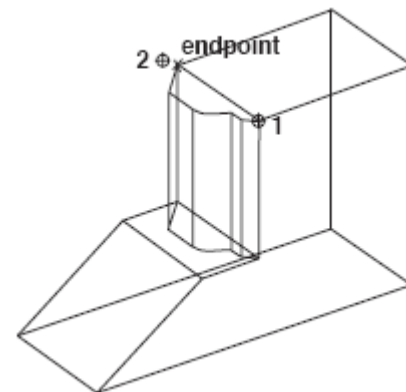
Take this contour and sweep it 90 degrees, using the corner of the block as the axis of revolution. Knowing this, type **90** into the *Sweep Angle* data field. Use **4** divisions for the *# of Steps*. You probably will have no idea how to fill in the remaining six data fields. But there is an asterisk again, which means, “use the cursor to enter values.” Define the axis of revolution to be from point 1 to point 2.

- Type **90** in the *Sweep Angle* data field.  
*Indicate how many copies should be placed within the Sweep Angle with the # of Steps.*
- Press TAB to move the cursor into one of the data fields for the *Origin*.
- Define the Axis of Revolution by dragging from endpoint 1 to endpoint 2 as illustrated below. Dragging in the opposite direction, the contour will sweep in the opposite direction.

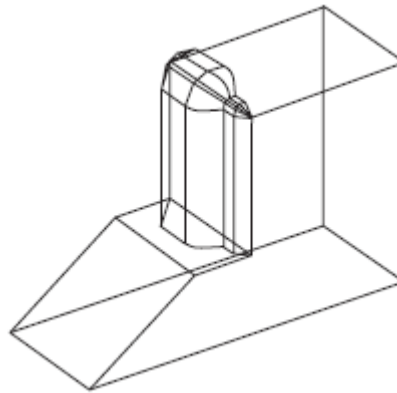
When the mouse is released, the data fields for *Origin* and *Axis* fill with a series of numbers.

Graphite automatically filled in the numbers for the axis and direction of revolution.

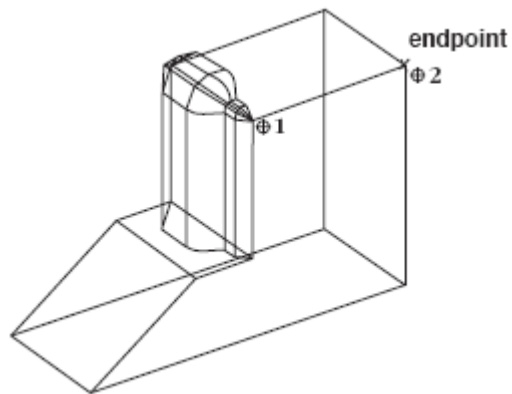
*It is also possible to click in one of the data fields.*



- Click OK.  
Graphite builds the sweep.

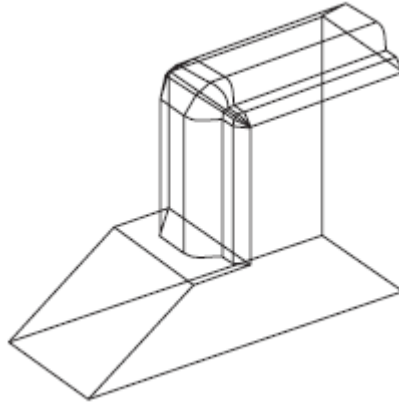


- Select the five contour objects at the end of the sweep.
- Select **3D>Extrude**.
- To specify the length and direction for the extrusion, drag from endpoint 1 to endpoint 2 as shown below.

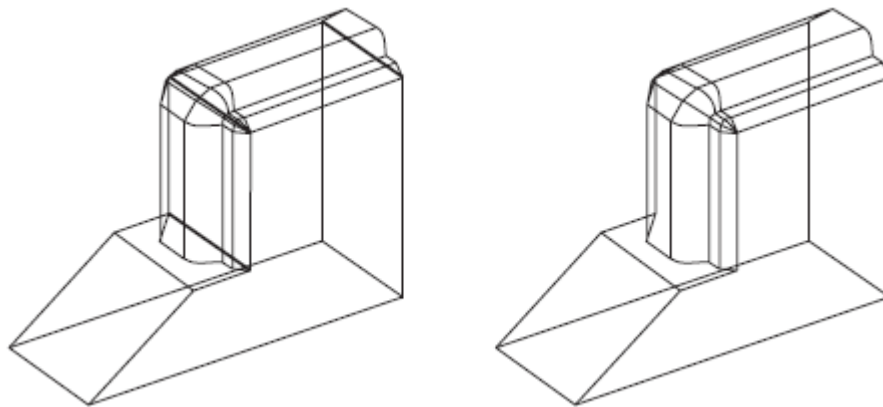


- Click OK.

The contoured face is finished.



10. The extrude operation has created some unnecessary lines. Select these lines and delete them to clean up the drawing.
  - Select the three lines shown by SHIFT-clicking on them, and then delete them.

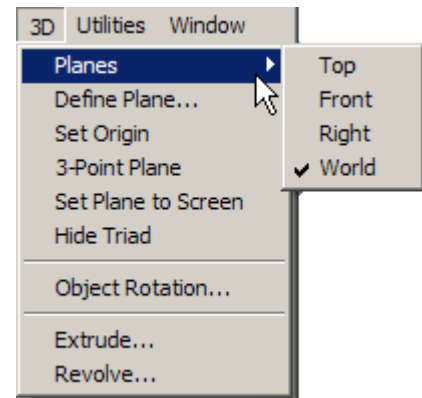



*At this point, get the Trackball out and rotate the part to see it from various angles.*

11. The next step is to put a hole on the front face of the wedge and extrude it through the part. By doing so, you will learn about the concept of Work Planes. Right now the Triad shows that the Work Plane is parallel to the bottom of the Wedge Die. It is necessary to draw a circle that stands up along the right face. Change the work plane to accomplish this.
  - Select **3D>Planes>Right**.



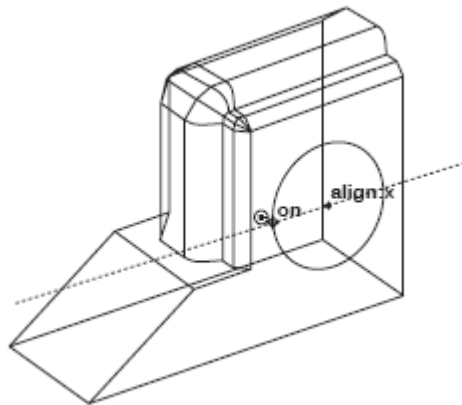
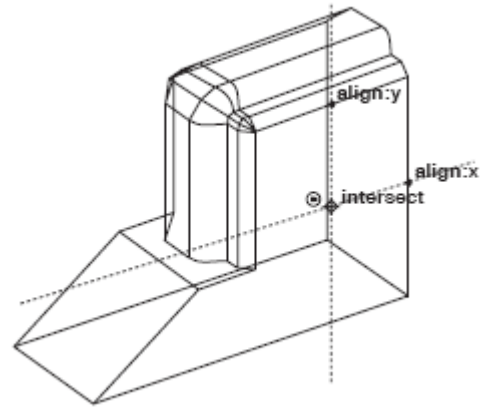
Notice that prior to releasing the mouse button, the current Plane was Top or World (indicated by a check mark). Once the mouse button is released, the Triad changes to reflect the new work plane.



- Select the **Center-Point Circle** tool. 
- Touch the *midpoint* of both the right side and the top edge of the front face to “wake up” these points. The Drafting Assistant now gives construction lines off of each point.

*Use the Trackball to rotate the part to make it easier to see the midpoints of the lines on the right side face.*

- Go to where the Drafting Assistant shows the *intersect* of the two alignments and drag the circle along the face. (The center of the circle is placed at the *intersect*.) Release the mouse button when the circle is approximately the size shown.



- While the circle is still active, select **Arrange>Divide**.  
*If you want to eventually surface this geometry, there is no need to divide the circle. However, this exercise includes these steps to introduce the Divide command. The Divide dialog box appears.*
- Make # of pieces equal to **4**, and deselect the *Show Points* option.
- Click OK.

The circle is now divided into 4 arcs. The circle will flash when the divide operation is executed.

- Select **3D>Extrude**.

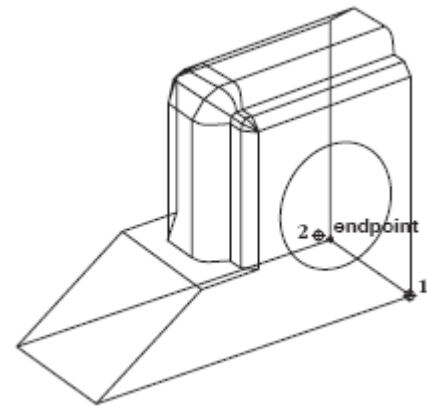
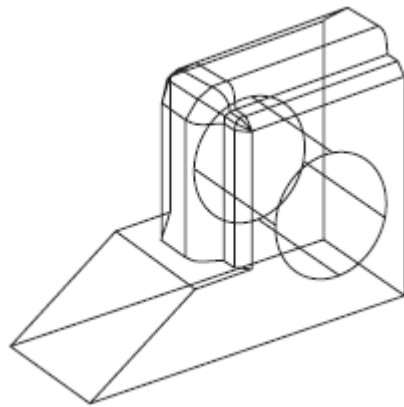
*Dividing the circle results in four extrusion lines (instead of one). The extra extrusion lines make it easier to visualize the extrusion when working in wireframe mode.*

- Drag from endpoint 1 to endpoint 2.

This defines the distance and direction the circle to be extruded.

- Click OK.

The circle extrudes with four extrusion lines.

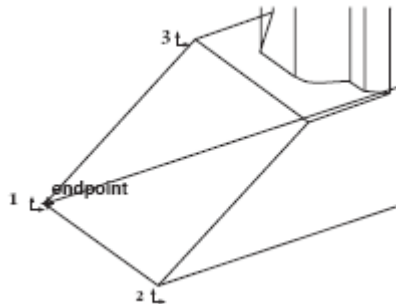


- The next step is to put a hexagon on the sloped face. This is a good exercise because it shows how Graphite deals with non-orthogonal planes. To draw anything directly on a sloped face, set the work plane to match it. In the **3D>Planes**, none of the choices are appropriate (Top, Front, Right and World). Define a new plane for this operation.

- Choose **3D>3-Point Plane**.

The Message Line asks for three specific things, first the origin, then the positive x-direction, finally the positive y-direction.

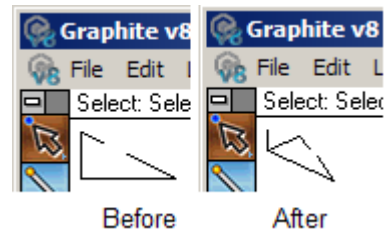
- Click first at endpoint 1 for the origin, then at endpoint 2 for the positive x direction, and then at endpoint 3 for the positive y-direction as shown in the drawing below.



Use the *Define Plane* command to use that plane orientation more than once.

The Triad changes to indicate that the current work plane now matches the sloped face.

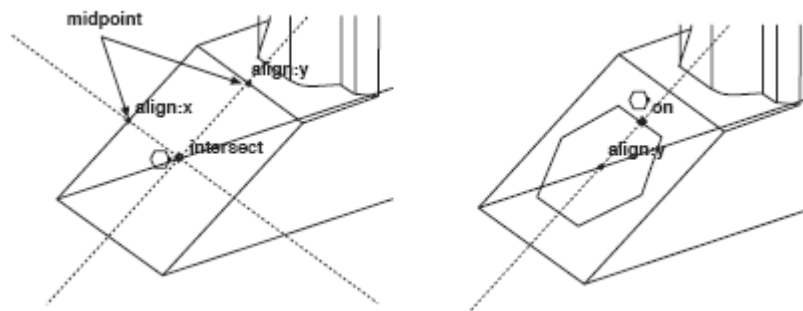
Now that the work plane is the necessary way, draw the hexagon.



- Select the **Circumscribed Polygon** tool. The Message Line reads, *Circumscribed Polygon: Pick center of polygon [Ctrl = Copy Previous (Windows) or Option = Copy Previous (Macintosh)].*

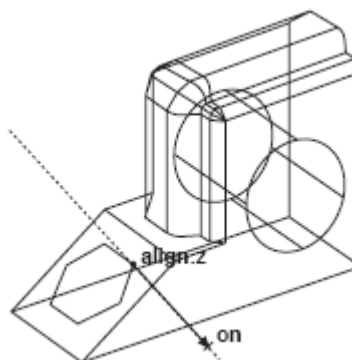


- Touch the two *midpoints* shown to wake them up and let the Drafting Assistant show where the *intersect* is located. This point will be the *center* of the hexagon. Drag the second point straight up, and the hexagon will be placed onto this sloped face. Release the mouse button when the hexagon is similar to the drawing below.

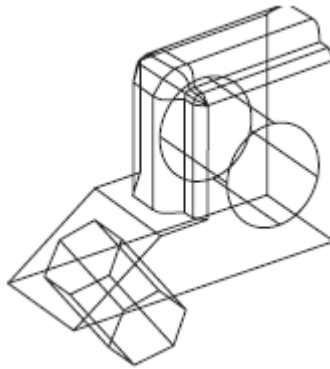


13. Now extrude the hexagon through the part, perpendicular to the face.

- Select **3D>Extrude**.
- Drag one of the points to below the part, along the z-direction. Take the extrusion well below the part and release the mouse button. Make sure there is *align:z* so that the extrusion will be perpendicular to the work plane.



- Click OK.

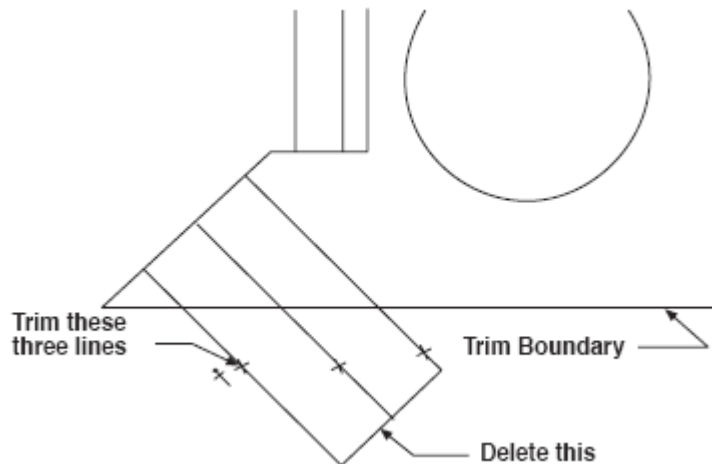


14. The extrusion is extended beyond the base. Use the **Simple Trim** tool to cut off the excess.

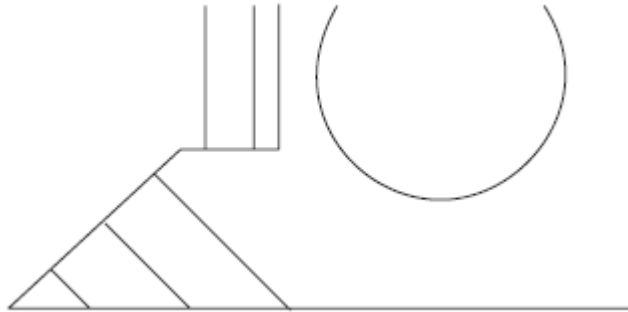
- Change the view to Right (either use the pop-up menu on the Trackball or **Views>Views>Right**).
- Use the **Selection** tool to select the bottom line of the part. This will act as a trim boundary.
- Select the **Simple Trim** tool.



- Click on the extrusion lines that extend below the bottom of the part. There should be two lines on top of each other in each location, click twice on each line.
- Select and delete the lower hexagon.

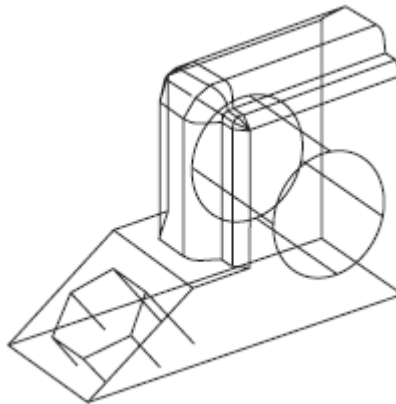


The hexagon trims to the bottom edge of the part.



*The **Simple Trim** tool works exactly the same as it did in 2D, except now it is working on a 3D part. This is great because it is like trimming to a surface.*

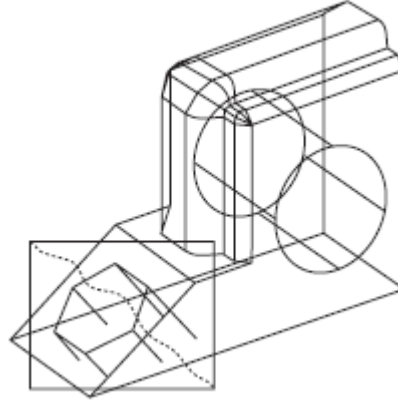
- Go back to the Trimetric view.



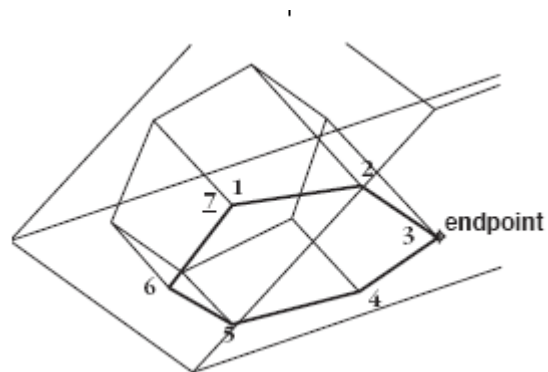
*In this case, because of the way the lines came out on the trim, use the **Trackball** to rotate the model slightly to see all the endpoints more clearly.*

15. Draw the hexagon on the bottom surface of the wedge.

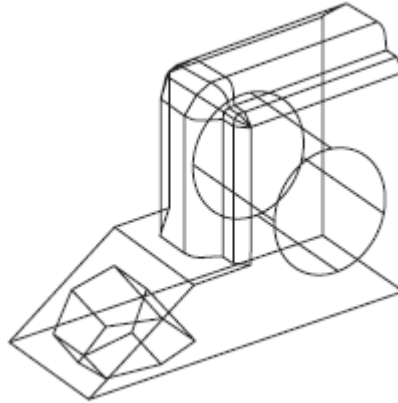
- Execute a Stroke-Zoom. Hold down the CTRL+SHIFT keys (Windows) or the ⌘ key (Macintosh) and drag a diagonal window from upper left to lower right, as shown.



- Using the **Connected Lines** tool, connect each of the six endpoints to finish the hexagon hole along the bottom of the part. Double-click at the last point (point 7) to end the connected line.



- Choose **Arrange>Zoom Previous** to get back to the previous zoom. Hold down the CTRL+SHIFT keys (Windows) or the ⌘ key (Macintosh) and drag a diagonal window from lower right to upper left.



#### 16. Save the view

- It is a good exercise to save custom views. The 4th view comes up as Isometric. Activate it, rotate it slightly and then save the new view. To do this, choose **Views>Define View**. Click New, and then OK. This will create a new view called View 1. Switch back and forth between this and other views. For the purposes of the rest of the tutorial, it is best to switch the work plane back to World and the view back to Trimetric.

The Part is finished, but the tutorial is not done yet. So read on.

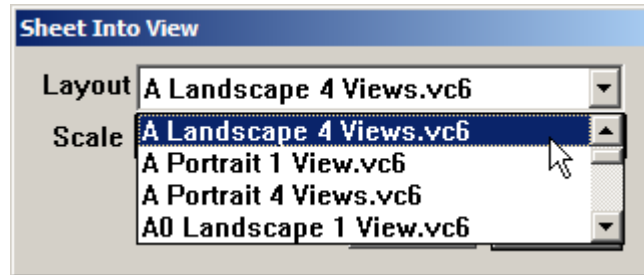
## Creating a 2D Drawing

17. Place this part into a 2D drawing with four views (Top, Front, Right, and Trimetric). In Graphite it takes one command.

- Select **Arrange>Zoom All**. Leave the part in the Trimetric view.
- Select **Views>Sheet Into View**.

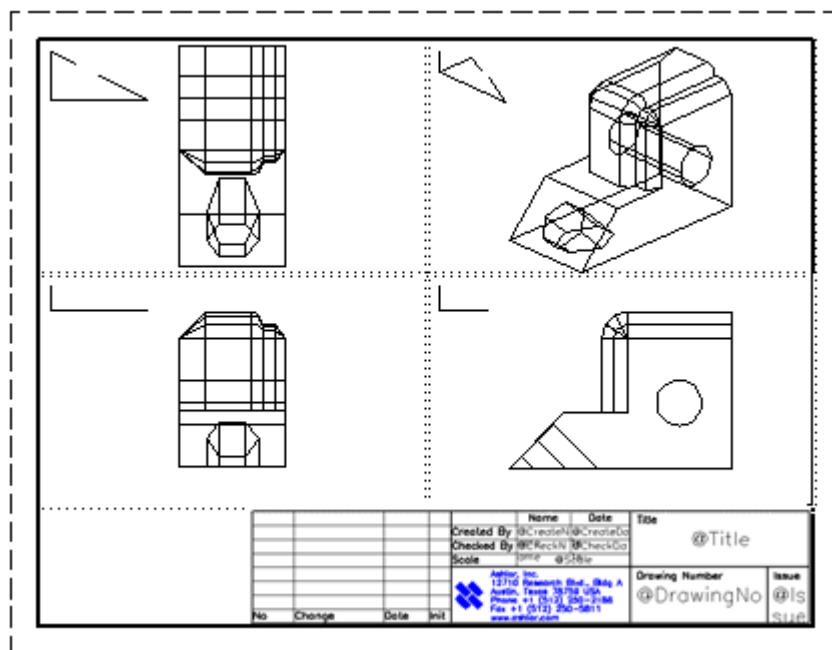
The following dialog box appears:

Specify a layout and viewing scale for the original model. There are many choices in this menu including different variations of view arrangements, surrounded by a border and title block. These choices are user definable.



- Working on a 13 or 19 inch monitor, select *A Landscape 4 View.vc6*. Set the *Scale* to **.75**.
- When finished, click OK.
- Select **Arrange>Zoom All**.

One command makes from a 3D wireframe model to a layout for a 2D drawing. It has the four views, a title block, and a border.



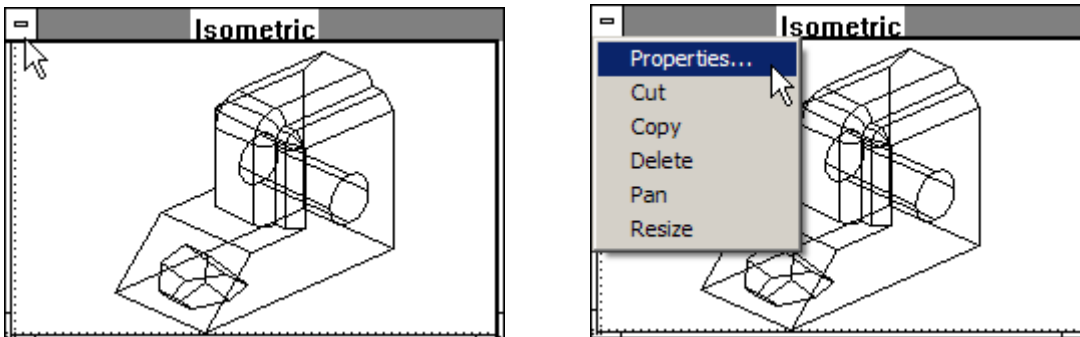


## 18. Edit the view windows.

If the end drawing is not something similar to what is shown in the previous illustration—if the part is too small or too large in each of the views—modify the scale of each of the four views.

If the drawing looks fine, then skip the next four steps.

- Activate one of the views by clicking on it.
- Open the pull-down menu from the upper left corner of the view boundary.

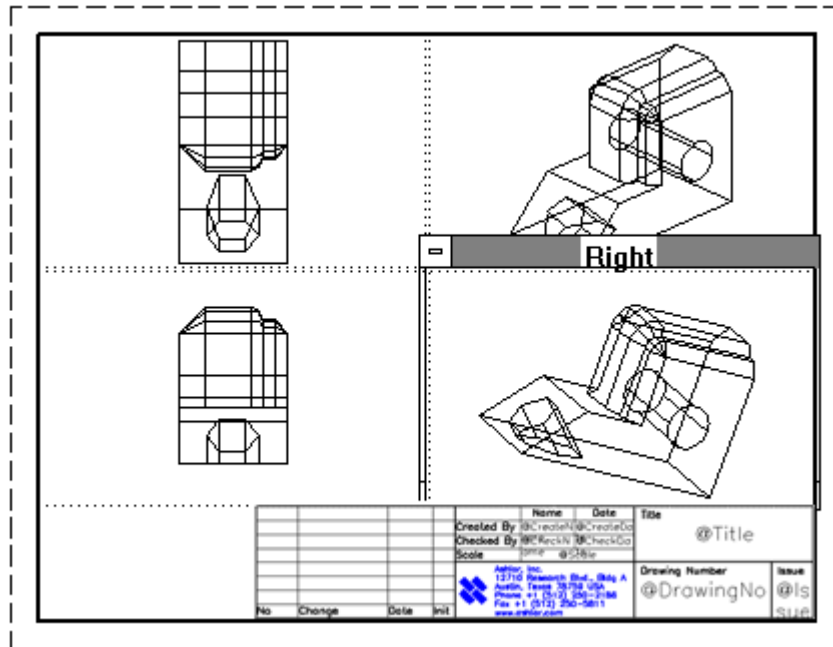


- Select Properties from the pull-down menu.
- Modify the scale to make the part show up in the view more clearly. In this case, since the part is too small at .75 scale, perhaps entering a scale of **1.5** would work better. Whatever number works well, make sure to enter the same value for all four of the views.

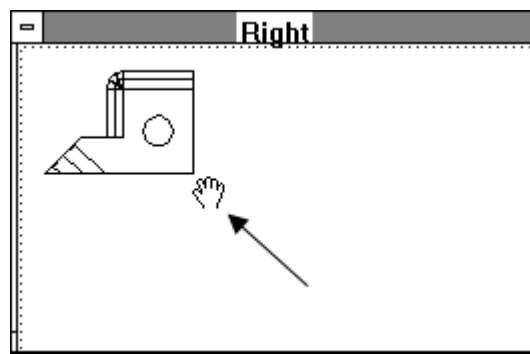
With the Trackball, rotate any of the views to something nonstandard.

- Select **Views>Show Trackball**.
- Click in the Top view window to make it active. (Its title bar will display.)

- Rotate the model in that view by dragging on the Trackball. Any of the four views can display any custom view. (Rotate the Right view window next.)

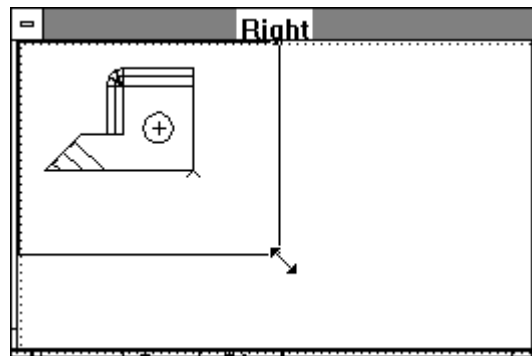


- While the Right view window is still active, pick Right from the Trackball pull-down menu. Click on the Top view window to activate it, and select Top from the Trackball menu to put it back to its orthogonal projection.
- Select **Arrange>Zoom Out** with the SHIFT key (Windows) or CONTROL (Macintosh) pressed down.
- Select *Pan* in the pull-down menu for the Right view window. The cursor changes to a mover hand icon.
- Drag the wedge to the upper left corner of the view window.

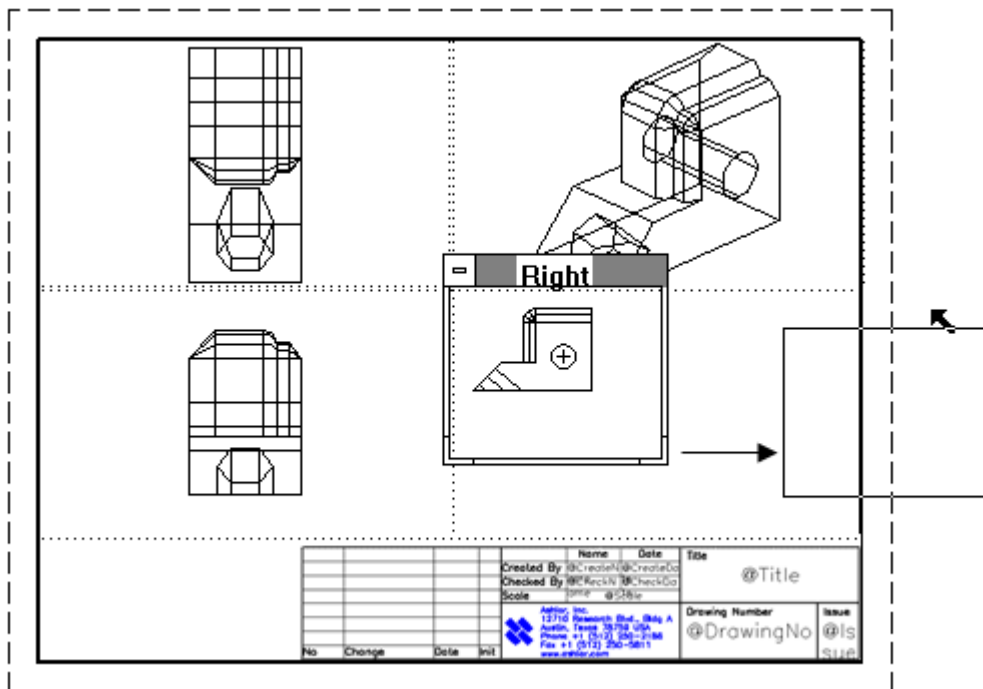


- To finish, drag the lower right corner of the view.

Drag it up, to reduce the size of the view.



- Drag the title bar of the new view and move it into a clean area.



Set the right view to its original size and position.

#### 19. Create an unfolded view.

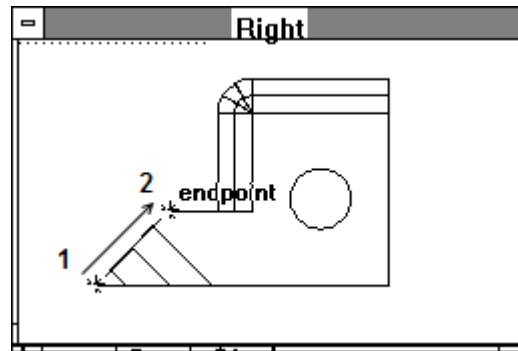
A common drafting operation creates a view on the drawing that looks straight at a specified face, much like the Projected View problem from high school drafting class.

Activate the view, and unfold it.

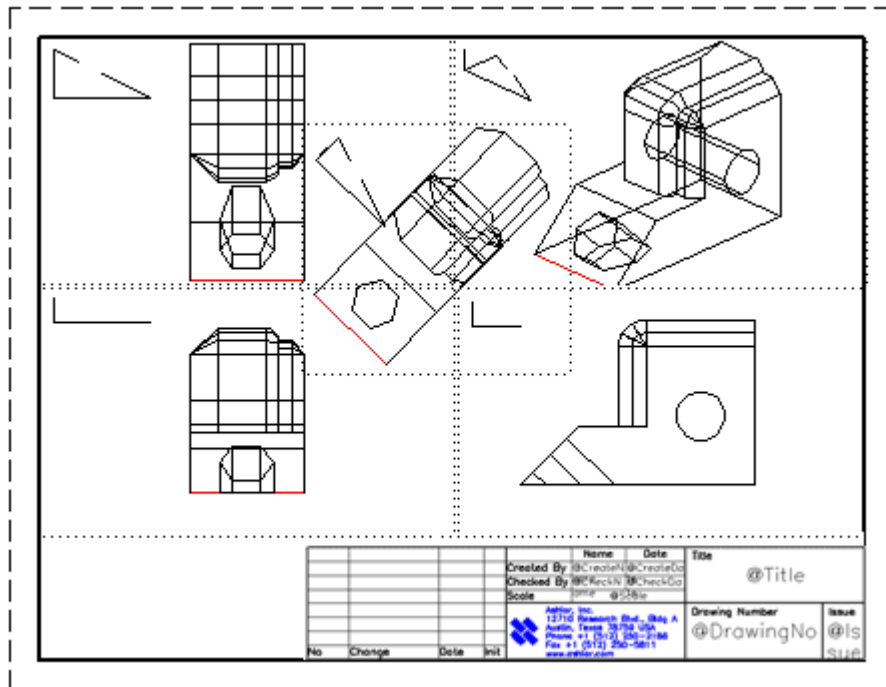
- Click on the Right view window to activate it.
- Choose **Views>Unfold View**.

The Message Line reads: *Pick start of fold line.*

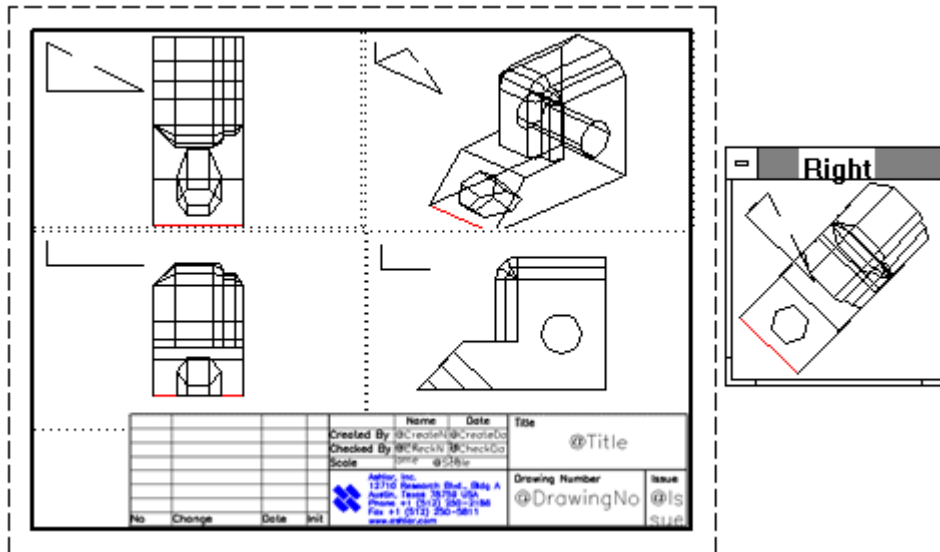
- Drag the mouse button from endpoint 1 to endpoint 2.



- When the mouse button is released, a new view appears on the drawing. (Note: it may appear below the current drawing, so it may be necessary to scroll down, or *Zoom All* to see it).



- Resize the unfolded view, drag its title bar and move it to a clean area.

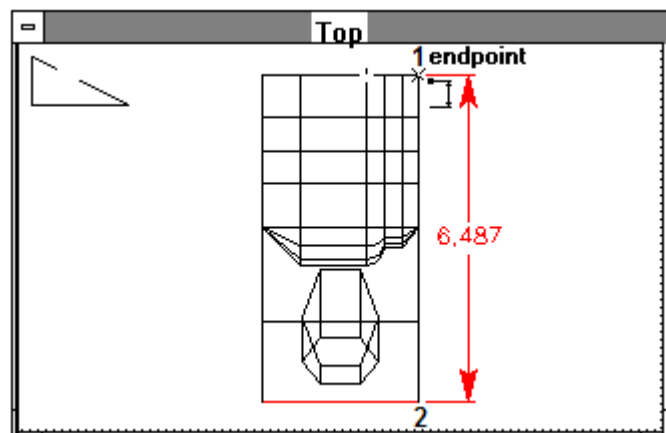


## 20. Dimension the part.

*During dimensioning pay attention to the Triad. The dimensions work only on the current x-y-plane. So a good trick is to pick Set Plane to Screen from the 3D menu. The Triad will show flat in all five views now. All dimensions work as if it were a 2D-drawing.*

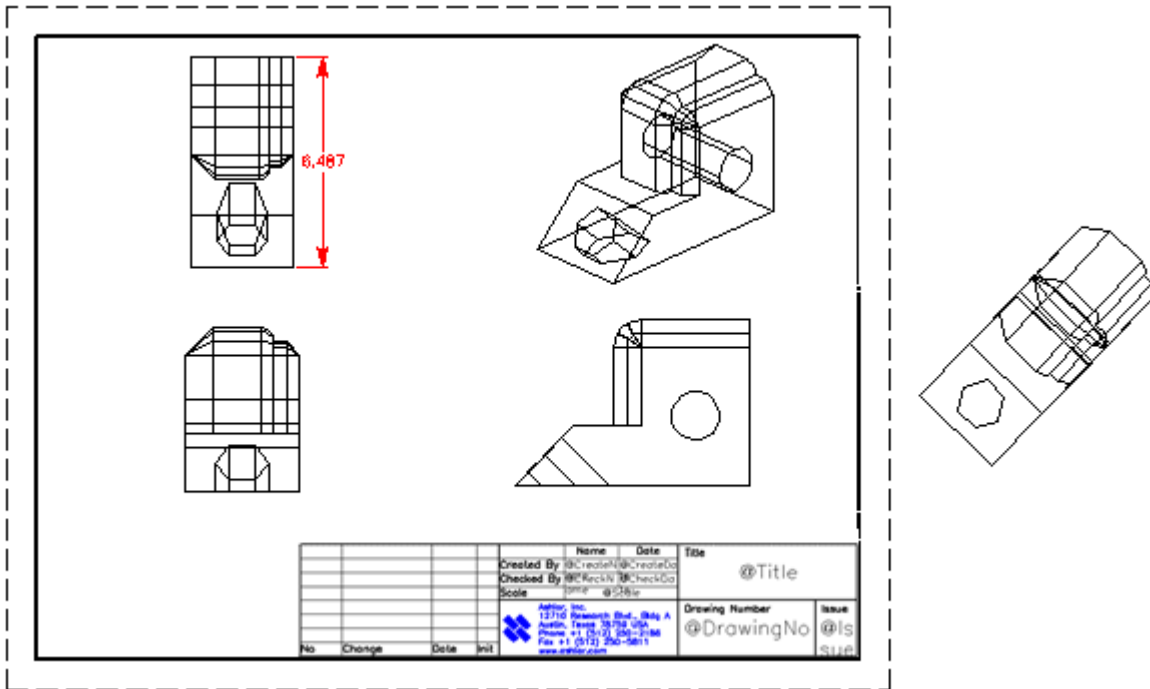
- Select the **Vertical** dimension tool.
- Click in the Top view window to activate it.
- Click on the right side of the part from top to bottom to make the dimension appear. Change its font size using **Dimension>Size** to make it readable.

The five views we have here are associative. However, the dimension object we just placed shows up only in the one view, because these views are smart. Dimensions show only in the view in which they are placed. The same is true for Crosshatching and Text.



21. Print the drawing.

- Hide the Trackball and the Triad.
- Deselect view boundaries (**Views>Draw View Boundaries**).
- Select **File>Print Setup** (Windows) or **Page Setup** (Macintosh) and prepare the page settings for the paper and printer.



- Use the **Layout>Drawing Size** command (if necessary) to scale the drawing to the page size.
- Select **File>Print**.

### Accomplishments

- Creating a 3D wedge die.
- Creating 2D drawings.