The Rectangular Problem

This chapter will cover:

1. Using the tools and toolbars for simple 2D Computer Aided Drafting (CAD)
2. Using the Smart Line command
3. Using AccuSnap for accurate graphical selecting
4. Using Copy command to create a new entity at another location on the drawing
5. Using the Copy command to create new and accurate lines
6. Using the IntelliTrim command to divide lines, change line lengths and create arcs from circles.
7. Using the Fillet command to trim lines and add arcs
8. Using the Circle command to make circles by radius and diameter
9. Using the Move command to change the location of an entity
10. Using the Rotate command to rotate a group of entities
11. Using the Array command to create a rectangular pattern

Working with Toolbars

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The rectangle problem is designed to introduce you to the most basic CAD commands while showing you how those commands can be used to create actual designs. These tools are located on toolbars, which, for easy access, you will need to position around your workspace.

Under the Menu bar, select Tools. The first three toolbars should be checked: Attributes, Primary, and Standard. These will be placed above your workspace. Select Main under the Tools menu to find the more toolbars you will need for this problem. Select **Modify**, **Polygons**, **Ellipses**, **Linear Elements**, and **Manipulate**: these will go on the left side of your workspace. Select **Text** and place it on the right. Finally, find Dimension Tools under the Tools menu and select **Angular**, **Linear**, and **Radial** dimensions. Place these toolbars on the right side of the screen with the Text toolbar.

At the bottom of the Tools menu, select "Tool Boxes…" to see a complete list of toolbars available. From this list, make sure the boxes beside 2D View Control and Snap Mode are checked. Hit ok and place these toolbars at the bottom of the screen.
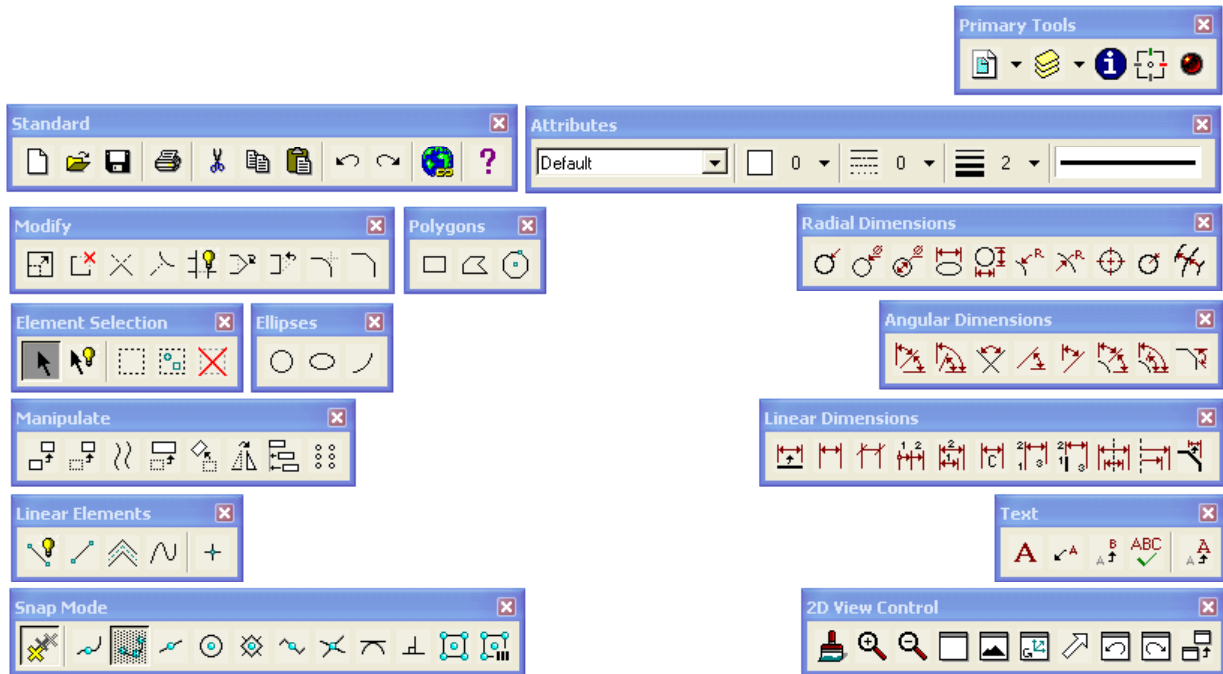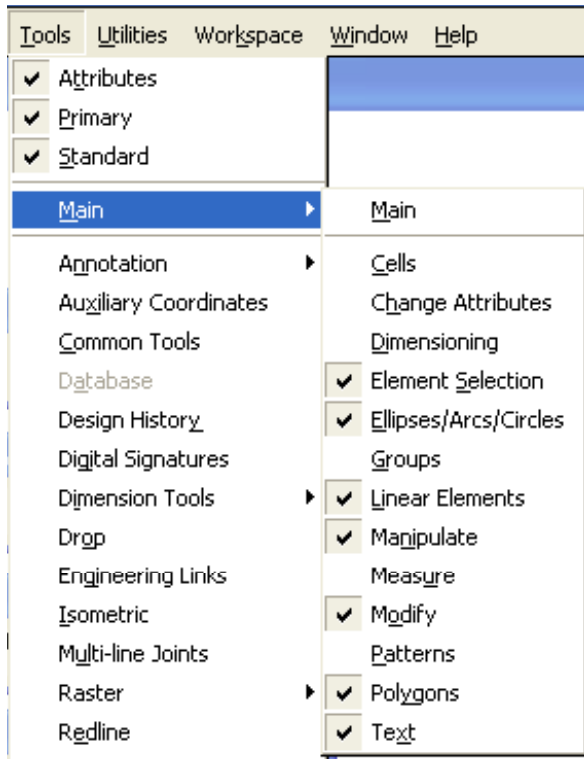
Figure 2.1 - Basic Toolbars
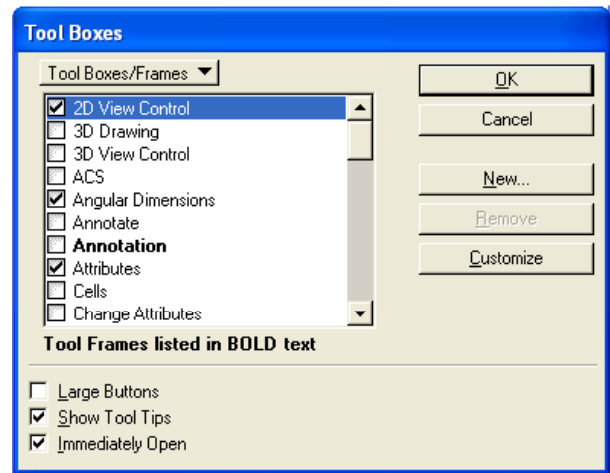
Figure 2.2 – The Main Toolbars

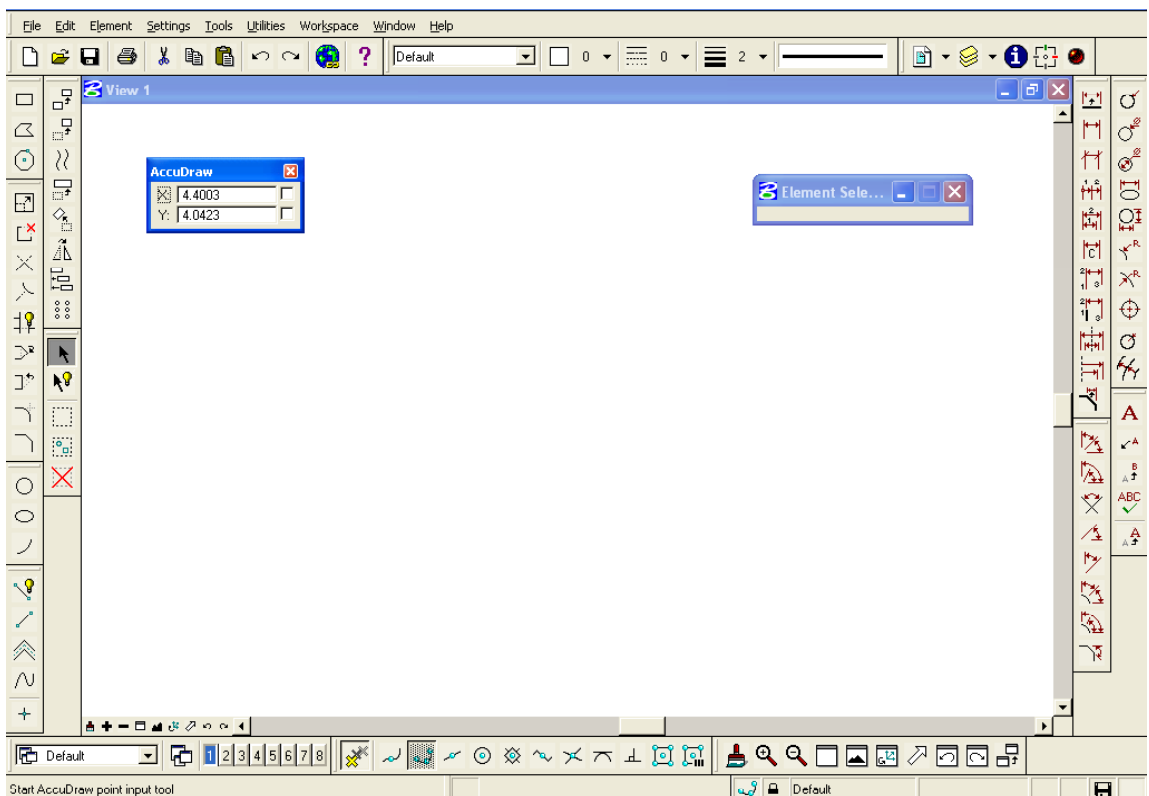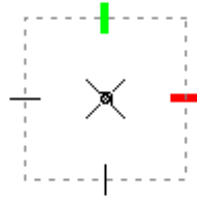**Figure 2.3 – The Toolbox Window**

Figure 2.4 – Toolbars Placed Around the Workspace

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AccuDraw

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The AccuDraw tool allows you to quickly accurately place select points and distances. When using AccuDraw, you will see this compass every time you select a point.

Lines you draw from the selected point will automatically snap to any one of the four hatch lines in the compass. You can toggle AccuDraw from the Primary toolbar at the top of your screen. Make sure it is on for this problem. You will become more acquainted with AccuDraw as you complete more drawings.

SmartLine

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PowerDraft's default workspace displays a grid. Most CAD drafters prefer to work without a grid, as it clutters the workspace. To toggle the grid on/off, hit CTRL+B and uncheck the box beside Grid. Click Apply to save the new settings. You can also maximize the View 1 window to enlarge your workspace.

Select the SmartLine tool from the Linear Elements toolbar and the Place SmartLine window will appear. Make sure the Segment Type is set to Lines and that the Vertex Type is set to Sharp. Uncheck the Join Elements box, as shown in Figure 2.5.
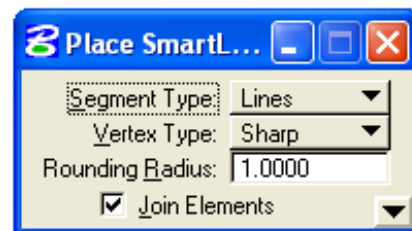

Figure 2.5 – Place SmartLine Window

Select any point in the bottom left corner of the screen, and the AccuDraw compass will appear. Notice that in the AccuDraw Window, the x and y coordinates show the exact point of your cursor anywhere you move it on the screen. Move the cursor to the right and type "6" and hit Enter. Now you will only be able to draw a line that extends 6 units on the x axis. Use the scroll wheel on your mouse if you need to zoom in or out on the workspace. Notice the AccuDraw window now only displays 6 in the x axis, as shown in Figure 2.6. If you place the line on the red hatch mark parallel to the x axis, you will draw a line 6 units to the right. Left-click to place the line.
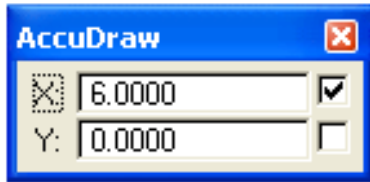
AccuDraw

X: 6.0000 ☑
Y: 0.0000 ☐

Figure 2.6 – The 6-unit SmartLine
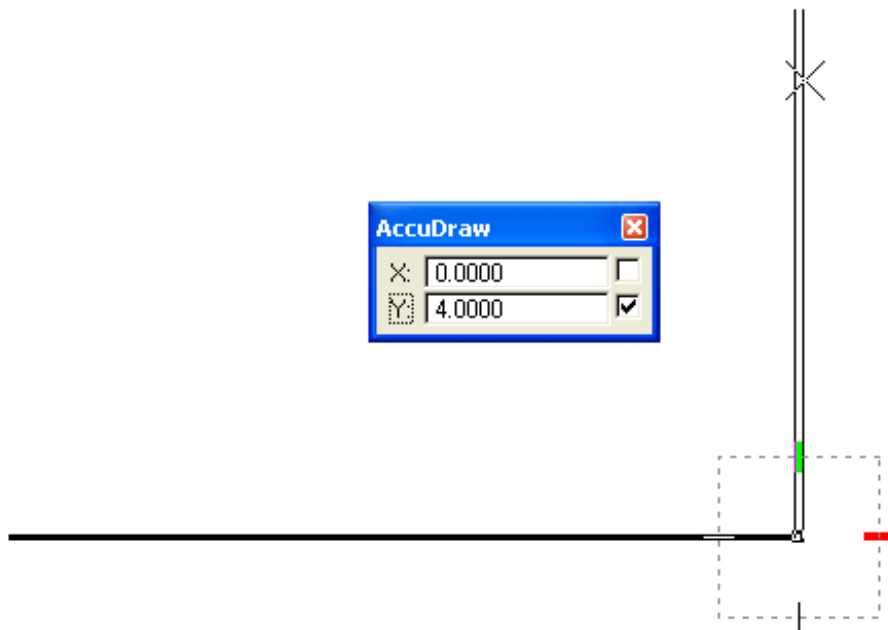
AccuDraw

X: 0.0000 ☐
Y: 4.0000 ☑

Figure 2.7 – The 4-unit Parallel SmartLine

After left-clicking to place the 6-unit line, you can see that the AccuDraw compass shifts to the other endpoint of the line, ready to draw the next line. In Figure 2.7, you can see a 4 unit line being plotted upwards parallel to the 6-unit line. Move the cursor up and type "4" and hit enter, then align the line with the green hatch mark and left click. The number you enter will set the axis in which you are directed, for this line, the y-axis.
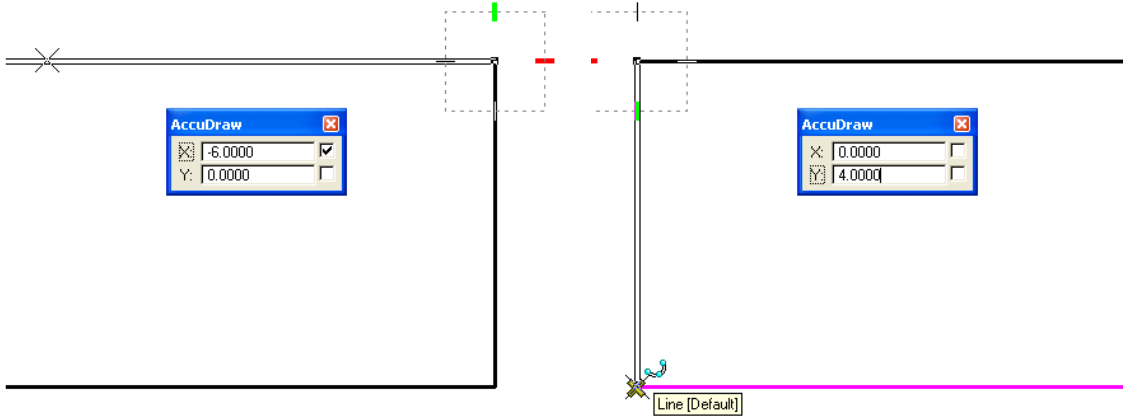
Figure 2.8 – Another 6-unit Parallel SmartLine

Figure 2.9 – The Final 4-unit Parallel SmartLine

Draw two more lines, one 6 units to the left, as in Figure 2.8, and then a line straight down, ending at the starting point of the first line you drew. Right-click to stop the current SmartLine. Notice how the first line changed color (magenta) and a yellow "X" appears when your cursor approaches the endpoint. This is called AccuSnap.

Figure 2.10 - The finished 6 x 4 rectangle.

Type "Time" at the Command Line and read your total time. When opening a new file you will note that drawing four lines should take less than twenty seconds.

* World Class CAD Challenge * – Close this file by selecting File from the menu bar and then Close. Start a new file by selecting File and New. Draw the 6 x 4 rectangle in less than 20 seconds.

Drawing Lines Using AccuSnap

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AccuSnap allows you to select points not necessarily known as coordinates, but definable by entities already drawn. When you drew the 4x6 rectangle, you used AccuSnap to select the endpoint of the last line by clicking the endpoint of the first line. You will use AccuSnap to draw the next two lines, but first you need to change the MultiSnap settings.

Right-click the Snap Mode toolbar and select the MultiSnap 3. Right-click the MultiSnap 1 button and click properties. Select all the checkboxes under the MultiSnap 1 button, and close the window.

Double-click the MultiSnap 1 button on the Snap Mode toolbar to lock the snap mode.

Select the SmartLine tool and bring your cursor near the midpoint of the left vertical line. The line will turn magenta and a yellow "X" will appear at the midpoint of the line. Left-click to place the starting point of the line, as shown in Figure 2.12.

Figure 2.11 - The MultiSnap Properties Window
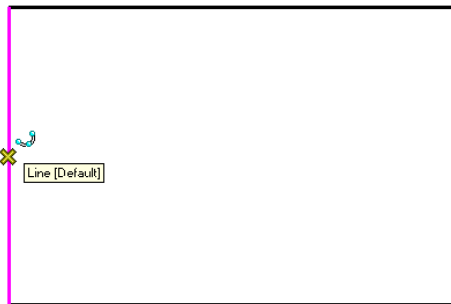
Figure 2.12 – Selecting the midpoint of a line

Figure 2.13 – Selecting the other midpoint

After you select the midpoint of the vertical line, the AccuDraw compass will appear. Bring the line across the rectangle to meet the midpoint of the other vertical line. Again, the line will change to a magenta color and a yellow "X" will appear. Left-click to place the line. When using AccuSnap, you do not need to enter the AccuDraw distance using the keyboard. The line will automatically snap to the point identified by the yellow "X". Right-click to stop the current SmartLine.

Draw a line using the same technique, only this time connect the top and bottom line by their midpoints, as shown in Figure 2.14 and Figure 2.15.
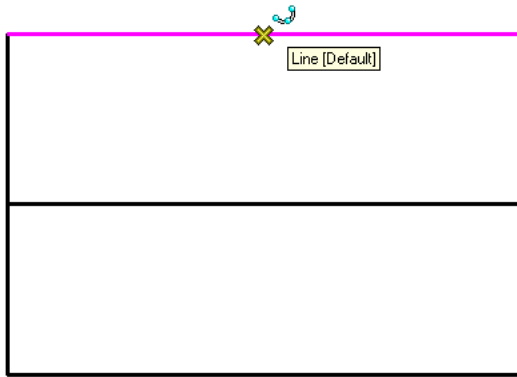
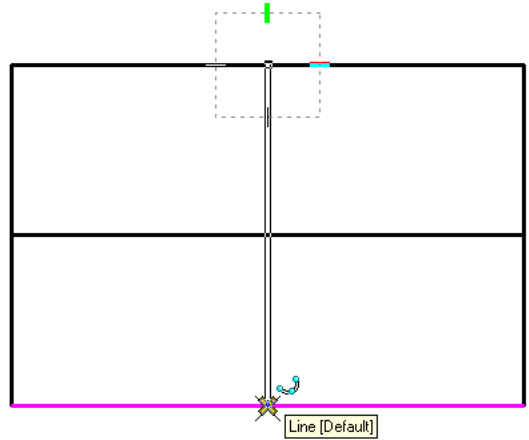**Figure 2.14 – Selecting the Midpoint of the Line**

Figure 2.15 – Selecting the Other Midpoint

Figure 2.16 - The 6 x 4 Rectangle with Two Tenterlines

* World Class CAD Challenge * - Close this drawing file. Create a New file and draw six lines: four for the 6 x 4 rectangle and two centerlines in less than 30 seconds. Continue this drill four times, each time completing the drawing under 30 seconds to maintain your World Class ranking.

Using the Copy Command

The Copy command is used to make an exact copy of an entity and then move it in relation to the original. You will use the copy command to help make the border of the rectangle problem.

Select the Copy command from the Manipulate toolbar. Select the object to copy by clicking on the left vertical line and the AccuDraw compass will appear. You can now move the new object anywhere on the screen. You want to move the line ¼" to the inside of the rectangle, so move it to the right (to specify the x-axis) and type ".25" and Enter. Left-click to place the line, and right-click to restart the Copy command.
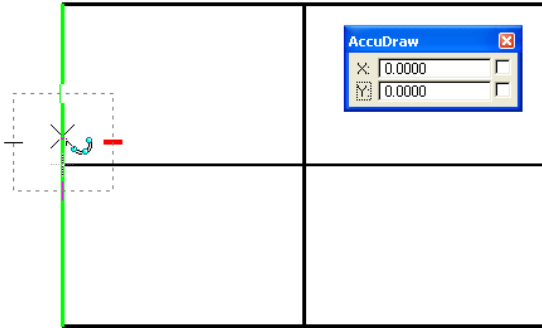
Figure 2.17 – Selecting the Line to Copy   **Figure 2.18 – Copying the Line 0.25 Units**
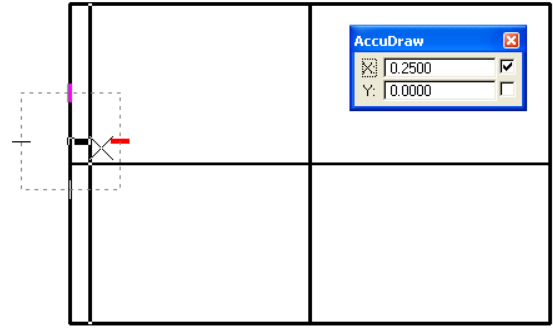
While still in the Copy command, select the top horizontal line, and move the new line down. You should see the line snap to 0.25 away from the original, as seen in Figure 2.19. AccuDraw remembers the last input, ".25", and automatically snaps to that distance if the cursor is in that general area. This means that you do not need to input the distance again. Instead, just move the line until it snaps to 0.25 units away and left-click. Right click to restart the Copy command, and copy the right and bottom lines of the rectangle using the same technique, as shown in Figure 2.20. If you make a mistake, press CTRL+Z to Undo the action.
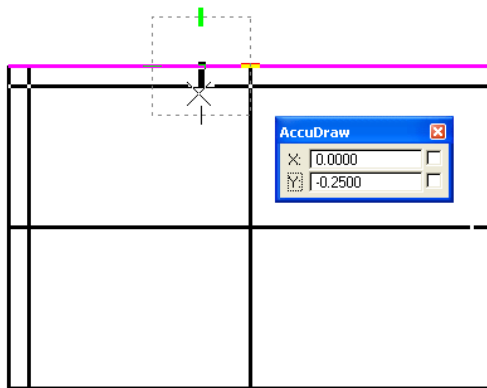
Figure 2.19 – Copying the Top Line   **Figure 2.20 – All the Outer Lines Copied 0.25 Units**
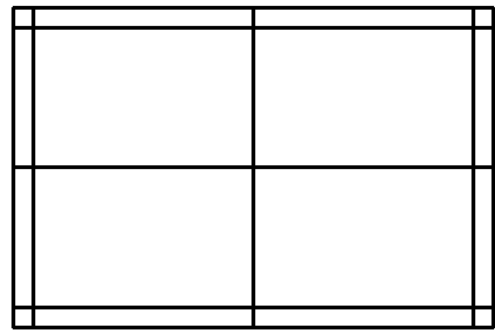
You also need to copy the two centerlines. Copy the horizontal centerline 1.5 units to the left and right (Figure 2.21 and 2.22). Copy the vertical centerline 0.8 units to the top and bottom (Figure 2.23 and 2.24). Remember, after you enter a distance once, AccuDraw will snap to that distance until you enter a new value.
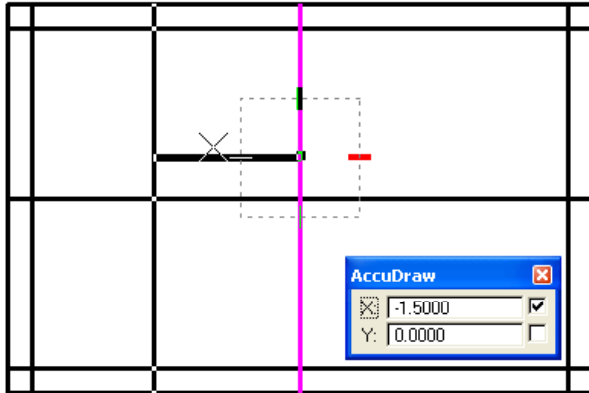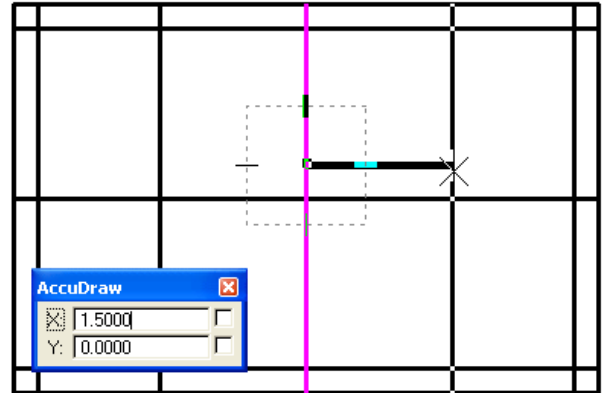
Figure 2.21 – Copying the Centerline Left
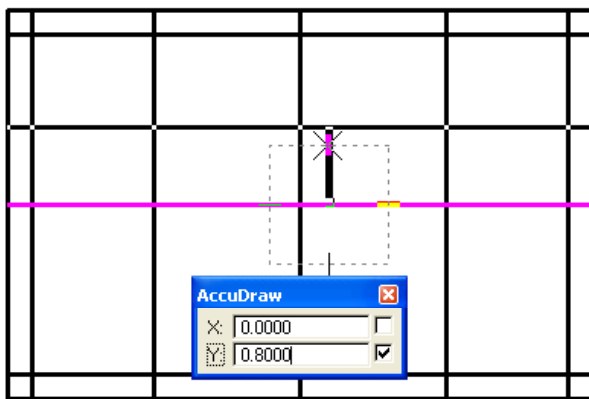

Figure 2.22 – Copying the Centerline Right

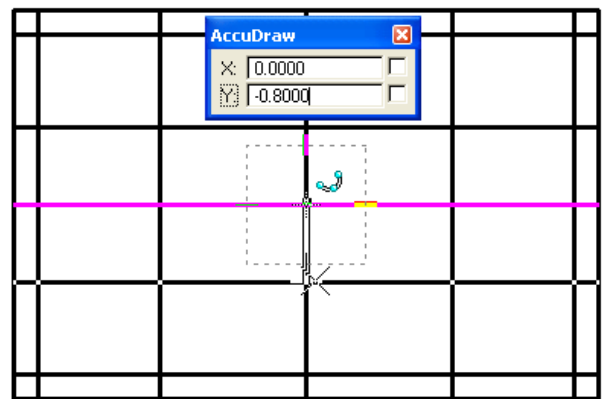**Figure 2.23 – Copying the Centerline Up**

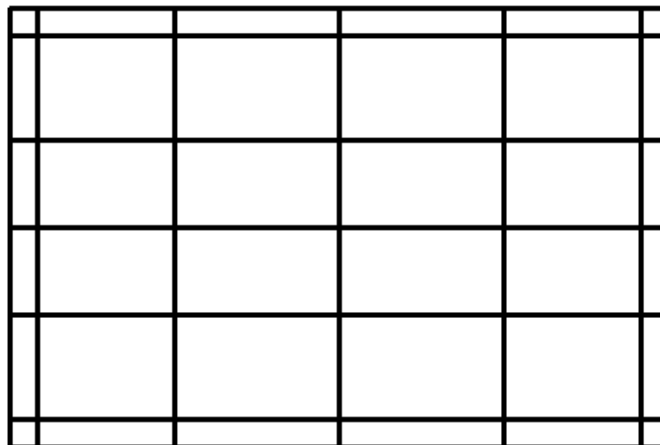**Figure 2.24 – Copying the Centerline Down**

Figure 2.25 - The 4 x 6 rectangle with two centerlines and eight copied lines

* World Class CAD Challenge * - Close this drawing file. Create a New file and draw fourteen lines: four for the 6 x 4 rectangle box, two centerlines and eight copied lines in less than 70 seconds. Continue this drill four times, each time completing the drawing under 70 seconds to maintain your World Class ranking.

Using the IntelliTrim Command

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The IntelliTrim command allows you to remove sections of an object without deleting it entirely. You will use the IntelliTrim tool to trim unwanted sections of this design.

Make sure that the IntelliTrim window resembles the one displayed in Figure 2.26. The Mode should be set to Advanced, the Operation should be set to Trim, and "Select Cutting Elements" should be selected.
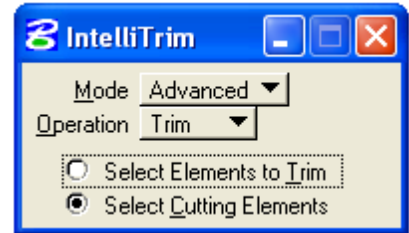
Figure 2.26 – The IntelliTrim Window
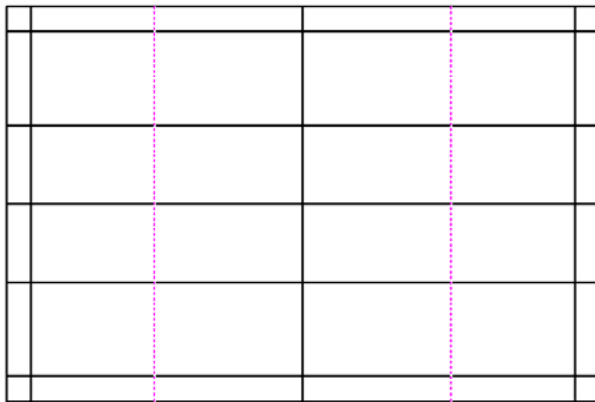
First, select the objects that define where you wish to cut (hence the "Select Cutting Elements" on the IntelliTrim window). In this case, select the two copied vertical lines you just created, as shown in Figure 2.27. Right-click to continue.

Figure 2.27 – Select Cutting Elements

Next, select the objects to be trimmed, in this case the top and bottom horizontal lines shown in Figure 2.28. Make sure both lines change color to magenta; you may need to select them more than once. Right-click to continue.
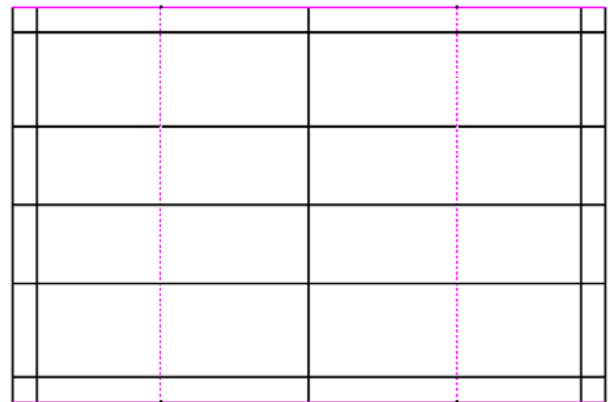
Figure 2.28 – Select Elements to Trim

Figure 2.29 – Select Portions to Keep

Finally, you need to select which side of the trimmed lines to retain in the drawing. Left-click to place a dot on the outside of both cutting elements, as shown in Figure 2.29. The trimmed line segment between the two cutting elements should disappear. Right-click to apply the trim.

Using the same technique, trim the Middle sections of the right and left outer vertical lines, as shown in Figure 2.30

Figure 2.30 – Trimmed Perimeter

Continue with the IntelliTrim tool by trimming the inner vertical and horizontal lines, as shown in Figure 2.31 and 2.32. You can always double right-click if you need to restart. If you make a mistake, just press CTRL+Z to Undo. You part should now look like the one in Figure 2.30.
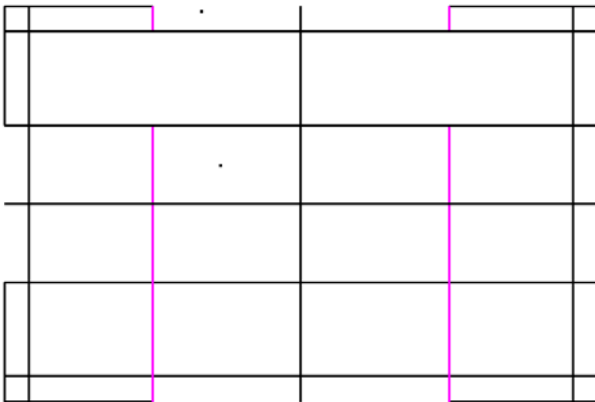
Figure 2.31 – Inner Vertical Lines Trimmed
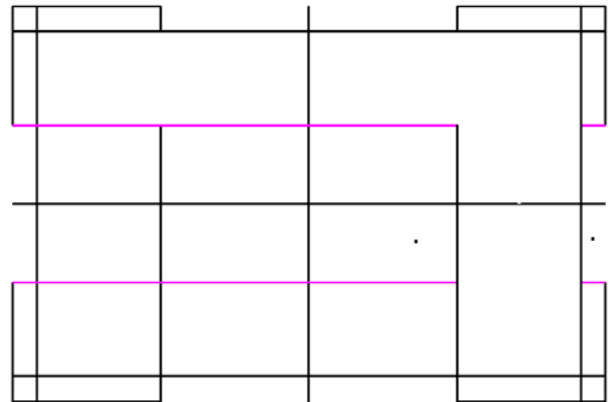
**Figure 2.32 – Inner Horizontal Lines Trimmed**
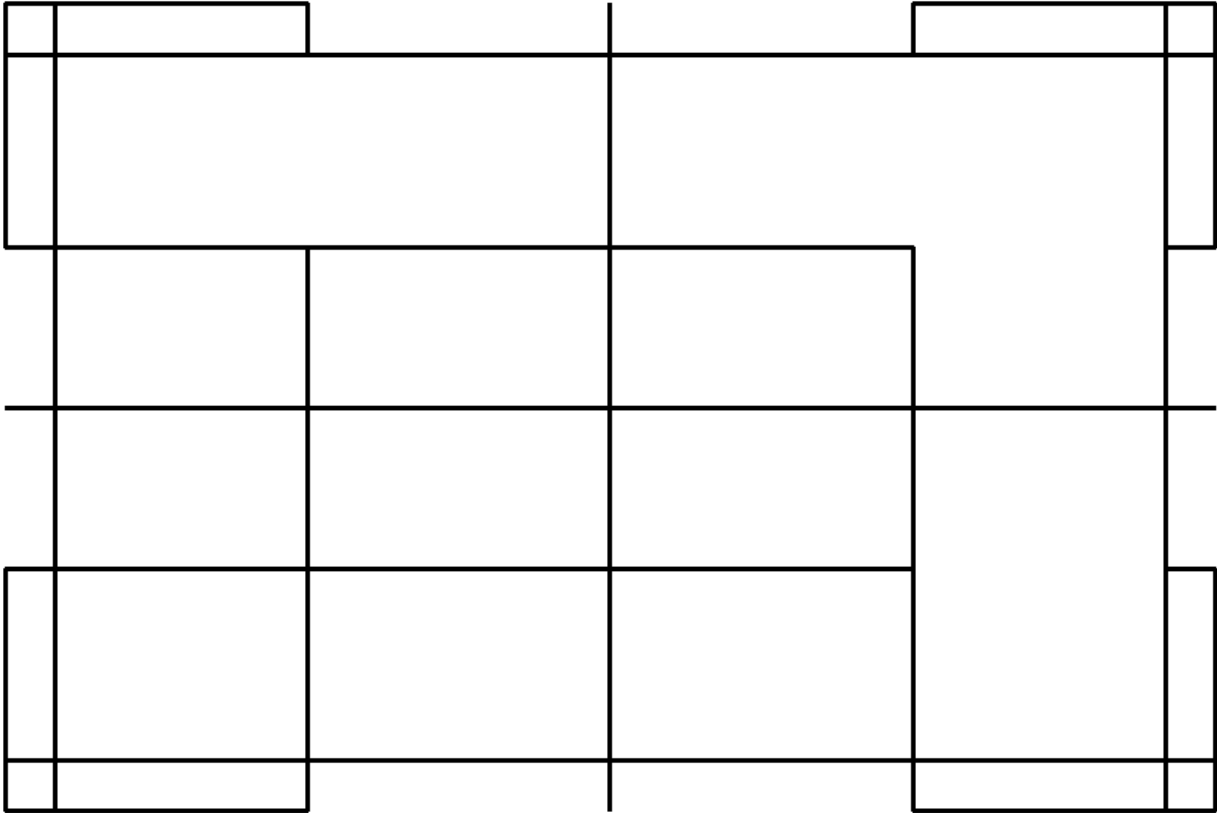
Figure 2.33 - Finished drawing before filleting

Using the Fillet Command

The Fillet command is used to place rounded edges on the intersection of two lines. Select the Construct Circular Fillet tool from the Modify toolbar.

In the Construct Circular Fillet window, set Truncate to Both and type "1/16" and Enter for the Radius. Notice how the window automatically changes the fraction to the correct decimal value. You can use this function for many of the tools in PowerDraft.
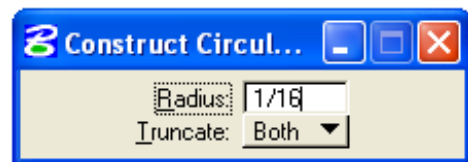
To fillet the 1/16 corners, select the two lines that intersect to make each corner. Notice you must select the line on the side of it that you wish to keep. The other end will be truncated, or trimmed, to create one line.
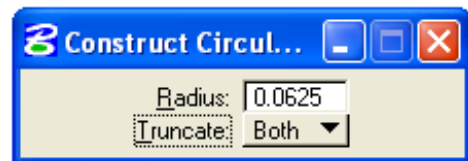
Figure 2.34 – 1/16 Becomes 0.0625
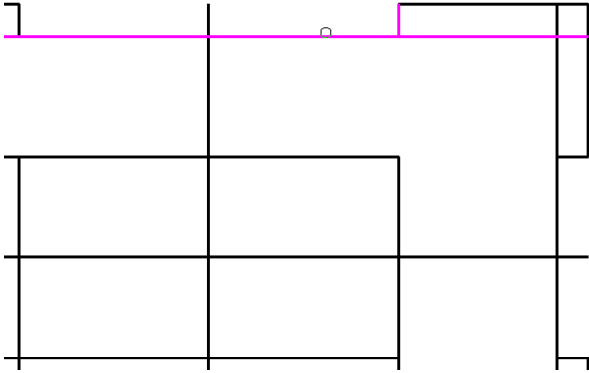
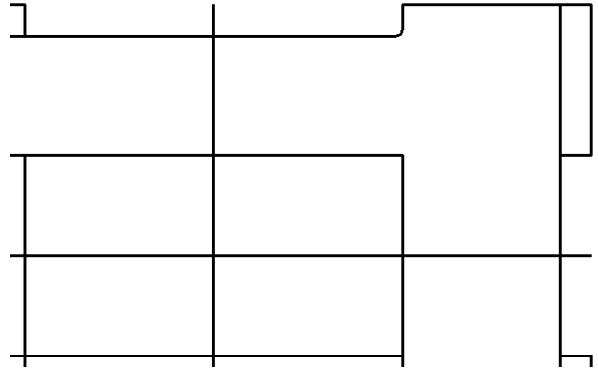**Figure 2.35 – Select Two Intersecting Lines**
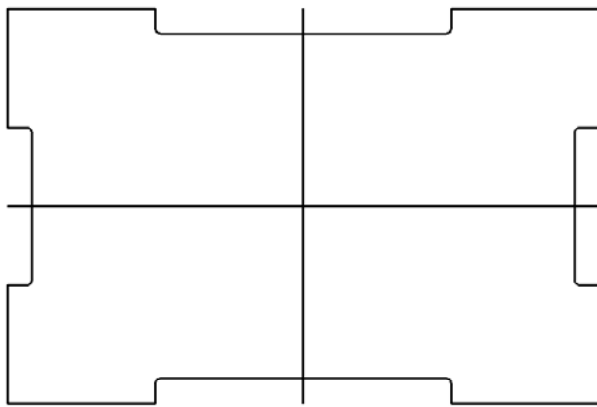

Figure 2.36 – The Filleted Corner

Figure 2.36 – All 1/16 Radii Filleted

You can use the Fit View tool on the 2D View Control toolbar to get a better view of the part. Use the Fillet tool a total of eight times using the 1/16 radius, so that the drawing resembles Figure 2.36.

Now change the radius to 0.5 and fillet the four corners of the drawing, as shown in Figure 2.37 and 2.38. You can see a completely filleted rectangle problem in Figure 2.39
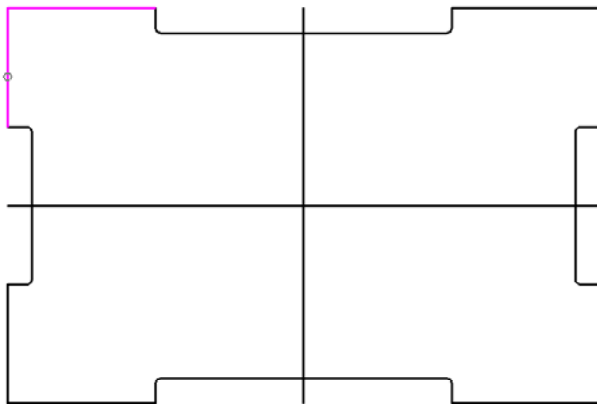
Figure 2.37 – Selecting the Corner
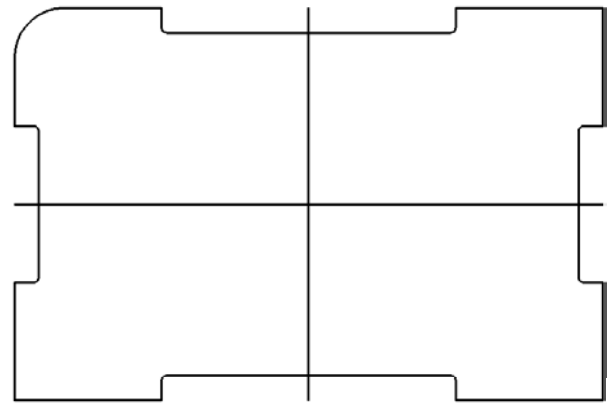
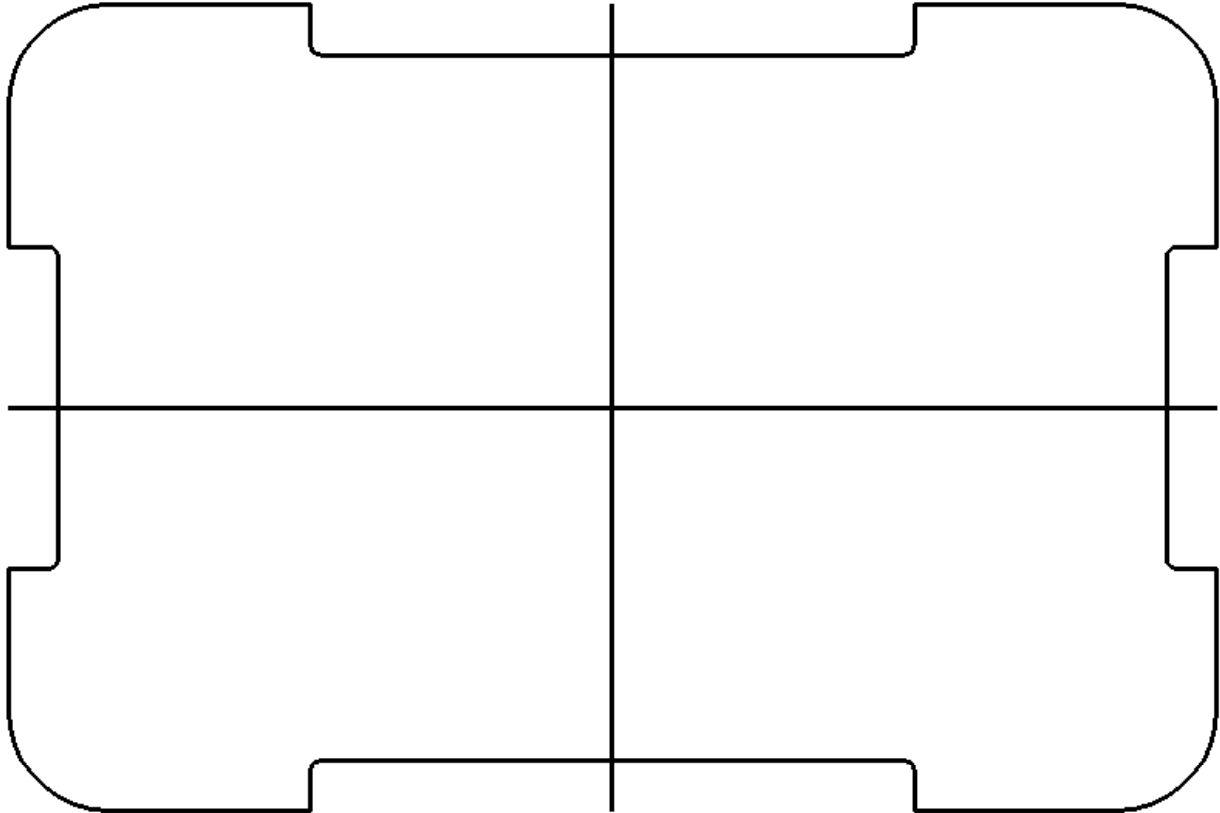**Figure 2.38 – A 0.5 Filleted Corner**

Figure 2.39 – The Finished Perimeter

* World Class CAD Challenge * - Close this drawing file. Create a New file and draw fourteen lines: four for the 6 x 4 rectangular box, two centerlines, and eight copied lines, trim the drawing and fillet the 12 corners in less than 2 minutes and 50 seconds. Continue this drill four times, each time completing the drawing under 2 minutes and 50 seconds to maintain your World Class ranking.

Drawing Circles

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The Circle command lies on the very aptly named Ellipses/Arcs/Circles toolbar. Select the Circle command to draw your very first circle.
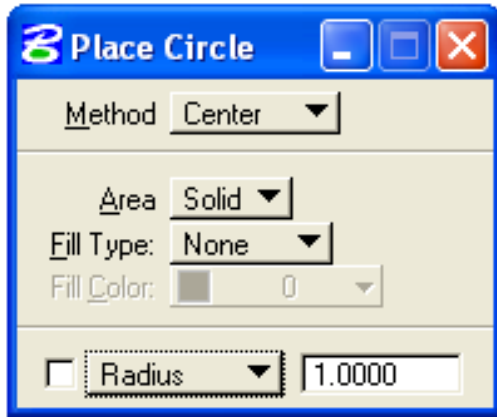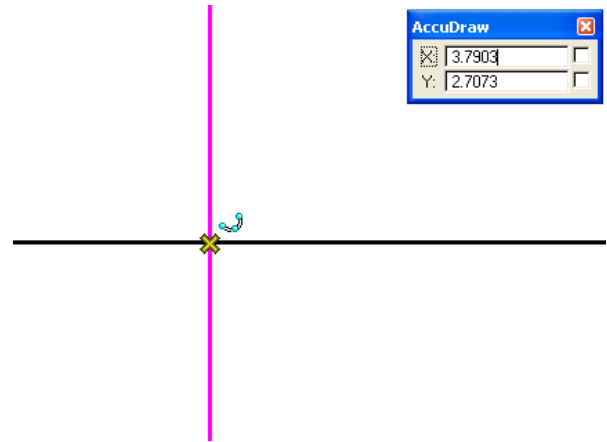
Figure 2.40 – Place Circle Window

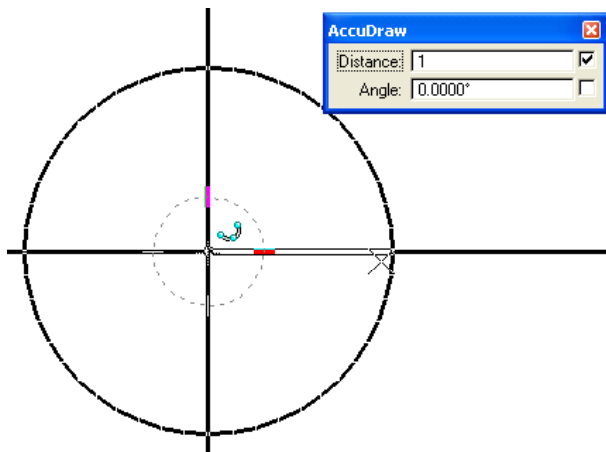**Figure 2.41 – Selecting the Midpoint**

Figure 2.42 – Selecting the Midpoint

Select the intersection of the two centerlines. An AccuSnap X should appear, so left-click to select the midpoint of the circle (Figure 2.41). The AccuDraw compass will appear, but this time the dashed outline will be a circle rather than a square. Type "1" and hit enter. This sets the radius of the circle to one (Figure 2 .42). Left-click to place the circle and right click to restart the Circle command.

Draw another circle using the same midpoint, but instead of using AccuDraw, this time use the diameter tool on the Place Circle Window. Type "0.75" in the Diameter box (Figure 2.43), hit Enter, and then click the intersection AccuSnap that was the midpoint of the first circle (Figure 2.44). The circle will appear in the center of the drawing.
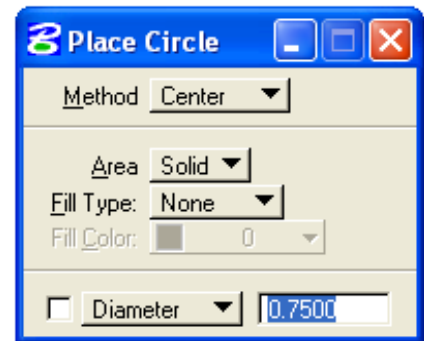

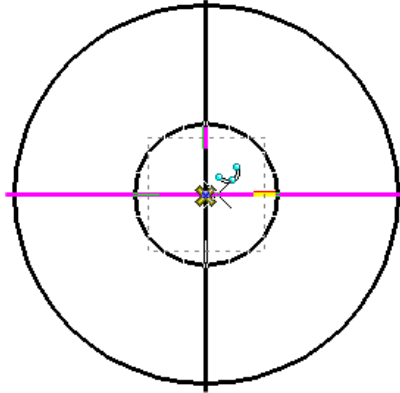**Figure 2.43 – Setting the Diameter to 0.75**

Figure 2.44 – Placing the .75 Diameter Circle

Place one final circle in the bottom left corner of the drawing. As you approach the center of the fillet arc, an AccuSnap X should appear, and the arc will turn magenta (Figure 2.45). Select the point and the AccuDraw compass will appear. Type ".25" and hit Enter to set the radius to 0.25 units (Figure 2.46). Left-click to place the circle and then right-click to restart the command. Your drawing should now resemble the one shown in Figure 2.47.
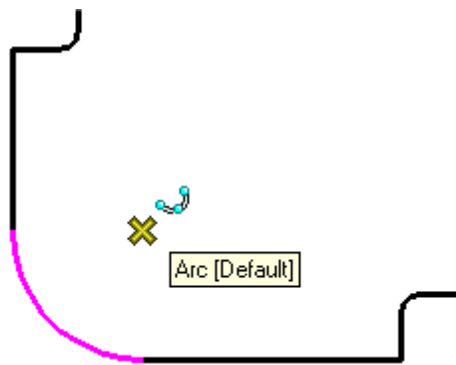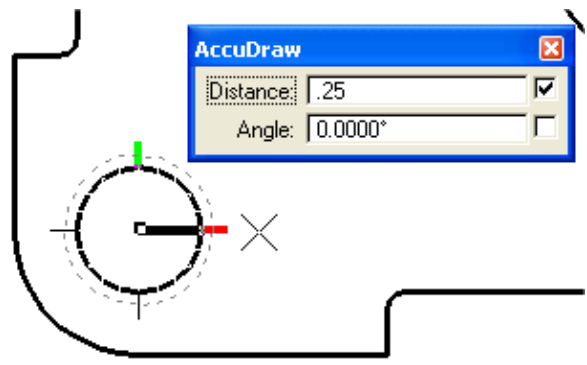

Figure 2.45 – Selecting the Midpoint of the Arc

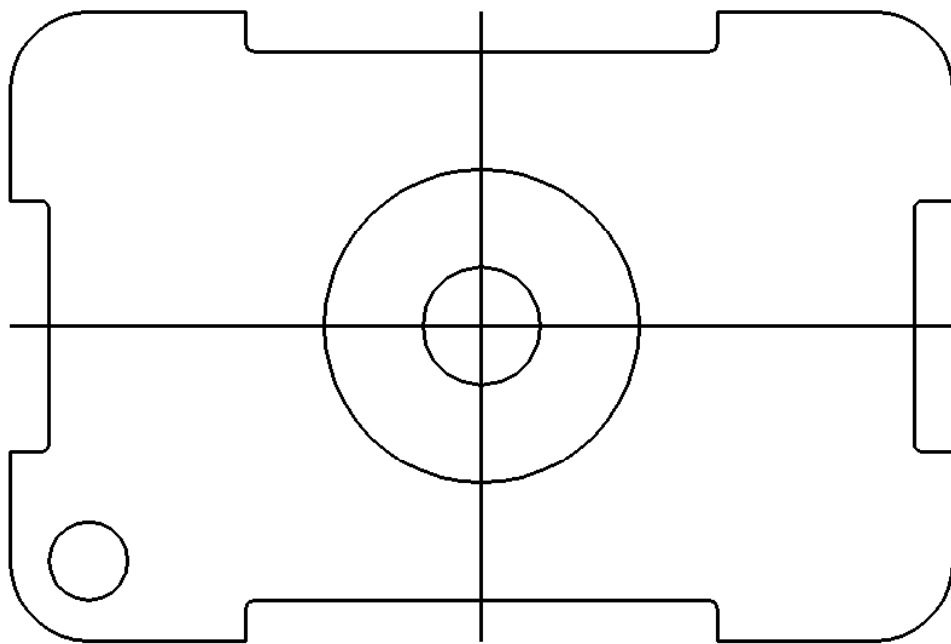**Figure 2.46 – Placing the 0.25 Radius Circle**

Figure 2.47 – Three Circles Drawn

Using the Move Command

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The move command is used to move objects around the workspace. Select the move command from the Manipulate toolbar.

Select the 0.75-diameter circle by selecting it at a point with an AccuSnap X (Figure 2.48). The AccuDraw compass will appear. Move the circle to the right and type "1.5" and Enter (Figure 2.49). Left-click to apply the move. The drawing should now resemble Figure 2.50.
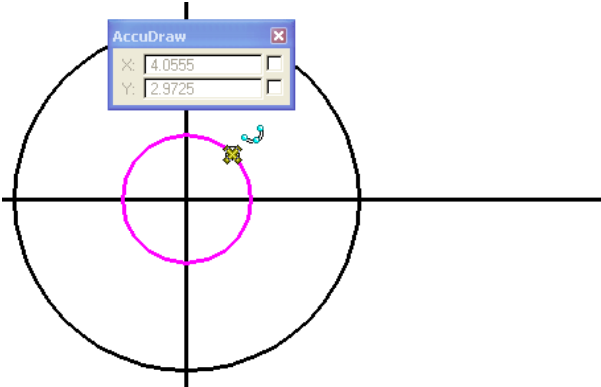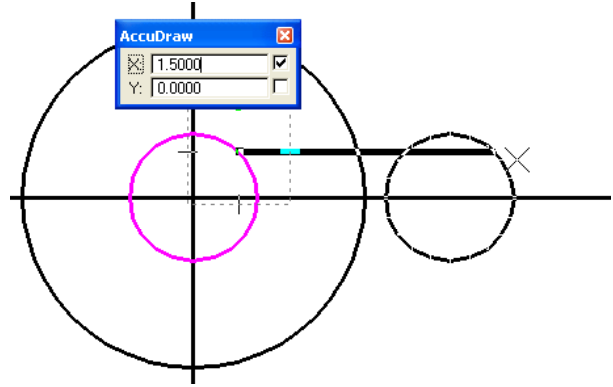
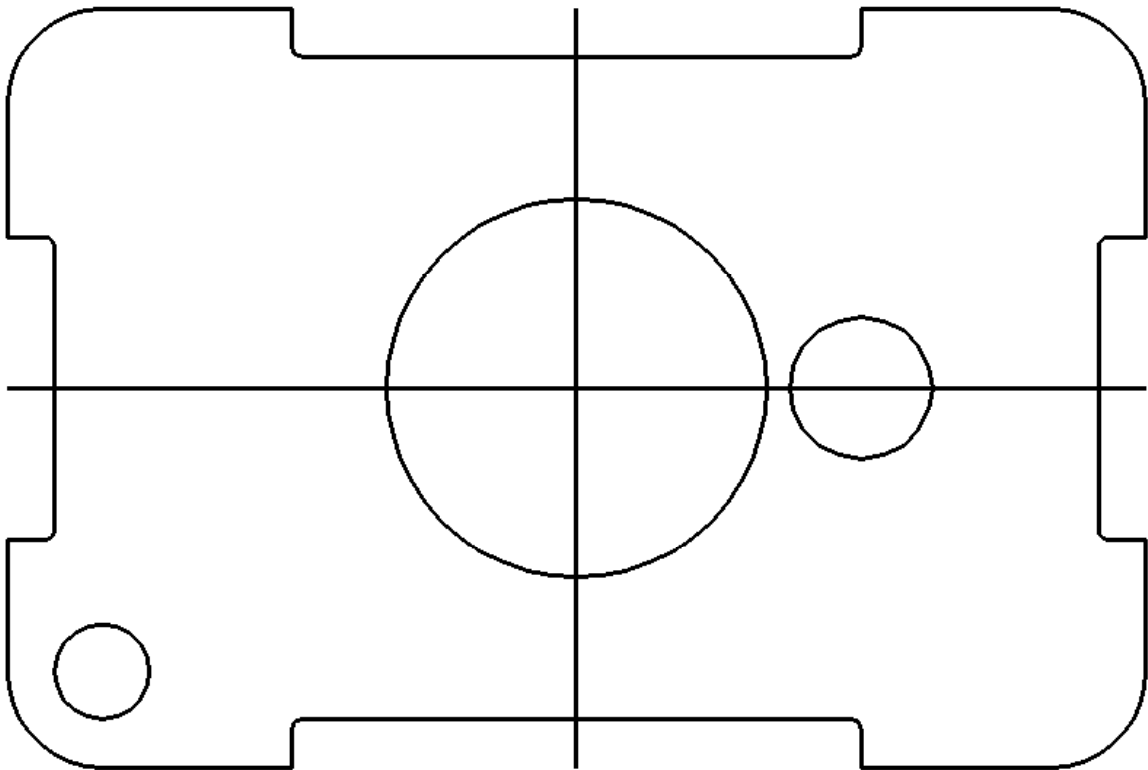**Figure 2.48 – Selecting the Circle**   **Figure 2.49 – Move 1.5 to the Right**

Figure 2.50 – The Moved Circle

Using the Copy Command

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You have used the Copy tool before, so this should seem familiar. Select the Copy
command from the Manipulate toolbar. Select the circle you just moved at one of its
AccuSnap X points (Figure 2.51).

The AccuDraw compass will appear. Move the circle to the left and type "3" and Enter (Figure
2.52). The circle will be moved three units to the left. Left-click to place the copied circle.
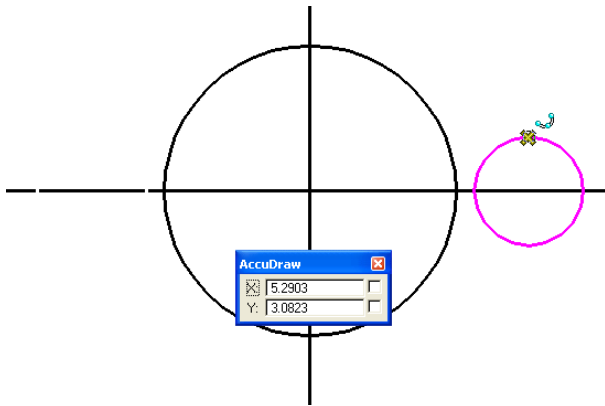The drawing should look like the one in Figure 2.53.
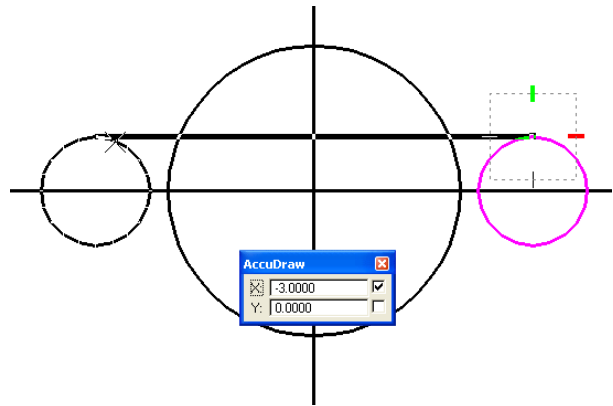
Figure 2.51 – Selecting the Circle   **Figure 2.52 – The Circle Copied to the Left**
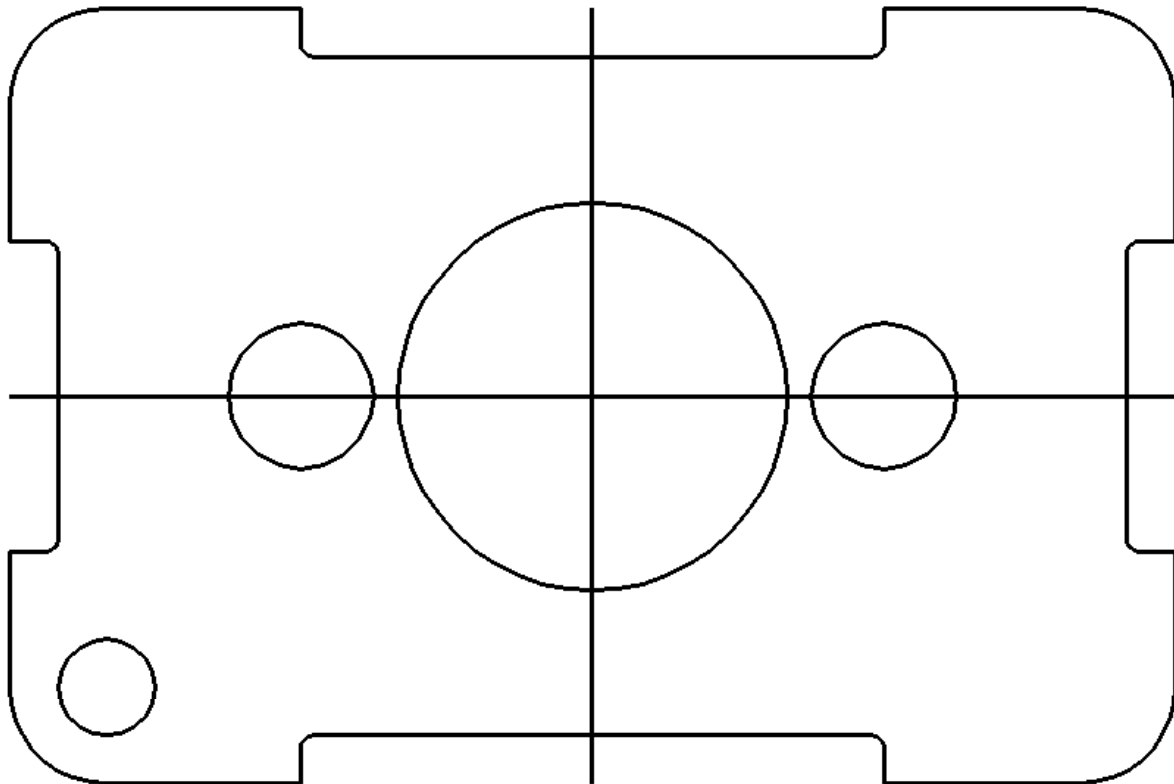
Figure 2.53 – The Copied Circle

* World Class CAD Challenge * - **Close this drawing file. Create a New file and draw fourteen lines: four for the 6 x 4 rectangle, two centerlines and eight copied lines, trim the drawing, fillet the 12 corners, draw the 3 circles and move and copy the 0.75 circle in less than 3 minutes and 10 seconds. Continue this drill four times, each time completing the drawing under 3 minutes and 10 seconds to maintain your World Class ranking.**

Using the SmartLine Command

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You need to connect the two 0.75 diameter circles with the SmartLine command. Select the SmartLine tool from the Linear Elements toolbar. The Place SmartLine Window should look like the one pictured in Figure 2.5 (near the beginning of the chapter).
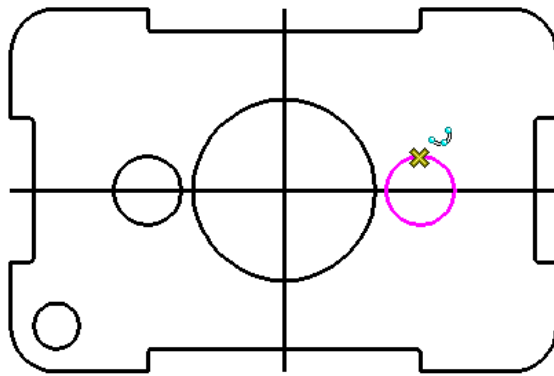

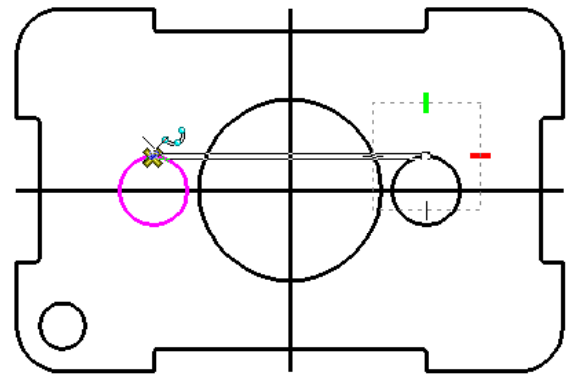**Figure 2.54 – Select the Top Quadrant**

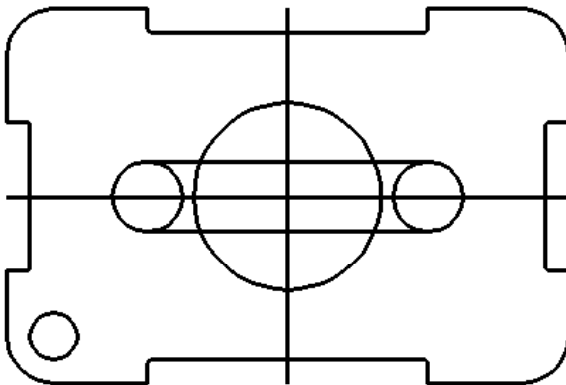**Figure 2.55 – The Other Top Quadrant**

Figure 2.56 – Selecting the circle to copy

Select the top quadrant AccuSnap, as shown in Figure 2.54. For this line you do not need to enter any distance. Just select the top quadrant AccuSnap of the other circle, as shown in figure 2.55. Right-click to repeat the SmartLine command. Draw the same line only now connect the two bottom quadrants of the circles. The two lines should be parallel, as shown in Figure 2.56.

The IntelliTrim Command

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You will use the IntelliTrim tool again to make a single hole out of the circles and lines in the middle of the part. Select the IntelliTrim tool from the Modify toolbar. The IntelliTrim window should look like the one pictured in Figure 2.26.
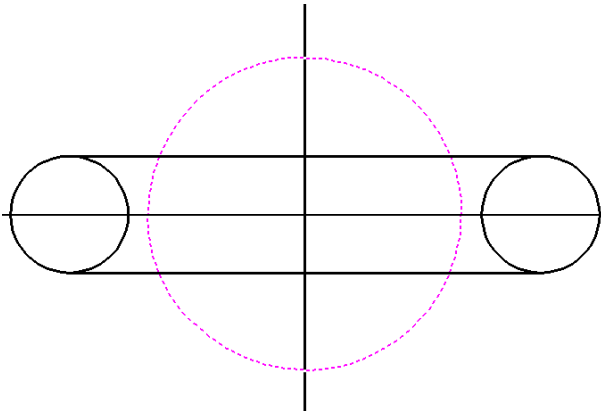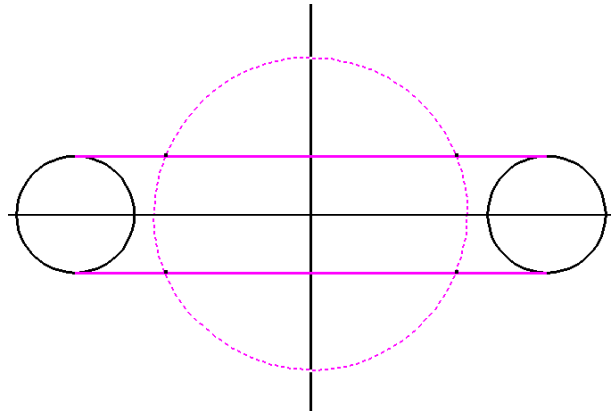
Figure 2.57 – Selecting Cutting Elements
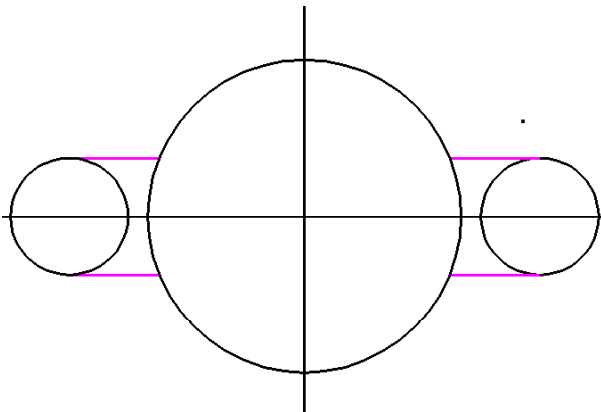
Figure 2.58 – Selecting The Elements to Trim

Select the large circle as the cutting element and right-click to continue (Figure 2.57). Select the two parallel lines as the items to trim and right-click (Figure 2.58). Finally, place a point near the sections you want to keep, in this instance outside the large circle. The lines should preview the correct trim, as shown in Figure 2.59. Right-click to confirm the trim.

Figure 2.59 – Selecting Sections to Keep

One more trim needs to be made. Select the four remaining line segments as the cutting lines, and the three circles as the elements to be trimmed, as shown in Figure 2.60. Select the sections to keep by placing a point outside each of the circles, as shown in Figure 2.61. Right-click to confirm the trim.
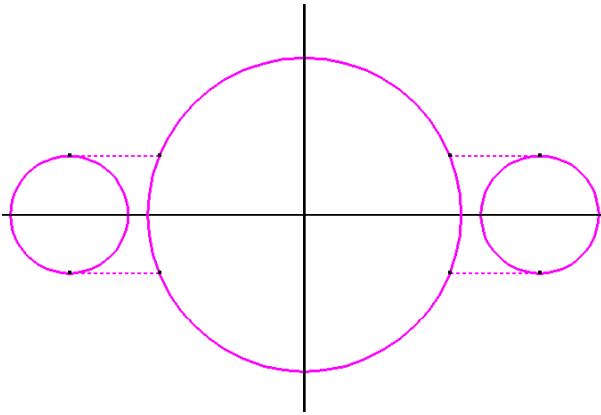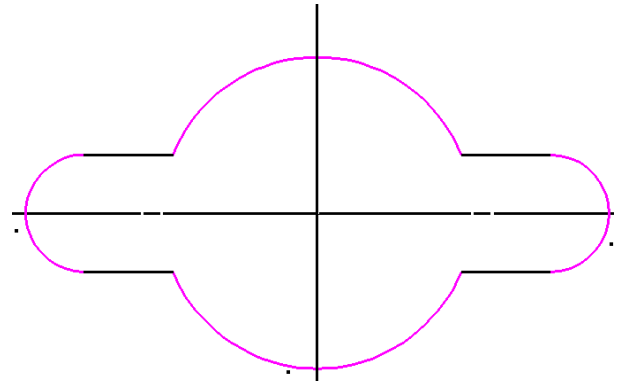
Figure 2.60 – 6 points to trim

Figure 2.61 – Finished with the trimming

Using the Rotate Command

The Rotate tool is used to rotate objects around a defined point. You are going to rotate the center hole 45 degrees counter-clockwise. Before selecting the Rotate tool from the Manipulate toolbar, select the Element selection tool from the Element Selection toolbar. Click and hold in the top left corner of the part, and drag the cursor down to form a box around the hole (Figure 2.62). The selected objects will turn magenta, as shown in figure 2.63.
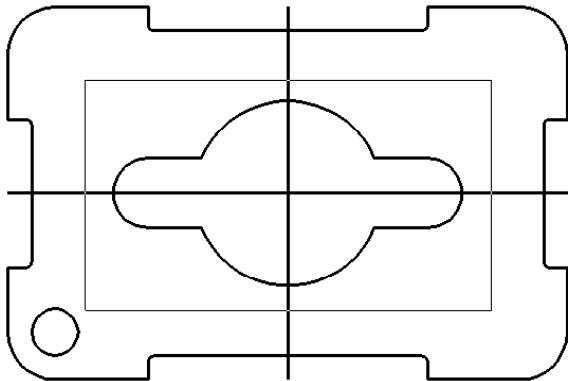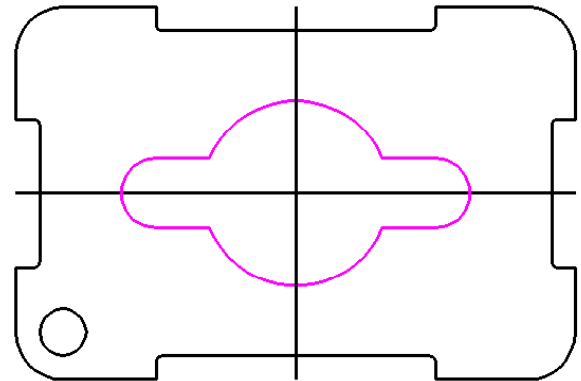

Figure 2.62 – Creating the Window

Figure 2.63 – The Selected Objects

With the hole highlighted, select the Rotate tool. In the Rotate window, type "45" for the active angle (Figure 2.64). Now select the center point AccuSnap of the part, and the selected objects should rotate together 45 degrees counter-clockwise (Figure 2.65). Right-click to restart the command. The drawing will now appear just like the one in Figure 2.66.
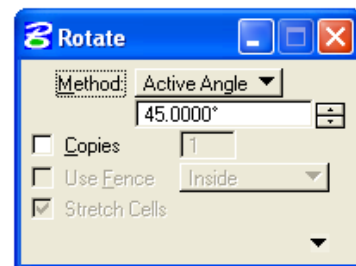
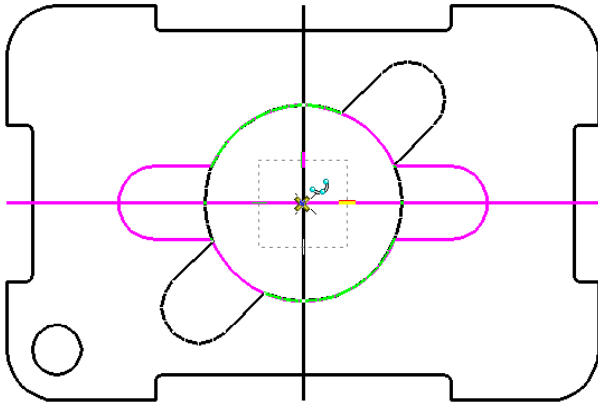

Figure 2.64 – The Rotate Window

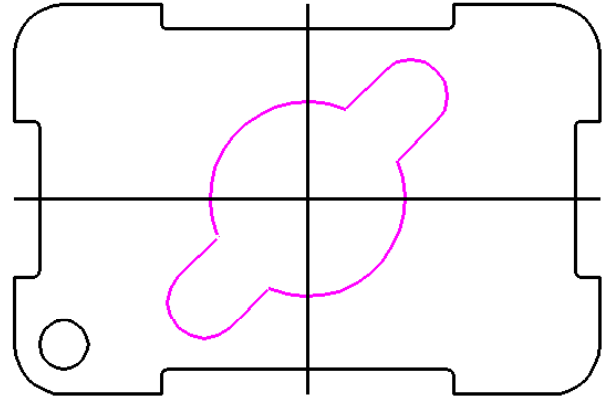**Figure 2.65 – Select the Center Point**   **Figure 2.66 – The Rotated Selection**

* World Class CAD Challenge * - Close this drawing file. Create a New file and draw fourteen lines: four for the 6 x 4 rectangle, two centerlines and eight copied lines, trim the drawing, fillet the 12 corners, draw the 3 circles, move and copy the 0.75 circle, draw the lines connecting quadrants, trim the detail and rotate it 45 degrees in less than 3 minutes and 30 seconds. Continue this drill four times, each time completing the drawing under 3 minutes and 30 seconds to maintain your World Class ranking.

Using the Array Command to Create Rectangular Patterns
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The Array command is a very powerful tool that copies multiple objects in a specific pattern. Before you start the Array command, select the 0.5 diameter circle in the bottom left corner of the drawing with the Element Selection tool. It should change color to magenta (Figure 2.67).
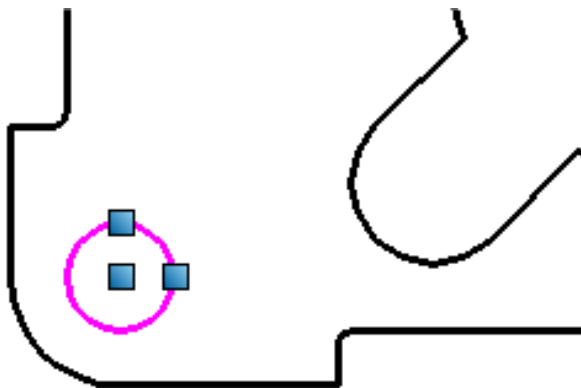

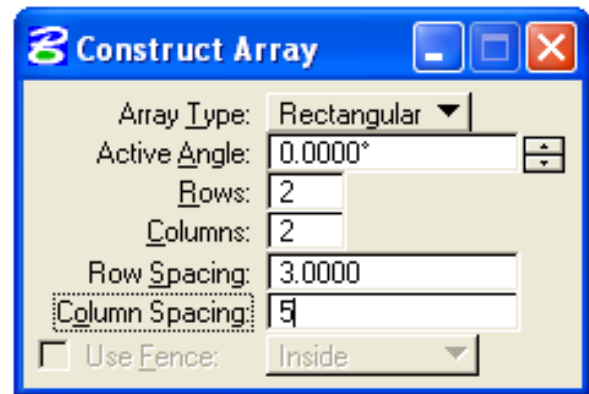**Figure 2.67 – The Selected Circle**   **Figure 2.68 – The Construct Array Window**

Select the Array command from the Manipulate toolbar. In the Construct Array window, make sure the Type is set to Rectangular and that the Active Angle is set to 0 degrees. Type 2 for the Columns and Rows, and make Row Spacing 3 and Column Spacing 5 (Figure 2.68). Left click

anywhere on the workspace to place the array. You have now successfully completed drawing the Rectangular Problem, and it should resemble the finished drawing shown in Figure 2.69.
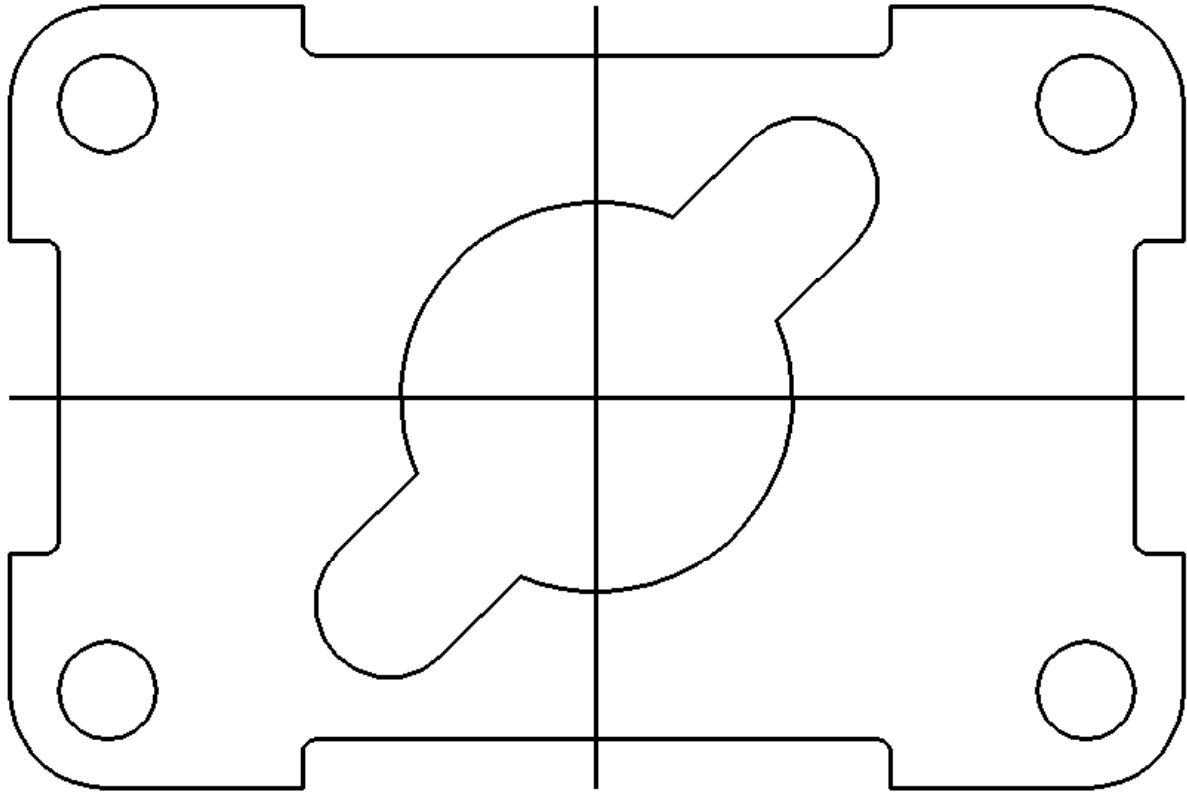

Figure 2.69 – The Finished Rectangular Problem

* World Class CAD Challenge * - Close this drawing file. Create a New file and draw fourteen lines: four for the 6 x 4 rectangle, two centerlines, and eight copied lines, trim the drawing and fillet the 12 corners. Draw the 3 circles, move and copy the 0.75 circle, draw the lines connecting quadrants, trim the detail, rotate it 45 degrees and array the 0.5 circle in less than 3 minutes and 50 seconds. Continue this drill four times, each time completing the drawing under 3 minutes and 50 seconds to maintain your World Class ranking.