MICRO-PRESS.com

You are viewing sample pages from our textbook:

MicroStation V8i Training Manual 2D Level 2

The full content of Module 9 is shown below, which discusses the generation of Complex Elements.

The instruction you see is typical of the combined information and exercise approach used throughout all Modules.

Please note the “Tool Tip” boxes on various pages; these are located throughout the Manual to emphasize a technique or to add specific points of information.

If you require more information about the contents of this book, paste this link into your web browser:

http://www.micro-press.com/Contents_MicroStation_Level_2.html

or go to our Home Page at:

http://www.micro-press.com

or contact us by E-mail at:

info@micro-press.com

MicroStation V8i 2D LEVEL 2

Module 9

COMPLEX ELEMENTS

Module Information

Prerequisites:

Module 8 MicroStation - 2D Level 2

Introduction:

It is often useful to create a single element from a collection of existing individual elements. MicroStation has a set of tools that will create an open complex chain or a closed complex shape from existing elements. There are several uses for complex elements as discussed on the next page. Perhaps the most important is the use of complex elements in the placing of hatches or patterns that enhance the information presented in a design. You will use complex shapes extensively in the next Module.

Objective(s):

9.1 Use SmartLine to create complex chains and complex shapes.
9.2 Create a complex chain using the Create Complex Chain tool.
9.3 Create a complex shape using the Create Complex Shape tool.
9.4 Create a region using the Create Region tool.
9.5 Apply tools to measure area and perimeter length of elements.
9.6 Use the Drop Element tool to drop the status of a complex chain or complex shape.

Time:

This Module should be completed within 2.5 hours.

DISCUSSION:

Complex elements are *single* elements that were either *originally drawn* as complex elements (a SmartLine with lines and arcs), or were *made into* complex elements at a *later time*. They come in two types:

Complex Chain A complex chain is an *open* element. As noted above, it may have been drawn *originally* as a series of different, but connected, element types (lines, line strings, arcs, curves, etc.), that was edited to form a *single* Complex Chain. It may also have originally been drawn with SmartLine as a complex chain.

Complex Shape A complex shape is similar to a complex chain, except that it is a *closed shape*.

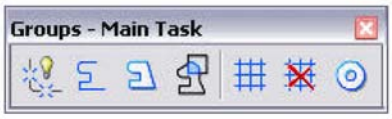
Why would you want to create complex chains or shapes? There are three main reasons:

Single Element A complex chain or shape is a *single* element even though it was created from several individual elements. The multiple elements can now be edited or manipulated as if they were one element.

Patterning When you look at *Patterning* (hatching) in the next Module, you will find that many patterning operations *require* closed shapes as a *boundaries* for the patterning process.

Derived Shapes Some of MicroStation's tools allows you to create *new shapes* from the boundaries of existing shapes. These are called *Boolean* operations. They are discussed later in this Module.

The tools for complex elements are found in the *Groups* tool box. This makes sense since you are essentially *grouping* multiple elements into single complex elements.



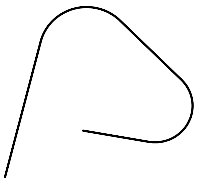
TOOL TIP !
The complex chain or complex shape will assume the *active element attributes* regardless of the attributes of the original elements. You should therefore set the desired active element attributes *before* starting the complex element creation process.

Let's look at the complex chain and complex shape creation process:

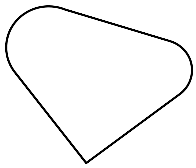
9.1 USING SMARTLINE

As you discovered in the Level 1 Course, SmartLine can be used to *directly place* complex chains and complex shapes. To refresh your memory, do the following:

Step 1 Start *SmartLine* and draw a *line string* and a *closed shape* as shown below (the dimensions are not important). Mix lines and arcs in the elements with *Join Elements* ON.



A line string.



A closed shape.

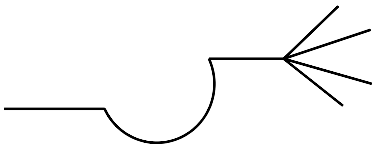
Step 2 Start the *Element Information* tool and *data-point* on each element. 

In the case of the line string, *Element Information* will report that the element is a *complex chain*. *Element Information* will report that the closed shape is a *complex shape*. This is so because you *combined* lines and arcs in the SmartLine elements, making them complex.

Now let's look at situations where you used SmartLine but did *not* make *joined elements*, or where you created a line string or shape from simple lines and arcs.

9.2 CREATING COMPLEX CHAINS

First, you need a set of lines and arcs as shown at the right. *Draw* the lines using the *Place Line* and the *Place Arc* tools. If you want to use SmartLine make sure that *Join Elements* is OFF. There are no dimensions for the lines and the proportions of the elements are not important.



Now create a complex chain from the individual elements:

MANUAL METHOD

Step 1 Start the *Create Complex Chain* tool. 

Look at the *Tool Settings* window. You have two choices under the *Method* option. Using *Manual* you will data-point on each element in turn to add them to the complex chain. When the *Automatic* mode is selected, MicroStation will attempt to create the chain automatically, but still under your direction. The *Max. Gap* value allows MicroStation to bridge a gap between elements that are not connected, but it won't bridge a gap larger than the set value. The *Simplify geometry* option allows connected line segments to be collected as a primitive line string rather than a complex chain.

Step 2 *Select* the *Manual* method.
Step 3 *Data-point* on the left-hand *line*.

The line will highlight.

Step 4 *Data-point* on the *arc*.
Step 5 *Data-point* on the second *line* segment.

The three elements should be highlighted. You must now choose which of the four diagonal lines are to be included in the chain.

Step 6 *Data-point* on *one* of the four diagonal lines.

If you have made a mistake or wish to change your mind about your choice of the diagonal line, you can press *Reset* to *deselect* the diagonal, then *data-point* on a *different* diagonal. You can *Reset* to *deselect* an element *at any point* in the element selection process.

Step 7 With the correct diagonal line selected, *data-point* anywhere in the view to *confirm* the element selections.
Step 8 *Reset* to stop the tool.

To test the existence of a complex chain, *move* the chain using the *Element Selection* tool. Only the lines in the chain should move. Also notice that when the chain is selected, four *handles* will appear, enclosing the complex chain.

Now try the same process using the *Automatic* method.

AUTOMATIC METHOD

Step 1 *Undo* the previous actions to return the complex chain to individual elements.
Step 2 Set the *Method* to *Automatic*.
Step 3 *Data-point* on the left-hand line. The line will highlight.
Step 4 *Data-point anywhere* in the view (not on the arc).

MicroStation will now try to find *all* elements connected to the left-hand line that *could* form a chain. The arc, the second line, and *one* of the diagonal lines should highlight. MicroStation is guessing the path of the chain for you.

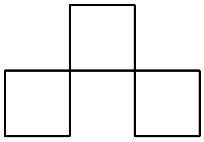
Step 5 If the *correct* diagonal line in not highlighted, press *Reset* to force the correct diagonal line selection. You may do this as many times as necessary.
Step 6 *Data-point* in the view to accept the chain selection.
Step 7 *Reset* to stop the tool.

This is a simple example where the elements are clear and are unobstructed by other elements. As you will see later, in areas where many elements are near or intersect, you may need to Reset several times to force MicroStation along the element path you want.

TOOL TIP !
In complex drawings it is often more efficient to use the *Manual* method.

9.3 CREATING COMPLEX SHAPES

Complex shapes are created in the same way as complex chains. The only difference in the *Tool Settings* window is that the standard *Fill* options are available.



Draw the elements shown at the right. Each square must be constructed from *individual lines*, not blocks, although you may make two copies of the first square. You are going to create a complex shape from the individual lines that *completely encloses* the three squares.

Step 1 Start the *Create Complex Shape* tool.
Step 2 Set the *Method* to *Automatic*.
Step 3 *Data-point* on the left-hand vertical line to start the automatic element selection.

If you now data point near the *top* of the line, MicroStation will search for a connecting element at the upper vertex. Conversely, if you now data point near the *lower end* of the line, MicroStation will search at the lower vertex. In this way you can control the initial search direction:

Step 4 *Data-point* above or below the first element to *accept* the first line and force MicroStation to search for the next element.
Step 5 *Data-point* or *Reset* to either *accept* MicroStation's element selections, *or to force* a different element selection. Remember that you are working your way around the lines of the squares to create an enclosing complex shape.

Follow this procedure until you return to the starting line.

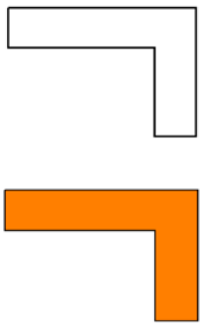
Step 6 *Data-point* after the last line is selected to stop the tool (a Reset is not required).

Check that the lines of the three squares are now a single complex shape by using the *Element Selection* tool to select and move the shape.

As you can see, the procedure is works well provided you pay attention to the element selections made by MicroStation. On your own, undo the complex shape and repeat the process using the *Manual Method.*

COMPLEX SHAPES BY THE FLOOD METHOD

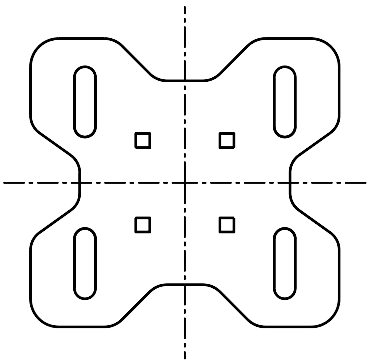
You can create a complex shape from the boundary made by existing elements using the *Flood* method. This is also an excellent way of adding *color* to and enclosed area. Try the following:



Step 1 Using the *Place Line* tool draw individual lines that create an enclosed area (but not a closed shape).
Step 2 *Start* the *Create Region* tool and select the *Flood* method. Select *Opaque Fill* and a *Fill Color*.
Step 3 *Data-point* inside the enclosed area and *data-point* again to accept the enclosed shape.

The tool creates a new region filled with the selected color. If *Keep Original* was ON, the original elements remain.

PRACTICE EXERCISES

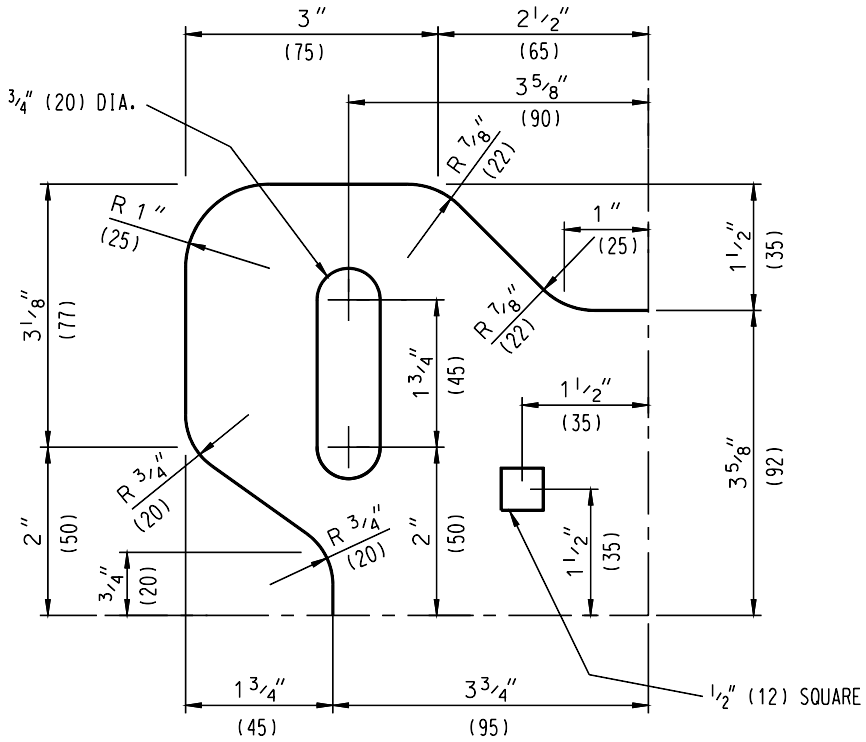


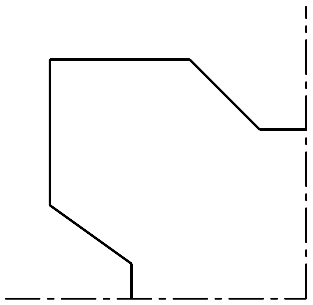
Use the drawings on the next two pages for practicing the creation of complex shapes. Practice is important because you will need to create complex shapes in the next Module for patterning purposes. In fact, you will be asked to reuse these two drawings in that Module, so you might as well draw them now!

Spacer Plate

As you can see, the plate is *symmetrical* about its centerlines. Therefore, you need only draw one quadrant and utilize the *Mirror* tool to complete the plate. The dimensional details for one quadrant are shown *on the next page*.

Note that the locational dimensions for the rounded corners are given to the vertices of the intersecting tangent lines. If you draw the outer boundary with the Place Line tool to the given dimensions (see detail, below-right) you can use the *Construct Circular Fillet* tool to fillet the corners. Although you would normally use *SmartLine* to draw the outer boundary, it will be better for this exercise if you create the boundary with connected lines and fillet arcs. The same applies to the two internal holes. Draw these with individual lines and arcs. You don't need to include the dimensions, but if you need the practice, put them on a different level from the object.



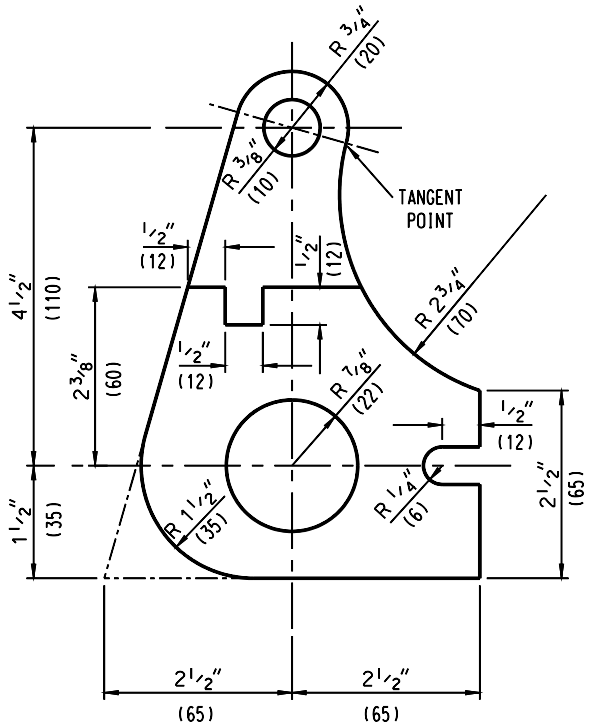


Draw the boundary with the Place Line tool, then fillet the corners.

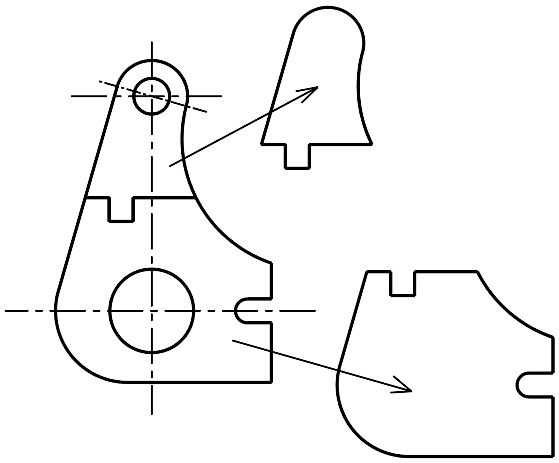
TOOL TIP !
If you know you will be creating complex shapes from individual elements for hatching purposes, it is helpful to draw the centelines on a different level and turn them off when creating the

When you have completed the full plate drawing, convert the entire outer boundary to a complex shape. Do the same for the four individual elongated holes and the four square holes.

The next drawing is a little more complex but it demonstrates what needs be done when you must break a drawing into two parts. As in the previous drawing, use only individual lines and arcs (although you may trim circles if you wish). Use the Fillet tool to fillet the bottom-left corner. For the large upper-right arc use the Arc tool with the *Edge* method and preset the 2 3/4" (70) radius.



When the drawing is completed, I want you to create *two* complex shapes from the object. When created, you should be able to make copies of the two shapes, as shown below. The difficulty is that you cannot force MicroStation to "turn a corner" where one element intersects a second element that is passing through the intersection. This situation occurs where the center horizontal line intersects with the left-hand diagonal line and with the right-hand arc. To ensure that a boundary vertex exists as these points you must use the *Delete Part of Element* tool to break the diagonal line and the arc into separate elements at the intersection with the horizontal line.

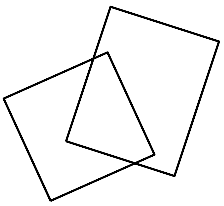


Separate the two complex shapes from the main drawing as shown here.

Save the drawings on this and the previous page for use in the next Module.

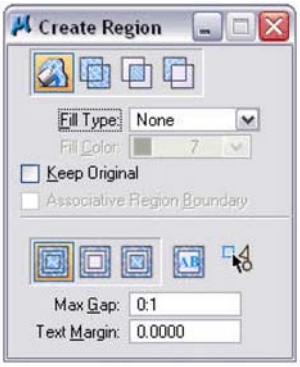
9.4 CREATING REGIONS (BOOLEAN OPERATIONS)

A *Region* is a complex shape that has been created from *two or more* closed elements. In other words, two or more closed shapes are *combined* to form another, single, complex shape. The combining of shapes is called a *Boolean* operation. Hatching and 3D operations make use of regions.



Draw the two rotated blocks shown at the left to any dimension.

Start the *Create Region* tool to see the available options. 



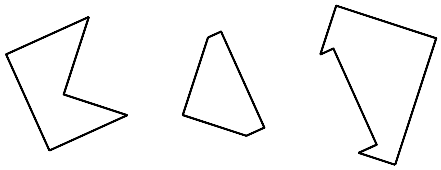
The top row contains the region creation methods, while the bottom row has options relating *only* to the *Flood* method as shown at the right. If you select any of the other three top-row methods, the lower options are not displayed. Run your cursor over the options to display their names.

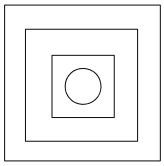
Start with the *Flood* method:

Step 1 Set the *Method* to *Flood* with the *Ignore Interior Shapes* option, and turn on the *Dynamic Area Locate* option.

Step 2 *Move* the cursor into each of the three boundary areas created by the overlapping blocks.

As you move the cursor note the three potential regions that are highlighted. *Data-pointing* will accept the *currently-highlighted* region. You can create the three regions at the right.





The remaining two interior shape *options* on the bottom row have the effect of creating a closed shape *within* a complex element (essentially a "hole" in the region) which is useful for hatching purposes.

To experiment with these two options, draw the three closed-block and single circle elements at the left. Using the *Flood* method, try each interior shape option to see the combinations of region and interior shape that can be created. Test the regions created by moving the region with the Element Selection tool.

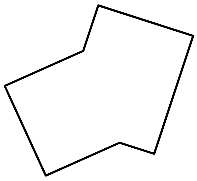
There are additional options to *fill* the created region with a color, *keep* the *original shapes* after the region is created, set a *maximum gap* which will be bridged by a *line element* during region creation, and set a *text margin* which set the space margin to be left around existing text or dimension text. The *Max Gap* option is useful if the geometry of the original elements is not perfect.

Now look at the *Boolean* options. Use the two shapes from Steps 1 and 2.

Step 1 Start the *Create Region* tool.

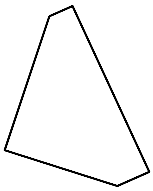
Each option, *Union*, *Intersection*, and *Difference*, creates a complex shape from the closed shapes in different ways. Try each in turn, making copies of the two blocks or undoing the operations:

Start with the Union operation:



Step 1 Set the *Method* to *Union*.
Step 2 *Data-point* on both blocks.
Step 3 *Data-point* anywhere in the view to accept the selections.
Step 4 *Reset* to stop the tool.

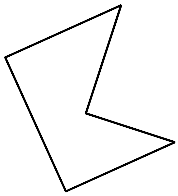
Now try Intersection:



Step 1 Set the *Method* to *Intersection*.
Step 2 *Data-point* on each of the two blocks and data-point to accept the operation.
Step 3 *Reset* to stop the tool.

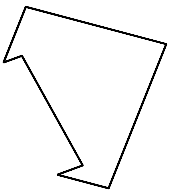
TOOL TIP !
If you want to *retain* the original blocks after the complex shape creation, turn the *Keep Original* option ON.

Now try the *Difference* method:



Step 1 Set the *Method* to *Difference*.
Step 2 *Data-point* on the *left-hand* block.
Step 3 *Data-point* on the *right-hand* block.
Step 4 *Data-point* anywhere in the view to accept the selections.
Step 5 *Reset* to stop the tool.

The resulting shape will be as shown on the right.



A *reverse selection*, however, will result in a *different* shape. Try this now: *undo* the shape and apply the tool again. This time select the *right-hand* block *first*. The resulting shape will look like the one at the left. If you think about the two resulting complex shapes, you will realize that in each case the *second* selected shape was *subtracted* from the *first* selected shape.

TOOL TIP !
With the *Flood* method you can set a *Max. Gap* value to bridge gaps between elements.

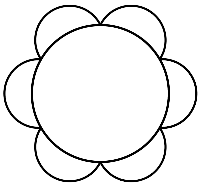
TOOL TIP !
Since complex shapes are closed, you can apply a *fill color* to the enclosed area.

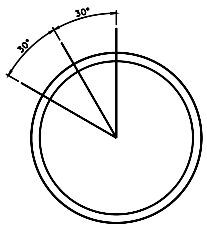
TOOL TIP !
If you find that MicroStation has trouble finding the flood boundaries, *zoom in* to the shape to be flooded. MicroStation analyzes all potential shapes in the view, so restricting the view to a specific area helps the calculation process.

9.5 PRACTICAL USES

Now that you know how to use the Region tool, what practical uses does it have? Aside from creating new shapes that can be used for various purposes, one significant application is the *measurement* of *perimeter* and *area* of complex elements. For an example of this application, complete the following exercise.

First, you are going to draw the "Flower" design shown at the right. It has a central circle with "petals" arrayed around the circumference.



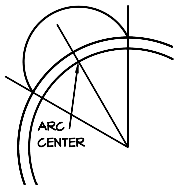


Steps 1 to 4.

Step 1 *Draw* the outer circle at 15'-0" (4500) radius.
Step 2 Through *Settings/Design File/Element Attributes*, set the *Class* to *Construction* (or right-click the *Attributes* tool box and turn ON *Active Element Class*).

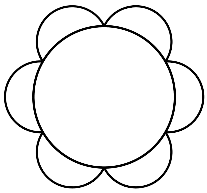
You are now drawing "construction" elements that can be turned off through *View Attributes.*

Step 3 *Draw* the inner circle at 13'-6" (4000) radius.
Step 4 *Draw* the vertical construction line and make t*wo copies* at a 30^0 and 60^0 rotation (use the *Rotate Element* tool with *Copy* ON).



Steps 5 and 6.

Step 5 Set the *Class* back to *Primary.*
Step 6 *Draw* the small "petal" arc as shown.



Steps 7 and 8.

Step 7 In *View Attributes* (Ctrl-B) turn *Constructions* OFF.
Step 8 *Array* the small arc around the circle *6* times.

You should now see the completed "Flower" drawing.

The next step is to take various measurements of the shapes using the Region tools and the Measure tools.

TAKING MEASUREMENTS

Take a little time to renew your acquaintance with the Measure tools. Since you are working with the "Flower" drawing, you are interested in the *Measure Length* and *Measure Area* tools. As you may remember from the Level 1 course, the *Measure Length* tool measures the length of an *element*, while the *Measure Area* tool measures the area and perimeter of a *closed shape.*

In the case of the Flower drawing, the petals are *open* arc elements and the circle is a *closed* shape.

There are two approaches you can take when you need perimeter and area measurements.

- You can create a complex chain or a complex shape and apply the measure tools to those elements. You may want to do this because you need the complex element for purposes other than the perimeter or area values. In addition, the measure tools may not be able to directly measure complex shapes without first creating a complex element.

- You can use the measure tools without first creating a complex element. You would use this method if you don't need a complex shape for other purposes, and if the measure tools are capable of creating a temporary complex element on their own.

You can easily measure the area and perimeter of the circle with the *Measure Area* tool. Simply start the *Measure Area* tool, set the *Method* to *Element*, and *data-point* on the circle. The values are shown in the *Tool Settings* (PopSet) window or on the *Status Line*. You can measure the length of the *arc* of one petal using the *Measure Length* tool. Do these measurements on your own right now.

Next, find the *area* and *perimeter* of one petal. As you know, the petal shape is formed from the arc element and a portion of the central circle. The Measure Areas tool requires that a closed shape be present, but that does not exist at the moment. One approach would be to make a complex shape from the arc of the petal and the arc of the circle, but you can't do this without *breaking* the circle at the petal's arc endpoints. Fortunately, the Measure Area tool can create temporary complex shapes using Boolean operations. In this case you will use the *Flood* method:

Step 1 Start the *Measure Area* tool.
Step 2 Set the *Method* to *Flood*.
Step 3 *Data-point* inside a petal area.

A temporary complex shape will appear, shown in the current highlight color.

Step 4 *Data-point* twice to *select* and to *accept* the complex shape.
Step 5 *Read* the area and perimeter values.

You should see values of 76.0394 sq ft and 40.3443 ft (6597724.3630 mm^2 and 11994.2011 mm).

Step 6 *Reset* to stop the too.

Now measure the area and perimeter of the *entire flower*. Since the petals are individual elements you will likely want to use the *Flood* method to find the total area. However, the flood method won't work because the inner circle is present and the *Locate Interior Shapes* option won't help. So, you first need to create a complex shape from the petals:

Step 1 Use the *Create Complex Shape* tool to create a complex shape from all the petals in the flower. The *Automatic* method works well because it will select all the arcs at once after selecting the first arc and data-pointing for the selection direction.

When the complex shape is created you can now use the Measure area tool:

Step 2 *Start* the *Measure Area* tool.
Step 3 *Set* the *Method* to *Element*.
Step 4 *Data-point* on the outer complex shape.
Step 5 *Data-point* again to accept the selection.

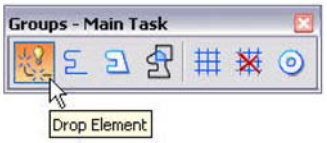
The values should be 1163.0949 sq ft and 147.8178 ft respectively (103203597.4134 mm^2 and 43690.8789 mm).

Step 6 *Reset* to stop the tool.

At this point you have the option of keeping the complex shape for other uses, or undoing the shape back to its original elements.

Can you think of another way of measuring the area and perimeter of the flower? What if you first deleted the circle and then used the *Flood* method of the Measure Area tool to perform the calculation? You would need to undo the circle deletion after the calculation, of course.

9.6 DROPPING COMPLEX ELEMENTS



Although this subject was discussed in the Level 1 course, it is useful to refresh the use of the *Drop Element* tool as it applies to complex elements.

You can easily drop the complex status of a complex element. Simply start the *Drop Element* tool and select the *Complex* option in the *Tool Settings* window. Data-point on the complex element to drop its status. Note that the dropped elements do not return to their original attributes (color, line style, weight, etc.). They will assume the attributes of the last entered element of the complex element.