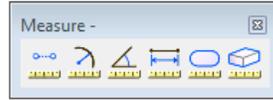


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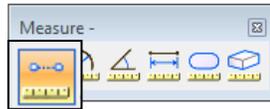
13.0 Measure tool box



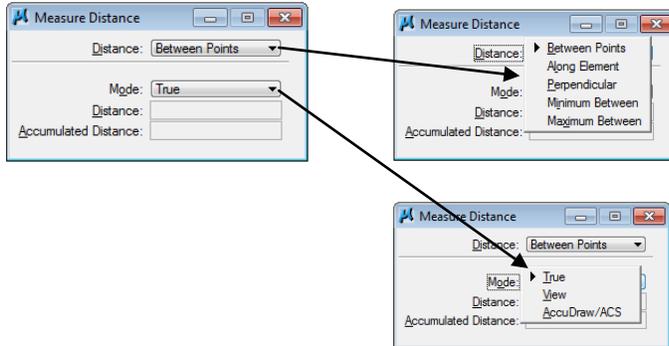
The tools in the Measure toolbox are used to perform measuring operations.

To	Select in the Measure toolbox
Measure the distance(s) along an element. or Measure the cumulative distance from a data point. or Measure the perpendicular distance between an element and a data point. or Measure the minimum distance between two elements.	 <i>Measure Distance</i>
Measure the radius of a circle, circular arc, cone, or cylinder, or the axes of an ellipse or elliptical arc.	 <i>Measure Radius</i>
Measure the angle between two lines.	 <i>Measure Angle Between Lines</i>
Measure the length of an element.	 <i>Measure Length</i>
Measure the area and perimeter of a shape, ellipse, or complex shape and to analyze mass properties.	 <i>Measure Area</i>
Measure the volume enclosed by an element or a set of elements and to analyze mass properties.	 <i>Measure Volume</i>

13.1 Measure Distance



Used to measure distance (I'll bet you saw that one coming).



Tool Settings	Effect
Distance	<p>Sets the method of distance measuring.</p> <ul style="list-style-type: none"> • Between Points — Measures the cumulative distance from an origin. • Along Element — Measures along an element from an origin. • Perpendicular — Measures the perpendicular distance between an element and a data point. • Minimum Between — Measures the minimum distance between two elements. • Maximum Between — Measures the maximum distance between two elements.
Mode	<p>Sets how measurements for distances are calculated.</p> <ul style="list-style-type: none"> • True — Measures the true distances in 3D, taking into account the depth component in the view. • View — Measures distances between projections of the elements on to the view plane (no allowance for the depth component). • AccuDraw/ACS — Measures distances between projections of the elements on to the AccuDraw drawing plane, or on to the active ACS.
Distance	Displays the result of the last measurement.
Accumulated Distance	(Distance set to Between Points only) Displays the total distance measured.
Segment Only	(Distance set to Perpendicular only) If on, the measurement is constrained to be perpendicular to the selected segment of the element, or the projection of the segment. If off, the perpendicular measurement is taken from the nearest segment of the selected element.

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To measure the cumulative distance from an origin

- 1) Select the *Measure Distance* tool.
- 2) In the tool settings window, set Distance to Between Points.
- 3) Enter a data point to identify the origin (the point from which to measure).
- 4) Enter a second data point.
The Distance and Accumulated Distance fields display the same distance.
- 5) Enter another data point(s). The cumulative distance from the origin is displayed in the Accumulated Distance field, while the Distance field displays the distance between the last two data points.
or
Reset to return to step 3.

To measure the distance along an element

- 1) Select the *Measure Distance* tool.
- 2) In the tool settings window, set Distance to Along Element.
- 3) Identify the element at the origin (the point from which to measure).
- 4) Enter a data point to define a point along the element. The distance from the origin along the element is displayed in the status bar.
If the element is closed, this data point defines the direction (clockwise or counterclockwise) in which measurements are made.
- 5) Enter a data point(s). The distance along the element from the origin is displayed in the Distance field.
or
Reset to return to step 3.

To measure perpendicular distance from an element

- 1) Select the *Measure Distance* tool.
- 2) In the tool settings window, set Distance to Perpendicular.
- 3) Turn off Segment Only.
- 4) Identify the element.
- 5) Enter a data point.
The perpendicular distance between the nearest part of the element and this point is displayed in the Distance field. A temporary "line" is displayed as a visual aid but is not placed in the design.
- 6) Enter another data point(s) to define other perpendicular measurements.
or
Reset to return to step 4.

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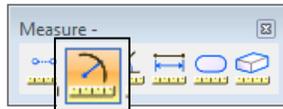
To measure perpendicular distance from a segment of an element

- 1) Select the *Measure Distance* tool.
- 2) In the tool settings window, set Distance to Perpendicular.
- 3) Turn on Segment Only.
- 4) Identify the element at the segment that is to be used.
- 5) Enter a data point.
The perpendicular distance between the element and this point are displayed in the Distance field. A temporary “line” is displayed as a visual aid but is not placed in the design. If the data point is not within the limits of the selected segment, then the projection of the segment is used.
- 6) Enter another data point(s) to define other perpendicular measurements.
or
Reset to return to step 4.
If the element is a line string, shape, curve, complex chain, or complex shape, the distance is measured perpendicular to the segment identified in step 3.

To measure the minimum distance between elements

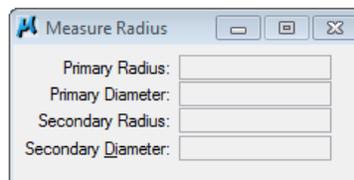
- 1) Select the *Measure Distance* tool.
 - 2) In the tool settings window, set Distance to Minimum Between.
 - 3) Identify the first element.
 - 4) Identify the second element.
 - 5) Accept the elements.
The minimum distance between the elements is displayed in the Distance field. A temporary “line” is displayed as a visual aid but is not placed in the design.
- To construct a minimum distance line between two elements, use the Construct Minimum Distance Line tool in the Linear Elements toolbox.

13.2 Measure Radius



Used to measure:

- The radius of a circle or circular arc.
- The radius of a cone or cylinder.
- The primary and secondary axes of an ellipse or elliptical arc.
- The radius of a circular segment or axes of an elliptical segment of a complex chain or complex shape



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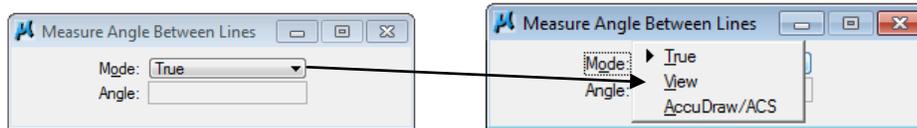
To measure an element's radius

- 1) Select the *Measure Radius* tool.
 - 2) Identify the element or segment.
 - 3) Accept the element.
The measurement displays in the status bar.
- To dimension an element's radius, use the Element Dimensioning tool.

13.3 Measure Angle between Lines



Used to measure the angle between two lines or segments of a line string, shape, or multi-line. If the identified lines do not intersect, an intersection point is computed to serve as the vertex of the measured angle.

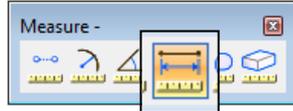


Tool Settings	Effect
Mode	Sets how measurements for the angle are calculated. Options are True, View, and AccuDraw/ACS.
Angle	Displays the result of the angle measured.

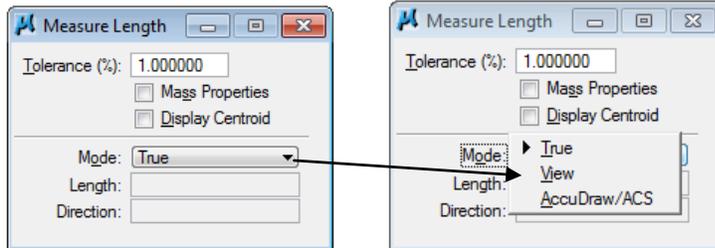
To measure the angle between two lines

- 1) Select the Measure Angle Between Lines tool.
- 2) Identify the first line.
- 3) Identify the second line.
- 4) Accept the lines.
The angle measurement is displayed in the status bar.

13.4 Measure Length



Used to measure the length of an element(s) and to analyze mass properties. For a closed element or a surface, the length of the perimeter or wireframe geometry is measured.



Tool Settings	Effect
Tolerance (%)	When measuring curves, the maximum percentage of the distance between the true curve and the approximation used to measure. A low Tolerance makes the measurement more accurate but increases calculation time.
Mass Properties	If on, the Mass Properties window displays the mass property analysis.
Display Centroid	If on, a graphic crosshair that represents the center of mass for the measured element(s) is displayed.
Mode	Sets how measurements for the length are calculated. <ul style="list-style-type: none"> • True — Measures the true distances in 3D, taking into account the depth component in the view. • View — Measures distances between projections of the elements on to the view plane (no allowance for the depth component). • AccuDraw/ACS — Measures distances between projections of the elements on to the AccuDraw drawing plane, or on to the active ACS.
Length	Displays the result of the last length measured.
Angle Of Line	Displays the result of the last angle measured.

To measure the length of an element

- 1) Select the element.
- 2) Select the *Measure Length* tool.
The length displays in the status bar. If Mass Properties is on, the mass properties are displayed in the Mass Properties window.

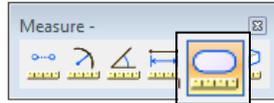
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Alternative Method — To measure the length of an element(s)

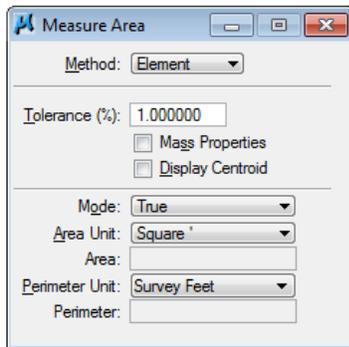
- 1) Select the *Measure Length* tool.
- 2) Identify the element.
- 3) Accept the element.

The length displays in the status bar. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.

13.5 Measure Area



Used to measure area and perimeter.



Tool Settings	Effect
Method	<p>Sets the area that is measured.</p> <ul style="list-style-type: none"> • Element — Area of one closed element (its Area attribute must be Solid). • Fence — (Fence present only) Area enclosed by the active fence, other than a named fence, or a fence created from an element. • Intersection — Area bounded by the intersection of two or more closed planar elements. • Where more than two elements are involved, use <Ctrl-data point> to select the extra elements. • Union — Area bounded by the union of two or more closed planar elements. • Where more than two elements are involved, use <Ctrl-data point> to select the extra elements. • Difference — Area bounded by the difference between two or more closed planar elements. • Where more than two elements are involved, use <Ctrl-data point> to select the extra elements. • Flood — Area enclosed by elements that either touch one another or whose endpoints fall within the Maximum Gap. • Points — Planar area with its vertices defined by a series of data points. Where the points are input in a figure 8 type shape, then the total area of the two loops is calculated.
Tolerance (%)	<p>For curves, sets the maximum percentage of the distance between the true curve and the approximation used to measure. A low Tolerance makes the measurement more accurate but</p>

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	increases calculation time.
Mass Properties	If on, the mass property analysis displays in the Mass Properties window.
Display Centroid	If on, a graphic crosshair that represents the measured element's center of mass is displayed.
Mode	<p>Sets how measurements for area are calculated.</p> <ul style="list-style-type: none"> • True — Measures the true distances in 3D, taking into account the depth component in the view. • View — Measures distances between projections of the elements on to the view plane (no allowance for the depth component). • AccuDraw/ACS — Measures distances between projections of the elements on to the AccuDraw drawing plane, or on to the active ACS.
Area Unit	<p>Sets the units used to display the last area measured.</p> <ul style="list-style-type: none"> • square <master units> • square m — (Metric units only) Square meters. • Acre (US) — (English units only) • Hectare — (Metric units only)
Area	Displays the result of the last area measured.
Perimeter Unit	Sets the units used to display the perimeter length for the last area measured.
Perimeter	Displays the perimeter length for the last area measured.
Locate Interior Shapes	(Method set to Flood only) If on, the area enclosed by the bounding elements is calculated, minus the area of any closed elements inside the bounding area.
Dynamic Area	(Method set to Flood only) If on, the area to be included displays dynamically as you move the screen pointer over the view.
Max(imum) Gap	(Method set to Flood only) Sets the largest distance allowed between consecutive elements. If zero, the elements must connect to bound an area.

To measure the area and perimeter of one element

- 1) Use the Element Selection tool to select the element.
- 2) Select the *Measure Area* tool.
- 3) In the tool settings window, set Method to Element.
- 4) Accept the element.
The element's Surface Area, and Perimeter, are displayed in the tool settings window.

Alternative Method — To measure the area and perimeter of one element

- 1) Select the *Measure Area* tool.
- 2) In the tool settings window, set Method to Element.
- 3) Identify the element.
The element's Surface Area, and Perimeter, are displayed in the tool settings window.

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To measure the area defined by a fence

- 1) Use the Place Fence tool to place a fence.
- 2) Select the *Measure Area* tool.
- 3) In the tool settings window, set Method to Fence.
- 4) Accept the fence contents.
The fence's Surface Area, and Perimeter, are displayed in the tool settings window.

To measure the area of the intersection or union of closed elements

- 1) Select the *Measure Area* tool.
- 2) In the tool settings window, set Method to Intersection or Union.
- 3) Identify one element.
- 4) Identify another element.
The resulting area is highlighted.
- 5) (Optional) Use <Ctrl-data point> to select further elements.
As you identify each successive element, the resulting area is highlighted.
If the elements do not overlap, the following occurs, depending on the Method:

Method	If elements do not overlap, then
Intersection	"Elements do not intersect" is displayed.
Union	Each element is highlighted.

- 6) After selecting the last element, accept to view the result.
The results display in the tool settings window. When measuring a union, the Perimeter value does not display if the elements do not overlap. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.

To measure the area of the difference between elements

- 1) Select the *Measure Area* tool.
- 2) In the tool settings window, set Method to Difference.
If any elements are selected, they are de-selected.
- 3) Identify the element from which to subtract.
- 4) Identify the element to subtract from the element identified in the preceding step.
- 5) (Optional) Use <Ctrl-data point> to select further elements to subtract.
- 6) Accept with a data point.
The results display in the tool settings window. When measuring a union, the Perimeter value does not display if the elements do not overlap. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.

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To measure the area enclosed by elements that touch

- 1) (Optional) Select the elements.
- 2) Select the *Measure Area* tool.
- 3) In the tool settings window, set Method to Flood.
- 4) (Optional) If you want to exclude, from the total measurement, the area of any closed elements inside the selected area, turn on Locate Interior Shapes.
- 5) Enter a data point in the area enclosed by the bounding elements.
- 6) Accept the elements.
The results display in the tool settings window. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.

To measure an area defined by data points

- 1) Select the *Measure Area* tool.
- 2) In the tool settings window, set Method to Points.
- 3) Enter a data point to define each vertex of an imaginary shape that encloses the area.
The imaginary shape is dynamically displayed.
- 4) When done, Reset.
The results display in the tool settings window. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.

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