Create Points

Overview

In this lesson, students learn how to work with points in AutoCAD® Civil 3D® software. Points are one of the most fundamental elements in site development and transportation projects. They can be used to represent existing conditions and proposed construction locations. Point data that represents existing conditions is usually created from survey data files generated from total station survey, GPS, or LiDAR survey equipment.

Engineers and construction personnel create points required for construction from design data. Once a design is completed, engineers extract point data from the design, and then send this information to the field for construction staking. Points created during the design are uploaded to GPS and Total Station survey equipment, and used for construction staking.

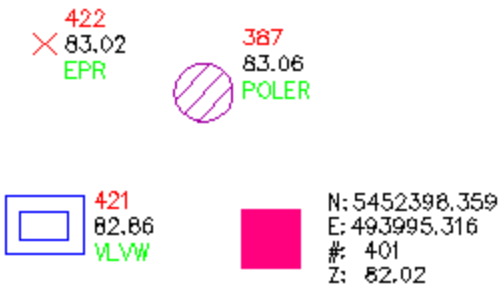
In common terms, a point represents a singular location in space. It is usually characterized with an X and Y (easting and northing) coordinate pair in two-dimensional (2D) space, or an X, Y, and Z (easting, northing, and elevation) coordinate triplet in three-dimensional (3D) space.

In Civil 3D, points are represented with a point object, which is an intelligent object with the following properties:

- Number
- Description
- Elevation
- Northing

- Easting

Point objects are as shown in the following illustration.



The Civil 3D point object consists of a marker and a label. The display of the marker is controlled with a point style. In this illustration, you can see how different point styles can be used to show different types of points. The display of the label is controlled with a point label style. Different label styles can be used to show specific point data.

Objectives

After completing this lesson, students will be able to:

- Explain how points are used in different phases of an engineering project.
- Describe how to use grips to modify points and point labels.
- Describe which objects can be used to create points in a drawing.
- Import points from an external text file into a drawing.
- Describe how point groups are used to identify characteristics shared by points.
- Explain the function of point tables.
- Create a description key.
- List the guidelines for managing points.
- Create points manually.
- Create point groups.

Exercises

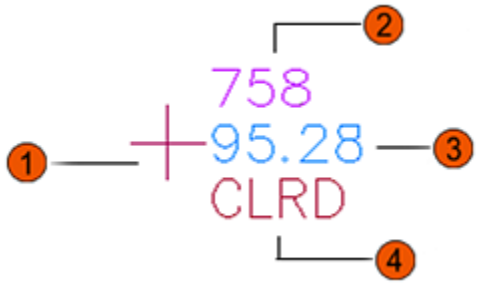
The following exercises are provided in a step-by-step format in this lesson:

1. Import Points
2. Create Description Keys
3. Create Points Manually
4. Create Point Groups

About Points

You create points from survey data to generate a base plan drawing and a surface object to model the existing conditions. Following the design process, you can also create points from Civil 3D object data that can be used for construction staking.

A point represents a singular location in space with elevation, northing, and easting coordinates. It also has properties that represent the point number, a raw (field) description, and an expanded (full) description. For modeling existing conditions, points are typically imported from a text file or created from the survey database. A Civil 3D point object is shown in the following illustration.



1. Point marker
2. Point number
3. Point elevation
4. Point description

Point Uses

Before the engineering begins, legal surveyors use points to define land parcel boundaries. Points represent the corners of property boundaries and are connected with parcel segments to define the land parcel. During this process, surveyors also use points to represent

horizontal and vertical survey control points. These points are referenced when establishing locations for boundary, topographic, and construction surveys.

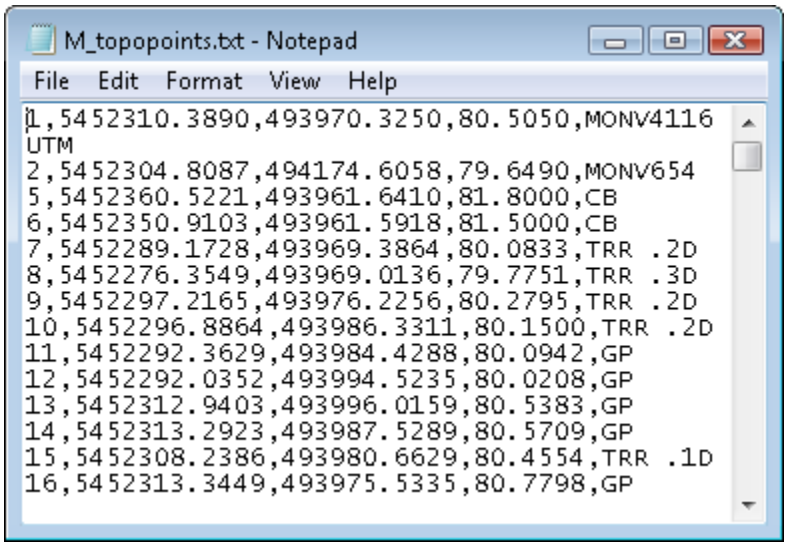
Topographic surveyors use points to define existing conditions prior to design and construction. Existing conditions are represented with a pre-engineering base plan drawing, and an existing ground surface model. The base plan drawing is created with symbols and linework. Symbols are inserted at spot locations such as catch basins, manholes, and power poles. Base plan linework is created by connecting points with similar descriptions, such as edge of pavement and bottom of ditch. The existing ground surface model is created from points that represent the true topography. Points representing manhole inverts and fire hydrant tops are excluded from the existing ground surface model.

Designers create points on the design model that can be used for construction staking. Points created on the design model contain description, coordinate, and elevation data that contractors can use to lay out the proposed design for field construction.

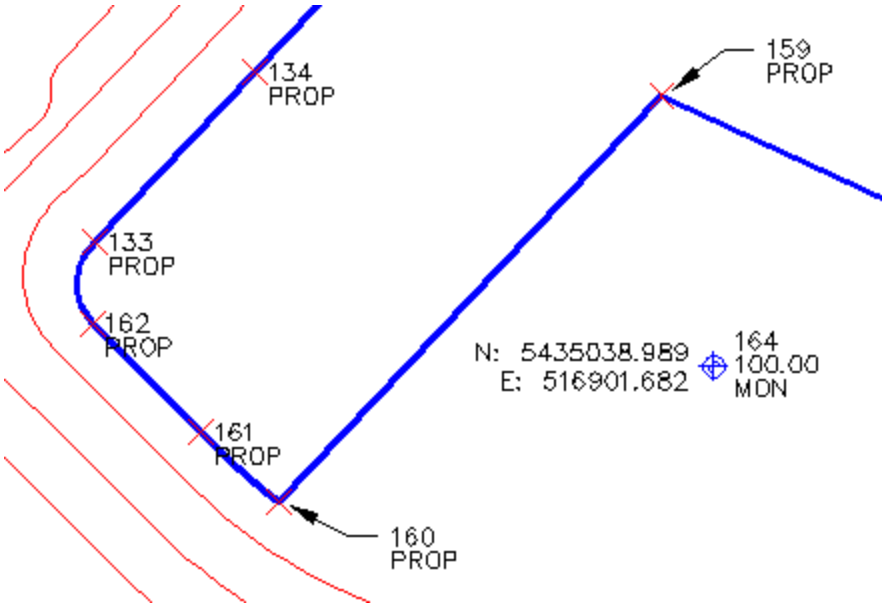
Examples

The following are examples of how points are used in projects.

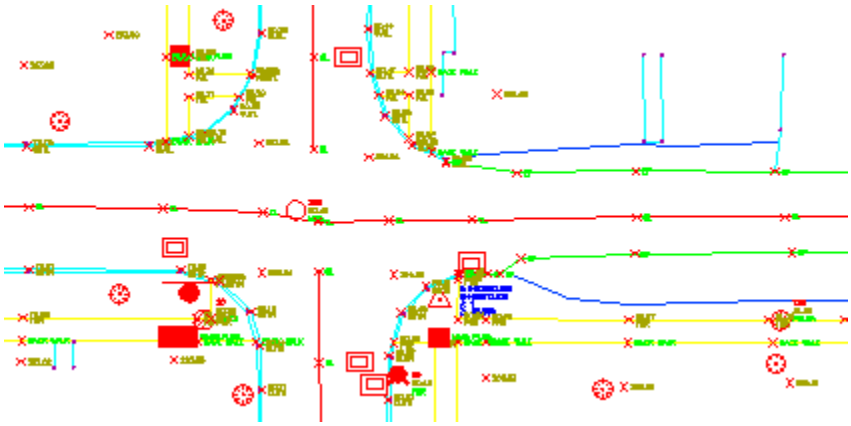
Points are imported from a text file that usually contains point number, northing, easting, elevation, and description. If point numbers are not provided in the text file, they are automatically created during the import. The following illustration shows an external text file with point data.



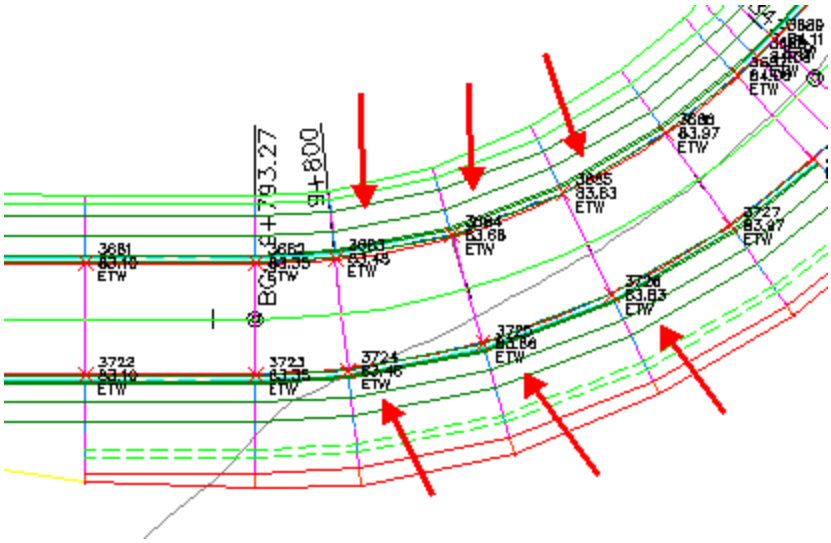
Prior to developing a parcel of land, a boundary survey is completed to define the limits of the parcel boundary. Surveyors use points to show property corners and survey control locations as shown in the following illustration.



Points are also used for pre-engineering topographic mapping and the creation of the existing ground surface model, as shown in the following illustration.



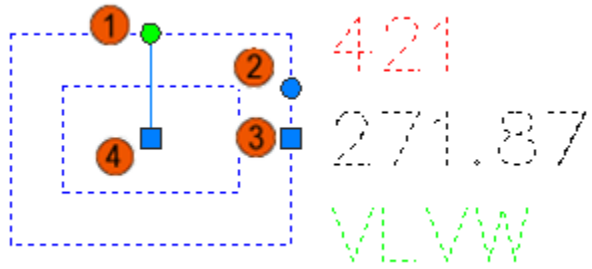
Points can also be used for construction purposes. Construction points can be created for road gutter lines and uploaded to a data collector for construction staking, as shown in the following illustration.



Graphically Editing Points Using Grips

Often points are created in close proximity to each other. This can make it difficult to read the data associated with the points. You can use grips to control the positioning of labels and other information associated with points.

The following illustration shows the grips used to control the display of points and points labels.



1. Rotate point grip
2. Toggle subitem grip
3. Drag point grip
4. Move point grip

The drag point grip is the square grip that is displayed on the point marker. When you click the drag point grip, you can move unlocked points to a new location. The northing and easting values for the point are updated based on the new location.

Use the drag label grip to reposition the entire point label away from the point object. When you use the drag label grip, the point label adopts its dragged state display property.

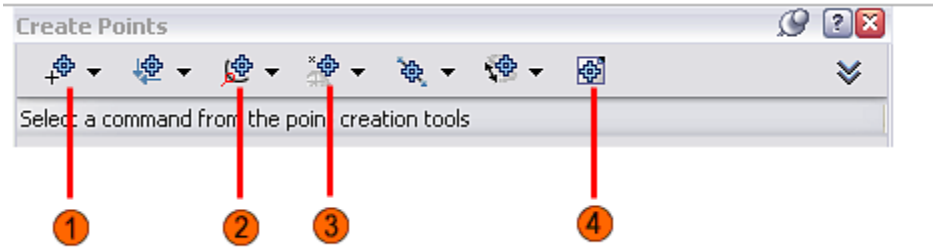
Use the toggle subitem grip to display grips for the individual point components. You can then move the point components individually.

Use the green circular rotate point grip to rotate the marker about its insertion point. You can use this grip to orient symbols to properly align with base plan linework.

Creating Points

The most common method for creating points that represent existing conditions is to import the points from an external text file, which is usually contains point number, northing, easting, elevation and description point data.

The Create Points toolbar offers many different tools for creating points, and is shown in the following illustration:



1. Create points manually, and other creation methods
2. Create points from horizontal and vertical alignments
3. Create points on surfaces and polylines
4. Create points from an external text file

Managing Points

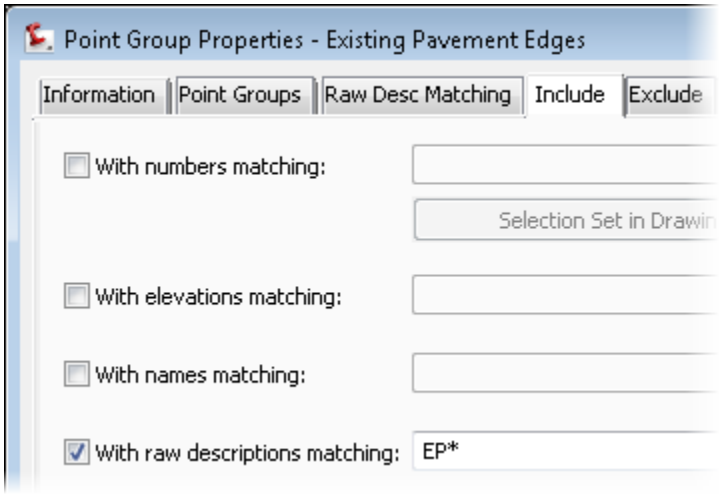
Points are used in different phases of engineering projects and can be difficult to organize and manage. Surveyors and designers sometimes work with thousands of points that have many different descriptions. Description keys and point groups are powerful tools that can help manage your points. Description keys help automate point layering and symbol insertion, while point groups enable you to collectively manage points with similar characteristics.

About Point Groups

Point groups provide a flexible and convenient way to identify points that share common characteristics or points that are used to perform a task, such as creating a surface. Point groups can also help control the display of points with certain characteristics during the design process.

You create point groups by defining the characteristics that a point must possess in order to be part of the group. For example, you can specify that a point belongs to a point group based on its point number, its name, its raw or full description, its elevation, or any combination of these parameters. Point group style overrides can be used to assign a point style and label style to the point objects.

The following illustration shows the Point Group dialog box.



You can control the display of points by assigning a point style and a point label style within a point group. In order to do this, however, you must use Point Group Overrides to override the assignment of a point style and point label style that was done through either default style assignment, manual style assignment, or assignment of styles with description keys.

Points groups are typically used to organize the points based on major features. For example, you would create a point group for an existing water main or existing storm sewers. Best practices for the use of description keys and point groups is to use description keys to assign the point style and the point label style, and to use point groups to temporarily override these style assignments to aid with the design process. When working with a large number of points, using many point groups may degrade the performance of the drawing.

Point Group Examples

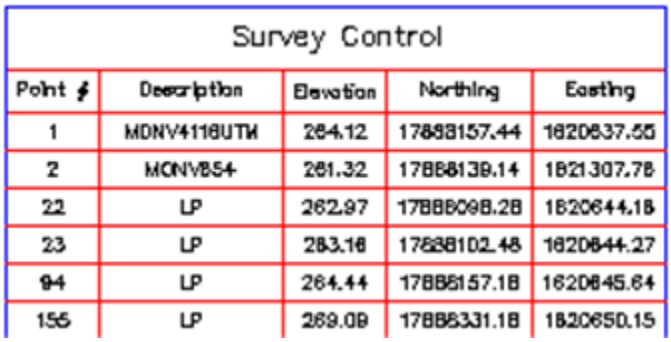
You use point groups to model an existing ground surface. A point group for surface modeling would exclude points that do not represent the terrain, such as manhole inverts and tops of

fire hydrants. A point group for survey control is useful to see which points make up the survey control network.

Point Tables

Points can contain critical information that sometimes needs to be displayed in a concise format in the drawing area. You can use point table objects to display point data in a table. Point tables are often used for showing survey control points or proposed tree planting schedules.

It is sometimes useful to show the point data for survey control in a point table in the drawing area, as shown in the following illustration. This makes it easy for construction staff to identify monuments and traverse hubs for construction staking.



Survey Control

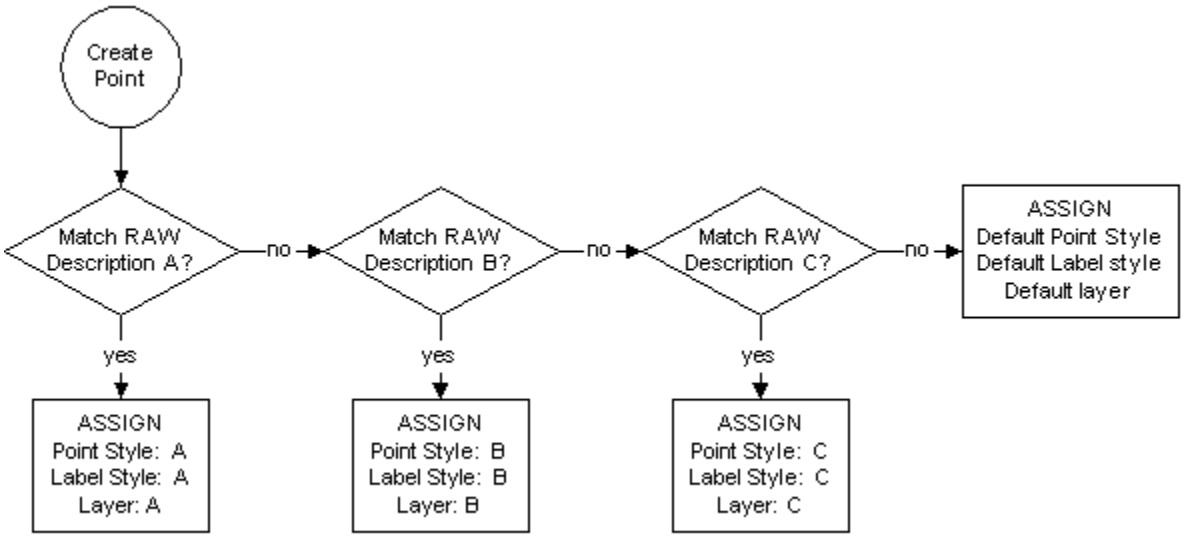
Point #	Description	Elevation	Northing	Easting
1	MONV4116UTM	264.12	17888157.44	1820837.55
2	MONV854	261.32	17888139.14	1821307.78
22	LP	262.97	17888098.28	1820644.18
23	LP	263.16	17888102.48	1820844.27
94	LP	264.44	17888157.18	1820845.64
155	LP	269.09	17888331.18	1820850.15

Description Keys

With description keys, you can simplify and standardize the creation of point data in your drawings. Description keys automate the base plan creation process.

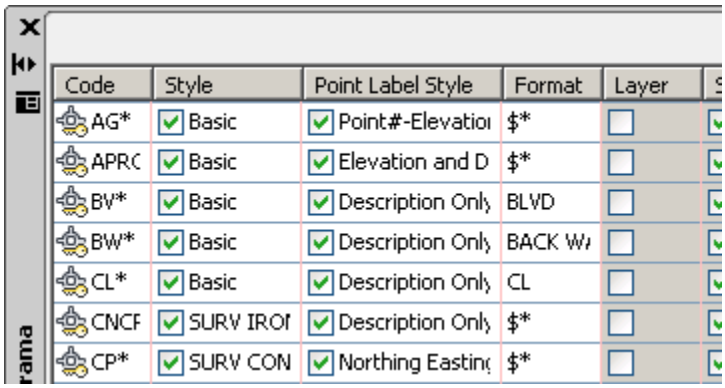
For example, when you create points, you can use a description key to assign the point style, a point label style, or to place the points on a specific layer. After you create description keys using your organization's standards, you can save them as a part of a drawing template (.dwt). When you use the template as the starting point for your drawings, the description keys are carried forward to the new drawing.

The following illustration shows how description keys manage imported points.



Description Key Functions

Description keys are organized in description key sets and can be saved in the drawing template.



Description keys are used for the following:

Alternate Point Descriptions

Surveyors collect data with field descriptions, also known as raw descriptions. Field descriptions are usually abbreviated and can sometimes be numeric. When you assign an alternate point description, you can expand on the abbreviated field description to make the description more meaningful to those in the office.

Point Style

The point style controls the display of the point node, or marker. The point style can reference an AutoCAD block and can be used to display base plan symbols such as catch basins, trees, and manholes.

Point Label Style

You can label points with elevation only, description only, point number only, or any combination of these and other parameters with point label styles.

Layer

The layer name is the layer the point is created on.

Description Key Examples

An organization can create a single set of description keys and use this set to import data from a number of survey companies. For example, a description key set can have entries for the raw descriptions APPLE* and TREE*. These entries ensure that an appropriate point style and other properties are assigned, regardless of whether the source data has a category for each specific type of tree or a single generic tree category. Instead of creating a description key set for each source of data, a firm can use the same set of description keys any time point data is imported.

Key Terms

Point	A point is a singular location in space. A 2D point is a location on a plane and identified with an X, Y coordinate pair. A 3D point adds an elevation coordinate and is identified with an X, Y, and Z coordinate triplet. Points are used to represent existing and proposed features.
Point Group	A point group is a collection of similar points in Civil 3D. Point groups can be created using both inclusion and exclusion criteria. You can create point groups based on point number range, descriptions, graphical selection, and elevation ranges. Point groups are useful for manipulating large groups of points with a single edit. You can assign point styles and point label styles to point groups. Point groups are recommended for surface modeling.
Point Style	The point style controls the display of the point node. You can use AutoCAD blocks to create customized point styles for different types of points.
Point Label Style	The point label style controls the display of the point label. You can

	create different point label styles to show different types of point data.
Raw Description	The raw description is the description a surveyor assigns to a point in the field. Raw descriptions are abbreviated alpha or numeric descriptions. Surveyors prefer these types of descriptions because they simplify the actual entry of the description in the field.
Full Description	The full description is an alternative point description that is assigned to a point. The full description expands on the abbreviated or numeric raw description assigned by the surveyor. Civil 3D description keys automatically assign a full description to a raw description.
Description Keys	Description keys are lookup tables in Civil 3D that automatically assign a full description to points. They also automatically assign point styles and point label styles to points. Description keys are stored in a description key set.
Manually Created Point	A manually created point is created using a number of different point creation tools. Manually created points can be edited directly and appear with a  symbol in the point list.
Reduced Coordinates	Reduced coordinates are created from survey observation data. Reduced coordinates indicate northing, easting, and elevation.
LiDAR Data	LiDAR (Light Detection and Ranging) data collection is a method of optical scanning that results in the collection of dense point data that can be used for surface modeling.

Exercise 1: Import Points From a Text File

In this exercise, students import points from an external text file to the drawing. The point data used in this module was collected by survey crews, and reduced to coordinates using software on their survey data collectors.

For this exercise open *…\I_CreatePoints-EX1.dwg (M_CreatePoints-EX1.dwg).*

Exercise 2: Use Description Keys

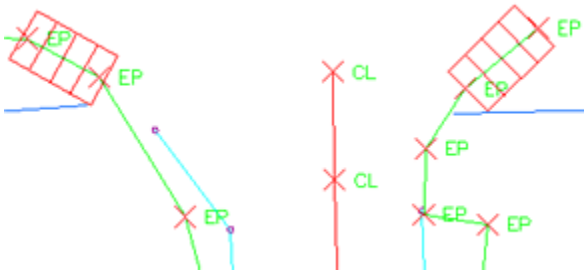
Description keys are used to automate the base plan creation process. Description keys are "lookup" tables that reference the point field descriptions (Raw Description) to do the following:

- Assign an alternative description (Full Description) to the point.
- Assign a point style to each point.
- Assign a point label style to each point.
- Scale and rotate points based on additional description parameters.

For this exercise, open *…\I_CreatePoints-EX2.dwg (M_CreatePoints-EX2.dwg)*

Exercise 3: Create Points Manually

In this exercise, students add catch basin points on the curb returns of an existing intersection.



Students may need to add points manually if survey data is incomplete. The location of manually created points is often identified by a position relative to two other points, or a position relative to an intersection curb return.

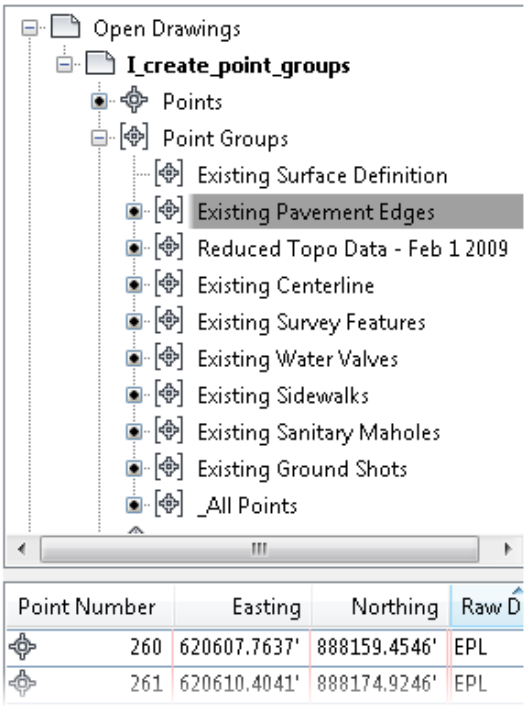
For this exercise open *…\I_CreatePoints-EX3.dwg (M_CreatePoints-EX3.dwg).*

Exercise 4: Create Point Groups

Site development projects usually involve thousands of points. These points are used for a number of civil engineering tasks including survey data reduction, base plan creation, design, and construction. Point data management becomes a task itself.

Point groups are used to organize points based on common properties. You can create point groups using a number of different criteria including description, point number, graphical selection, and elevation ranges.

You can even create point groups from other point groups.



One of the more common uses for point groups is for surface definition. In this exercise, students organize point data by creating point groups.

For this exercise open *…\I_CreatePoints-EX4.dwg (M_CreatePoints-EX4.dwg).*

Assessment

Challenge Exercise

Instructors provide a master or challenge exercise for students to do based on this lesson.

Questions

1. Name three methods for creating points in AutoCAD Civil 3D.
2. What controls the display of the point node?
3. What controls the display of the point label?
4. Why would an engineer use point groups on a civil engineering project?
5. What is a common use for point groups?
6. Name three criteria you can use to create a point group.
7. Explain the difference between raw and full point descriptions.
8. Name three specific functions of description keys.
9. Explain why an engineer would want to use description keys.
10. When you select a point graphically, a square grip and circular grip appear. Explain the significance of these grips.

Answers

1. To create points in Civil 3D, you can manually create points, import points from an external text file, or you can create points from a survey database.
2. The point style controls the display of the point node.
3. The point label style controls the display of the point annotation.
4. A civil engineering project typically involves thousands of points. Point groups enable engineers to organize points with similar characteristics.
5. A common use for point groups is surface modeling.
6. You can create a point group using point number ranges, descriptions, and elevation ranges.
7. Surveyors use a raw description to assign descriptions to points. The raw description is usually an abbreviated or numeric description. The full description is used in the office and expands on an abbreviated raw description.
8. Description keys assign point styles, point label styles, and alternate or full descriptions to points.

9. Description keys assist with the automatic creation of the pre-engineering base plan.
10. The square grip is the Drag Label grip. This grip enables you to drag the entire label away from the point. The circular grip is the Toggle Subitem grip. This grip enables individual grips for the point attributes. The individual grips enable you to drag individual attributes away from a point. The second circular grip is the Rotate Point grip, which is useful for rotating the point marker symbol.

Lesson Summary

In this lesson, students learned how to work with points in AutoCAD Civil 3D. At the beginning of the lesson, students imported points from an external text file.

Students then created description keys to automatically assign a point style, assign a point label style, and assign an alternate description. The final steps involved manually creating points, adjusting the point orientation, and creating point groups.