A Practical Guide to Autodesk Civil 3D® 2025

Rick Ellis

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Rick continues to use Autodesk Civil 3D on projects in a production environment, in addition to teaching classes to organizations both large and small.

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Exercise Data

I would like to thank the City of Springfield, Oregon for providing the data for this book. The dataset provided is for illustration purposes only. While it is based on real world information to add relevance to the exercises, it has been altered and modified to more effectively demonstrate certain features as well as to protect all parties involved. The data should not be used for any project work and may not represent actual places or things. It is prohibited to redistribute this data beyond your personal use as a component of training.

A Practical Guide to Autodesk Civil 3D 2025

Introduction

Congratulations on choosing this course to help you learn how to use Autodesk Civil 3D 2025. The term “practical” is used in the title because this course focuses on what you need to effectively use Autodesk Civil 3D 2025 and does not complicate your learning experience with unnecessary details of every feature in the product. Should you want to pursue aspects of features and functionality in greater detail than provided in this course, you are directed and guided to that information.

Each lesson contains the concepts and principles of each feature to provide you with the background and foundation of knowledge that you need to complete the lesson. You then work through real world exercises to reinforce your understanding and provide you with practice on common tasks that other professionals are performing with Autodesk Civil 3D 2025 in the workplace every day.

You can take the lessons in this course in whatever order is appropriate for your personal needs. If you want to concentrate on specific features, the lesson for those features does not require that you complete prior lessons. With this course organization, you can customize your own individual approach to learning Autodesk Civil 3D.

When you complete this course, you will be armed with the background and knowledge to apply Autodesk Civil 3D to your job tasks, and become more effective and productive in your job.

Course Objectives

The objectives of this course are performance based. In other words, once you have completed the course, you will be able to perform each objective listed. If you are already familiar with Autodesk Civil 3D, you will be able to analyze your existing workflows, and make changes to improve your performance based on the tools and features that you learn and practice in this course.

After completing this course, you will be able to:

- Understand and work with Object Styles.
- Create, manage and apply Label Styles.
- Import and manage Points, and work with Point Groups.
- Create and edit Alignments.
- Define Parcels.
- Create and edit Profiles and Profile Views.
- Create Corridors and extract information from them.
- Sample Sections and plot Section Views.
- Import and leverage GIS Data in your Civil 3D projects.
- Use Queries to manage and share data.
- Layout Pipe Networks and edit them in plan and profile.
- Layout Pressure Networks and edit them in plan and profile.
- Create Sheets with the Plan Production tools.
- Work with the Grading tools.
- Create reports for Civil 3D objects.
- Calculate Volumes.
- Share project data with Data Shortcuts.

Prerequisites

Before starting this course, you should have a basic working knowledge of AutoCAD. A deep understanding of AutoCAD is not required, but you should be able to:

- Pan and Zoom in the AutoCAD drawing screen.
- Describe what layers are in AutoCAD, and change the current layer.
- Create basic CAD geometry, such as lines, polylines and circles.
- Use Object Snaps.
- Describe what blocks are, and how to insert them.
- Perform basic CAD editing functions such as Erase, Copy, and Move.

If you are not familiar with these functions, you can refer to the AutoCAD Help system throughout the course to gain the fundamental skills needed to complete the exercises.

For a more in-depth AutoCAD tutorial check out our book, ***A Practical Guide to AutoCAD 2025***.

Conventions

The course uses the following icons and formatting to draw your attention to guidelines that increase your effectiveness in Autodesk Civil 3D, or provide deeper insight into a subject.

The magnifying glass indicates that this text provides deeper insights into the subject.

The compass indicates that this text provides guidance that is based on the experience of other users of Autodesk Civil 3D. This guidance is often in the form of how to perform a task more efficiently.

Downloading and Installing the Datasets

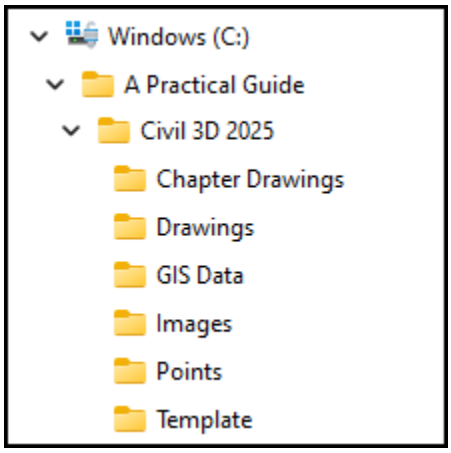
In order to perform the exercises in this book, you must download a zip file and install the datasets.

Type the address below into your web browser to load the page where you can download the dataset.
www.cadapult-software.com/data

If you are using a previous version of Civil 3D you can download previous versions of the dataset to use with this book.

Unzip the Files

Unzip the file **APG_C3D2025.zip** directly to the C drive. The zip file will create the following folder structure:



A folder called *Chapter Drawings* is created that contains a drawing that can be used to begin each exercise. This will allow you to jump in at the beginning of any exercise in the book, and do just the specific exercises that you want, if you do not have time to work through the book from cover to cover. The drawings in the Chapter Drawings folder are not necessary and only need to be used if you want to start in the middle of the book, or if you want to overwrite any mistakes that you may have made in previous chapters.

Three drawing templates called *_Practical Guide Training by Style.dwt*, *_Practical Guide Plan & Profile.dwt* and *_Practical Guide Section.dwt* are also available in the template folder.

Exercises

The exercises in this course have been designed to represent common tasks that are performed by civil engineers, surveyors, designers and drafters. The data included in the exercises are typical drawings, point files and other data used by professionals like you. You work with drawings, point files, aerial photos, GIS data, and much more; as you work through a road design project that also includes a sewer extension and detention pond.

Exercises provide higher level process information throughout the exercise tasks. You are given information about not only what to do, but why you are doing it. In most cases, an image is included to help guide you.

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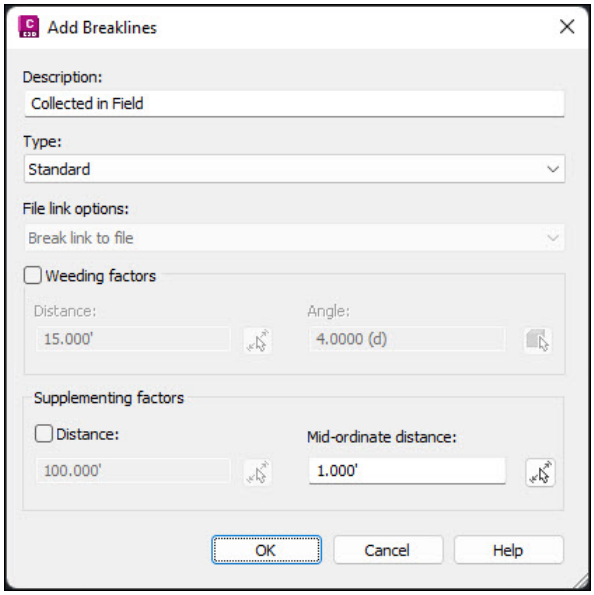
Sample Lesson

5.1 Lesson: Building Surfaces from Survey Data

Introduction

Any time you build a surface the most important step is to understand what data you have available to work with. In this chapter, you will work with points that will be managed with a *Point Group* and breaklines that you will create based on some of those same survey points.



Key Concepts

Concepts and key terms covered in this lesson are:

- Surface
- Points
- Point Group
- Breaklines
- Surface Styles

Objectives

After completing this lesson, you will be able to:

- Create a Point Group for use building a Surface
- List the types of data that can be used to build a Surface.
- Describe what a breakline is.
- Draw and define breaklines.

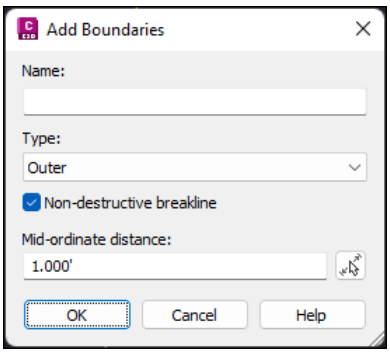
Types of Surface Data

Surfaces can be built from a combination of many different types of data:

- Boundaries
- Breaklines
- Contours
- DEM files (Digital Elevation Models)
- Drawing Objects
- Point Files
- Point Groups
- Point Survey Queries
- Figure Survey Queries

Boundaries

A boundary is a closed polygon that limits the triangulation of a surface.



Boundary Types:

- Outer
  - Defines the outer boundary of a surface
  - Triangles outside of this boundary are removed
- Show
  - Displays the triangles inside the boundary
  - Can be used inside of a Hide boundary
- Hide
  - Removes triangles inside of the boundary
  - Creates a hole in the surface
  - Can be used for building footprints to keep contours from crossing through them
- Data Clip
  - Keeps data outside this boundary from being added to the surface
  - Must be added before other surface data or moved up in priority in the surface definition
  - Useful for limiting the size of large datasets

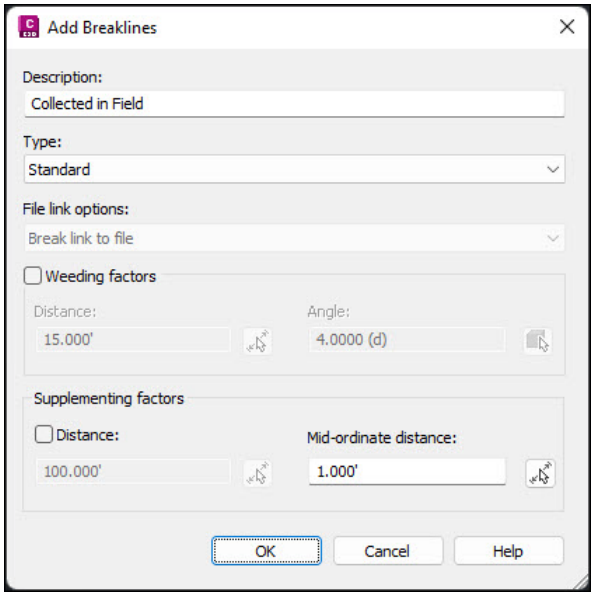
Non-destructive breakline boundaries

Outer, Show and Hide boundaries have the option to be created as non-destructive breaklines. When this option is enabled it trims the TIN lines at the boundary. When it is not used it erases all the TIN lines that touch the boundary.

This can be a good option if you have good surface data on each side of the boundary as it will cut a clean and straight boundary through the surface. However, if this option is used on an outer boundary where all of the surface data is inside the boundary and the only triangle touching it are long and inaccurate, then you may be left with short triangles along the edge that are still at the wrong slope.

Breaklines

Breaklines define grade breaks in a surface. They are lines in a TIN that represents a distinct interruption in the slope of a surface; like road centerlines, curbs, gutters, streams, tops and toes of slopes, or any other grade break. No triangle in a TIN may cross a breakline (in other words, breaklines are enforced as triangle edges).

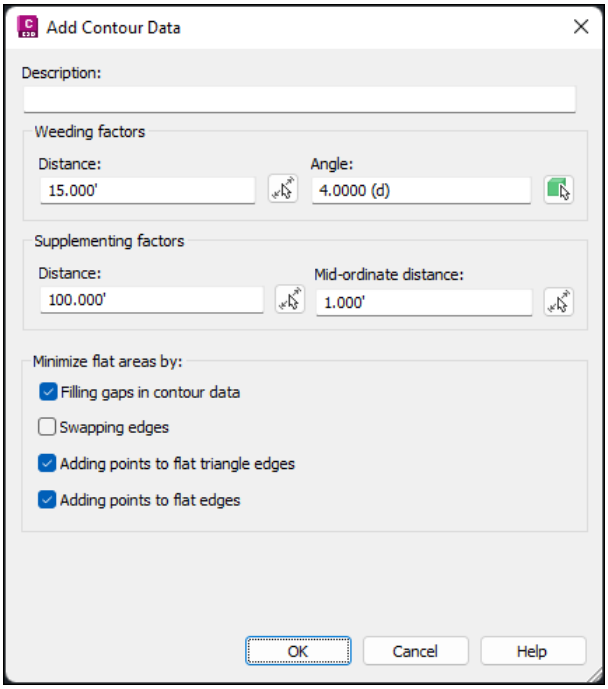


Types of breaklines:

- Standard
  - Defined by selecting 3D polylines, 3D lines, feature lines, or splines
- Proximity
  - Defined by selecting a 2D polyline, feature line or spline
  - The vertices of the breakline are snapped to the nearest point in the TIN, or closest proximity
  - Accuracy is dependent on how close the vertices of the proximity breakline are to the points in the TIN
  - Can be very accurate and efficient if you have drawn the selected object from point to point
- Wall
  - Defined by selecting 3D polylines, 3D lines, feature lines, splines or by selecting points.
  - You enter the elevation on each side of the wall at each vertex
- From file
  - Can be imported from an ASCII FLT file
- Non-destructive
  - Break the triangles in the TIN without changing the slope of the lines

Contours

Contour data in the form of 2D polylines can be added to your surface.



Weeding factors can help you skip over extra, unnecessary vertices when the data is added to the surface. While supplementing factors will allow you to sample extra points off long contours with minimal vertices.

Since by its nature, contour data tends to create flat triangles that do not accurately reflect the surface, there are several options to minimize those flat triangles. In most cases it is a best practice to enable all four options to minimize flat areas when adding contour data to a surface.

DEM Files

DEM files (Digital Elevation Models) are grid based surfaces. This is a format that is used by many different Civil, Survey, and GIS programs.

DEM files are a format that is commonly used by the USGS and there is a tremendous amount of data that is available online for free in this format.

Drawing Objects

AutoCAD object that have elevations can be used to build a surface. These objects include:

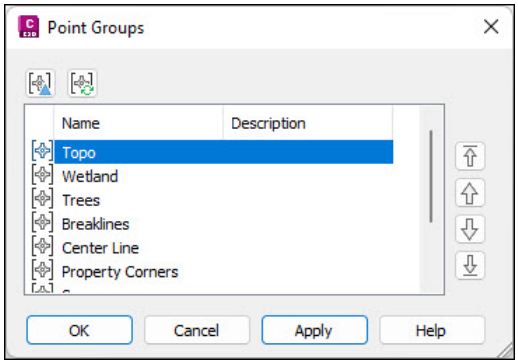
- Points
- Lines
- Blocks
- Text
- 3D Faces
- Polyface

Point Files

ASCII point files can be imported directly into the surface. This is a good option for large datasets or points that you do not need in the drawing for anything other than building a surface.

Point Groups

Point groups can be used to add a specific selection set of points to a surface. It may be common that some of the points in your drawing are not related to a surface. For example, you would not want to include a point representing the invert of a manhole in the surface. A point group consisting of only surface related points is an efficient way to add only the appropriate points to the surface.



Point Survey Queries

Point Survey Queries are a dynamic reference to a selection of survey points that are included in a survey database. If the points in the survey database are updated, the surface will be marked as out of date and will use the updated values when it is rebuilt.

Figure Survey Queries

Figure Survey Queries are a dynamic reference to a selection of survey figures that are included in a survey database. If the figures in the survey database are updated, the surface will be marked as out of date and will use the updated values when it is rebuilt.

Exercises: Build a Surface from Survey Data

In these exercises, you create a new surface from point group data. You will draw breaklines from survey points and add them to the surface. Then you will view the surface in the Object Viewer to examine it in 3D from different angles.

You do the following:

- Create a Point Group of surface related points.
- Create a Surface.
- Draw Breaklines.
- Add Breaklines to the Surface.
- View the Surface in 3D using the Object Viewer.

5.1.1 Creating a Point Group to Be Used As Surface Data

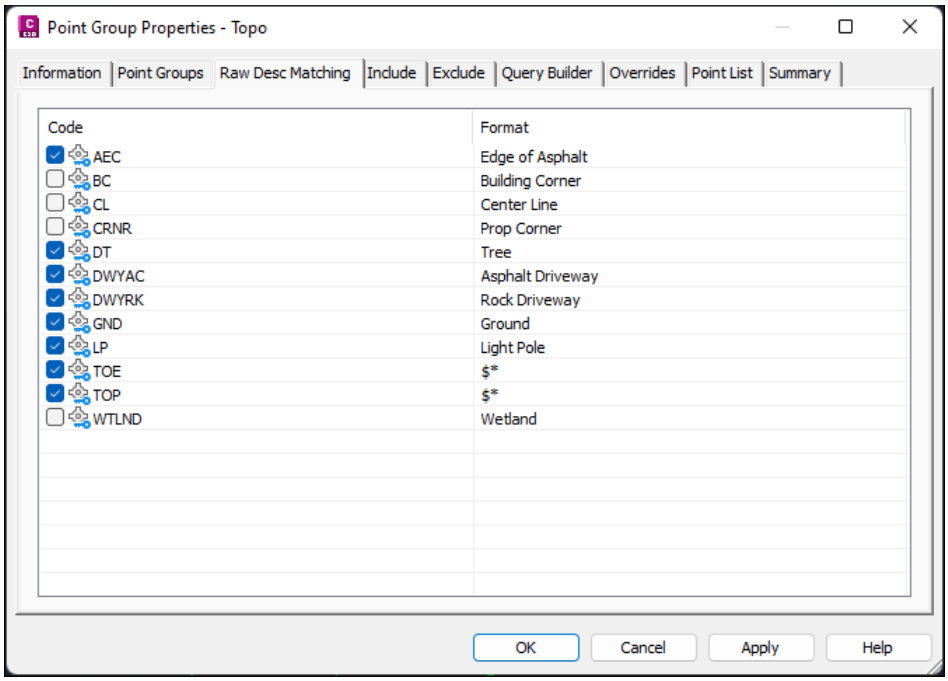
Before you create the surface you need to create a *Point Group* that will be used to select only the points that you want to use for the surface data. Points that should not be included in the surface should not be included in the point group. Points for utility potholes or points that are part of the project for horizontal control and do not have accurate surface elevations are examples of points that should not be included in this group.

1. Continue working in the drawing **Design.dwg**.

This drawing contains the *Points, Alignment, Parcels*, and *Surface* from the previous chapters. Currently only the parcel lines and labels are displayed.

Reminder: You can also open the drawing with this exercise number in the *Chapter Drawings* folder of the dataset if you prefer a fresh start at this point.

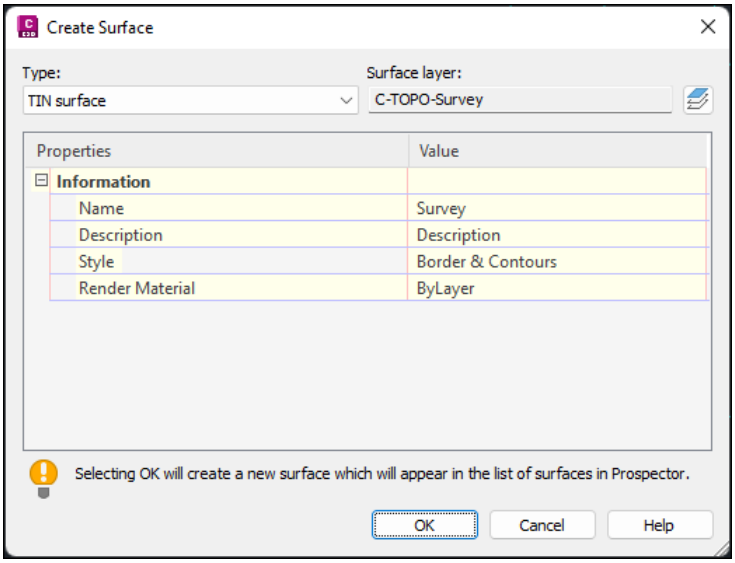
2. On the *Prospector* tab of the *Toolspace*, right-click on **Point Groups** and select ⇒ **New**.
3. Enter **Topo** for the **Name**.
4. Select the **Raw Desc Matching** tab in the *Point Group Properties* **dialog box**.



5. Select the description keys **AEC, DT, DWYRK, DWYAC, GND, LP, TOE,** and **TOP.**
6. Click **<<OK>>** to create the *Point Group*.

5.1.2 Creating the Survey Surface

1. On the *Prospector* tab of the *Toolspace*, right-click on **Surfaces** and select ⇒ **Create Surface**.
2. Confirm that **TIN surface** is selected as **Type**.
3. Enter **Survey** for the **Name**.
4. Set the **Style** to **Border & Contours**.
5. Confirm the *Surface layer* is set to **C-TOPO-Survey**.



This layer name that includes the surface name as a suffix was setup in an earlier exercise through the Drawing Settings command.

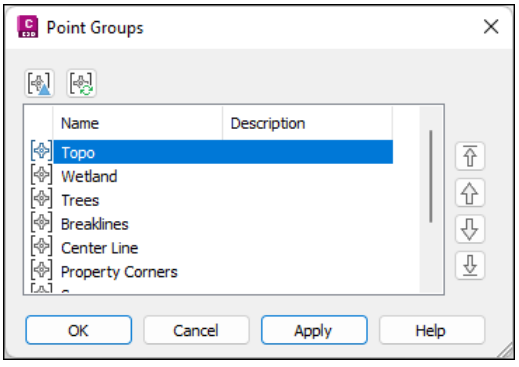
6. Click **<<OK>>** to close the *Create Surface* dialog box and create the surface.

At this time the surface has not been given any data so it is not displayed. However, it has been created and you will see it in the *Prospector*. This is where you will access the surface definition commands and add data to the surface.

5.1.3 Adding Point Group Data to a Surface

Point information contained in a *Point Group* can be added to a *Surface* through the *Prospector*. Once the *Point Group* is added the *Surface* is automatically rebuilt to incorporate and display the new data.

1. On the *Prospector* tab of the *Toolspace*, expand **Surfaces**.
2. Expand the *Surface* **Survey**.
3. Expand the **Definition** node under *Survey*.
4. Right-click on **Point Groups** under *Definition* and select ⇒ **Add**.
5. Select the *Point Group* **Topo**.
6. Click **<<OK>>** to add the point group data to the surface.



The surface is built with the point group data and displays 5 foot contours colored brown and green with a yellow border. This display is controlled by the surface style you selected when you created the surface. If the surface is not visible turn on and thaw the layer *C-TOPO-Survey*.

5.1.4 Creating Breaklines by Point Number

Civil 3D does not use special commands for drawing and defining breaklines the way that *Land Desktop* and many other programs do. Instead, you draw the breaklines with standard *AutoCAD* commands, like the *3D Polyline* command, and then define these objects as breaklines after they have been drawn.

1. Create a new *Layer* named **Breaklines-Survey** and set it **Current**.

2. Thaw the layers **PNTS-AEC, PNTS-BREAK,** and **PNTS-DRIVEWAY**.

3. Freeze the layers **C-ANNO, C-PROP, C-PROP-LINE, C-PROP-TABL, EX-WETLAND-LINE,** and **PNTS-WTLND**.

The drawing will now display the surface as contours and points that you will use for breaklines. You may need to *Regen* to clean up the display.

4. Enter **3P** at the command line to start the **3D Polyline** command.

5. Enter **'PN** to change the prompt to **Point Number**.

Alternatively, you can also select the *Point Number* button  from the *Transparent Commands* toolbar.

6. At the command line enter: **1408-1447** and **[Enter]** to draw the line.

7. **[Esc]** to end the Point Number prompt.

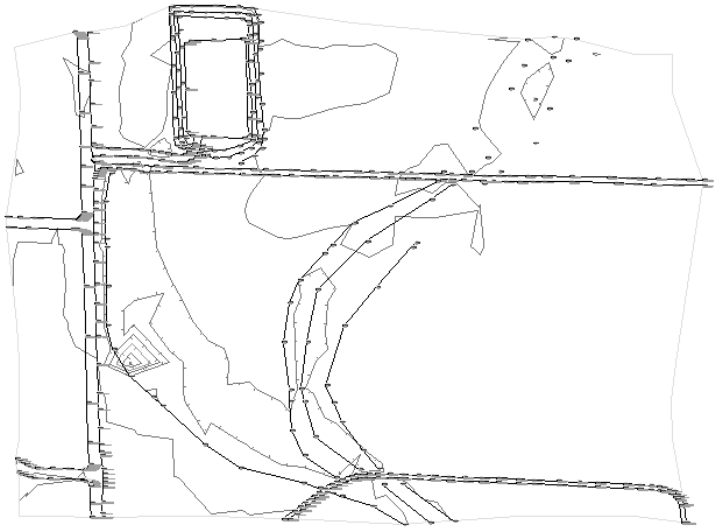
8. **[Enter]** to end the line.

9. Enter **3P** at the command line to start the **3D Polyline** command.

10. Use the points in the following list of points to draw the breaklines the same way that you drew the previous line. Be sure to use the **Point Number** transparent command to change the prompt to Point Number and to end the command completely after drawing each line. Also be sure to **[Enter]** after each non-sequential point number as shown below in the list.

    Point Numbers
    1448-1486
    1008-1021
    1191-1209
    1226-1257
    1258-1278
    1281-1324
    1295 [Enter] 1661-1710
    1622-1660 [Enter] 1294
    1286 [Enter] 1348-1398 [Enter] 1287
    1022-1074
    1075-1105
    1155-1158
    1159-1160
    1153-1154
    1143-1151
    1130-1142
    1121-1129

The new *3D Polylines* will look like the graphic below. However, they have not yet been added to the surface as breaklines.



5.1.5 Creating Breaklines by Point Selection

1. On the *Prospector* tab of the *Toolspace***,** select the *Point Group* **Breaklines.**

This will display a list of all the points used in the surface in the preview window at the bottom of the *Prospector*, if the *Prospector* is docked. If the *Prospector* is not docked it will display on the side.

2. Find point number **1110** in the preview window.

3. Right-click on point **1110** and select **Zoom to**. You may want to zoom out some to see the surrounding points.

4. Enter **3P** at the command line to start the **3D Polyline** command.

5. Enter **'PO** to change the prompt to **Point Object**.

Alternatively, you can also select the *Point Object* button  from the *Transparent Commands* toolbar.

6. Pick point **1110** from the screen.

7. Then pick points **1109, 1108, 1107, and 1106** to draw a breakline between the TOP points toward the northeast corner of the site.

When using the *Point Object* transparent command to draw lines between point objects you will not see the rubber band line that you normally see with the line command.

8. **[Enter]** to end **the Point Object** prompt.

9. **[Enter]** again to end the line.

10. Starting at point **1116,** define a second breakline along the bottom of the ditch using the **3D Polyline** command with the **'PO** transparent command and points **1116, 1117, 1118, 1119**, and **1120**.

11. **[Enter]** to end the Point Object prompt.

12. **[Enter]** again to end the line.

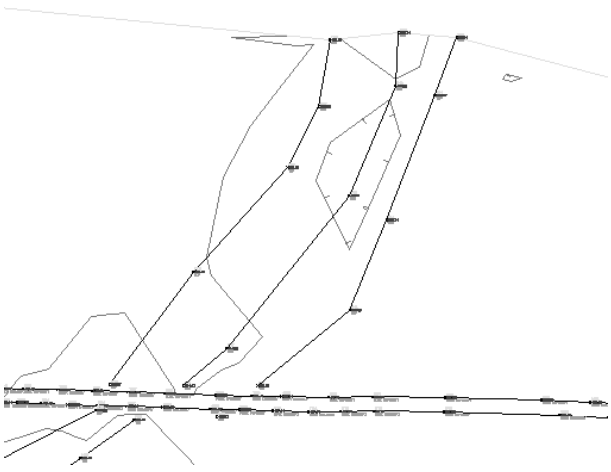
13. Starting at point **1111,** define a third breakline along the bank of the ditch using the **3D Polyline** command with the **'PO** transparent command and points **1111, 1112, 1113, 1114**, and **1115**.

14. **[Enter]** to end the Point Object prompt.

15. **[Enter]** again to end the line.

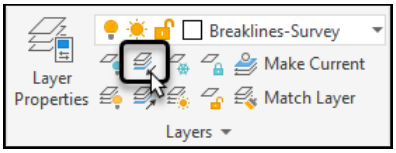
16. Save the drawing.

The three new *3D Polylines* will look like the graphic below. However, they have not yet been added to the surface as breaklines.



5.1.6 Adding Breaklines to the Surface

1. Select **Ribbon: Home ⇒ Layers ⇒ Isolate**.



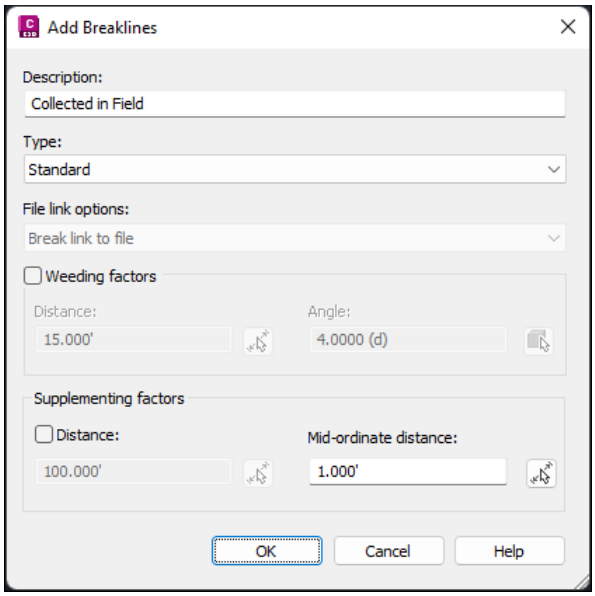
2. Pick one of the breaklines and one of the contours from the surface to isolate the **Breaklines-Survey** and **C-TOPO-Survey** layers.

3. Confirm that the **Definition** under the *Surface* **Survey** is expanded on the *Prospector* tab of the *Toolspace*.

4. Right-click on **Breaklines** under the **Definition** and select ⇒ **Add**.

5. Enter a **Description** for the breakline set of **Collected in Field**.

6. Confirm that the **Type** is set to **Standard**.



You will not use any *Weeding* or *Supplementing factors* in this exercise. These options allow you to remove or add vertices to breaklines respectively. These are useful options if you have breaklines that have been over digitized and may have thousands of extra vertices very close together or if you need to add vertices to a breakline that has long distances between vertices.

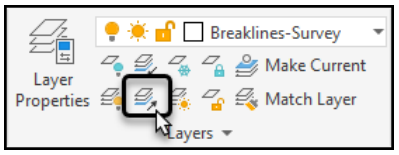
7. Click **<<OK>>**.

8. Select the **Breaklines** with a crossing window.

9. **[Enter]** to add the breaklines to the surface.

The surface is now updated to include the new breakline data.

10. Select **Ribbon: Home ⇒ Layers ⇒ Unisolate** to restore the previous layer state.



11. Save the drawing.

5.1.7 Viewing the Surface

The Object Viewer is a separate window that will allow you to view a selected object or objects in 3D and rotate them in real-time.

1. Pick one of the **contours** to highlight the entire surface.

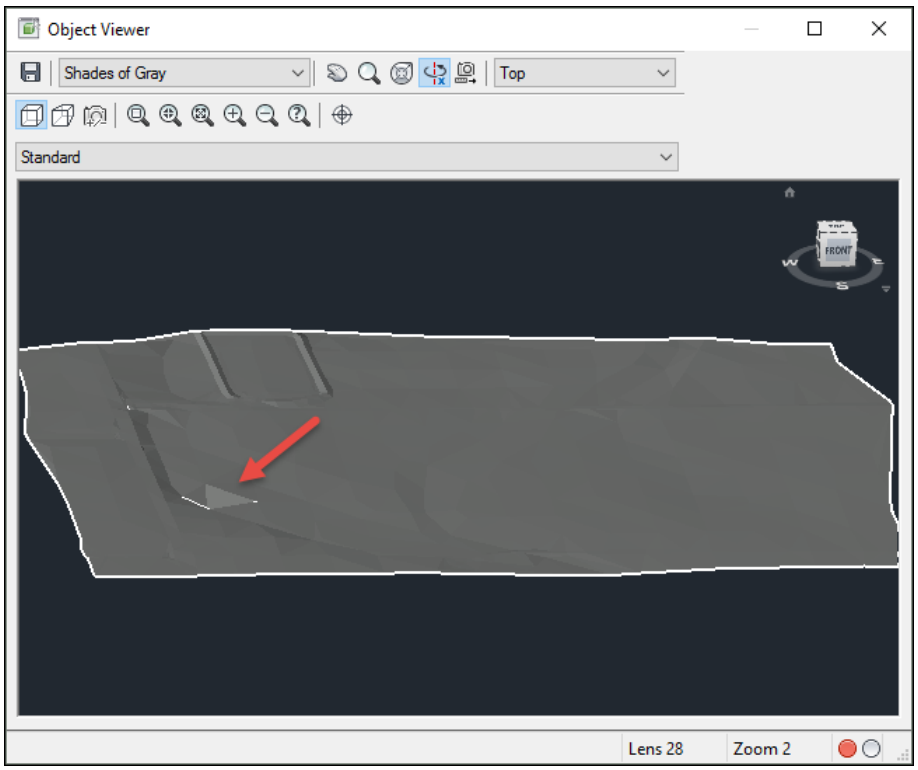
2. **Right-click** and select ⇒ **Object Viewer**.

3. In the **Object Viewer**, click and drag while holding down the left mouse button to rotate the surface in 3D.

Once you rotate to a 3D view the contours will change to 3D faces. This is controlled by the surface object style.

4. If the surface is not shaded right-click and select **Visual Styles ⇒ Shades of Gray**.

5. Continue to rotate the surface to examine it from different angles. You will notice a large hole, or spike, in the surface.



6. When you are finished viewing the surface close the object viewer window to return to the drawing editor. You should also be able to identify this hole by looking at the contours in plan view.

In the next lesson, you will learn to edit the surface to fix this and other errors.

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