CHAPTER 2

Leveraging a Dynamic Environment

Let's switch back to the airplane analogy again. So far we've sat down in the cockpit and talked about the most important gauges and controls. In several cases, we've even pushed a few buttons and looked behind a few hidden panels. You now have a greater familiarity with the user interface.

In this chapter, we're going to take the plane for a ride and observe and discuss how it works. How does it turn? How fast can it go? And, most important, how do the parts work together? You won't be able to fly solo after completing this chapter, but you will gain the experience of applying specific instructions, producing specific results, and discussing those results.

How does this translate to the AutoCAD® Civil 3D® software? Civil 3D has a unique, dynamic environment that is all about leveraging interactions and relationships. If you capitalize on this while you're working with Civil 3D, you will be much more productive and efficient. After completing this chapter, you will understand the dynamic capabilities of the Civil 3D environment and the importance of taking advantage of those capabilities.

In this chapter, you'll learn to:

- **Understand and leverage the connection between objects and styles**
- **Understand the connection between labels and label styles**
- **Understand the connection between objects**
- **Understand the connection between objects and labels**
- **Appreciate the richness of the 3D model**
- **Share data in the dynamic Civil 3D environment**

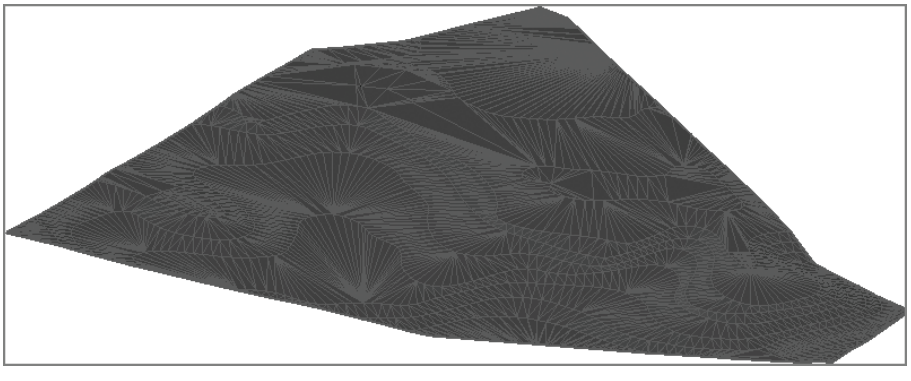
Connecting Objects and Styles

Certification Objective

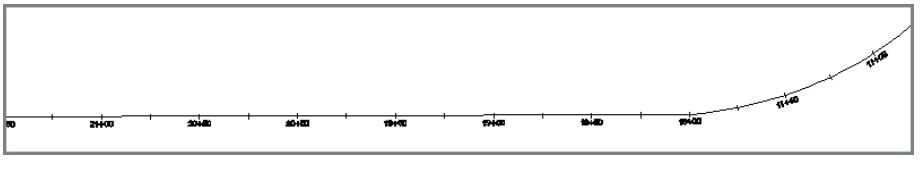
The word *object* is usually considered pretty generic, but in the world of Civil 3D it means something very specific. A Civil 3D object is an intelligent piece of your design model that stores information about itself and has the ability to interact with other objects in the drawing. Another characteristic of a Civil 3D object is that it is affected by a Civil 3D style. A Civil 3D *style* is a collection of settings that control the appearance and behavior of a Civil 3D object.

The relationship between objects and styles is one of several key relationships that you must understand and be able to take advantage of when using Civil 3D. Here are a few examples of Civil 3D objects that you'll encounter in this book as well as in a production environment:

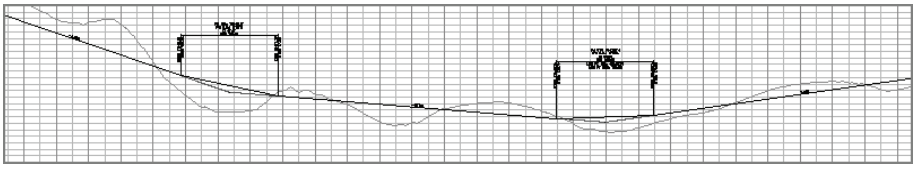
Surface A 3-D model typically used to represent the shape of the ground, either existing or proposed



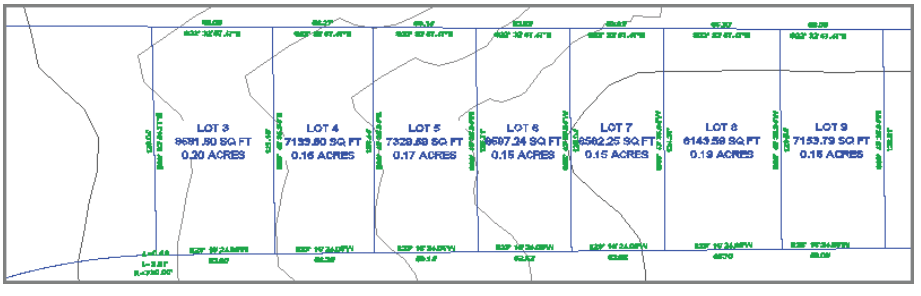
Alignment A series of 2-D lines, arcs, and spirals typically used to represent a linear feature such as a road centerline



Profile A series of lines and curves that represent changes in elevation along an alignment



Parcel A closed shape typically used to represent a legal property boundary



Recap of Important Definitions

A Civil 3D *object* is an intelligent piece of your design model that stores information about itself and has the ability to interact with other objects in the drawing.

A Civil 3D *style* is a collection of settings that control the appearance and behavior of a Civil 3D object.

What Is Elevation?

Depending on where you are in your civil engineering or surveying learning experience, the term *elevation* may be foreign to you. One way to visualize this concept is to think of it in terms of a piece of grid paper laid out over an area of land with the horizontal lines running west to east and the vertical lines running south to north. Elevation would be coming straight up out of the paper. So, the top of a hill would have a greater elevation than the bottom of a ravine. Another way of thinking about this is in terms of an XYZ coordinate system. X and Y would be the lines on the grid paper, and Z (elevation) would be coming out of it. Because Civil 3D combines general AutoCAD® software and civil engineering commands, elevation and the z-axis are the same.

One more thing—depending on where you live in the world, it may be appropriate to use the word *level* instead of *elevation*.

Each of the objects listed previously can be controlled by styles. For example, surface styles can be used to show a surface in many forms, including contour lines, a 3-D grid, a series of arrows pointing downhill, shading representing different elevation ranges, and more (see Figure 2.1). In addition to changing the overall appearance of an object, styles can control specific details that differ slightly between similar configurations. For example, in one case there may be surface contours that need to be shown on an existing layer, whereas in another case the same contours are shown on a proposed layer (see Figure 2.2). The configuration is the same (contours), but the way that configuration is displayed (which layer) is different between two different styles.

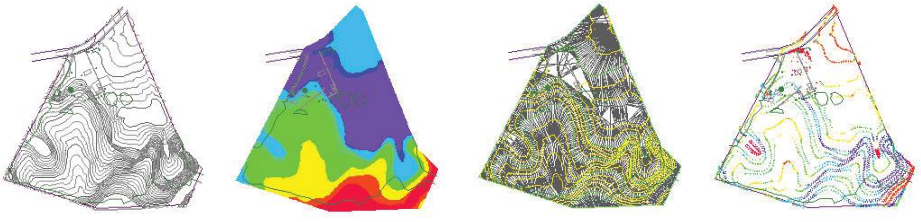


FIGURE 2.1 The same surface is shown in four different configurations using four different styles (from left to right): contours, elevation banding, TIN lines and contours, and slope arrows.

The acronym TIN will be covered in Chapter 4.

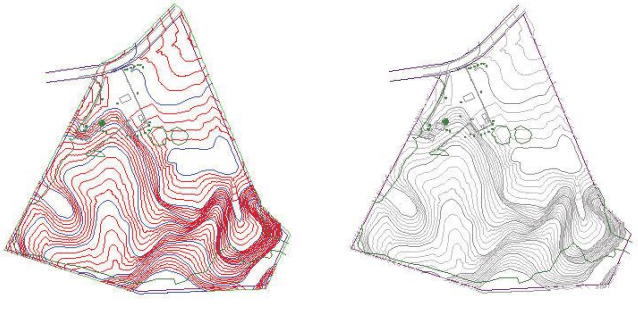


FIGURE 2.2 The contours on the left are displayed using proposed layers that are typically darker and more prominent. The contours on the right are displayed using existing layers that are typically lighter, so they appear more as background information.

Exercise 2.1: Apply Styles to Objects

In this exercise, you will use styles to change the appearance and behavior of Civil 3D objects.

1. Open the drawing named `Objects and Styles.dwg` located in the `Chapter 02` class data folder.

   The plan view of the surface in the left viewport should appear similar to the first image shown in Figure 2.1.

2. Click one of the contour lines in the drawing to select the surface object.

3. If the Properties palette is not visible, click Properties on the Home tab of the ribbon. 

4. In the Properties window, change the Style property to Elevation Banding (2D).

   The surface will display as colored bands, representing different ranges of elevations, similar to the second image in Figure 2.1.

5. Change the Style property to Contours & Triangles.

   The surface should now appear similar to the third image in Figure 2.1. The triangles are the fundamental framework of the surface and give it the shape that it has.

6. Change the Style property to Contours 1' and 5' (Design) (0.5 m and 2.5 m (Design)).

   The surface should now resemble the left image in Figure 2.2.

7. Change the Style property to Contours 1' and 5' (Background) (0.5 m and 2.5 m (Background)).

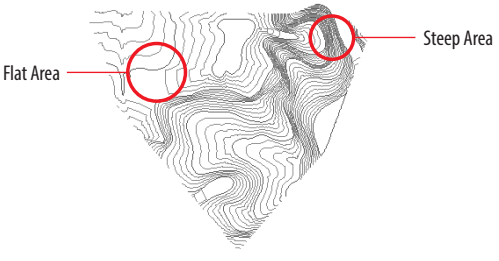
If you haven't already done so, download and install the files for Chapter 2 according to the instructions in this book's Introduction.

Notice that when you click a contour, the entire surface object is selected and all the contours appear highlighted.

This is the style that was assigned to the surface when you first opened the drawing. Note that both of the last two styles displayed contours but on different layers. Some of the contours change to the new color as a result of this change.

What Are Contours?

Contours are lines that are used to represent topography or changes in elevation across the ground. Most people experience contours in things like trail maps that cover a large area (square miles or square kilometers) in comparison to what we typically see in Civil 3D. By definition, contours are lines that connect points of equal elevation. If you took a giant horizontal blade and passed it through the ground at equal elevation intervals, you would get contour lines. In flat areas, the lines would be far apart, and in steep areas, the lines would be close together. With practice, you can look at a contour map and visualize the 3D shape of the land that the map represents.



The Tin Surface: Existing Ground tab is an example of a special ribbon tab that is displayed because you selected a surface. These are often referred to as *contextual* ribbon tabs, as you may remember from the previous chapter.

8. With the surface still selected, click the Tin Surface: Existing Ground ribbon tab and then click Surface Properties ➢ Edit Surface Style.
9. Click the Display tab, and then click the color column next to Major Contour.
10. Choose a noticeable color, and click OK. Click OK again to return to the drawing.
11. Save and close the drawing.

Some of the contours change to the new color as a result of this change.

You can view the results of successfully completing this exercise by opening `Objects and Styles - Complete.dwg`.

As you worked through the previous exercise, did you notice that no extra steps were required to update or redraw the surface when a new style was assigned or the style was edited? The effect was immediate—as soon as you modified the assigned style or assigned a different style, the appearance of the surface changed. This is because of a dynamic relationship between the object and its style, a relationship that is honored throughout the software.

Editing a Style vs. Assigning a Different Style

In steps 4 through 7 of the previous exercise, you changed the appearance of the surface by assigning a different style to it. This is the way to do it 99 percent of the time. In steps 8 through 10, you edited the style that was already assigned to the surface. Editing styles is typically the responsibility of a CAD manager. In fact, in many companies, end users are not permitted to modify or create styles. However, it is still important to understand that when a style is modified, any object using that style will change its appearance or behavior to honor the new version of the style.

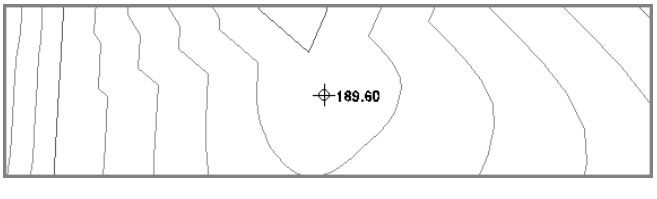
Connecting Labels and Label Styles

Certification Objective

Labels are an important part of any design because they provide specific information about the design that is often necessary for it to be properly constructed. Civil 3D enables you to create many different types of labels that associate themselves with the different types of Civil 3D objects. Labels are Civil 3D objects too, and just like the objects listed in the previous section, their appearance and behavior are controlled by styles. Also, just as with the relationship between objects and their styles, labels react when a different style is assigned or the assigned style is modified.

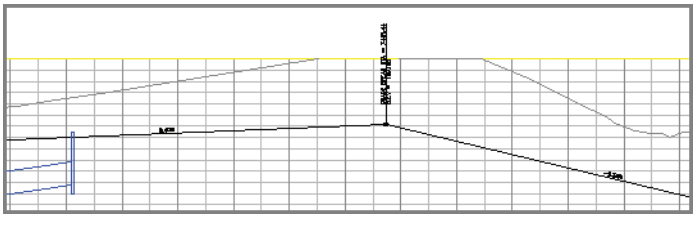
Here are some label types that correspond to the Civil 3D objects listed in the previous section:

Surface Spot Elevation Label This type of label is typically used to display the elevation of a key point in the design, such as a low point that water will drain toward or a high point that water will drain away from.



Alignment Station Offset Label This type of label is used to express the location of a feature in reference to a linear object. For example, you can express the location of a manhole by saying that it is a certain distance along the length of the road (station) and a certain distance to the left or right of it (offset).

Profile Grade Break Label This type of label is used to show the location and elevation of a slope change along a profile. For example, if the profile slopes upward and then changes to a downward direction, the highest point where the change occurs is considered a grade break and is a common location to place a label.

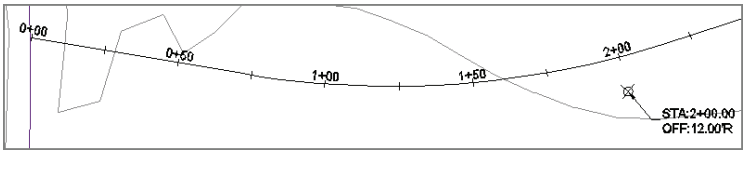


Station and Offset

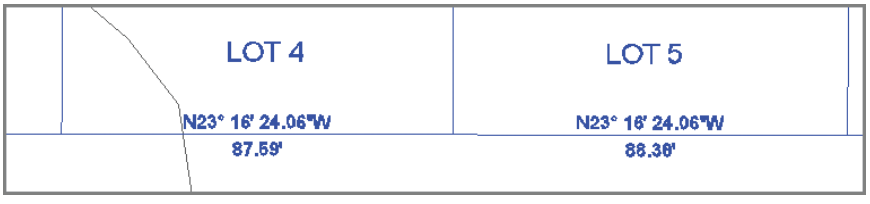
Long linear designs such as roads and pipelines often use station and offset notation to express locations. Stations themselves are usually expressed in a special notation that has a plus sign in it.

For example, if you're working in imperial units, a station of 2+00 refers to a location that is 200 feet "down the road" (assuming the road begins at station 0+00). To get to station 2+00, offset 12', you would travel down the road exactly 200 feet, turn right exactly 90 degrees, and travel exactly 12 feet.

If you're working in metric units, a common format is to use three digits after the plus sign. In this case, a station of 0+200 refers to a location 200 meters down the road. To get to station 0+200, offset 4 m, you would travel 200 meters down the road, turn right exactly 90 degrees, and travel exactly 4 meters.



Parcel Segment Label This type of label is typically used to express geometric information about a line or curve that forms part of a legal boundary. For example, it is common to label the bearing and distance of a straight line segment along a property boundary.



Exercise 2.2: Apply Label Styles to Labels

In this exercise, you will use label styles to change the appearance and behavior of labels.

If you haven't already done so, download and install the files for Chapter 2 according to the instructions in this book's Introduction.

1. Open the drawing named `Labels and Styles.dwg` located in the `Chapter 02` class data folder.
2. In the top-right viewport, click the label. If the Properties palette is not visible, click Properties on the Home tab of the ribbon.
3. Change the value for Station Offset Label Style to Station And Offset, as shown in Figure 2.3. Notice how the content of the label changes.

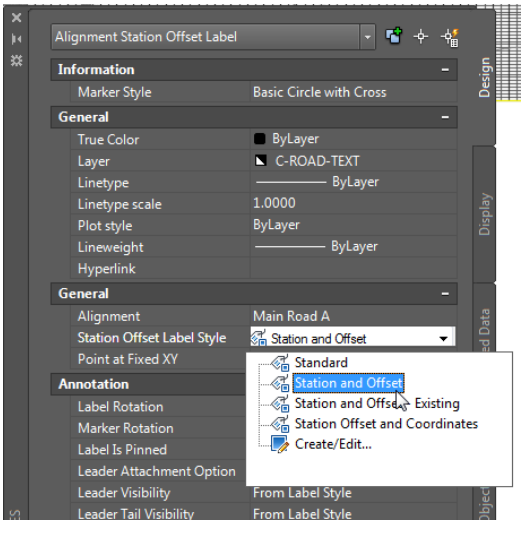


FIGURE 2.3 Assigning the Station And Offset label style to the label

4. Change the value for Station Offset Label Style to Station And Offset – Existing. This time, the content stays the same but the style of the text changes.

5. With the label still selected, click Label Properties ➢ Edit Label Style on the Labels – Alignment Station Offset Label contextual ribbon tab.

This is another example of a *contextual* ribbon tab.

6. In the Station Offset Label Style dialog box, click Edit Current Selection, as shown in Figure 2.4.

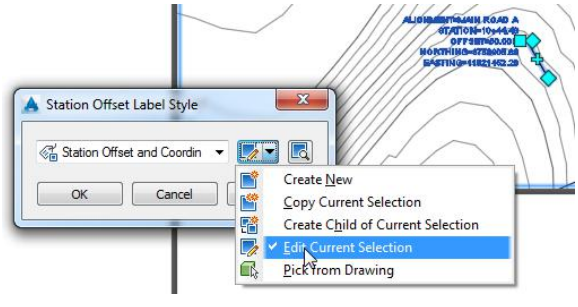


FIGURE 2.4 Clicking the Edit Current Selection command for the selected label style

7. In the Label Style Composer dialog box, click the Dragged State tab. Change the Visibility value for the leader to False, as shown in Figure 2.5.

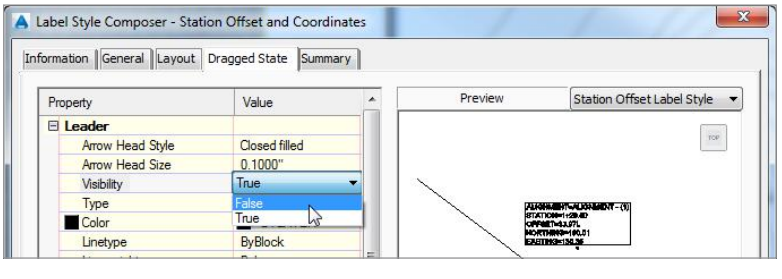


FIGURE 2.5 Changing the visibility of the leader by modifying a label style

The label is updated to reflect the change to the style and no longer displays a leader.

8. Click OK twice to dismiss all dialog boxes and return to the drawing.
9. Save and close the drawing.

You can view the results of successfully completing this exercise by opening `Labels and Styles - Complete.dwg`.

Styles and Company Standards

Civil 3D styles can make it easier for end users to meet company standards and can make graphical output more consistent. With a good set of styles that integrate company standards, all that an end user has to worry about is choosing the right style from a manageable list of choices. Conversely, if end users have to create their own styles, labels, and/or other graphical components, their drawings will most likely vary and may not comply with those standards.

Connecting Objects to Objects

The most important type of relationship that you'll see in this chapter is the one between objects. A typical land development project is a collection of dozens of mini-designs that often tie in to one another. For example, a road is designed by first drawing the 2D path of its centerline, then the proposed changes in elevation along that centerline, and finally the lanes, curbs, and sidewalks extending outward from that centerline. To provide drainage during a rainstorm, ditches must be installed along the sides of the road. The location and depth of these ditches can be traced back through the design process the entire way to the layout of the road centerline. If the layout of the centerline needs to change for some reason, that change must propagate downstream through the design process, ultimately changing the location and depth of one or more ditches.

Before Civil 3D, the many implications of such a change had to be addressed manually. An engineer or designer would have to inspect the road elevations, curbs, sidewalks, and ditches and manually address any changes required because of a change "upstream" in the design. With Civil 3D, you can build relationships between design objects and cause these changes to take place automatically, saving time and money and reducing opportunity for human error.

Exercise 2.3: Explore Object Relationships

In this exercise, you will study how object relationships are leveraged to make design changes in a drawing.

1. Open `Object Relationships.dwg` located in the `Chapter 02` class data folder.

If you haven't already done so, download and install the files for Chapter 2 according to the instructions in this book's Introduction.

2. Press the F3 key, and observe the command line. If it reports `<Osnap On>`, then press F3 again. If it reports `<Osnap Off>`, this is the correct condition for this exercise, and you can move on to the next step.

3. Click the top-right viewport, which shows a profile of the road design. The black lines represent the elevations along the centerline of the new road. The blue lines represent storm drains and pipes connecting them.

4. Click the black line representing the road profile. Zoom in until you can clearly see the triangular grip located at the intersection of two lines.

5. Click the triangular grip, and drag it upward to a location just below the top edge of the profile view grid, as shown in Figure 2.6.

   Notice that the 3-D view (bottom-right) of the road automatically updates, including the height of the Inlet 2 drain. In the profile view (top-right), the top of the drain is elevated to match the road.

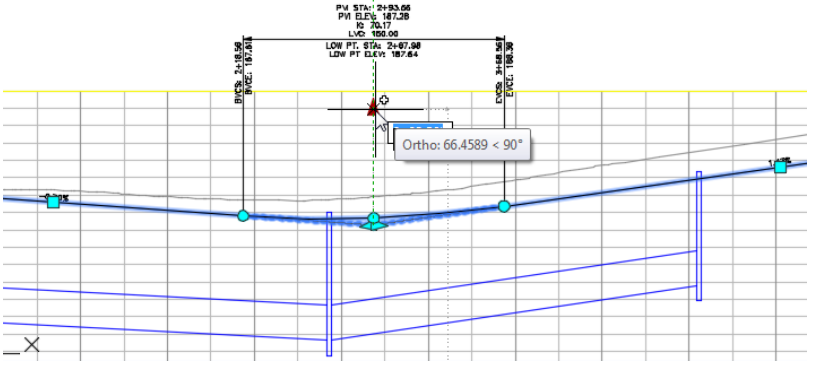


FIGURE 2.6 Grip-editing the profile

6. Save and close the drawing.

You can view the results of successfully completing this exercise by opening `Object Relationships - Complete.dwg`.

This simple exercise illustrates the power of relationships between objects. The ease with which you just updated the design may cause you to take the underlying processes for granted; however, there is a lot happening behind the

`<Osnap Off>` prevents your cursor from locking on to objects in the drawing that are near it.

Be sure that your command line is docked at the bottom of your screen and that the background color is set to white before proceeding with these steps.

scenes. The following is a general account of the events that took place when you changed the location of the triangular grip:

- The slopes of the lines leading into that triangular grip were changed to match the new location of the grip.
- The parabolic curve geometry at the location of the grip was updated automatically.
- The corridor object, which represents a 3-D model of the road, was automatically rebuilt and updated to match the new profile geometry.
- A surface representing the pavement, concrete, and earthen embankment elevations of the corridor was automatically rebuilt.
- The storm drain updated its top elevation to match the surface in the previous step.
- The 3-D representation of the storm drain was automatically updated (bottom-right view).
- The profile view representation of the storm drain was automatically updated (top-right view).

A simple grip edit triggered a chain of events that might have taken an hour or more to update manually. In addition to all this, other changes took place that did not affect the design of the storm drain. This is the power of the Civil 3D dynamic environment. You should know, however, that the existence of these relationships is not necessarily automatic. They have to be considered and at times consciously built in to the design by the Civil 3D user.

Connecting Objects to Labels

There is also an important relationship between objects and labels. Labeling is one of the most time-consuming aspects of preparing a set of construction documents. Although it is a very important part of the process, it really has nothing to do with the design. Usually, labels are placed when the design is already complete, as a means of communicating the necessary information for constructing the design in the field. The big advantage of the dynamic relationship between objects and labels is that it enables the user to create a single label that is valid for the life of the object. As the object changes, the label changes with it—so the label is always up to date and never has to be edited manually.

If you haven't already done so, download and install the files for Chapter 2 according to the instructions in this book's Introduction.

Exercise 2.4: Explore the Relationship Between Objects and Labels

In this exercise, you will study how dynamic labels respond when changes are made to the objects they annotate.

1. Open `Objects and Labels.dwg` located in the `Chapter 02` class data folder. Notice the elevation label, which currently reads 190.02 (57.92).
2. Click one of the dark gray contour lines. On the ribbon, click Edit Surface ➢ Paste Surface.
3. Select Main Road A FG, and click OK. Press Esc to clear the selection.
   In the top-right viewport, notice how the label updates and now reads 187.33 (57.07).

This step is like using a bulldozer to cut the road into the hillside, causing the elevation to drop about 3 feet (1 meter).

4. In the top-right viewport, pan southward and note the station value of 10+95.68 (0+333.96) and the offset value of 68.49L (20.88m L) in the label to the south of the spot elevation.
5. Click the road centerline to select it and display its grips. Then click the triangular grip and drag it west to a point near the west edge of the road, as shown in Figure 2.7.

FIGURE 2.7 Grip-editing the alignment

After a pause while Civil 3D rebuilds several aspects of the design, the label updates once more. Because the road is no longer influencing the elevation of this spot, the label reverts to its original value of 190.02 (57.92). The station offset label now displays updated values for station and offset.

6. Save and close the drawing.

You can view the results of successfully completing this exercise by opening `Objects and Labels - Complete.dwg`.

Appreciating the Richness of the 3-D Model

Even though what you have done to this point may seem a bit foreign at the moment, at some point you will realize that all you're doing with Civil 3D is creating instructions for how to build something. If you've ever assembled a piece of furniture or a bicycle that you bought at a store, you can relate to this concept. The primary purpose of Civil 3D is to help you prepare the instructions for how to build a land development project.

Thirty years ago, the method used to prepare land development plans was relatively the same as it had been for hundreds of years: plans were drawn on paper, providing only a two-dimensional depiction of what was to be built. The information that existed for the design was limited to what could be displayed on paper. Then, with the advent of computers, something magical started to happen. Virtual versions of design components could be modeled electronically. They could be represented in all three dimensions and even have additional information attached to them. Now, instead of using an ink line on paper to represent a pipe, you could do it with a 3-D cylinder that also stored the pipe's material, structural characteristics, and flow characteristics. This "smart" object could be ported to hydraulic design software for further analysis in conjunction with local rainfall data to determine whether it was large enough to handle a storm with a specific likelihood of occurring within the life span of the pipe. And so on, and so on.

Thus, in 30 years we have progressed from ink on paper to 3-D intelligent objects. The step from drawing with a pen to drawing with a mouse came early in that evolution—not 3D or intelligent, but lines on a screen that could be printed. Civil 3D contains all the basic tools to represent designs in this manner, and unfortunately, many users create only basic 2-D drawings even though they have access to the dynamic 3-D environment that you've seen in this chapter. My sincere hope is that you will not be this type of end user but instead will squeeze every dynamic relationship possible into the models you build with Civil 3D. You may not realize the full potential of the dynamic relationships you build until you have the opportunity to use them, but you can bet that they will pay dividends on every single project. The following are examples where it is essential to have a dynamic 3-D model.

Building Information Modeling

Building information modeling (BIM) has been a hot topic in the design, construction, and facilities management fields for quite some time now. Although some would argue that Civil 3D has little to do with the *B* (building), it definitely has the *I* (information) and the *M* (modeling) aspects. Many civil engineering projects are incidental to building construction and therefore present an opportunity for Civil 3D models to be integrated with BIM. No model, no BIM.

GPS-Guided Machine Control

Imagine being able to download the instructions to assemble your bike and then upload them to your own personal robot, which would assemble the bike for you. That might sound like science fiction, but something similar is common practice in the land development industry. Models built with Civil 3D are being uploaded to GPS-guided earthmoving machines. These giant "robots" synchronize GPS-based locations of themselves and their digging implements with the dimensions of the Civil 3D model until the real dirt and rock are a match to the model. Without a model, there is no GPS-guided machine control.

Construction Simulation

If you think about it, one thing that Civil 3D enables you to do is to simulate the project before having the contractor attempt to build it in the field. Why do this? It's a lot cheaper to undo a CAD command than to undo the placement of several truckloads of concrete. Contractors are taking this one step further by simulating the construction itself. The sequence of operations, staging of materials, arrangement of equipment, and many other aspects can all be simulated with several products available on the market. These 4-D (3-D + time) or even 5-D (3-D + time + cost) simulations are becoming commonplace in nearly all major construction projects. No model, no simulation.

Visualization

Visualization is itself a form of simulation. With design software now commonly producing 3-D models, the leap to 3-D visualization is much shorter and easier to accomplish than ever before. Clients, review agencies, and the public are beginning to expect renderings and even animations of proposed designs to be available for them to assess. No model, no visualization.

Building your designs as dynamic models does take a bit more effort and time, but as you develop more and more skills, the extra time and effort become a

smaller fraction of the overall process. The resulting models are much more useful, much more information rich, and much more valuable to your clients and the other parties involved in your projects. There's no telling how this information will be used, but one thing is for sure: It won't be used at all if it's not there.

In addition, building designs as dynamic models improves the quality and efficiency of the design process. Designers who make full use of the dynamic model produce better designs by creating more design iterations and what-if scenarios than those who don't. They can respond more quickly to design changes, reducing the overall cost involved in designing the project and increasing the bottom line. Leveraging the dynamic model isn't just cool, it's also practical and very smart from a business perspective.

Sharing Data in a Dynamic Environment

Certification Objective

So far, you have studied many ways in which relationships and interactions are used to make Civil 3D a powerful design solution, but all these relationships have been confined to a single drawing or a single user. What happens in a team environment? Are there ways in which whole drawings can interact with one another? Can multiple team members establish dynamic relationships between their designs? The answer is yes, and the feature that makes it possible is the *data shortcut*.

Earlier, in the section "Connecting Objects to Objects," you observed how a profile, a road design, and a pipe system design can be related to one another. Now, imagine a design team where Joe designs the profile in one drawing, Susan designs the road model in another drawing, and Jill designs the pipe system in yet another. Data shortcuts make it possible for these designs to be linked together just as you witnessed earlier—even across drawings.

A data shortcut is a link to a Civil 3D object that enables another drawing to get access to that object. For example, if you create a profile that represents the proposed centerline elevations of a road, you can publish a data shortcut for that profile, which makes that profile "visible" to other drawings. You or someone else can then open another drawing and use that data shortcut to access the profile. Once you have accessed the profile, you can use it as part of another design, such as the case with the road model.

When a data shortcut is created, it is displayed in Prospector beneath the Data Shortcuts heading (see Figure 2.8). Data shortcuts are stored within a *data shortcuts projects folder*. This enables related data shortcuts, such as those pertaining to a given project, to be grouped together in one location. The folder

that contains data shortcuts folders is the *working folder*. It allows you to set up one location where all projects are stored.

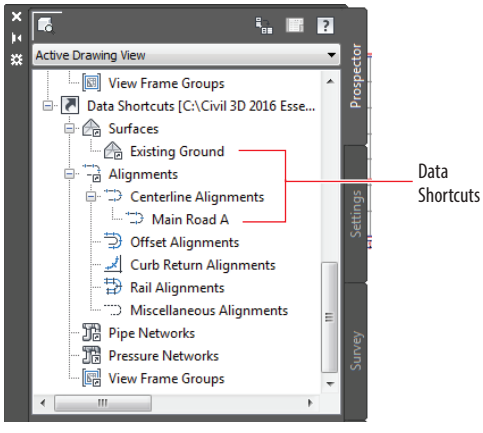


FIGURE 2.8 **Data shortcuts shown in Prospector**

Once a data shortcut is made available, you can use it to create a *data reference* in another drawing. Objects that are data referenced, such as surfaces, alignments, and profiles, appear in Prospector along with other "native" objects. An icon next to them indicates that they are data references. In Figure 2.9, the Existing Ground surface and the Main Road A alignment have an icon next to them indicating that they are data references.

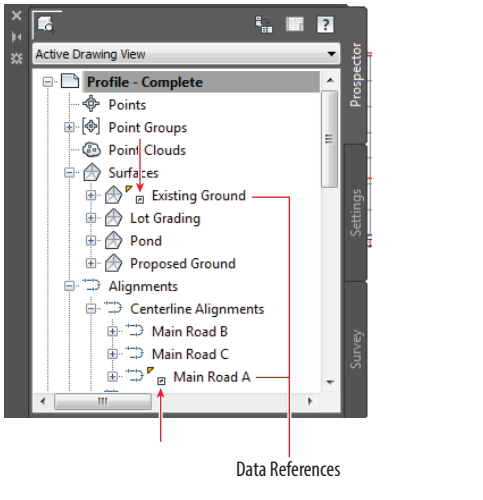


FIGURE 2.9 **A surface data reference and an alignment data reference shown along with other surfaces and alignments in Prospector**

Exercise 2.5: Share Data Using Data Shortcuts

In this exercise, you will use data shortcuts to share data between drawings. You will publish a surface and an alignment as data shortcuts from two separate drawings. Then you will reference the alignment and surface into a third drawing and use the information to create a profile.

If you haven't already done so, download and install the files for Chapter 2 according to the instructions in this book's Introduction.

1. Open the file named `Surface.dwg` located in the `Chapter 02` class data folder.
2. If the Toolspace is not visible, click Toolspace on the Home tab of the ribbon.

3. On the Prospector tab of the Toolspace, right-click Data Shortcuts and select Set Working Folder. The Browse For Folder dialog box opens.
4. Browse to the `Chapter 02` class data folder, and select Sample Working Folder. Click OK.
5. Right-click Data Shortcuts, and select New Data Shortcuts Project Folder. The New Data Shortcut Folder dialog box opens.
6. Type **`Sample Project`** in the Name field, and click OK.
7. Save the drawing. Click the Manage tab of the ribbon, and then click Create Data Shortcuts. The Create Data Shortcuts dialog box opens.

8. Check the box next to Existing Ground, and click OK.
9. Open the file named `Alignment.dwg` located in the `Chapter 02` class data folder.
10. Repeat steps 7 and 8 for the alignment named Main Road A.
11. Open the file named `Profile.dwg` located in the `Chapter 02` class data folder.
12. In Prospector, expand Data Shortcuts ➢ Surfaces. Right-click Existing Ground, and select Create Reference.
13. Click OK to accept the default settings in the Create Surface Reference dialog box. Contours in the left viewport and a 3-D model in the lower-right viewport indicate a newly added surface.
14. Repeat steps 12 and 13 for the alignment data shortcut named Main Road A. A new alignment is created in the drawing.

You will need to expand Alignments ➢ Centerline Alignments to find the Main Road A alignment.

15. On the Home tab of the ribbon, click Profile ➢ Create Surface Profile. The Create Profile From Surface dialog box opens.
16. Click Add, and then click Draw In Profile View. The Create Profile View – General dialog box opens.
17. Click Create Profile View. Pick a point in the top-right viewport. A new profile is created that is the result of relating an alignment to a surface (see Figure 2.10). This profile represents the interaction among three different drawings.

When you click Add, you are in a sense *adding* the surface to the alignment to generate the profile data.

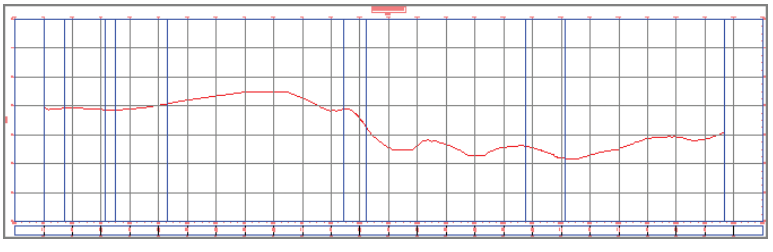


FIGURE 2.10 A profile created from an alignment data reference and a surface data reference

18. Save and close all drawings.

You can view the results of successfully completing this exercise by opening `Profile - Complete.dwg`.

Now You Know

Now that you have completed this chapter, you understand the dynamic environment of Civil 3D. You comprehend how styles are applied to objects to change their appearance and behavior. This includes objects such as alignments and surfaces and also labels. You understand how objects are connected to one another and interact automatically so that you don't have to spend extra time "fixing" your design when something changes. You appreciate the richness of a 3-D model and understand how powerful it is for performing design in today's fast-paced and demanding world. And, finally, you can share data within a team by using data shortcuts to share design data between drawings.

Now that you understand and appreciate the dynamic Civil 3D environment, you will move forward into the next chapters with greater insight. As you progress through this book, be on the lookout for instances where this dynamic environment offers power and efficiency. Remember these examples and take them with you when you begin designing your own projects using Civil 3D.