Getting Started

Autodesk® Roadway Design for InfraWorks 360™ is an add-on module that runs within Autodesk® InfraWorks 360™. It provides additional functionality for designing roads from an engineering perspective rather than the preliminary layout and visualization perspective that is provided by basic InfraWorks. It is a powerful tool for anyone laying out roads in InfraWorks who has an understanding of roadway engineering principles.

In this chapter, you’ll learn to

▶ Identify and understand the capabilities of Roadway Design for InfraWorks 360

▶ Navigate the user interface

Understanding the Capabilities of Roadway Design for InfraWorks 360

Roadway Design for InfraWorks 360 extends the capabilities of InfraWorks 360 by offering advanced design and analysis tools for roadway design. The following sections break down these capabilities into several major areas.

Engineering Geometry

The roads you create with basic InfraWorks do not employ geometry that is consistent with civil engineering practices. These roads are considered to be “sketched” objects with no engineering design principles applied. With Roadway Design for InfraWorks 360, you will be creating roads that are defined by horizontal curves, spirals, vertical curves, and other characteristics unique to engineered roads. You will have access to many tools that allow you to view and edit these engineering-based geometric properties. These include specialized grips, additional asset cards, additional panels, and others. In Figure 1.1, you see the PI, PC, and PT gizmos (if you don’t know what these abbreviations mean, refer to the “P-What?” sidebar), which
indicate the geometry of an engineered horizontal curve, along with a Road asset card showing design speed, design standards, and other information. This is much more sophisticated than the sketched roads created by the basic InfraWorks tools.

![Diagram of an engineered curve and its associated asset card](image)

**Figure 1.1** An engineered curve and its associated asset card

### P-What?

If you’re new to the engineering aspects of road design, it might help to know what some of the common terms and abbreviations are. These terms and abbreviations can vary based on location. The ones listed here are commonly used in much of the United States.

**Baseline** A *baseline* is a geometric pathway that the road geometry is based on. Often this is the centerline of the road, but it doesn’t have to be.

**Station** A *station* refers to your location along a baseline and is expressed using plus sign notation. If station 0+00 (0+000) is at the beginning of the baseline, then station 13+50 (1+350) would be 1,350 feet (meters) away from the beginning but along the path of the baseline.

(Continues)
Offset  Offset is the perpendicular distance from the baseline to a given point. The locations of objects in reference to the baseline are often expressed using a station and offset.

Tangents (Baseline Segments)  Tangents are the straight-line portions of a baseline.

Tangent (Geometric Condition)  A tangent (geometric condition) is the kind of tangent you learned about in high school.

- It means touching or passing through at a single point.
- In the case of a line and arc, it means perpendicular to a line drawn from the intersection point to the center point of the arc.
- In the case of two arcs, it means intersecting in such a way that a line drawn from the center point of one arc to the center point of the other arc passes through the intersection point.

Curves  Curves are the curved portions of a baseline that have a constant radius.

Spiral  A spiral is a curved portion of a baseline that changes in radius from one end to the other. Most curves have a spiral placed at the beginning and end.

Point of intersection (PI)  PI is the place where two tangents intersect or would intersect if they were extended.

Point of curvature (PC)  PC is the place where the curve begins.

Point of tangency (PT)  PT is the place where the curve ends.

Point of reverse curvature (PRC)  PRC is the place where one curve meets another and the curve directions are different.

Point of compound curvature (PCC)  PCC is the place where one curve meets another and the curve directions are the same.

Rules-Based Design

When you create roads with the tools provided in Roadway Design for InfraWorks 360, design standards are built in. At the time that this book was written, the only standard available in the software was AASHTO 2011, but the availability of additional standards is expected. When you create a road, you
choose from several classifications (see Figure 1.2). Based on the classification you choose, a design speed is assigned that then automatically determines horizontal and vertical geometry for your road. In other words, as you click points on the screen, the software is automatically designing the road for you.

**Figure 1.2** The available road classification options

### Profiles

If you have performed road design before, perhaps using AutoCAD Civil 3D, you know that the profile view is a critical tool in any road design. Roadway Design for InfraWorks 360 provides the Profile View panel (see Figure 1.3) where you can view your design and have a complete set of tools for modifying the design in profile view.

**Figure 1.3** The Profile View panel
**Intersections**

Intersection design is often one of the most challenging aspects of any road design. In basic InfraWorks, the software handles road intersections to some extent, but there is a limited amount of control afforded to the user. Roadway Design for InfraWorks 360 enables design of the intersection through specialized gizmos and asset cards. Figure 1.4 shows a four-way intersection with the Intersection asset card. Notice the option where you can select a design vehicle and InfraWorks will automatically design the intersection geometry based on your choice.

![Specialized gizmos and asset cards for intersections](image)

**Figure 1.4** Specialized gizmos and asset cards for intersections

**Sight Distance Analysis**

One of the most important aspects driving the design of a road is sight distance. With Roadway Design for InfraWorks 360, you can perform a sight distance analysis for a road that will assess the geometry of the road as well as components of the model that may serve as obstructions. The analysis provides useful graphical and textual feedback in the forms of colored bands, tooltips, and sight pins. Figure 1.5 shows a sight distance analysis that highlights an accident zone and an area of sight failure.
Profile Optimization

Earthwork is another critical aspect in performing road design, one that dramatically affects cost. Roadway Design for InfraWorks 360 provides a powerful optimization tool that will analyze and adjust your road profile to minimize the costs associated with earthmoving. Because of the computing power required to perform an optimization, InfraWorks uses the cloud via InfraWorks 360 for this feature. Your design is uploaded to the cloud, analyzed, and adjusted, and a new profile is sent to you when the optimization is complete. This new profile is accompanied by a report describing the resulting geometry along with a detailed earthwork and cost analysis. Figure 1.6 shows the Profile Optimization panel where an optimization is configured.
Generate Civil 3D Drawings

When your InfraWorks design is complete and you’re ready to move on to detailed design and documentation, Roadway Design for InfraWorks 360 provides a tool that will automate the process of converting your InfraWorks model into a series of DWG files that can be opened within Autodesk AutoCAD Civil 3D. Figure 1.7 shows a plan and profile drawing generated by the View Civil 3D Drawings command in InfraWorks. The command not only has created the necessary drawing files but also has created Civil 3D alignments and profiles and generated a series of plan and profile sheets complete with properly configured viewports.
Navigating Roadway Design for InfraWorks 360

The user interface for Roadway Design for InfraWorks 360 is provided as its own set of Intelligent Tools. The Home icon for these Intelligent Tools appears at the top left of the InfraWorks window as a tan circular icon with the tooltip Design, Review And Engineer Roads, as shown in Figure 1.8.
When you click the Roadway Design Home icon, it expands to reveal a toolbar containing three icons, as shown in Figure 1.9. I’ll refer to this as the Roadway Design toolbar and the individual icons contained within it as the Analysis, Design, and Review icons.

Each of the icons on this toolbar opens another toolbar on the side of the InfraWorks window. The following sections cover the toolbars and the tools on them.

**Analysis Toolbar**

On this toolbar you will find tools for analyzing your model.

**Terrain Themes** Terrain Themes is a basic InfraWorks command. It opens the Terrain Themes panel where you can configure a theme to color-code a terrain based on elevation, slope, or aspect (direction in which hillsides face).

**Profile Optimization** Use this command to have InfraWorks 360 calculate the best profile design for your road based on cost, as well as design considerations such as maximum grade and PVI frequency.

**Sun & Sky** Sun & Sky is a basic InfraWorks command. It opens the Sun & Sky asset card where you can adjust the appearance of light, shadow, and sky animation.

**Design Toolbar**

On this toolbar you will find tools for creating new design.

**Highway Roads** This command launches road layout using the Highway design classification. This classification uses the highest design speed, resulting in larger horizontal curve radii, longer vertical curves, and other geometric properties consistent with high-speed roads. The design speed for the Highway classification is 70 mph (110 km/h).
**Arterial Roads**  This command launches road layout using the Arterial design classification. This classification is typically used for high-volume urban roads. The design speed is 50 mph (80 km/h).

**Collector Roads**  This command launches road layout using the Collector design classification. This classification is typically used for low-volume urban roads that provide access to residential areas. The design speed is 40 mph (60 km/h).

**Local Roads**  This command launches road layout using the Local Road design classification. This classification is typically used for low-volume urban roads that provide access to individual residential properties. The design speed is 30 mph (45 km/h).

**City Furniture**  This is a basic InfraWorks command. It allows you to add detail to your model by inserting 3D models of things such as light poles, cars, people, and a whole list of other items. Plus, you can include your own 3D models, so just about anything can be added to your model as city furniture.

**Coverages**  This is a basic InfraWorks function. You can think of a coverage as an area of land that is covered with something. That can be grass, pavement, concrete, sand, or just about anything. Coverages can also be used to shape the land that they cover.

**Points Of Interest**  This is a basic InfraWorks command. Create a point of interest to call out an important location in your model. Any 3D model can be used as a marker for a point of interest.

**Review Toolbar**

On this toolbar you will find tools for reviewing, analyzing, and exporting your design.

**Profile View**  This tool opens the Profile View panel where you can view and edit a road design in profile view. From here you can adjust PVI locations and elevations, add new PVIs, and edit vertical curves.

**Sight Distance Analysis**  This command opens the Sight Distance panel where you can configure and run a sight distance analysis. The analysis will tell you where there are sight distance failures and accident zones through a series of visual feedback and tooltips.

**Surface Opacity**  This is a basic InfraWorks feature. It is a handy toggle that switches your terrain surface from see-through to opaque. It is great for working on underground features such as pipes or bridge foundations.
Sun & Sky  Sun & Sky is a basic InfraWorks command. It opens the Sun & Sky asset card where you can adjust the appearance of light, shadow, and sky animation.

Profile Optimization  This command opens the Profile Optimization panel where you make choices and set values related to design constraints, quantities, cost, and construction rules. Once you’ve made your choices and run the optimization, pertinent data from the model is uploaded to the cloud via InfraWorks 360. Then, after processing the data, a revised profile and an optimization report are sent to you.

View Civil 3D Drawings  This command opens the Create Civil 3D Drawings dialog where you configure the options for creating drawings of your road design. From here you select the road you want to export, configure the area of the surface that will be included, and provide information that will configure the resulting drawing files and sheets.

Job Monitor  This command opens the Job Monitor panel where you can check on jobs that you have submitted using the Profile Optimization command. Here you can find out the status of the jobs and also download the resulting output when a job is complete.

Exercise 1.1: Explore Roadway Design for InfraWorks 360

To begin this exercise, go to the book’s web page at [www.sybex.com/go/roadwayessentials](http://www.sybex.com/go/roadwayessentials) and download the files for Chapter 1. Unzip the files to the correct location on your hard drive according to the instructions in the introduction.

1. Launch InfraWorks 360.

2. On the Start Page, click Open.

3. Browse to C:\InfraWorks Roadway Essentials\Chapter 01\ and select Ch01 Bimsville Roads.sqlite. Click Open.

   You are looking at a model of the Bimsville Bypass project. If you have worked through the book *Autodesk InfraWorks and InfraWorks 360 Essentials*, then you are quite familiar with this project. In this version of the model, only a portion of the bypass has been created.
4. Click the Bookmarks icon on the Utility Bar; then click Bridge Plan to restore that bookmark.
You are looking at a bridge in a top-down, or plan view, orientation.

5. Click the road to select it.
The road should highlight in yellow, and the Road asset card should appear immediately, as shown in Figure 1.10, although the Summary and Attributes sections may not be expanded in your view.

![Figure 1.10 A selected road and its associated asset card](image)

6. With the road still selected, click Edit on the Utility Bar.

7. Zoom out so that you can see the gizmos associated with the curve to the northeast of the bridge.
   If you are familiar with the sketched roads created by basic InfraWorks, you should notice right away that the gizmos are different. Also notice that the asset card has an additional section entitled Geometry (see Figure 1.11).

8. Orbit the model so that you are now looking at the bridge from a lower angle. Continue to rotate the view until the gizmos change.
Once you’ve rotated the view beyond a certain point, the gizmos change to those intended for vertical editing (see Figure 1.12). These gizmos demonstrate the advanced, engineering-based road geometry that is provided by the presence of Roadway Design for InfraWorks 360.

9. Click the Roadway Design icon to reveal the Roadway Design toolbar.

10. On the Roadway Design toolbar, click the Analyze icon to open the Analyze toolbar along the left side of the InfraWorks window.


13. With the road still selected, click Profile View.
   The Profile View panel should open showing you the design of the road in profile view, as shown in Figure 1.13. The light blue triangles are PVIs.

![Figure 1.13](image)

**Figure 1.13** The Profile View panel

14. Click Close The Current Model in the upper-left corner of your InfraWorks screen.
   The model is closed, and you are returned to the start page.

**Now You Know**

Now that you have completed this chapter, you understand the capabilities of Roadway Design for InfraWorks 360. You understand that it runs in InfraWorks 360 and extends its functionality by providing road design tools with engineers in mind. You are aware that these tools enable you to design and modify roads using engineering-based geometry such as horizontal curves, spirals, and vertical curves. You also know that you will have access to the profile view of your road designs—a critical requirement for performing road design effectively.

You now know that with the extended functionality provided by Roadway Design for InfraWorks 360, you can perform powerful functions such as automated intersection design, sight distance analysis, and profile optimization. You also have learned that with one command, you can generate a whole set of engineering drawing files that can be opened in Civil 3D where detailed design and documentation can be done.

Finally, after completing this chapter, you took a brief tour of the user interface that controls Roadway Design for InfraWorks 360, and you’re ready to begin using it to perform some serious road design.