AutoCAD Civil 3D®

Using Civil View for Autodesk 3ds Max Design Software to Visualize AutoCAD Civil 3D Designs

Image courtesy of Arup.

This document outlines suggested best practices for producing visualizations of civil engineering projects created in AutoCAD® Civil 3D® 2013 or 2012 software, using either Autodesk® 3ds Max® Design 2013 or 2012 software and the Civil View feature set.

Civil View runs inside Autodesk 3ds Max Design, helping streamline the process of passing AutoCAD Civil 3D data. The tools included in Civil View also greatly ease the process of populating a scene with further 3D content— enabling virtually anyone working on a civil engineering design to produce compelling visualizations of projects large and small.

Civil View enables visualizations created in 3ds Max Design to react to frequent design changes made in AutoCAD Civil 3D. This opens the potential for the creation of high-quality visualizations to become an integral part of the design process, since civil visualizations created in Autodesk 3ds Max Design can evolve in tandem with design models created in AutoCAD Civil 3D. This document intentionally uses terminology familiar to civil engineers, and more specifically to AutoCAD Civil 3D users. The primary aim of the paper is to demonstrate how high-quality visualizations can be developed more rapidly using a workflow integrated with the design process in order to display projects for public consultation and design validation purposes. The aim of this paper is to help dispel the myth that the production of civil engineering visualizations is a complex and time-consuming task that should be left to visualization experts. It will also describe how these techniques can be used to help improve the quality of designs in general: to help evaluate the environmental and visual impact of projects, and to help drive extra business to AutoCAD Civil 3D users by improving the way their proposals are communicated to clients.

Audience

The primary target audience for this document is civil engineering professionals using AutoCAD Civil 3D software. Particular care was taken to avoid the use of visualization jargon in order to make the paper as accessible to civil engineers as possible.

The reader should be familiar with basic design concepts in AutoCAD Civil 3D, and be comfortable enough with 3ds Max Design software to navigate through a scene in 3D and to understand the fundamental principles of materials, lighting, and rendering.

Terminology Guides

There are some key differences between terminology generally encountered in AutoCAD Civil 3D and that in Autodesk 3ds Max Design, creating a challenge in communicating a design visualization workflow to a civil engineering audience.

The terminology used in this document draws from both products in order to accommodate the most appropriate terms relevant to the application use in each part of the workflow. For a quick reference to the key AutoCAD Civil 3D terminology and 3ds Max Design equivalents used, refer to Appendix A.

Although only a basic understanding of 3ds Max Design is required to follow the workflow outlined in this document, Appendix B outlines a list of terms that may be unfamiliar to a civil engineering audience.

Contents

The Benefits of Design Visualization for Civil Infrastructure Projects

Design visualization for civil infrastructure projects is often seen as a luxury, but these techniques can bring many business benefits to civil engineering design teams. Apart from the obvious communication benefits, visualization techniques can help design teams evaluate their proposals and speed up the approval process, and even help companies win new business.

Figure 1. The more traditional application of civil infrastructure visualization on a high-profile, large-scale project. Image courtesy of Parsons Brinckerhoff.

The key to driving the use of design visualization for civil infrastructure projects is to put the visualization tools in the hands of engineers and designers. Traditionally, this type of work has been outsourced to specialist visualization bureaus. However, these services can be prohibitively expensive—particularly when you consider the problem of incorporating frequent design changes into the visualization.

Many people think of visualization as a process that is applied at the end of a project design cycle—but why should this be the case? Visualization is a preferable medium for checking sight line requirements on highways and railways, for minimizing the visual impact of a project during the preliminary stages of a design, and for conveying certain aspects of the design to other stakeholders who simply do not have the technical background to read an engineering drawing.

Evaluating Civil Infrastructure Designs

Sometimes, even though a designed highway alignment meets all the applicable technical standards, industry experience can tell the designer that something about the design is not quite right when considered from the driver's visual perspective, or from a comfort point of view. Both of these considerations will ultimately affect safety, but how do you evaluate and react to such concerns without the ability to experience the project before it is built?

Figure 2. Arup uses visualization techniques to identify potential safety concerns on proposed highway alignments. Image courtesy of Arup.

Piotr Janicki of Arup UK uses visualization techniques to help identify safety concerns on proposed highway alignments. As Piotr explains, "It can be difficult to communicate your concerns to other members of the design team when, technically, all applicable design standards have been met. Being able to quickly produce a few simple rendered views from a driver's viewpoint can be invaluable in understanding the combined effect of the horizontal and vertical alignment of a highway, sitting within its surrounding environment."

Oranjewoud, an engineering firm based in the Netherlands, is a good example of a company that recognizes the growing prominence of visualization in the world of civil infrastructure design. The firm's key aim is to include visualization as an integral part of the civil design process at a reasonable price to clients, and without the need to involve a third party.

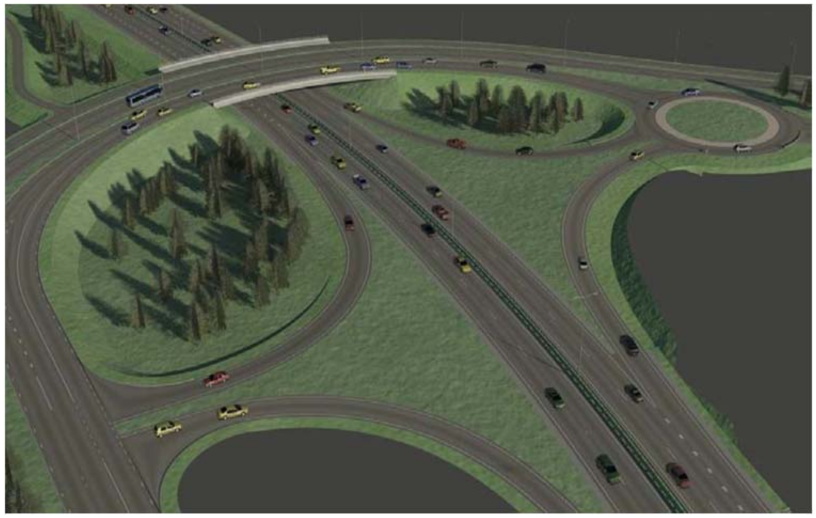


Figure 3. Oranjewoud must verify the integrity of their AutoCAD Civil 3D design models, which makes design visualization an integral part of their design validation process.

Remco Bastiaans of Oranjewoud explains, "We have found it to be very beneficial to include visualization with our proposals to clients. In our experience, it is far quicker and easier to convince a customer to choose our services when we can communicate our ideas so much more effectively."

During the design phase, Oranjewoud constantly produces visualizations of designs created in AutoCAD Civil 3D software, making it easier to evaluate their projects at an early stage in the design process.

Remco continues, "We often simply need to quickly check whether all the 3D elements in the design are correctly aligned—and being able to more rapidly simulate what it will be like for the car or other vehicle to drive on the road is invaluable. If we notice an aspect of the design that needs to be modified, we switch back to AutoCAD Civil 3D to make the necessary adjustments and then run an update to the visualization in order to check the corrections that have been made. We continue this procedure until we are happy that we have met or even exceeded the client's requirements."

All of these factors mean that, for many companies, design visualization is rapidly becoming an integral part of the civil infrastructure design process.

The Civil Visualization Workflow in Detail

When the need to develop a visualization of any civil engineering project arises, it should never be necessary to model or construct the project from scratch. In fact, the number one requirement for any visualization of this type is that it should more accurately reflect the current project design. When dealing with environmental impact assessments or public consultation matters, there is no room for artistic license.

The workflow described in this document deals specifically with using 3D content developed using the modeling and design tools within AutoCAD Civil 3D. By adopting a model-based design approach in AutoCAD Civil 3D, a strong basis for the development of compelling rendered visualizations already exists.

Figure 4. The redesigned Keystone Parkway in Carmel, Indiana, features the state's first teardrop roundabout interchanges. Image courtesy of American Structurepoint, Inc.

Introducing 3ds Max Design

Autodesk 3ds Max Design software builds on the award-winning technology of Autodesk 3ds Max to help provide sophisticated modeling, animation, visual effects, rendering, and lighting analysis tools aimed primarily at architects, engineers, designers, and visualization specialists.

The Civil View Feature Set for 3ds Max Design

Civil View is designed specifically to help make the process of visualizing civil engineering projects quicker and easier. This is achieved partly through a simplified user interface inside 3ds Max Design. Civil View is an integral feature set within Autodesk 3ds Max Design 2013 and is an optional install for Autodesk 3ds Max Design 2012.

Civil View also features strong integration with AutoCAD Civil 3D, enabling the benefits of 3D modeling in AutoCAD Civil 3D to be utilized for the production of high-quality visualizations. Materials are assigned and managed automatically, while a style or template-driven approach enables almost complete automation of the process of populating the scene with 3D content.

Applied content in Civil View retains a dependency on the paths of imported alignments and feature lines from AutoCAD Civil 3D. This means that as projects evolve and highway alignments and other details are refined, the visualization adapts to those changes.

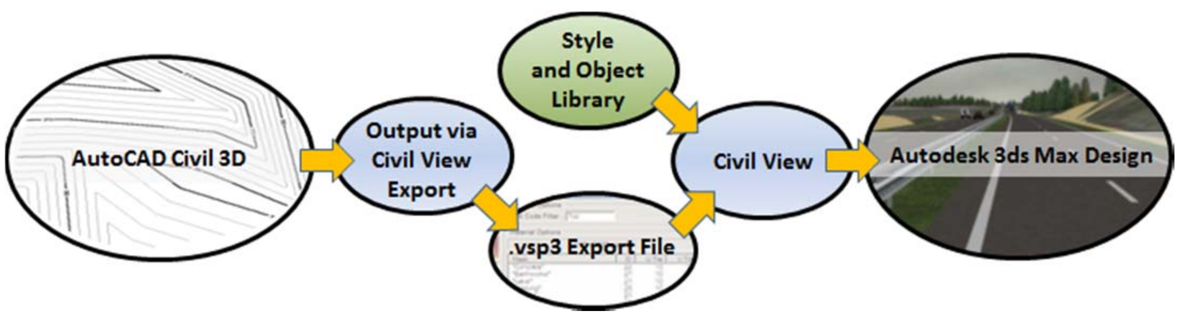


Figure 5*.The flow of civil design data from AutoCAD Civil 3D to Autodesk 3D Max Design using Autodesk Civil View for 3ds Max Design.*

Civil View Interface Overview

Civil View appears as a drop-down menu item in the Autodesk 3ds Max Design menu bar. The Civil 3D model data is imported from this menu and the Civil View Explorer panel is launched from this menu.

The Civil View Explorer panel acts as a primary focal point for the tools that are accessible via Civil View. In the Explorer, all of the scene objects may be accessed. The right-click menu is context-sensitive to the objects and displays the available options for the selected object type.

The primary purpose of this panel is:

- To provide a near instant snapshot of the scene contents at particular moments
- To provide access to almost every Civil View command through a combination of context-sensitive rollouts and right-click menus

- To expose selected 3ds Max Design functions in a more accessible and civil engineering–oriented manner (daylight settings, environment, exposure control, indirect illumination, and active materials)

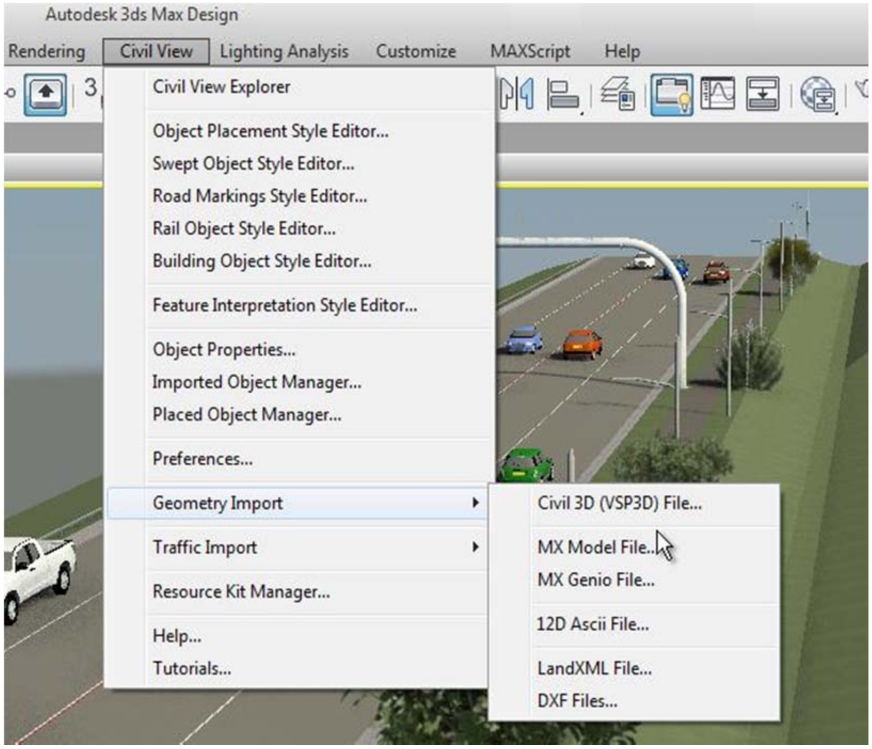


Figure 6. *Civil View appears as a menu item in Autodesk 3ds Max Design.*

Styles in Civil View

Much of the normal workflow in Civil View is template or style driven, which enables repetitive tasks that would otherwise be labor intensive in 3ds Max Design to be almost entirely automated. Examples of style-driven functionality in Civil View are the generation of road markings and guardrails, or the population of models with signs, trees, streetlights, and animated vehicles.

Much of this style-driven approach is based on the concept of being able to identify imported AutoCAD Civil 3D feature lines by name, and using them to help define the paths for further 3D content in the model.

The product also enables georeferenced orthographic photography to be draped over imported AutoCAD Civil 3D surfaces, and lofted structural elements: bridges, tunnels, retaining walls, and noise barriers to be swept along imported AutoCAD Civil 3D feature lines.

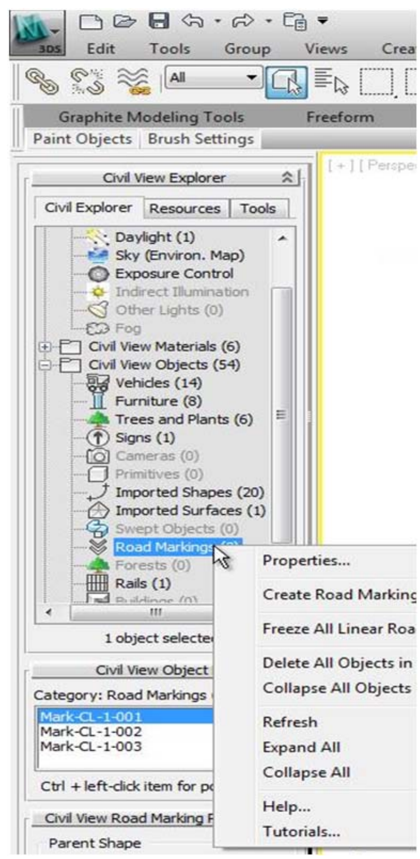


Figure 7*. The Civil View Explorer panel is similar to the prospector tab in the AutoCAD Civil 3D tool space.*

The Key Civil Visualization Steps

The civil visualization process can be divided into five key steps:

1. Transfer of AutoCAD Civil 3D data to Autodesk 3ds Max Design
2. Adding further 3D content to the scene using Civil View
3. Lighting the scene in Autodesk 3ds Max Design
4. Rendering in Autodesk 3ds Max Design
5. Incorporating Civil 3D based design changes into the visualization with Civil View

Now let's examine these steps in more detail.

Step 1: Transfer of AutoCAD Civil 3D Data to Autodesk 3ds Max Design

How the AutoCAD Civil 3D Model Is Interpreted by Civil View

There are a number of key objectives to the process of more intelligently transferring AutoCAD Civil 3D content to Civil View and 3ds Max Design:

By default, subsurface corridor surfaces are ignored, unless otherwise specified by the user. This helps keep the geometric complexity of the 3ds Max Design scene to a minimum at all times.

Duplicate points are removed from all exported surface geometry.

Civil View retains as much AutoCAD Civil 3D intelligence as possible. From 3ds Max Design, users can query imported geometry in order to identify individual feature lines, corridor regions, subassemblies, link codes, and station/chainage values.

Materials are applied by identifying known subassemblies and link codes from exported corridor geometry. If desired, textures can be automatically scaled and oriented to follow the direction of the road, and these parameters may be controlled independently for each individual subassembly and link code.

Global Import Shift Values

Due to the nature of digital floating-point calculations in 3ds Max Design, distances that are extremely large or extremely small in 3ds Max Design can cause severe round-off discrepancies. Symptoms may include navigation problems (zooming and panning becoming too fast or too slow), unwanted viewport clipping, and, most critically, inaccurate interpretation of large coordinate values.

These problems can be avoided by making sure that the scene is generated as closely as possible to the 3ds Max Design scene origin (0,0,0). This is because round-off discrepancies in 3ds Max Design are most noticeable at large distances from the origin.

Civil View automatically calculates, and invisibly manages, the most appropriate global shift values for imported AutoCAD Civil 3D projects, helping to make sure that such projects are always placed as close to the scene origin as possible in 3ds Max Design without the need for manual intervention.

Output to Civil View: Overview

The export to Civil View provides a dedicated solution for the transfer of 3D civil design data from AutoCAD Civil 3D to Civil View running in Autodesk 3ds Max Design. The Civil View export creates a .vsp3d file format, which is a proprietary binary file format designed specifically for the purpose of preparing 3D civil design geometry for visualization purposes.

The export option: Output to Civil 3D is an integral part of the export functionality in AutoCAD Civil 3D 2012 and 2013 software.The exporter intentionally recognizes only the contents of the 3D civil model in AutoCAD Civil 3D, and ignores standard AutoCAD drawing entities. The panel consists of a simple

Prospector view that enables various parts of the civil design to be selected for export, a link code filter, and a material configuration table.

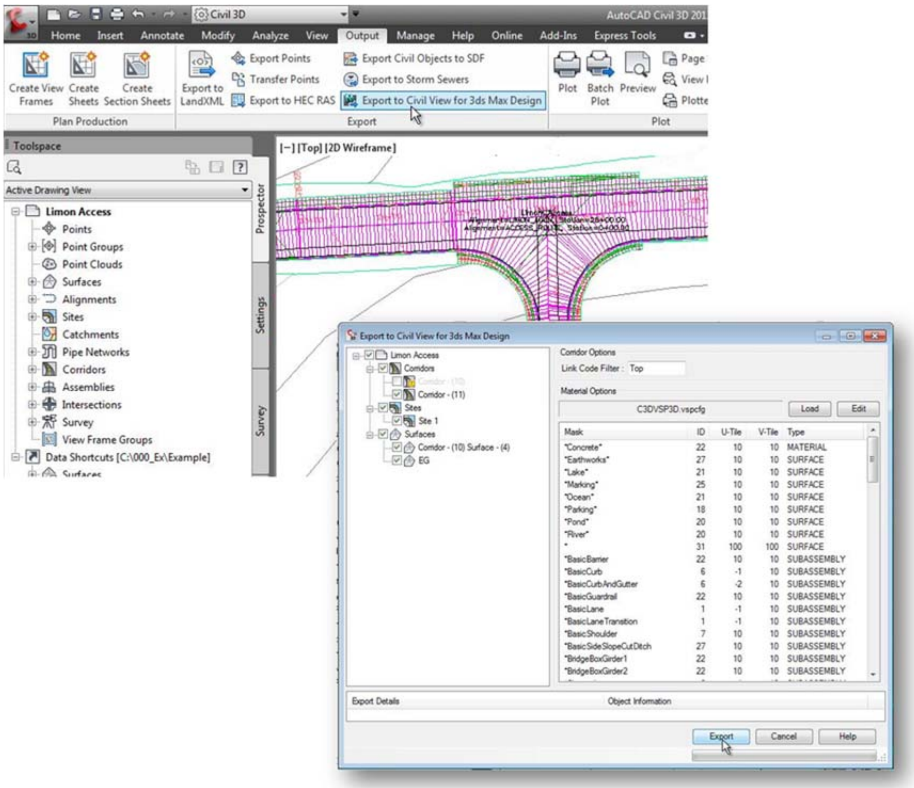


Figure 8. Civil 3D model objects are exported to Civil View for 3ds Max Design from the option found in the Export panel of the Output display. The export creates a .vsp3d file type from the selected model objects.

The Export to Civil View for AutoCAD Civil 3D: Supported Objects
The following AutoCAD Civil 3D object types are currently supported by Civil View:

Point Groups—Point Groups are exported to Civil View Point System objects. Point Systems in Civil View are derived from the standard 3ds Max Particle System functionality.

Grading/Site Feature Lines—Grading/site feature lines are exported to 3ds Max Design shape objects. A resulting 3ds Max Design shape object may contain multiple splines, with each spline representing a single feature line in AutoCAD Civil 3D, and consisting of a continuous sequence of linked points.

Corridor Baselines—Corridor baselines are exported to 3ds Max Design shape objects.

Corridor Feature Lines—Corridor feature lines are exported as 3ds Max Design shape objects. A resulting 3ds Max Design shape object may contain multiple splines, with each spline representing a single feature line in AutoCAD Civil 3D, and consisting of a continuous sequence of linked points. One 3ds Max Design shape object is generated for each unique feature line name per corridor region. If multiple feature lines using common feature line names exist within a single corridor region, resulting splines will be ordered firstly by start station/chainage, and then by sequence from left to right across the corridor assembly. This consistent use of spline ordering is essential when imported feature lines are used as the basis for constructing swept objects in Civil View: bridges, tunnels, and retaining walls.

Corridor Surfaces—Civil View automatically generates a surface mesh for every exported corridor. It is not therefore necessary to manually generate a corridor surface in AutoCAD Civil 3D in order to export corridor surface geometry to Civil View. This approach means that far more information can be considered when constructing the export mesh. Station, offset, and elevation data for each mesh vertex is used to apply independent alignment-aware texture mapping to each subassembly or link when imported into Civil View.

Figure 9. Alignment-aware texture mapping applied automatically in Civil View.

Corridor Offset Assemblies—Corridor surfaces and feature lines derived from offset assemblies are treated in the same way as normal corridor feature lines and surfaces except that one surface/feature line definition (per name) is created per offset assembly rather than per region.

Enhanced Civil 3D Interoperability—The Civil View feature now supports elliptical-shaped profiles for piping and tubing.

Civil View for AutoCAD Civil 3D: Automated Material Assignment

The Civil View Exporter is driven by a user-customizable configuration file which provides full control over the way that materials are assigned to the individual components from an AutoCAD Civil 3D model. The benefit of using a standard library of subassemblies and standardized surface naming in AutoCAD Civil 3D is that it is usually possible to define a single configuration file that is suitable for use in projects. You also have a higher degree of control over the scaling, repetition, and alignment of texture mapping to follow the corridor alignment.

Importing Civil View Exporter Files into Autodesk 3ds Max Design

The basis of every visualization project is the import of 3D civil engineering data from a supported civil design application such as AutoCAD Civil 3D. Civil View for 3ds Max Design enables Civil View Exporter files (.vsp3d file types) to be imported directly into Autodesk 3ds Max Design. The import is initiated using the Geometry Import menu item found under the Civil View drop-down menu in Autodesk 3ds Max Design.

The Civil View import panel reproduces the original hierarchy of the civil design model and facilitates the selection of individual scene objects for editing. Model objects may be imported as entire collections or by filtered selection, such as by individual corridor feature line types. This enables the user to selectively decide what needs to be imported into the visualization scene, making the process of visualizing complex civil engineering projects in 3ds Max Design much more efficient. The general principle is that it is better to keep the geometry in 3ds Max Design as simple as possible to avoid unnecessary increases in rendering times later.

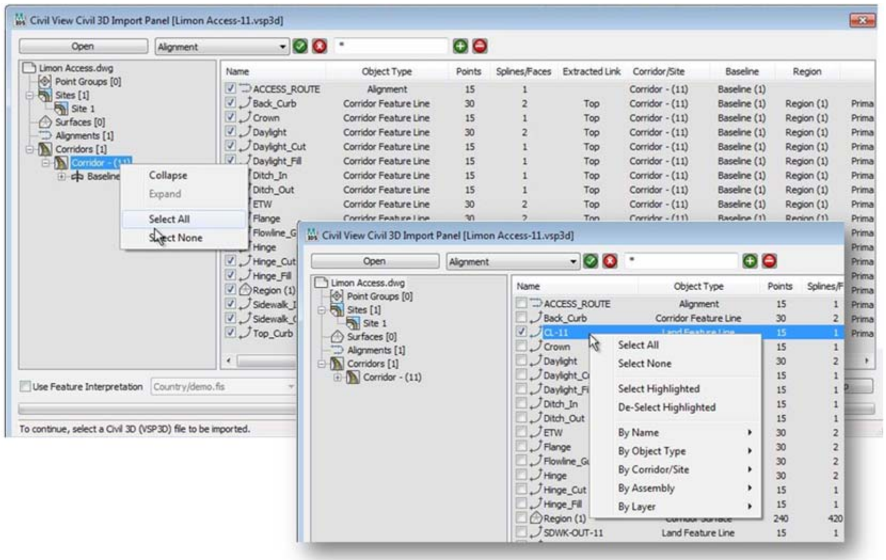
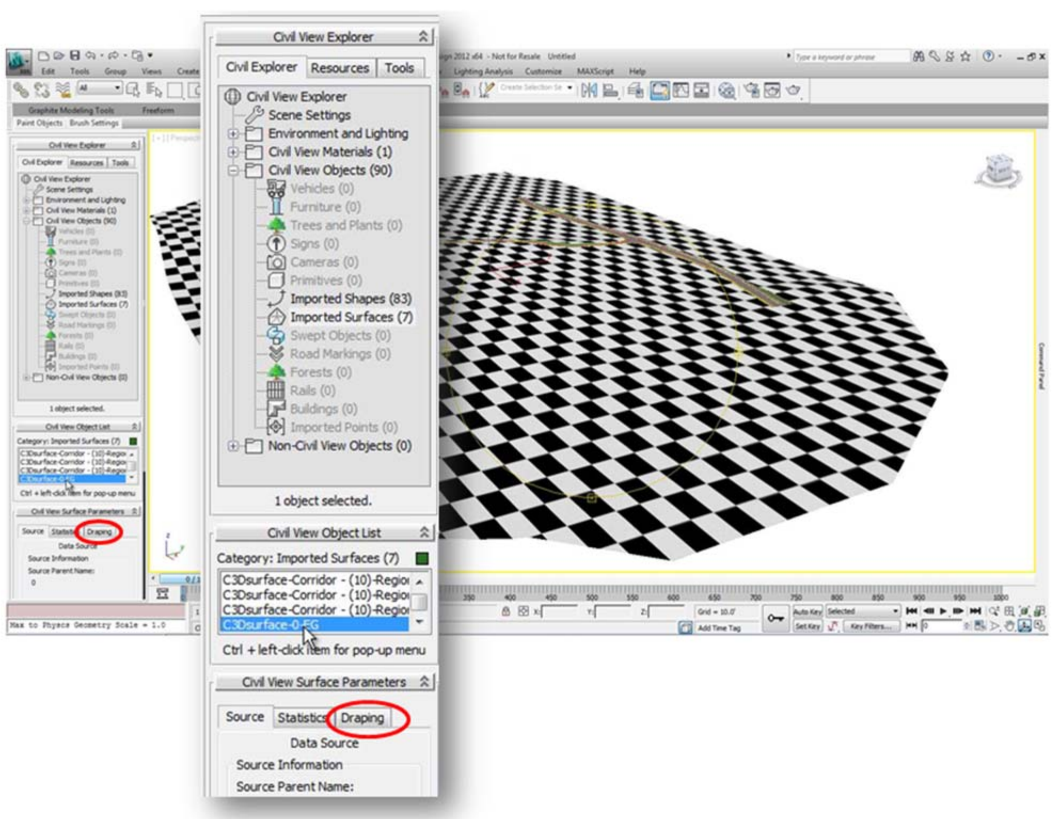


Figure 10. The Civil View import panel allows for group, individual, and filtered selection of model objects from the .vsp3d file to be imported into the Autodesk 3ds Max Design scene.

Step 2: Adding Further 3D Content to the Scene Using the Autodesk Civil View for 3ds Max Design

Draping Orthographic Photographs

In Civil View, it is possible to apply a draped orthographic aerial photograph to an imported ground surface in a few simple steps. Civil View recognizes the World File format for image georeferencing purposes. To apply an orthographic photograph to an imported AutoCAD Civil 3D surface, select the target surface in 3ds Max Design, and then choose the Draping tab from the Civil View Explorer panel.



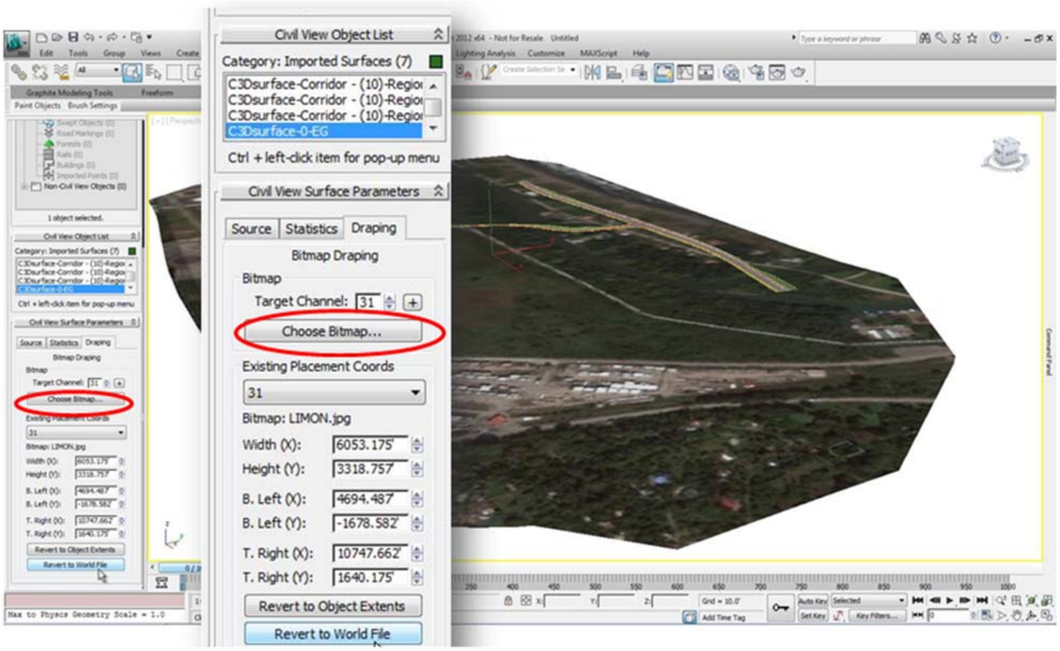


***Figure 11**. The imported surface before and after assigning and georeferencing the draped orthographic photograph.*

After checking that the correct target Material ID is selected in the Surface Parameters rollout, the Choose Bitmap button enables an image file to be selected—preferably one with a supporting World File.

Adding Road Markings

Road Markings are a vital aspect of highway visualization, providing the scene with context and scale. However, the creation of road markings has traditionally been a complex process.

Civil View features unique parametric road marking objects that make extensive use of opacity maps (see Appendix B for the 3ds Max Design Terminology Guide) to represent dashed marking lines and chevrons or hatched areas. These opacity maps help eliminate the need to build the full 3D geometry of every marking block. In Civil View, road markings are offset by a small amount (vertically, above their parent feature line) to avoid render-time conflicts between the road marking geometry and the underlying surface of the road.

By default, road marking objects have a permanent dependence on their associated parent shapes, which in turn are generally derived from imported design feature lines. The most efficient way to apply road markings is to use the Road Markings Style Editor, accessible from the Civil View drop-down menu, and apply marking characteristics to corridor, or other, feature lines. Imported feature line names may also be matched against the contents of the saved road marking styles to automatically determine the specific road marking type to be applied to each part of the model.

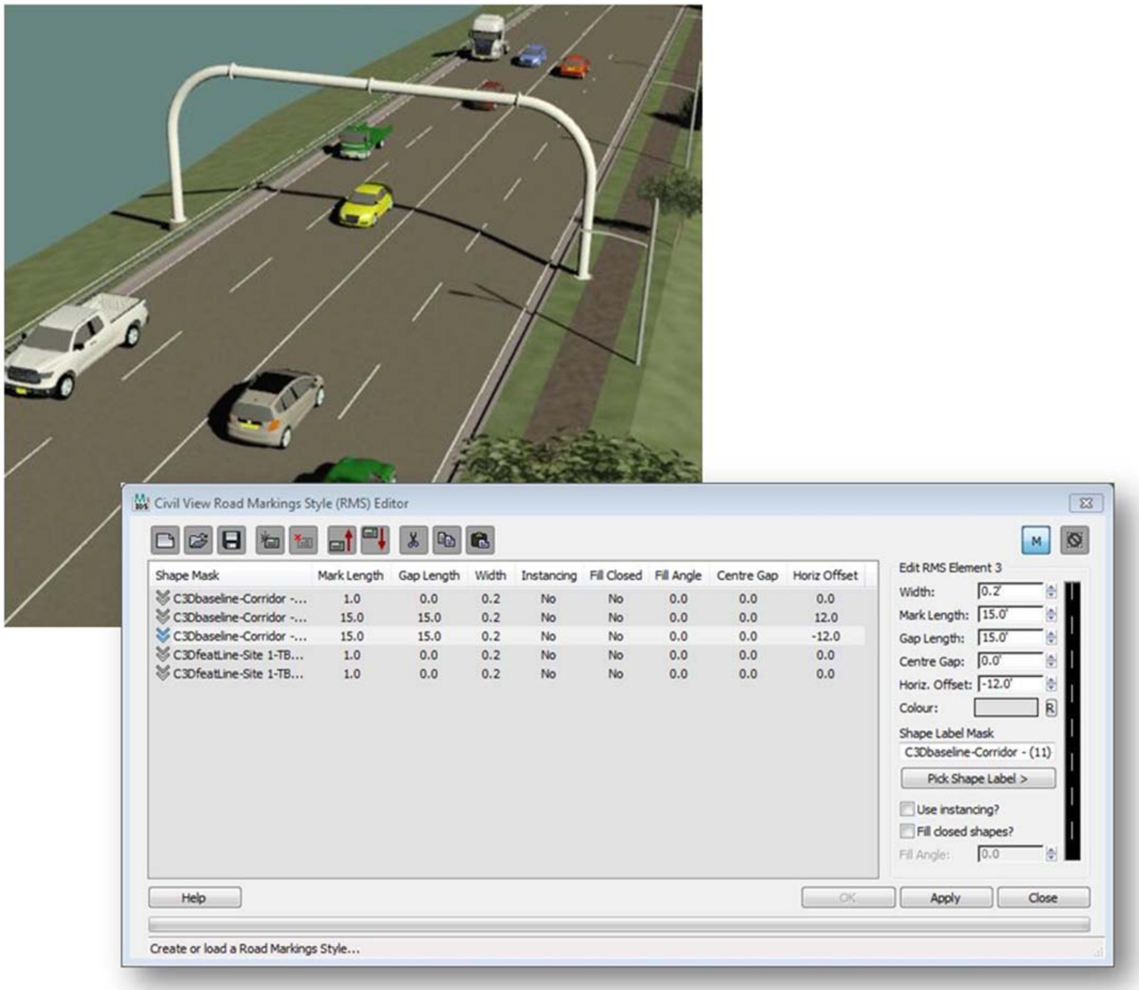


***Figure 12**. Civil View road markings and the Road Markings Style Editor panel.*

Adding Simple Structural Elements

Structural elements, bridges, retaining walls, and noise barriers, may be modeled using the Civil View Swept Object Style Editor, accessible from the Civil View drop-down menu.

A parent shape is used to help define the path of each swept object. Parent shapes are normally derived from imported AutoCAD Civil 3D alignments or feature lines. The use of swept objects in Civil View can be likened to the use of assemblies in AutoCAD Civil 3D. Swept object profiles are defined using a sequence of profile elements that may be saved to a reusable style for subsequent use on a different parent shape or even a different project. These elements collectively describe the cross-sectional shape of the desired object to be swept along the path of any nominated parent shape. Each element (or link) in the profile features a variable horizontal/vertical offset and an independent material assignment.

The offsets for each individual profile element may be dynamically varied both laterally and longitudinally, which means that tapered profile elements can be defined. In addition, full control over the texture mapping coordinates and smoothing group of each element may be adjusted independently. This helps provide complete control over the way that textures are applied to each part of the swept object profile.

Gap elements can be defined to help prevent geometry from being created between two adjacent points on a swept object profile. This is useful for creating swept objects that are generated at an offset from the nominated parent shape(s).

A maximum of 32 elements may be defined in any swept object profile. However, this profile may optionally be assigned to both sides of the parent shape(s) in order to generate a symmetrical swept object with up to 32 identical elements on each side of the parent shape(s). Swept objects retain a permanent dependence on their respective parent shapes. If a parent shape is updated in any way, the geometry of any associated swept object will be updated accordingly.

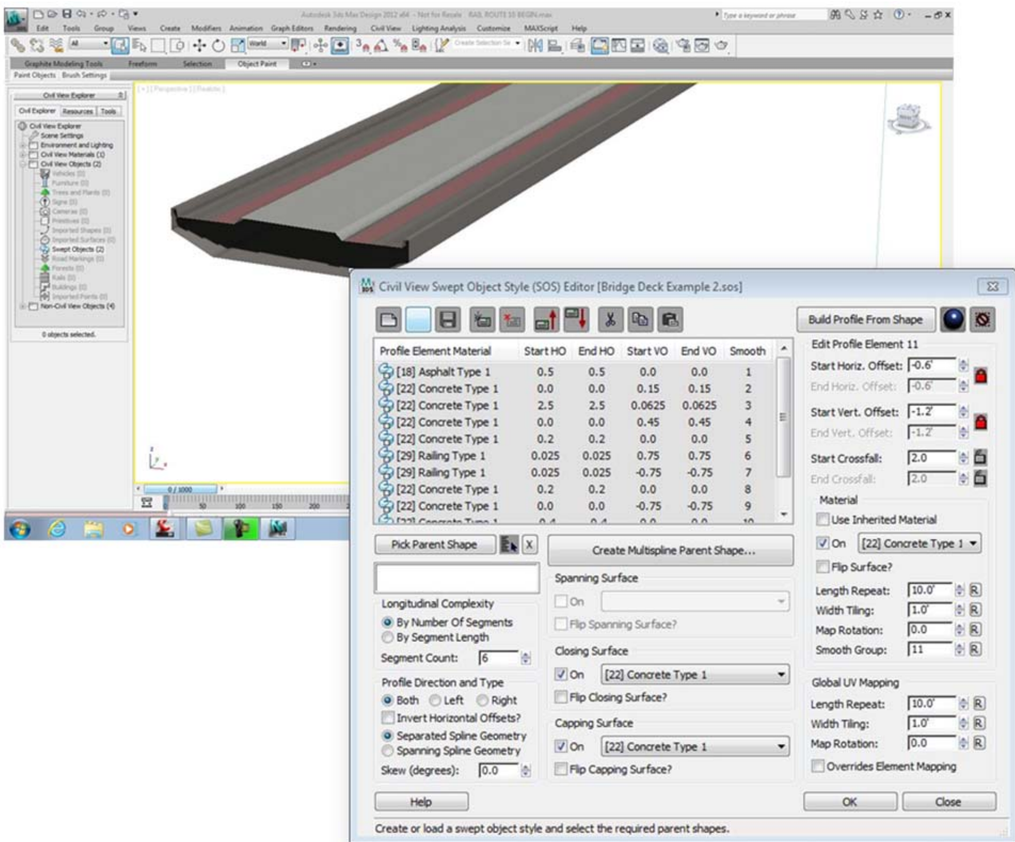


Figure 13. Civil View swept objects and the Swept Objects Style Editor panel.

Adding Guard Rails

The process of adding railings, guard rails, and rail track geometry to a visualization is managed through the Civil View Rail Object Style Editor, accessible from the Civil View drop-down menu. A series of parent shapes are used to help define the path of each rail object. Parent shapes are normally derived from imported AutoCAD Civil 3D alignments or feature lines.

Civil View rail objects are made up of three key components – a post, a brace, and one or two rails. Control over the geometry of each of these components is provided in addition to the ability to disable one or more of these components. This enables the creation of evenly spaced posts only, or perhaps walls using only the rail component.

- Posts can be created in one of two cross sectional profiles: “rectangular post” and “z post”
- Braces can be created in one of two cross sectional profiles: “I beam” and “rectangular beam”
- Rails can be created in one of three cross sectional profiles:
  - Simple vertical section (for highway guard rails)

- Flanged vertical section (also for highway guard rails)
- Railway section (very versatile—can be used for creating walls, railways, concrete barriers, or any object that features a basic rectangular cross-sectional profile)

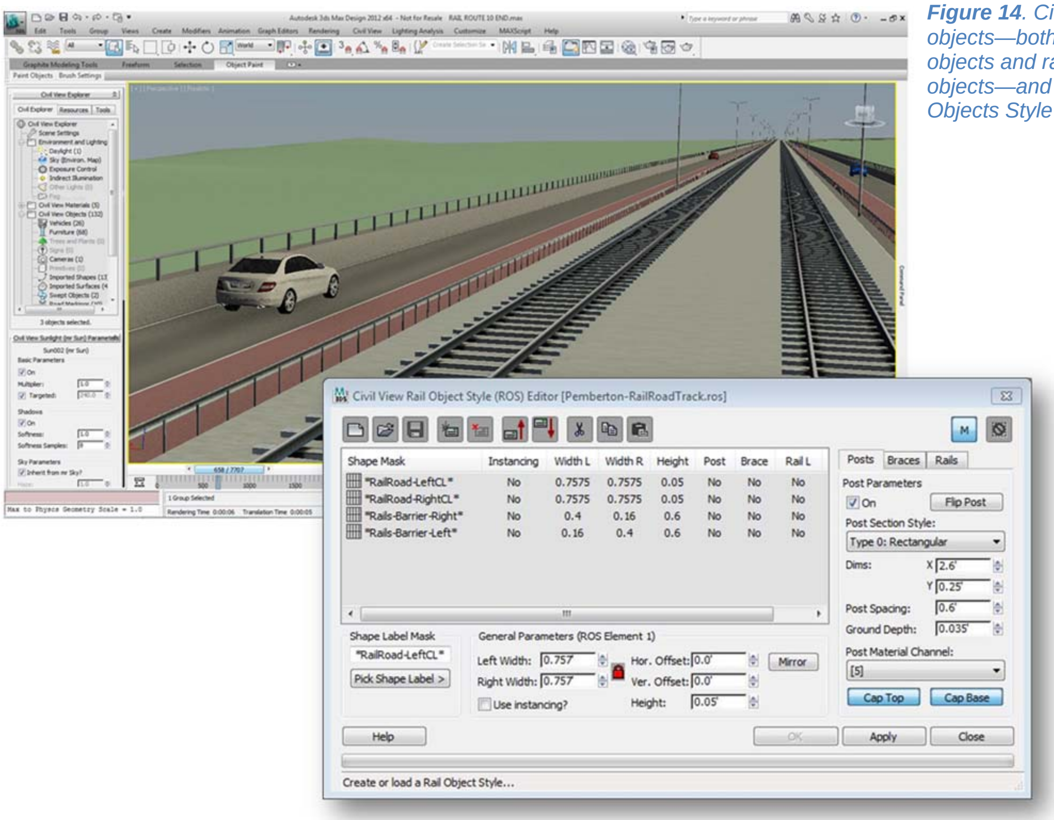


Figure 14. Civil View rail objects—both guardrail objects and railroad track objects—and the Rail Objects Style Editor panel.

Figure 15. A scene with Civil View railroad track objects.

Populating the Model with Placed Objects

The object placement process is managed through the Civil View Object Placement Style Editor, accessible from the Civil View drop-down menu. The Object Placement Style Editor enables static items such as lamp columns, trees, and signs, as well as animated objects such as cameras and vehicles, along the path of a predefined parent shape. Parent shapes are normally derived from imported AutoCAD Civil 3D alignments or feature lines.

Optional surface tracking can be applied to easily animate the movement of a vehicle over an underlying ground surface while retaining its relationship with the nominated parent shape object.

The geometry for these placed objects is derived from a customizable object library in Civil View that features vehicles, trees, cameras, road signs, and other items of street furniture. These object libraries are stored within localized and fully customizable Country Resource Kits that contain collections representing local standards for which each kit has been developed. Several Country Resource Kits are included in Civil View, and others are available for download as they are developed. Additionally, it is easy to edit any object's criteria as defined in the kits and to add more object definitions as well.

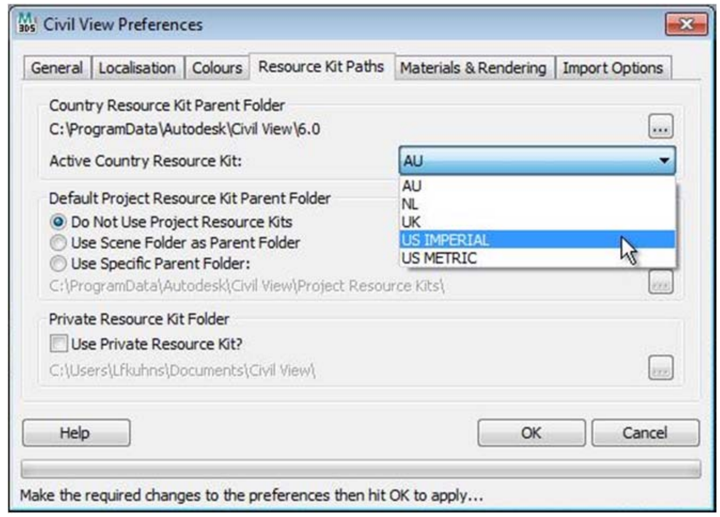


***Figure 16**. Country Resource Kits are used in Civil View to automatically apply local standards when objects are added to a scene. The active kit is selected on the Resource Kit Paths tab in the Civil View Preferences.*

By default, placed objects have a permanent dependence on their associated parent shape, which in turn has a permanent dependence on an imported alignment or feature line from AutoCAD Civil 3D. When a design change occurs, the locations of all associated placed objects are therefore updated automatically.

Placement instructions are defined in terms of station (chainage), horizontal offset, vertical offset, and rotation from the selected parent shape. An optional animation parameter enables objects to be easily animated at a constant speed between a specified start and end station (chainage). A negative speed may be defined to cause a vehicle to drive in the reverse direction or to cause a camera to travel in the opposite direction to the parent shape direction.

By default, vehicles are automatically assigned one of nine random body colors, and a random selection of vehicles may be generated from a single object placement instruction.

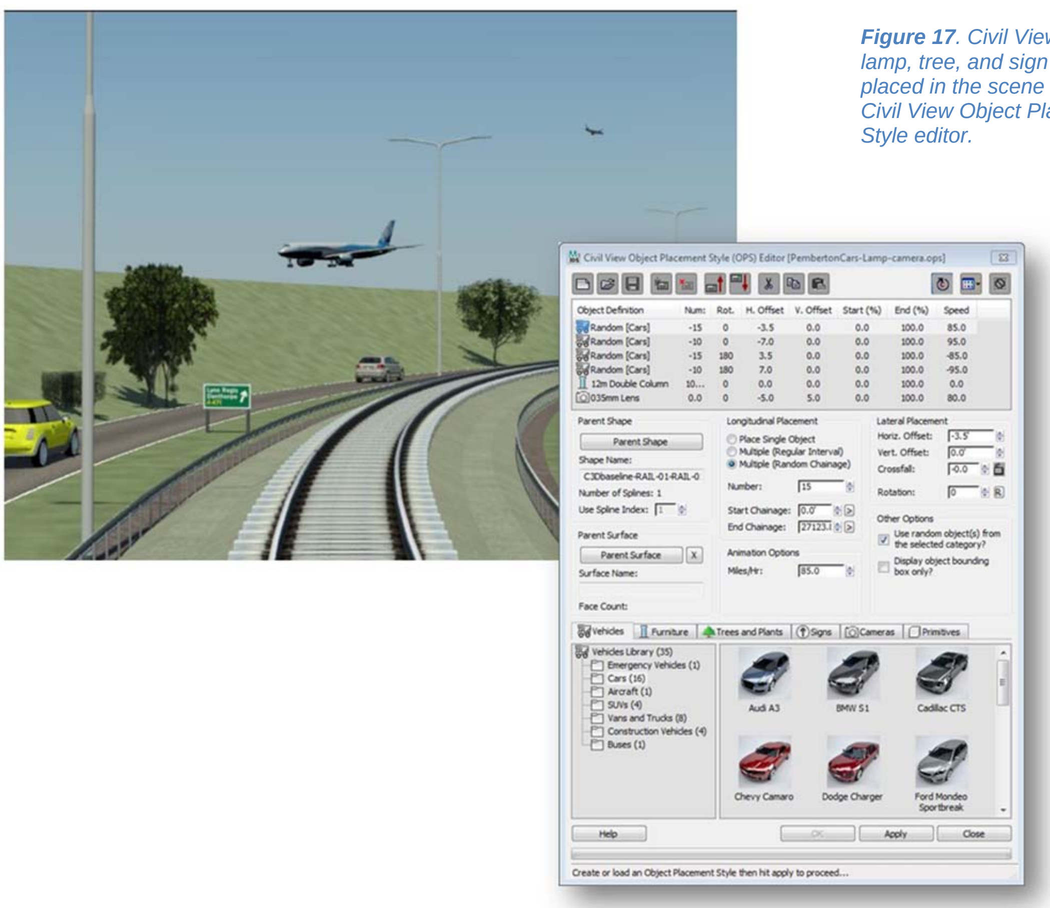


***Figure 17**. Civil View vehicle, lamp, tree, and sign objects placed in the scene using the Civil View Object Placement Style editor.*

Step 3: Lighting the Scene in 3ds Max Design

Before rendering the visualization, a daylight system based on the mental ray® renderer is added to the scene to help simulate the effects of daylight, and make rendered images look much more believable. This can be achieved in a few simple steps via the Civil View Explorer panel.

Before creating a daylight system, it's worth reviewing certain global settings in 3ds Max Design to make sure that appropriate program defaults are selected for the type of project being visualized.

Initial Environment Settings in Autodesk 3ds Max Design

There are two global settings in Autodesk 3ds Max Design that should be checked to ensure a proper environment for the scene. First, check the units that are set in the Customize menu of 3ds Max Design. Verify both the system units and the display units.

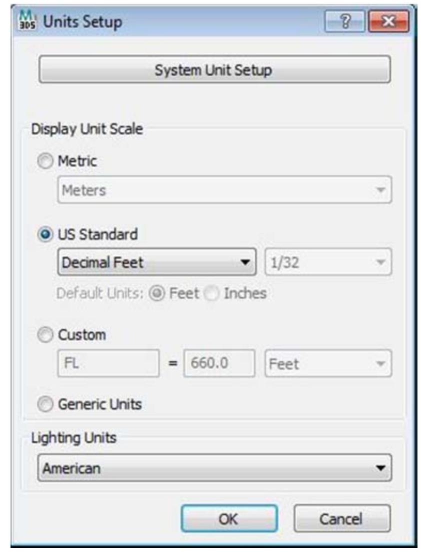


***Figure 18**. The 3ds Max Design units should be verified in the Units Setup panel.*

Second, the tool options and the UI scheme (similar to the concept of Civil 3D workspaces) should be set to more closely match the type of work that is to be done. This reflects the fact that artists and designers from different industries use 3ds Max Design in different ways.

The current tool setting can be checked by opening the Custom UI & Defaults Switcher option in the Customize menu in 3ds Max Design. For Civil View work, the selected tool option should be DesignVIZ.mentalray and the UI should be set as the DefaultUI. If you need to change the current setting, a restart of 3ds Max Design will be required.

Using the DesignVIZ.mentalRay setting selects mental ray (see 3ds Max Design Terminology in Appendix B) as the current renderer in 3ds Max Design, and helps make sure that daylight systems, exposure controls, and materials are automatically composed from components optimized or specifically built for mental ray.

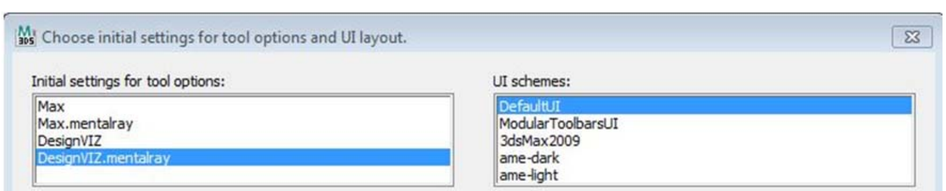


***Figure 19**. The initial settings for tool options and UI layout are set to give best results when using Civil View. These settings are accessed from the Custom UI & Defaults Switcher option in the Customize menu.*

Creating a Daylight System

Adding a daylight system using Civil View greatly simplifies the complex task of applying natural lighting effects to visualization scenes. The natural light may represent the true geographic location and reacts to date and time of day which gives another level of analysis to the evaluation and presentation of the project.

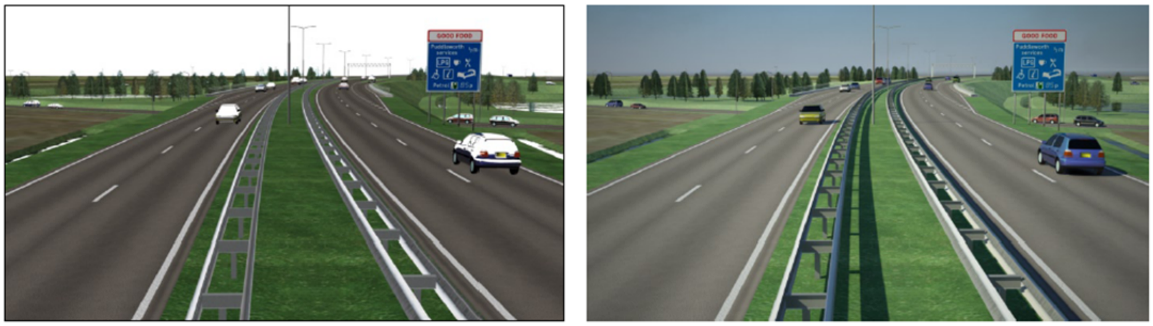


Figure 20. *A comparison of before (left) and after (right) adding a mental ray daylight system to a scene. Note that using a daylight system provides the inclusion of shadows, which adds a sense of three-dimensional depth to the resulting image.*

Using the Daylight option in the Environment and Lighting collection in the Civil View Explorer, you can light the scene with physically accurate daylight in a few simple steps:

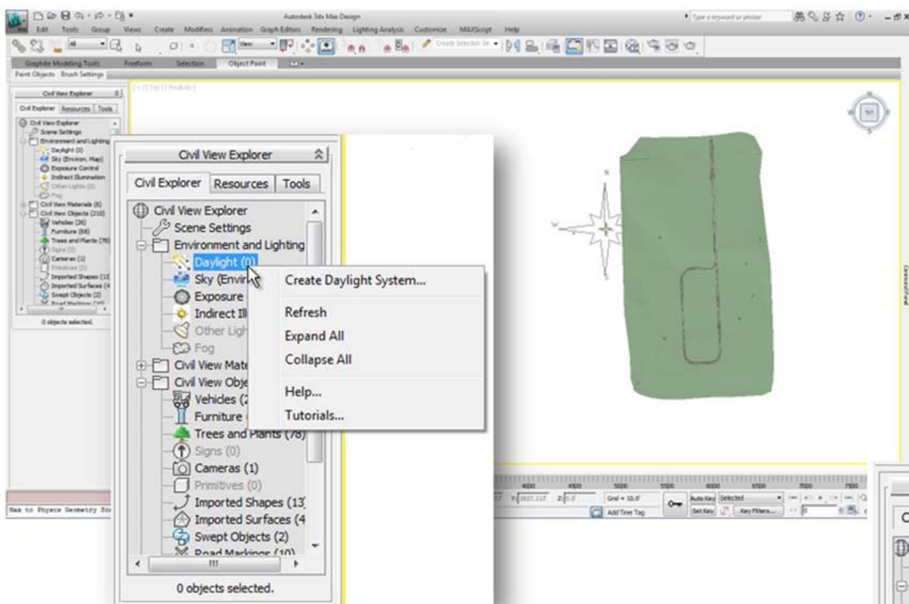


Figure 21. *A daylight system is added to the Top view. Care must be taken when clicking and slightly dragging to place and size the compass icon, then a second click is needed to place the distant sun object icon.*

- Before adding a daylight system, place the model in a top view.
- From the Civil View Explorer panel, right-click the Daylight node and select “Create Daylight System” from the right-click menu.
- After confirming that the recommended Exposure Control settings should be activated, choose a target position for your Daylight System in your viewport. Since sunlight rays are considered to be parallel, it doesn’t matter where the target point of the daylight system is placed in the model. A compass icon is visible at the target point of the daylight system once it has been created. Size the compass by holding the mouse button and slightly dragging the mouse before releasing the button.

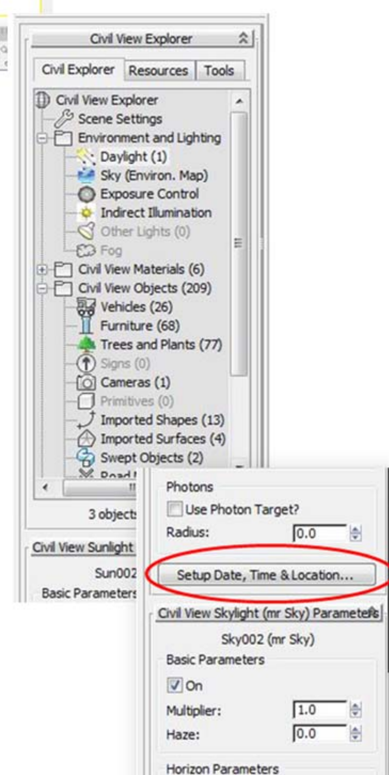


Figure 22. *To set natural lighting parameters, select Daylight and then scroll down and select the Setup Date, Time, & Location button.*

- The sun itself is generated with the second click of the mouse. The angle of the sun in relation to its target is permanently constrained by the associated time and geographic location settings. These can be adjusted separately from the 3ds Max Design Command panel. For the time being, simply drag the mouse away from the model to place the sun in the sky.

- The daylight system is composed of two components: sunlight, which helps simulate the effect of direct light; and skylight, which helps simulate the real-world phenomenon of indirect light created by the scattering of sunlight through the atmosphere. If necessary, the compass symbol may be rotated to adjust the north-south-east-west orientation of the sun in relation to the actual position of the current project. However, if the scene was put in Top view prior to adding the daylight system the compass will be oriented correctly.

- To make adjustments to the daylight system, select the sun icon. Remember that this icon is just a visual representation in the viewport of the orientation of the daylight system. The real source of the daylight effect is considered to be an infinite distance from the model.

Setting the Geographic Location and Time of Day

The natural lighting of a scene by the daylight system may be set to the true sun angles based on the project’s geographic location and the date and time of day. To add this intelligence, select the Daylight item in the Environment and Lighting collection on the Civil View Explorer panel. Scroll down and select Setup Date, Time, & Location. You will see an alert box that informs you that the controls for the geographic location and time of day are found in the 3ds Max Design Motion area of the Command Panel. The Command Panel is accessed on the right of the screen and, if miminized, will fly out when hovered over. The Motion area exposing the Daylight system options will automatically appear.

Use the Control Parameters to get the location and to help determine the time of day and date that you wish to simulate. It is a good idea to experiment with the default time of day to create more interesting shadows across your scene. It is also interesting to note that the angle and intensity of the sun may be derived from a weather data (EPW) file. Refer to the 3ds Max Design documentation for further details.

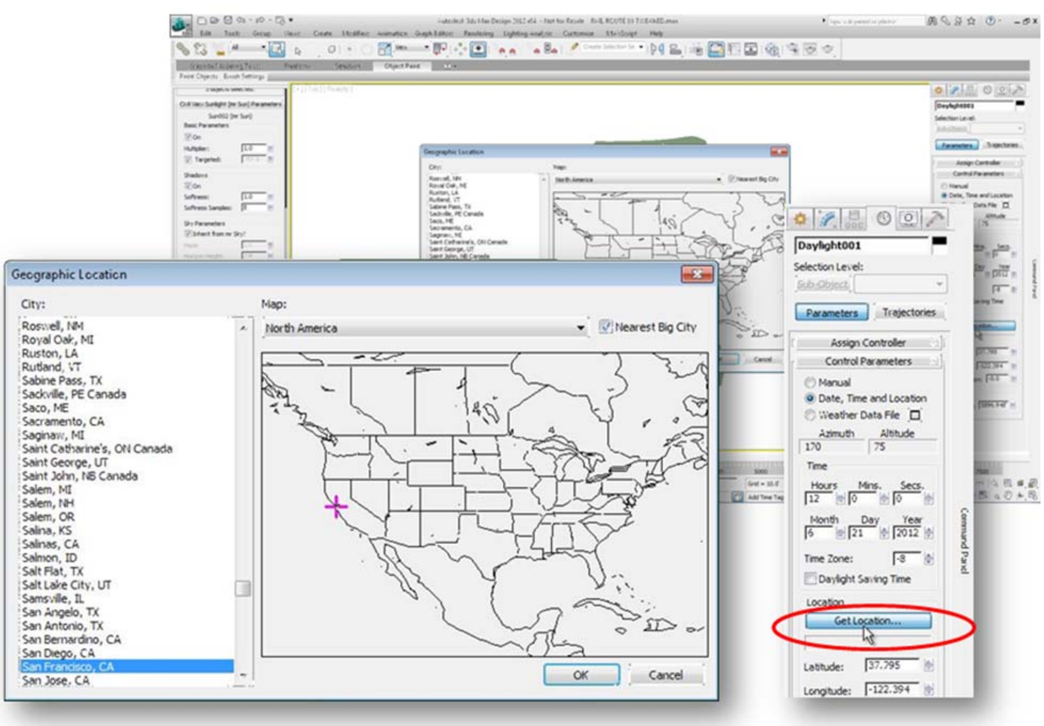


__Figure 23__. Parameters for the daylight system are set in the Motion area of the Command panel.

Controlling Exposure

Exposure controls enable rendered output to be modified with camera-like controls. They are used to adjust the output levels and color range of a rendering, as if you were adjusting film exposure. It is essential to activate an exposure control when working with daylight systems in 3ds Max Design.

When a mental ray daylight system is created in 3ds Max Design, a mental ray Photographic Exposure Control is automatically activated. The parameters of the exposure control can be adjusted by selecting the Exposure Control in the Environment and Lighting collection in the Civil View Explorer panel.

The easiest way to control the exposure values of renderings is to adjust the Exposure Value (EV) parameter in the mental ray Photographic Exposure Control. Higher values yield darker images, and lower values yield brighter images, as shown in the following examples.

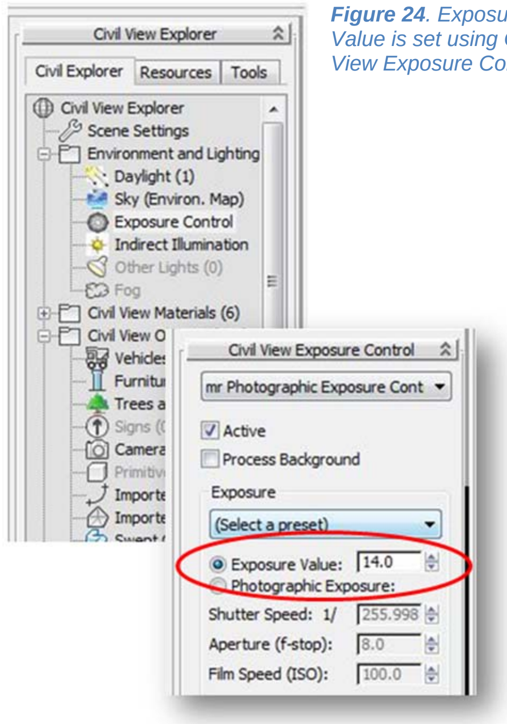


***Figure 24**. Exposure Value is set using Civil View Exposure Control.*

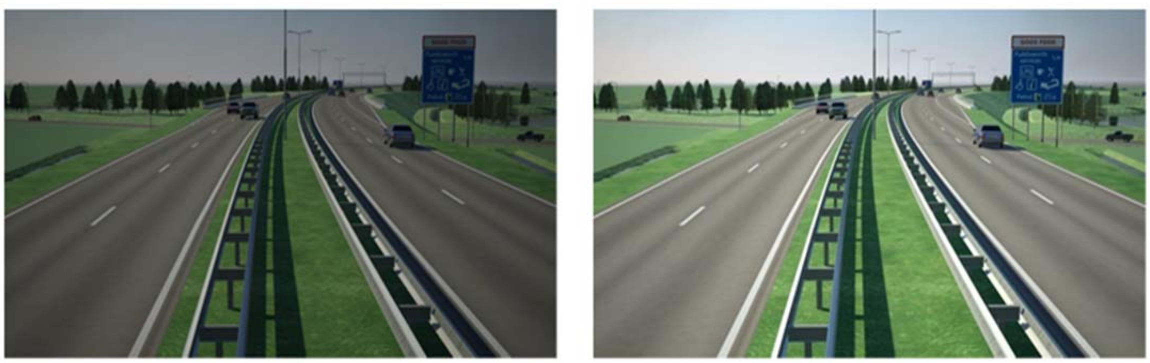


***Figure 25**. Exposure Values are needed to adjust output lighting levels. The higher the EV value the darker the scene. The scene on the left has an EV of 15; the scene on the right has an EV of 14.*

Step 4: Rendering

Rendering is generally the final process in creating visualization. Rendering creates 2D images or animations based on the 3D content of a scene. It shades the 3D geometry using lighting, materials and environmental settings: sky backgrounds and atmospheres. The Render command is found in the Rendering menu.

Render settings are applied in the 3ds Max Design Render Scene dialog, which may be accessed by selecting the Render Setup option in the Rendering menu in 3ds Max Design. The Render Setup dialog contains a number of tabs, which may vary depending on the selected renderer. The Common tab, as its name implies, is common to all renderers.

Time Output

The time output group enables you to specify which frames to render, which in turn defines whether to render a single image, a sequential series of frames to form an animation, or a combination of different frames that are not sequential.

Output Size
The output size drop-down list provides a number of standard film and video output resolutions and aspect ratios. Custom settings may also be applied to render to other image sizes.

When rendering for animation, bear in mind that typical frame resolutions for DVD production or television broadcast are 720 x 576 at 25 frames per second (PAL), or 720 x 486 at 30 frames per second (NTSC). The introduction of high-definition (HD) broadcasting increases these sizes significantly—full high-definition frames should be rendered at 1920 x 1080, and they require significantly more rendering time to produce.

When rendering still images for print, it is necessary to consider the print resolution of the output device in order to decide the render output size. Output sizes for print generally need to be much larger than output sizes for animation, which increases render times (per frame) dramatically. The Print Size Assistant in 3ds Max Design can help define the required output size for various standard paper sizes and print resolutions. To use the assistant use the Print Size Assistant found in the Rendering menu.

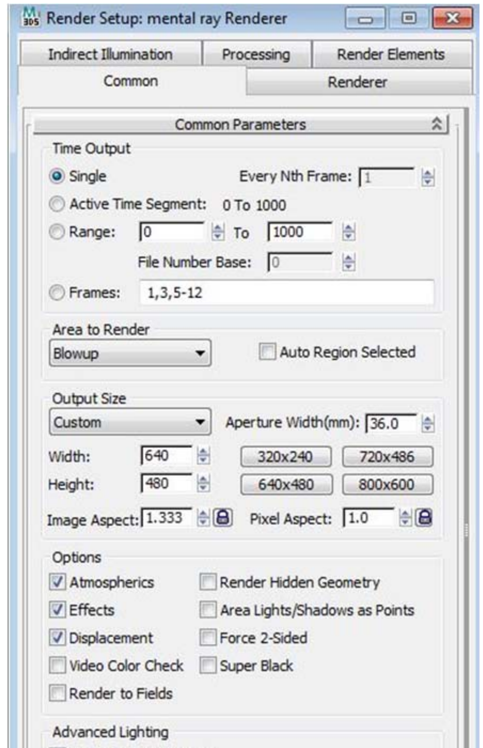


***Figure 26**. Rendering Parameters are set in the Common tab of the Render Setup panel.*

Render Output
This group enables rendered output to be saved to disk in a number of file formats. Even if you are rendering an animation, it is good practice to render to a sequence of still images, using a file format, PNG, TIF, or TGA. This helps to make sure that the highest quality is maintained during the most time-consuming process of producing an animation—rendering from 3D. These still frames may later be composited to an AVI, MPG, or WMV movie file.

Other Types of Stylized Output
Sometimes it is effective to present a visualization in conceptual terms, such as an artist's rendering. 3ds Max Design is able to translate scenes to several common artistic styles such as: graphite, colored pencil, ink, colored ink, acrylic, and pencil. To stylize a scene, select Stylized from the View Controls drop-down menu in the upper left of the scene. To save the scene as an image, use the Grab Viewport command found in the Tools menu.

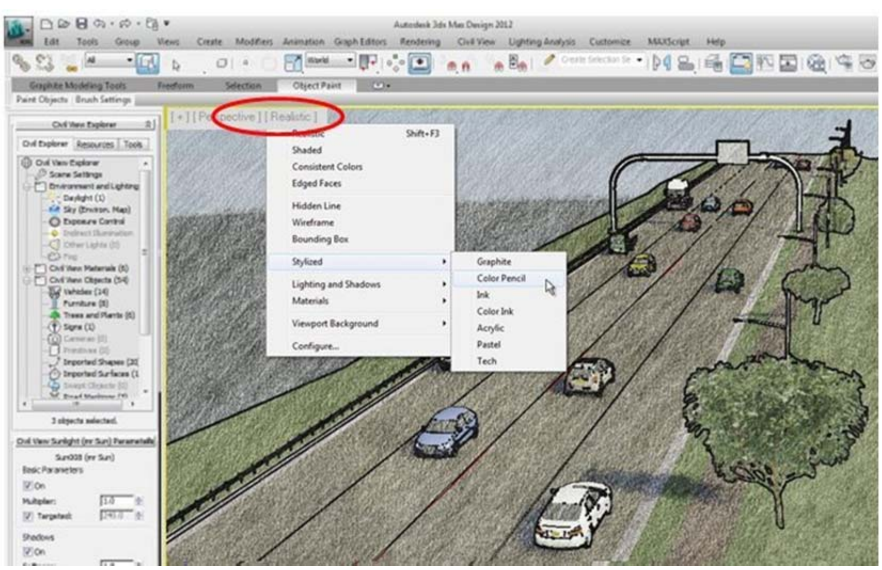


***Figure 27**. Scenes may be conceptually styled using the Viewport Controls, and a still image can be saved by using the Grab Viewport command in the Tools menu.*

Step 5: Incorporating Future Design Changes

Accommodating AutoCAD Civil 3D–Based Design Changes in the Visualization
In order to more effectively utilize visualization techniques in rapidly evolving civil engineering projects, it is essential that a visualization model can react to frequent design changes in AutoCAD Civil 3D.

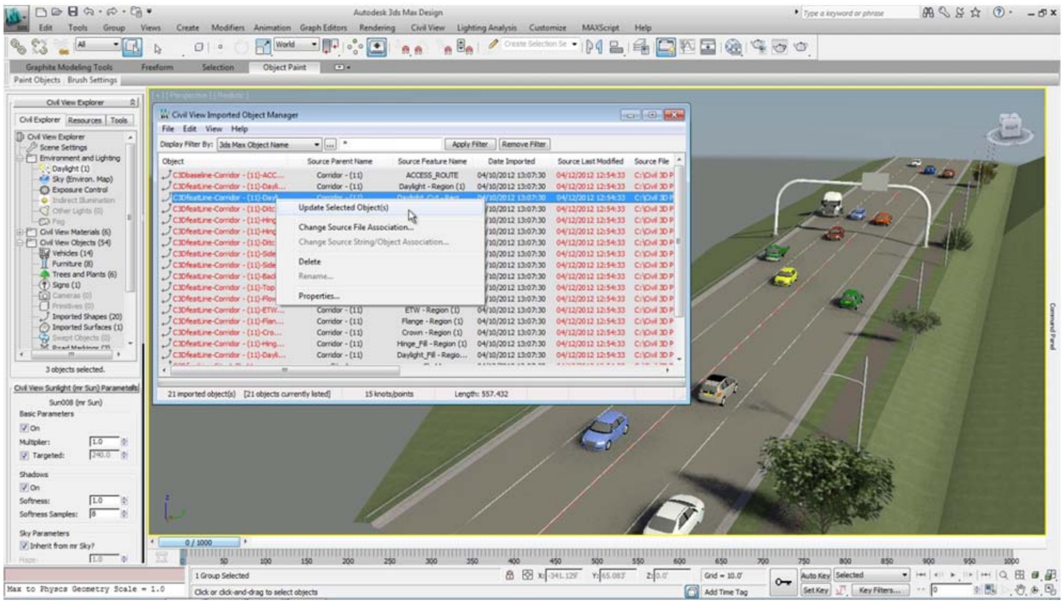


Figure 28*. Here the Civil View Imported Object Manager is used to update previously imported Civil 3D design elements.*

Civil View retains a permanent reference back to any imported .vsp3d files from which AutoCAD Civil 3D content has been derived. This provides the ability for Civil View to update a visualization model after a design change occurs.

After a design change has been applied in AutoCAD Civil 3D, the civil model should be re-exported, overwriting the original Civil View .vsp3d file. In Civil View, the Imported Object Manager panel found in the Civil View menu is used to view the status of all imported design elements from AutoCAD Civil 3D or any other source. To apply an update, right-click the desired objects in the Imported Objects list and select Update Selected Objects.

Dependencies built into a Civil View model mean that all subsequently generated objects that have been placed in the model will react to these changes, eliminating the need to manually rebuild a visualization after every design change.

Tips and Best Practices in AutoCAD Civil 3D

This section contains recommendations on how to best structure your civil design model in AutoCAD Civil 3D in order to help prevent subsequent roadblocks in the visualization process.

Corridor Surfaces

There is no need to generate a corridor surface in AutoCAD Civil 3D in order to make that surface available for export to Civil View. The Civil View output for Civil 3D features its own corridor surface generator which can negate the need for an AutoCAD Civil 3D user to generate corridor surfaces.

This enables the DWG file to be optimized for design/drawing purposes without the need to carry the overhead/burden of defining traditional AutoCAD Civil 3D corridor surfaces. If traditional corridor surfaces do exist in the active DWG file, they should not be selected for export to avoid the possibility of duplicate corridor surfaces being written to the Civil View exporter file.

Hide Boundaries

In any AutoCAD Civil 3D model, the existing ground surface that immediately surrounds the main design forms an essential part of the context of the site. In AutoCAD Civil 3D, this surface usually needs to have cutouts (or hide boundaries) applied for all areas in which new roads or design surfaces have been defined.

If hide boundaries are not generated, parts of the design that fall below the existing ground surface will not be visible in the visualization.

The generation of hide boundaries is streamlined by tools in AutoCAD Civil 3D.

One of the new features added to Civil 3D 2013 is the ability to select a surface and use it as a boundary for another overlapping surface. This creates the desired cutout needed for an unobstructed visualization of the finished corridor design surface.

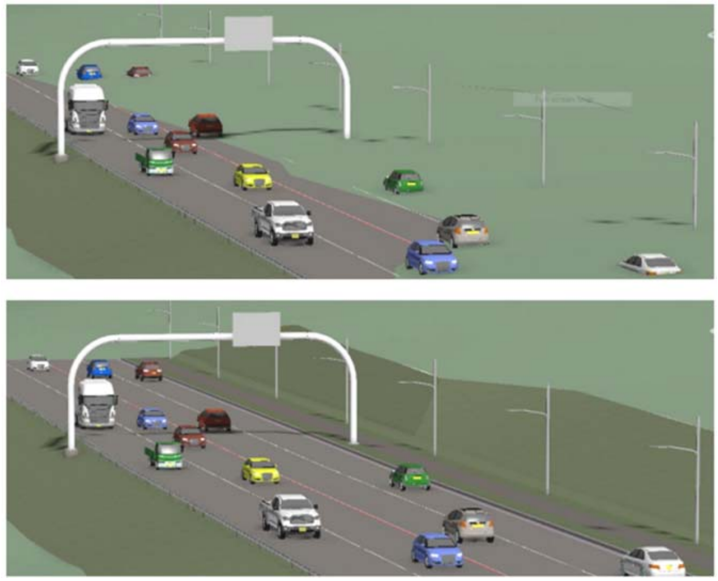


Figure 29. In the top image the existing surface has not been cutout and it occludes areas where the finished design surfaces dip below grade. In the bottom image a hide boundary created from the daylight limits of the design creates a cutout in the existing surface and the full design is displayed.

To do this the corridor surface boundary is used to hide the areas on the existing ground surface. Since it is necessary to maintain the integerety of the existing ground surface, a new surface is created using the Paste command, and the corridor boundary is applied to that.
The procedure is as follows:

1. Hide the existing ground surface by either applying the 'No Display' style or by using the Hide Objects utility.

2. Create new blank surface, with a meaningful name such as EG Cutout, and use the Paste command to paste in the existing ground surface

3. Add a hide boundary to this newly created surface, select Surface for the boundary type.

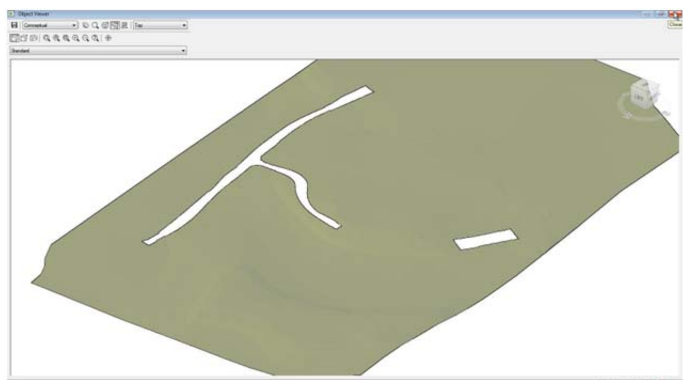


***Figure 30**. Objects are added as hide boundaries to the existing surface to create cutouts so the finished design data is not occluded.*

4. Select the desired corridor surface from either the drawing or from a list.

5. If more than one cutout is needed, add additional hide boundaries.

Use the "MarkPoint" Subassembly

This subassembly is used to mark an existing point on an assembly with a custom point code. This is ideal for causing feature lines to be generated with a specific label at any location on a corridor assembly, making it ideal for the generation of road marking feature lines.

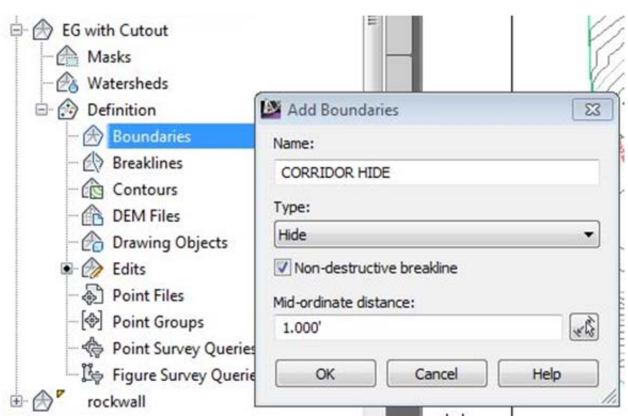


***Figure 31**. Hide boundaries are added to a surface definition to create cutouts.*

Use the "GenericPavementStructure" Subassembly

Individual link codes within subassembly definitions in AutoCAD Civil 3D are used to help determine material assignments applied to each part of the corridor surface on import into Civil View. In many subassemblies, these link codes are hardcoded as part of the subassembly definition itself. If you require more control over the individual link codes in a corridor assembly, consider using subassemblies that enable users to define their own custom link codes.

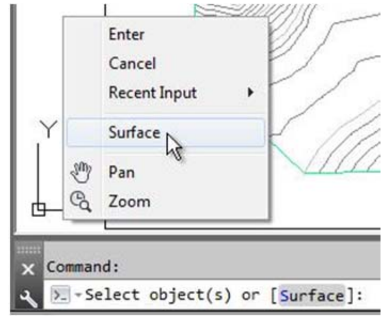
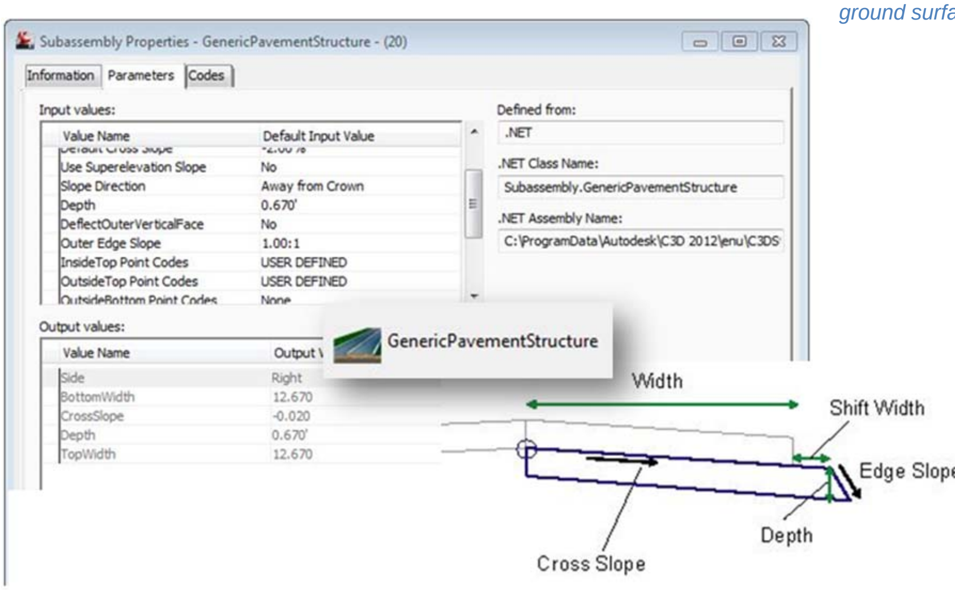


Figure 32. Hide boundaries may now be added directly from other surfaces. For example, a corridor surface may be selected to create cutouts on an existing ground surface.

A good example is the GenericPavementStructure subassembly, which can be used to represent a simple road structure with user-definable point, link, and shape codes.



Tips and Best Practices in 3ds Max Design Using Civil View

Figure 33. The GenericPavementStructure subassembly can be used to represent a simple road structure with user-definable point, link, and shape codes that can aid in the automatic generation of visualization features.

Understanding Global Import Shift Settings in Civil View

Making sure that imported civil design data is transformed on the XY axis towards the scene origin is absolutely crucial in order to avoid single precision accuracy limitations in 3ds Max Design.

Civil View automatically calculates appropriate Global Import Shift settings to apply to the imported civil design geometry for each project.

It is worth noting that global import shift settings are only applied to geometry imported via Civil View, and not geometry imported via the standard 3ds Max Design import options.

Remember to check that these values are set correctly right at the start of your project. These values cannot be subsequently changed.

Apply Selective Import Policies

Only import parts of the civil design from AutoCAD Civil 3D that are directly required for visualization purposes in 3ds Max Design. This helps keep the geometric complexity of the scene to a minimum at all times.

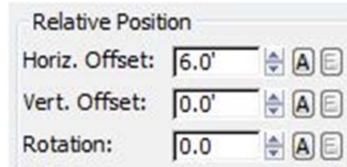


***Figure 34**. An example of spinner controls*

Use mental ray Consistently

To get the best rendered results from 3ds Max Design, it is recommended to use the mental ray renderer. However, when rendering with mental ray, optimum results can be achieved by also using Arch&Design materials and Pro-Materials, exposure controls, and daylight systems.

Learn to Use 3ds Max Design Spinner Controls

Learn how to interact properly with 3ds Max Design spinner controls. These versatile user interface widgets are used to help control numerical parameters throughout Civil View and 3ds Max Design.

Spinner control values can be modified in the any of the following ways:

- Type a new value into the keyboard entry field
- Type a relative value into the keyboard entry field by prefixing the new value with "r"
- Right-click the spinner to reset the spinner to its minimum possible value (normally zero)
- Click the spinner's up or down arrow to increment or decrement the value
- Click and hold the spinner's up or down arrow and move your mouse up and down the screen for continuous change. This is a useful technique to adjust the station (chainage) or offset of placed objects in Civil View
- Press Ctrl while you drag to increase the rate at which the value changes
- Press Alt while you drag to decrease the rate at which the value changes

Check System Units in 3ds Max Design

Make sure that you are aware of the current System Unit settings before you start working in 3ds Max Design, and match these against the current units of your AutoCAD Civil 3D project. Don't confuse System Units with 3ds Max Design Display Units, which don't affect the true scale of the visualization.

System Units can be set by selecting System Unit Setup from the Customize menu.

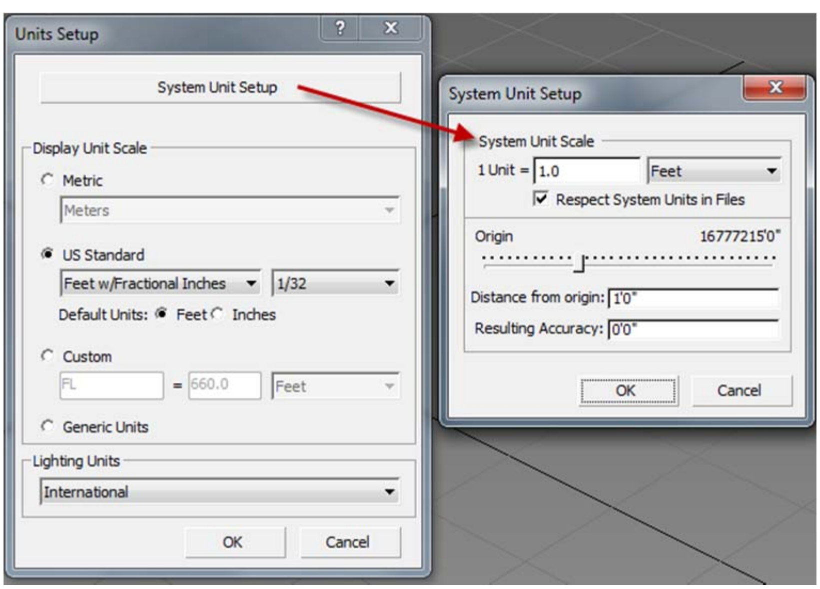


***Figure 35**. The System Setup dialog box.*

Set Project Folder in 3ds Max Design

The project folder provides a simple way of keeping all of your files organized for a particular project in 3ds Max Design.

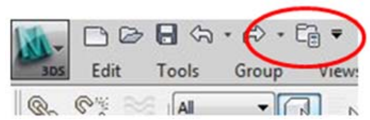


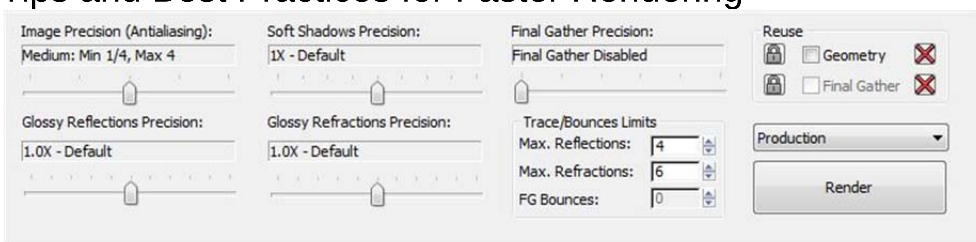
Figure 36. *The Set Project Folder option is located in the Quick Access toolbar at the upper left of the screen.*

The default project folder is:\My Documents\3dsMaxDesign

The Set Project Folder option found in the Quick Access toolbar is be used to specify a different location. Using a project folder causes 3ds Max Design to automatically create a series of dedicated folders for holding project-related information, scene files, and render output files. Saving or opening files from the file browser uses this location by default.

Employing a consistent project folder structure among team members is good practice for both organizing and sharing files.

Tips and Best Practices for Faster Rendering



v

Figure 37. *When the Render command is used, the rendering settings are exposed.*

For Fast Rendering Times, Use Lower Image Precision (Anti-Aliasing) Settings

These controls set the minimum and maximum sample rates for anti-aliasing the rendered output. and can have a huge effect on rendering times. Start with a low quality setting and only increase these values if the quality of the resulting image is inadequate.

For Fast Rendering Times, Use “Draft” Final Gather Precision

These controls provide a range of quick preset solutions for final gathering. The default presets are: Draft, Low, Medium, High, and Very High. Final gathering is an important part of producing higher quality renderings, but to keep render times to a minimum, start with draft quality and increase to a higher quality setting only if the quality of the image is inadequate.

For Faster Draft Rendering, Use Lower Global settings

Anti-aliasing samples set the minimum and maximum sample rates for anti-aliasing the rendered output. These controls can have a huge effect on rendering times, so start with a low-quality setting and increase these values only if the quality of the resulting image is inadequate. Do the same for Glossy Reflection, Soft shadow, and Glossy refraction precision.

For Faster Draft Rendering, Use “Draft” Final Gather Precision

These controls provide a range of quick preset solutions for final gathering. The default presets are: Draft, Low, Medium, High, Very High, and Custom. Final gathering is an important part of producing higher-quality renderings, but to keep render times to a minimum, start with draft quality and increase to a higher quality setting only if the quality of the image is inadequate.

Appendix A

AutoCAD Civil 3D Object	Description	3ds Max Design Equivalent
Alignment / Baseline	Alignment objects in AutoCAD Civil 3D generally represent the basic path of centerlines, lanes, shoulders, rights-of-way, or construction baselines. Creating and defining horizontal alignment is usually one of the first steps in roadway, railroad, or site design.	Shapes (the combined result of both the alignment and profile)
Profile	Profile objects in AutoCAD Civil 3D are used to help define surface elevations of a road or railway along a predefined horizontal alignment.	Shapes (the combined result of both the alignment and profile)
Corridor	Corridor objects in AutoCAD Civil 3D generally represent full 3D definition of the road or other feature being designed.	Multiple editable meshes and shapes
Assembly	An assembly defines an overall cross-sectional structure of a corridor object in AutoCAD Civil 3D.	Portions of editable meshes and shapes
Subassembly	Subassemblies are basic building blocks of assemblies. They represent individual components; curbs, lanes, ditches, or slopes.	Portions of editable meshes and shapes
Link Code	Links are basic building blocks of subassemblies. Links may have one or more codes associated with them to help identify their purpose and meaning within a subassembly definition.	Portions of editable meshes and shapes
Feature Line	Site and corridor feature lines in AutoCAD Civil 3D are used to help represent a path of linear features: fences, curbs, lane edges and embankments.	Shapes
Surface	Surfaces in AutoCAD Civil 3D can be defined by a collection of points or breaklines, or can be derived from a corridor definition.	Editable Meshes
Parcel	Parcels in AutoCAD Civil 3D are typically used to help represent real estate parcels; lots in a subdivision.	Not Supported
Point Group	Point Groups in AutoCAD Civil 3D are generally used to help represent locations of objects: trees, lighting columns, signs, and traffic signals.	Particle System
Site	A collection of objects that share a common topology; feature lines, alignments, and parcels.	Not directly relevant. See feature lines and alignments.

Appendix B

3DS Max Design Term	Description
Multi/Subobject Material	Multi/subobject materials enable different materials to be assigned at subobject levels of your geometry. For instance, for imported corridor surfaces it is possible to have a different material assigned to curbs, the sidewalk, and the surface of a road—even though all of these materials are part of a single multi/subobject material definition that has been applied to the entire surface.
Material ID	The material ID of a face or polygon is a numerical channel that helps determine specific sub-material of a multi/subobject material that is assigned to that face or polygon.
mental ray	It is possible to choose between a number of different renderers in 3ds Max Design. The mental ray renderer is recommended as the preferred renderer for the workflow described in this document. mental ray is capable of more efficiently generating physically correct simulations of lighting effects, and is optimized to use multiple processors.
Daylight System	A daylight system is a physically accurate group of managed components that help provide simulated sunlight in a scene. These systems are capable of following the geographically correct angle and movement of the sun over the earth at a given location. Optionally, weather data (EPW) files may be used to define the angle and intensity of the sun.
Exposure Control	Exposure controls enable rendered output to be modified with camera-like controls. They are used to adjust output levels and color range of a rendering, as if you were adjusting film exposure. It is essential to activate an exposure control when working with Daylight Systems in 3ds Max Design.
Final Gather	Final Gather is an optional rendering feature in the mental ray renderer, which helps calculate the effect of indirect lighting in a scene. The use of Final Gather is an essential part of building realism and believability into rendered images, but can dramatically increase the time required to produce a rendered image.
Opacity Maps	Opacity or cutout maps are applied to geometry to make them appear partially transparent. White areas of the bitmap cause the underlying geometry to render as opaque, and black areas of the bitmap cause the underlying geometry to render as transparent. Opacity maps are widely used in Civil View to dynamically adjust linear dimensions of road markings and the shape of sign faces. The term opacity map relates to standard materials and the term cutout map relates to architecture and design materials.