

Using the Autodesk Civil Visualization Extension for 3ds Max Design and AutoCAD Civil 3D



Image courtesy of Arup.

This document outlines suggested best practices for producing visualizations of civil engineering projects created in AutoCAD® Civil 3D® 2011 or 2010 software, using either Autodesk® 3ds Max® Design 2011 or 2010 software with the Autodesk® Civil Visualization Extension.

The Civil Visualization Extension contains Autodesk Dynamite VSP™, a plug-in that runs inside Autodesk 3ds Max Design, helping streamline the process of passing in AutoCAD Civil 3D data. Dynamite VSP also greatly helps 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.

Dynamite VSP is able to react to frequent design changes in AutoCAD Civil 3D. This opens the potential for visualization to become an integral part of the design process, enabling civil visualizations created in Autodesk 3ds Max Design to 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 showcase 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

Table of Contents

The Benefits of Design Visualization for Civil Infrastructure Projects	3
The Civil Visualization Workflow in Detail	5
Tips and Best Practices in AutoCAD Civil 3D	22
Tips and Best Practices in 3ds Max Design and Dynamite VSP	23
Tips and Best Practices for faster rendering	25
External Links	26
Appendix A	27
Appendix B	28

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 that their proposals are communicated to clients.

Audience

The primary target audience for this document is civil engineering professionals using AutoCAD Civil 3D. Particular care has been 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 to navigate through a scene in 3D, and understand the fundamental principles of materials, lighting, and rendering.

Terminology Guides

One of the challenges in communicating a design visualization workflow to a civil engineering audience is the key difference between terminology generally encountered in AutoCAD Civil 3D and Autodesk 3ds Max Design. This can cause confusion depending on the background of the reader.

The terminology used in this document draws from both products in order to accommodate the most appropriate terms relevant to the application being used 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.

The Benefits of Design Visualization for Civil Infrastructure Projects

Design visualization for civil infrastructure projects is often seen as an extravagant 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 to evaluate their proposals, speed up the approval process, and even help companies win new business.

The key to driving the use of design visualization for civil infrastructure projects is to put the visualization tools in the hands of the 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 don't 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 isn't quite right when considered from the driver's visual perspective, or from a comfort point of view. Both of these considerations will ultimately impact safety, but how do you evaluate and react to such concerns without the ability to experience the project before it is built?

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."



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



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

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 infrastructural 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.

Remco Bastiaans of Oranjewoud explains, "We have found it to be very beneficial to include a 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, making it easier to evaluate their projects at an early stage in the design process.

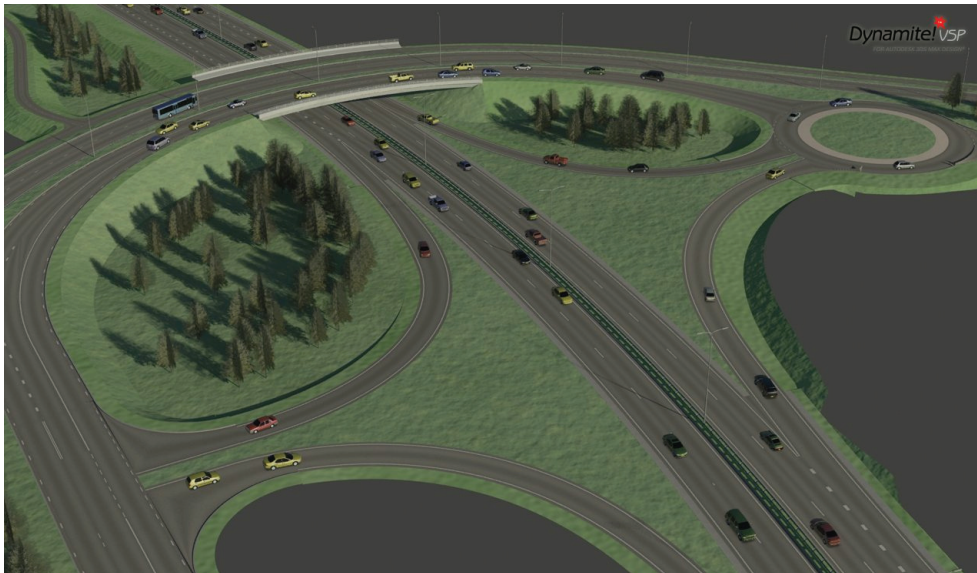


Figure 3 - Oranjewoud has a need to verify the integrity of their AutoCAD Civil 3D design models, which makes design visualization an integral part of their design validation process.

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.



Figure 1 - Courtesy of the Benelux Civil 3D User Group

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.

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.

Introducing the Autodesk Civil Visualization Extension for 3ds Max Design

The Civil Visualization Extension, which includes the Dynamite VSP plug-in for 3ds Max Design and the Dynamite VSP Exporter for AutoCAD® Civil 3D, 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.

The extension also features strong integration with AutoCAD Civil 3D, enabling the benefits of 3D modeling in AutoCAD Civil 3D to be leveraged 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.

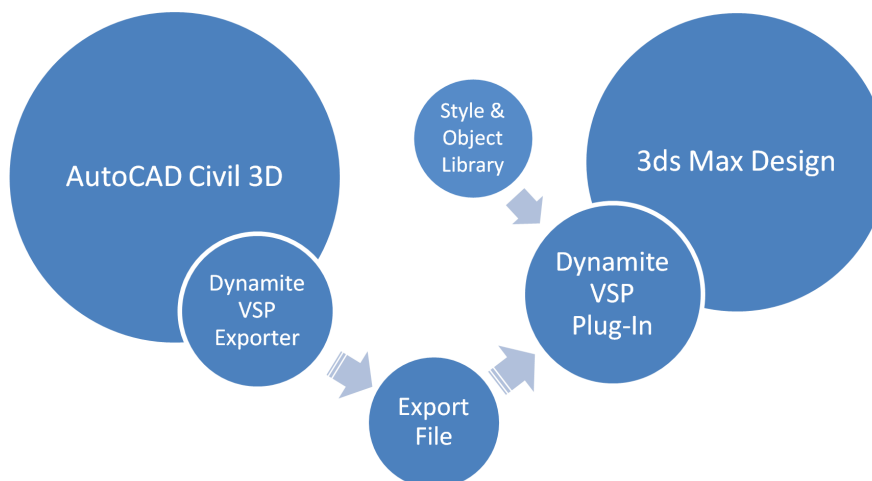


Figure 2 - The flow of civil design data with the Civil Visualization Extension and other content into Dynamite VSP

Applied content in Dynamite VSP 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.

Dynamite VSP Plug-In User Interface Overview

The Dynamite VSP Civil Explorer panel acts as a primary focal point of Dynamite VSP (Dynamite VSP > Dynamite VSP Civil Explorer). 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 Dynamite VSP 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)

Styles in Dynamite VSP

Much of the normal workflow in Dynamite VSP 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 Dynamite VSP are: the generation of road markings and guard rails, or the population of models with signs, trees, street lights, 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 geo-referenced 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.

The Key Civil Visualization Steps

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

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

Now let's examine these steps in more detail.

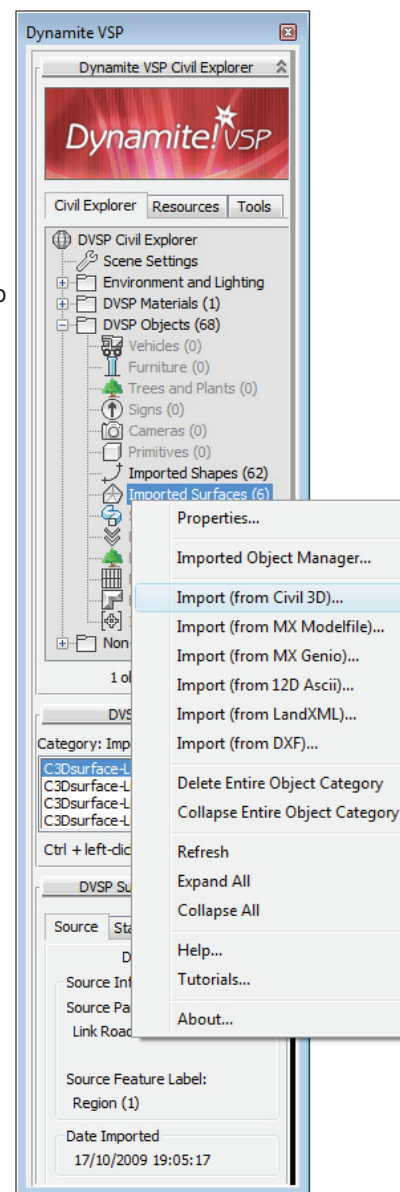


Figure 3 - The Dynamite VSP Civil Explorer panel

Step 1 - Transfer of AutoCAD Civil 3D data to Autodesk 3ds Max Design

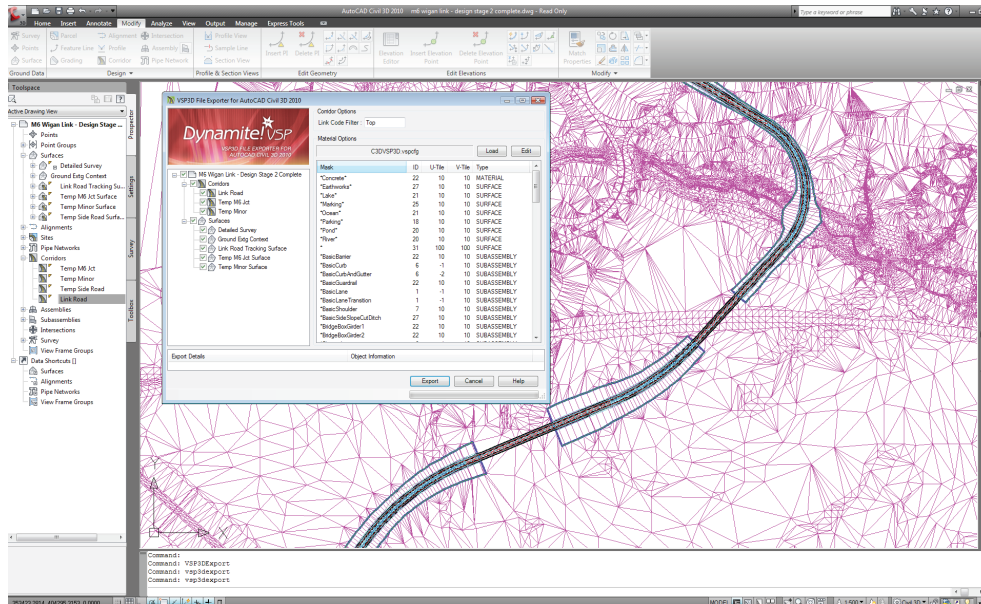


Figure 1 - Using the Dynamite VSP Exporter in AutoCAD Civil 3D

How the AutoCAD Civil 3D Model is Interpreted by Dynamite VSP

There are a number of key objectives to the process of more intelligently transferring AutoCAD Civil 3D content to Dynamite VSP 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.
- As much AutoCAD Civil 3D intelligence is retained in Dynamite VSP as possible. From 3ds Max Design, it is possible to 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

Because of 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 visualization scene is generated as closely to the 3ds Max Design scene origin (0,0,0) as possible. This is due to the fact that round-off discrepancies in 3ds Max Design are most noticeable at large distances from the origin.

Dynamite VSP calculates, and invisibly manages for you, the most appropriate global shift values for imported AutoCAD Civil 3D projects automatically, 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.

The Dynamite VSP Exporter for AutoCAD Civil 3D – Overview

The Dynamite VSP Exporter for AutoCAD® Civil 3D® provides a dedicated solution for the transfer of 3D civil design data from AutoCAD Civil 3D to Dynamite VSP running in Autodesk 3ds Max Design. The Dynamite VSP Exporter file format itself is a proprietary binary file format designed specifically for the purpose of preparing 3D civil design geometry for visualization purposes.

The Dynamite VSP Exporter is available on the Autodesk Subscription Center as part of the .zip file containing the Civil Visualization Extension. Once installed, it can be accessed by right-clicking the Export to Dynamite VSP option in the Toolbox tab of the AutoCAD Civil 3D Toolspace panel.

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.

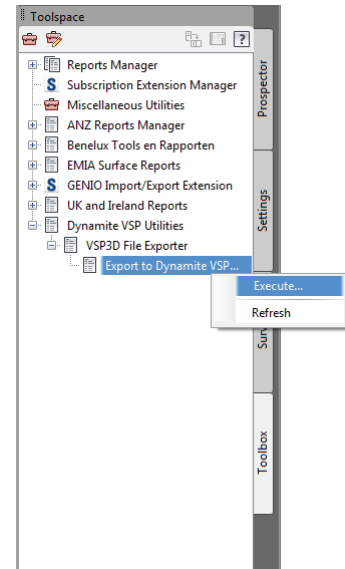


Figure 2 - Starting the Dynamite VSP Exporter from the AutoCAD Civil 3D Toolbox

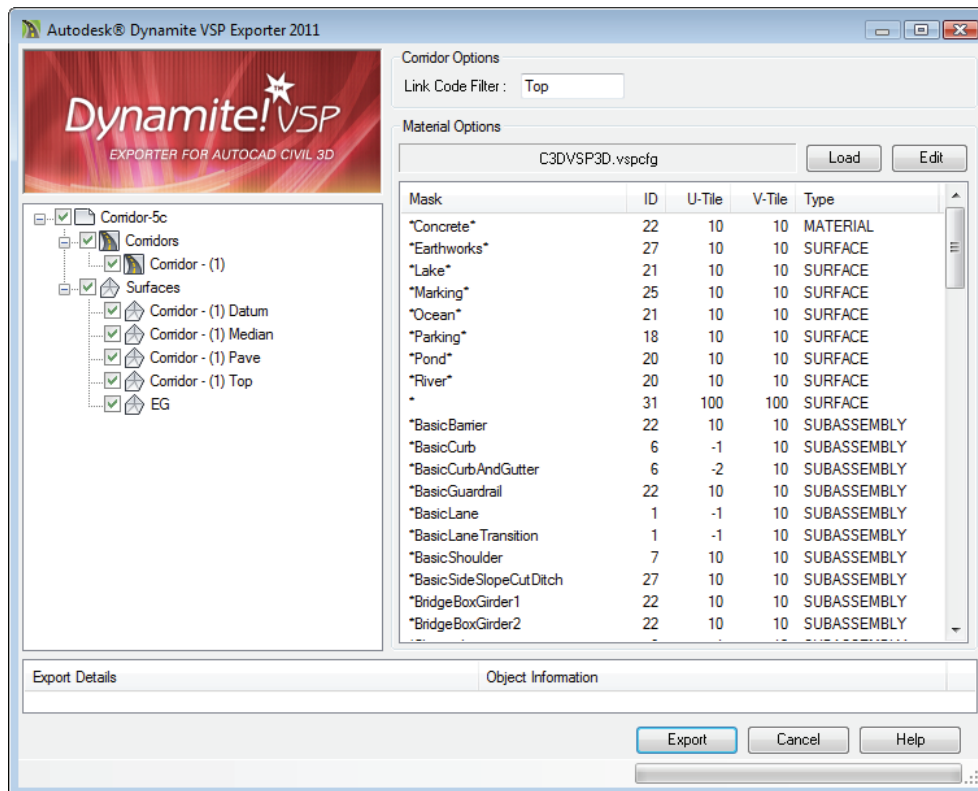


Figure 3 - The Dynamite VSP Exporter for AutoCAD Civil 3D

The Dynamite VSP Exporter for AutoCAD Civil 3D - Supported Objects

The following AutoCAD Civil 3D object types are currently supported by the Dynamite VSP Exporter:

Point Groups - Point Groups are exported to Dynamite VSP Point System objects. Point Systems in Dynamite VSP 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 Dynamite VSP: bridges, tunnels, and retaining walls.

Corridor Surfaces - The Dynamite VSP Exporter 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 Dynamite VSP. 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 Dynamite VSP.

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.

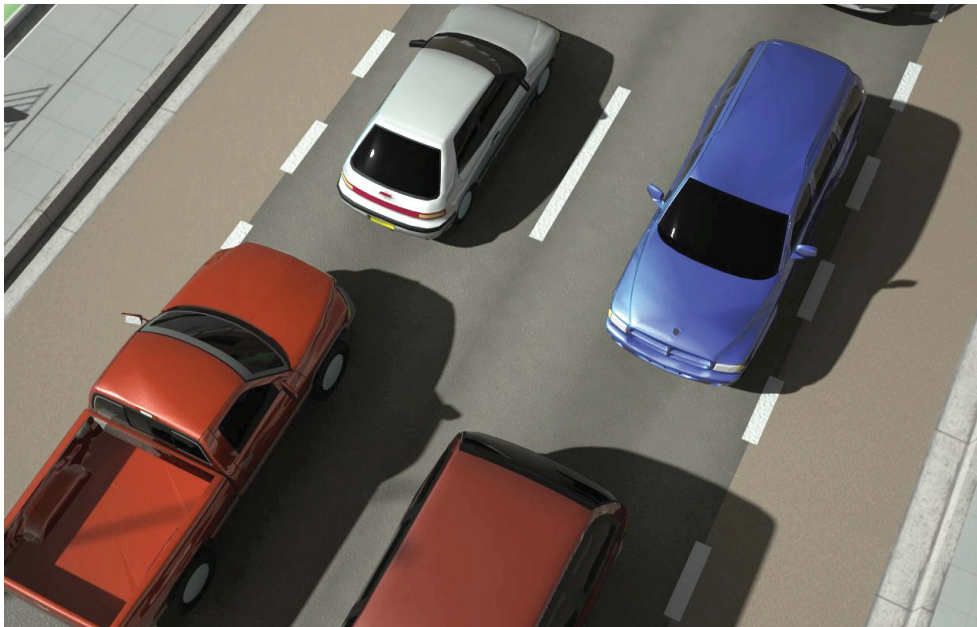
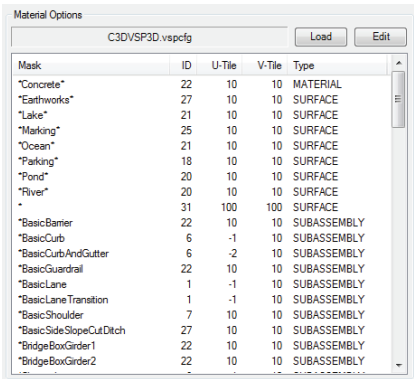


Figure 4 - Alignment-aware Texture Mapping applied automatically in Dynamite VSP

Dynamite VSP Exporter for AutoCAD Civil 3D – Automated Material Assignment

The Dynamite VSP Exporter is driven by a user-customizable configuration file which provides full control over the way that Dynamite VSP 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 which 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.



Mask	ID	U-Title	V-Title	Type
"Concrete"	22	10	10	MATERIAL
"Earthworks"	27	10	10	SURFACE
"Lake"	21	10	10	SURFACE
"Marking"	25	10	10	SURFACE
"Ocean"	21	10	10	SURFACE
"Parking"	18	10	10	SURFACE
"Pond"	20	10	10	SURFACE
"River"	20	10	10	SURFACE
"	31	100	100	SURFACE
"BasicBarrier"	22	10	10	SUBASSEMBLY
"BasicCurb"	6	-1	10	SUBASSEMBLY
"BasicCurbAndGutter"	6	-2	10	SUBASSEMBLY
"BasicGuardrail"	22	10	10	SUBASSEMBLY
"BasicLane"	1	-1	10	SUBASSEMBLY
"BasicLaneTransition"	1	-1	10	SUBASSEMBLY
"BasicShoulder"	7	10	10	SUBASSEMBLY
"BasicSideSlopeCutDitch"	27	10	10	SUBASSEMBLY
"BridgeBoxGirder1"	22	10	10	SUBASSEMBLY
"BridgeBoxGirder2"	22	10	10	SUBASSEMBLY

Figure 5 - Customizing the VSPCFG Configuration File

Importing Dynamite VSP Exporter Files into Dynamite VSP

The basis of every visualization project in Dynamite VSP is the import of 3D civil engineering data from a supported civil design application such as AutoCAD Civil 3D.

The Dynamite VSP AutoCAD Civil 3D Import Panel enables Dynamite VSP Exporter files to be imported directly into 3ds Max Design. It can be accessed by right-clicking the Imported Shapes or Imported Surfaces node in the Dynamite VSP Civil Explorer panel, and selecting Import from Civil 3D.

The panel reproduces the original hierarchy of the civil design model and facilitates the selection of individual components of the model for import, right down to corridor, baseline, and even region level. This can bring huge benefits to the process of visualizing complex civil engineering projects in 3ds Max Design, by enabling the user to selectively decide what needs to be imported into the visualization scene. The general principle is that it is much better to keep the geometry in 3ds Max Design as simple as possible to avoid unnecessary increases in rendering times later.

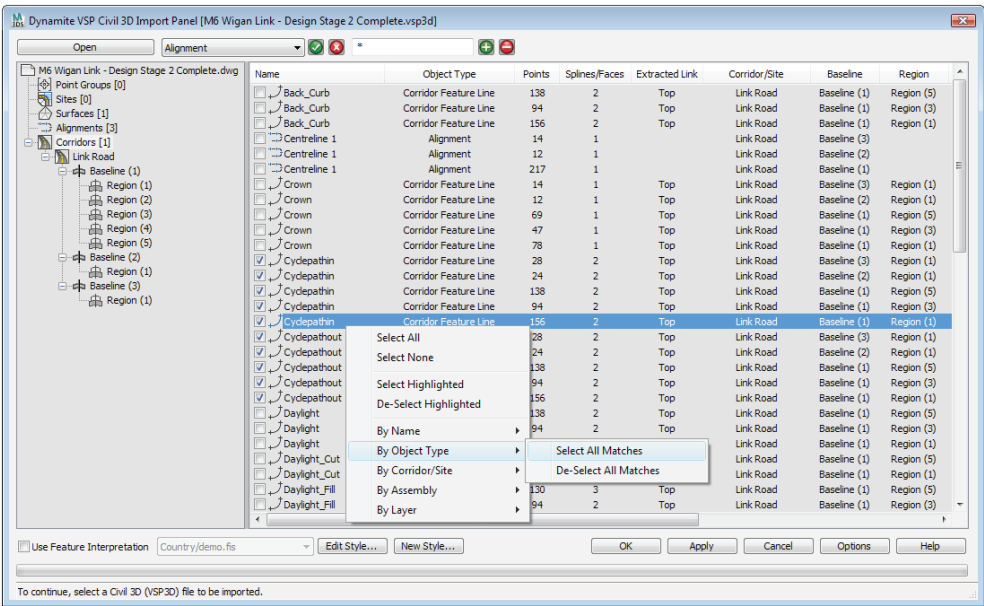
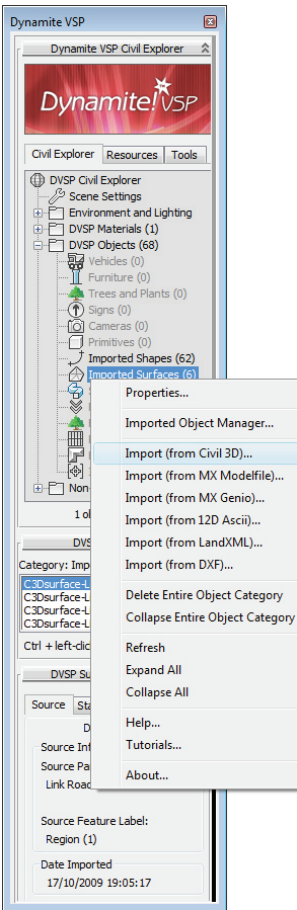


Figure 6 - The Civil 3D Import Panel in Dynamite VSP



Step 2 - Adding further 3D content to the scene using the Dynamite VSP Plug-In for 3ds Max Design

Draping Orthographic Photographs

In Dynamite VSP, it is possible to apply a draped orthographic aerial photograph to imported ground surfaces in a few simple steps. Dynamite VSP recognizes the World File format for image geo-referencing purposes (see External Links on Page 27).

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 Dynamite VSP Civil Explorer panel.

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.

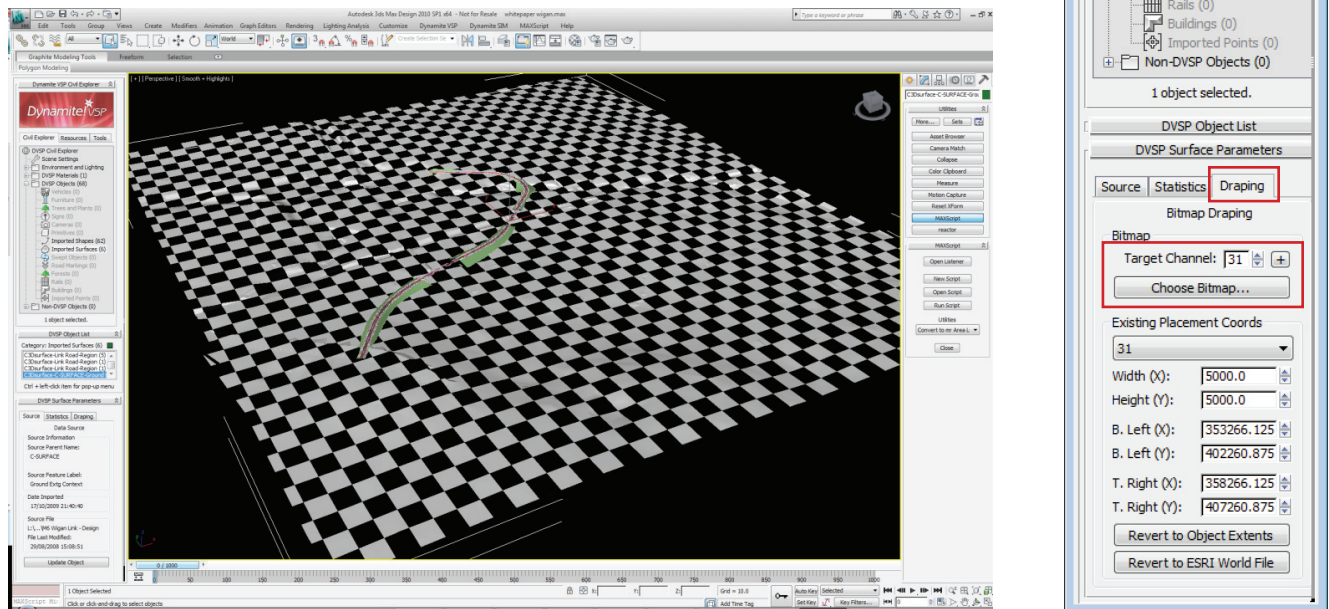
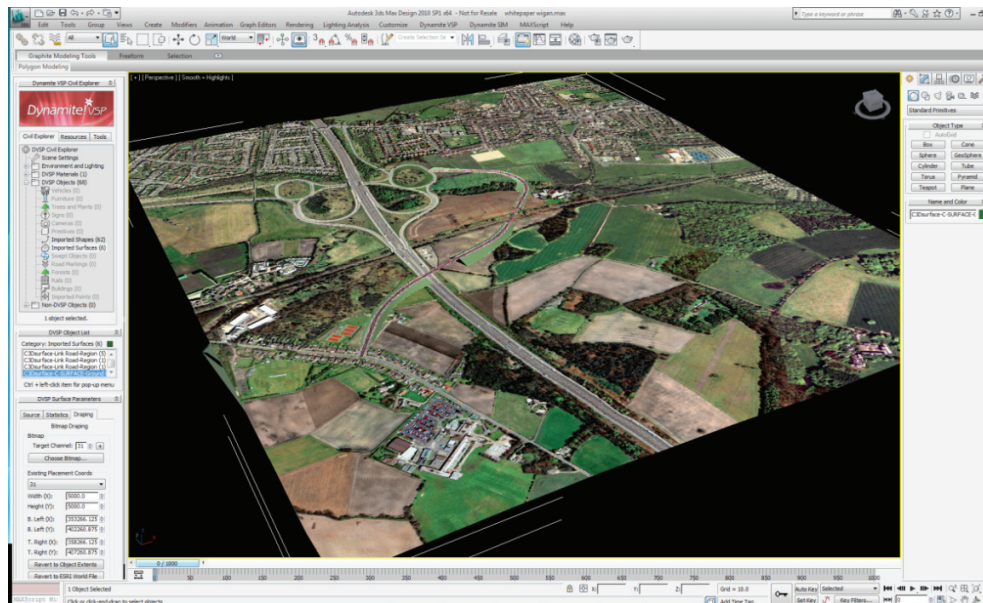


Figure 7- The imported surface before and after assigning the draped orthographic photograph



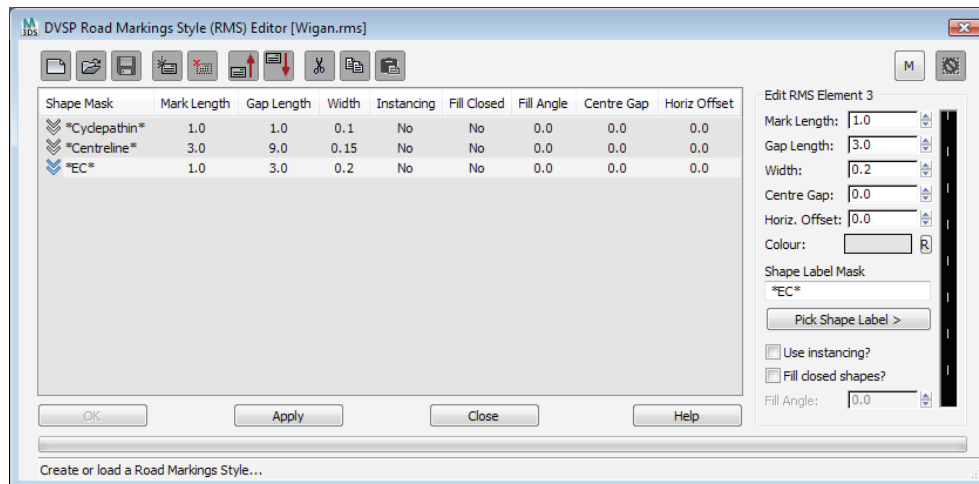
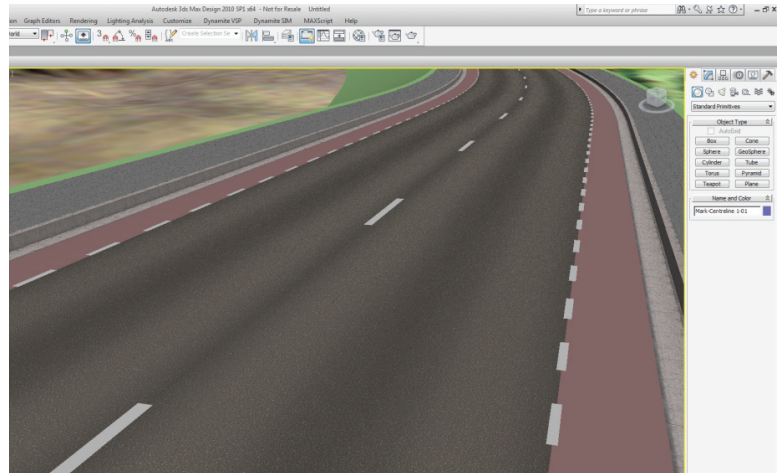
Adding Road Markings

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.

Dynamite VSP features unique parametric road marking objects which help 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 Dynamite VSP, 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 (Dynamite VSP > Road Markings Style Editor) to help define the road marking dimensions that should be applied to each imported feature line. Imported feature line names are matched against the contents of the road marking style to determine the specific road marking type to be applied to each part of the model.



Adding Simple Structural Elements

Structural elements, bridges, retaining walls, and noise barriers, may be modeled using the Swept Object Style Editor in Dynamite VSP (Dynamite VSP > Swept Object Style Editor).

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.

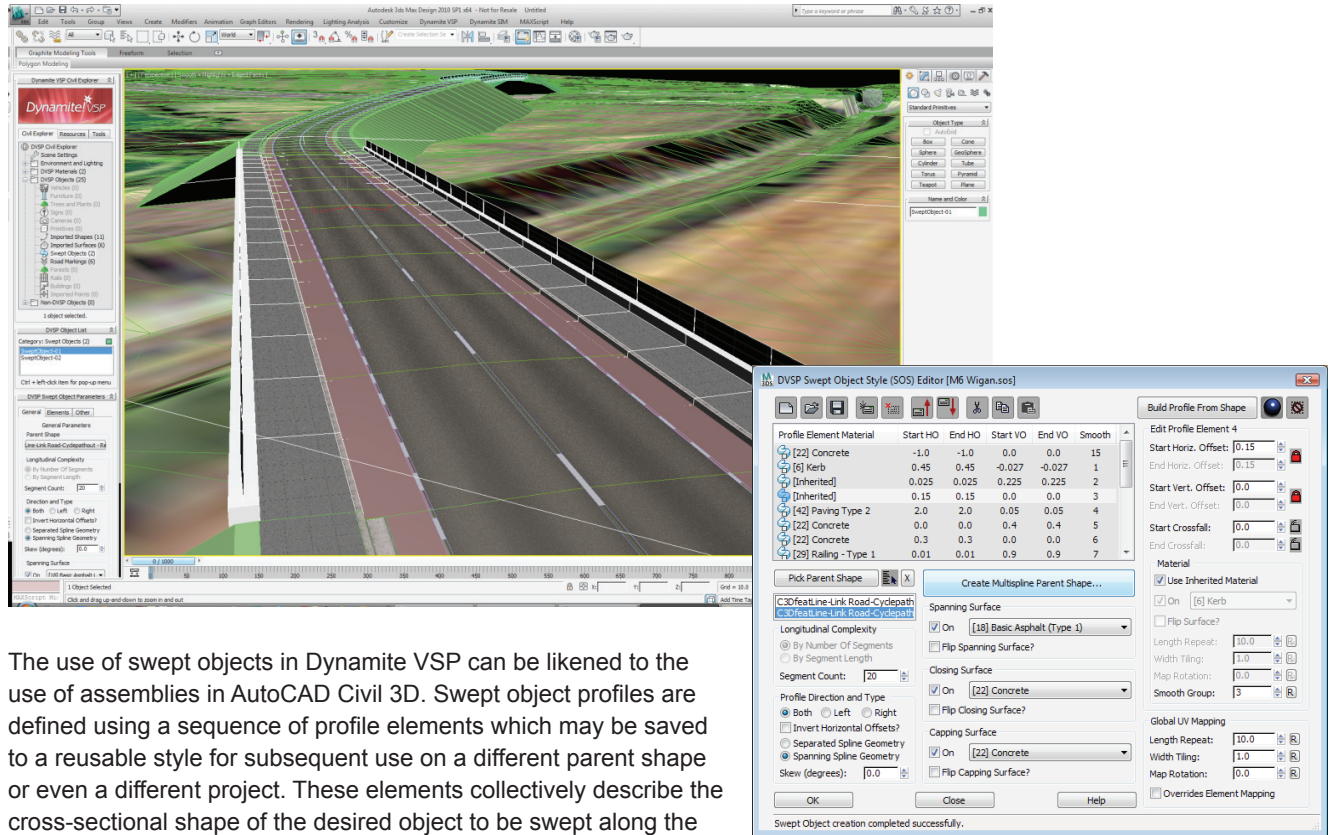


Figure 8 - The Swept Object Style Editor in Dynamite VSP

The use of swept objects in Dynamite VSP can be likened to the use of assemblies in AutoCAD Civil 3D. Swept object profiles are defined using a sequence of profile elements which 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 which 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.

Adding Guard Rails

The process of adding railings, guard rails, and rail track geometry to a visualization is managed through the Dynamite VSP Rail Object Style Editor (Dynamite VSP > Rail Object Style Editor). 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.

Dynamite VSP 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, and the ability is also provided 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—in fact, any object which features a basic rectangular cross-sectional profile).

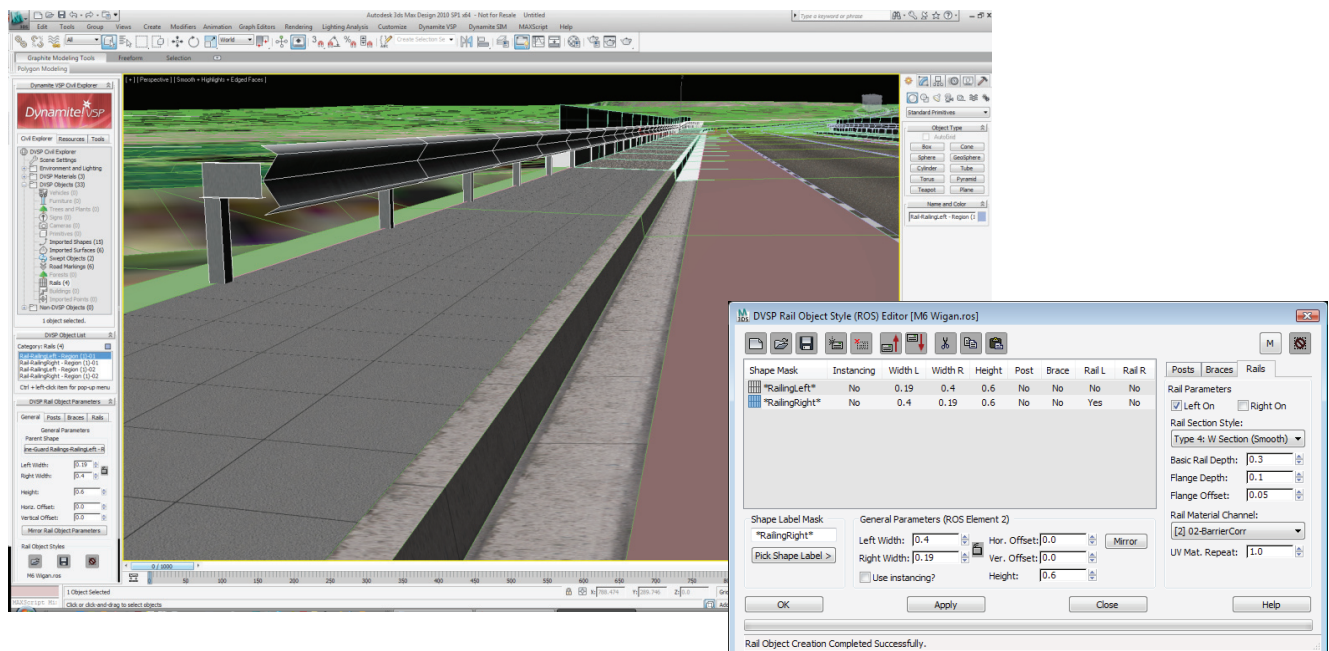


Figure 9 - Dynamite VSP rail objects used to model railway track following the path of imported rail alignments.

Populating the model with Placed Objects

The object placement process is managed through the Dynamite VSP Object Placement Style Editor (Dynamite VSP > Object Placement Style Editor).

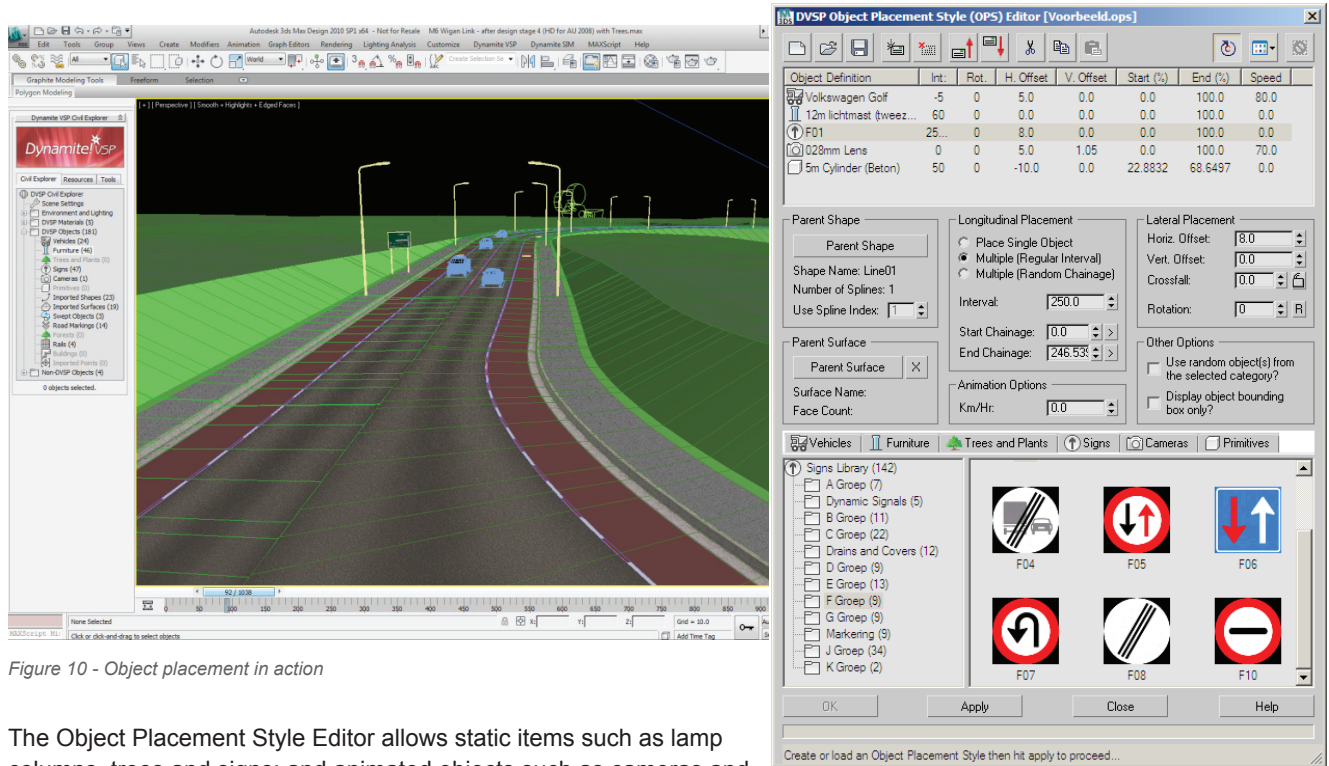


Figure 10 - Object placement in action

The Object Placement Style Editor allows static items such as lamp columns, trees and signs; and 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 whilst still retaining its relationship with the nominated parent shape object.

The geometry for these placed objects is derived from a customizable object library in Dynamite VSP which features vehicles, trees, cameras, road signs and other items of street furniture. These object libraries are stored within a localised and fully customisable Country Resource Kit which forms part of the standard Dynamite VSP installation.

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 allows 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 or camera to drive 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.

Step 3 - Lighting the Scene in 3ds Max Design

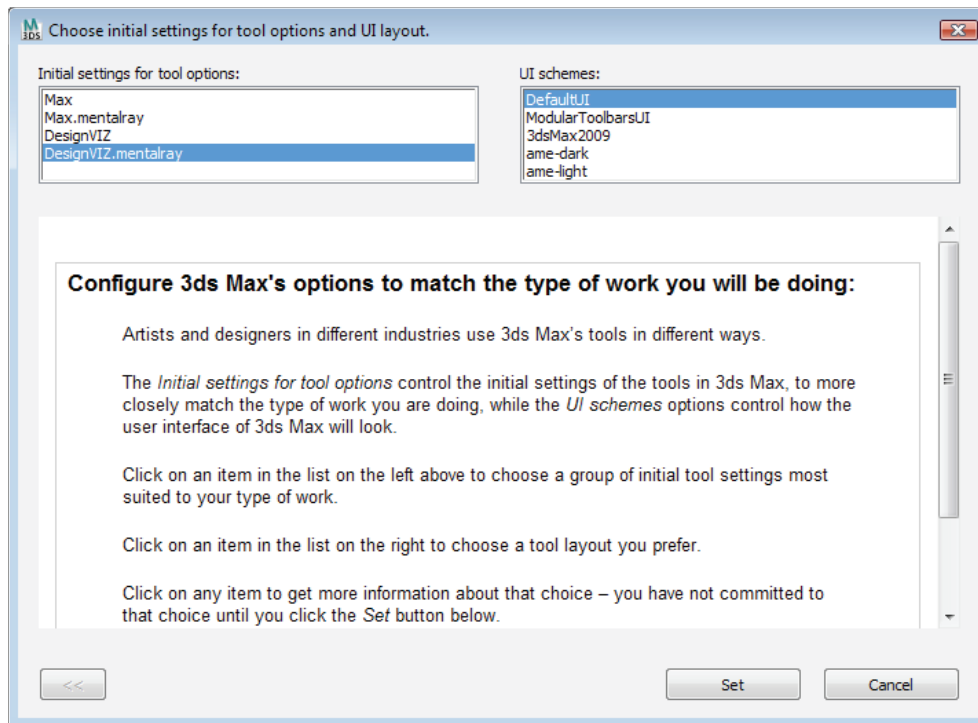
Before rendering the visualization, a daylight system based on the mental ray® renderer is added to the scene to help simulate the effects of daylight, and make rendered images look much more believable. This can be achieved in a few simple steps via the Dynamite VSP Civil Explorer panel.

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 Settings in 3ds Max Design

Initial Settings for Tool Options in 3ds Max Design enable the initial program defaults to more closely match the type of work being carried out. 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.



Make sure that DesignVIZ.mentalRay is the currently selected Initial Tool Setting in 3ds Max Design. If you need to change the current setting, a re-start 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.

Creating a Daylight System

With these basic settings taken care of, lighting the scene with physically accurate daylight can be achieved in a few simple steps:

- From the Dynamite VSP Civil 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. Because 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.
- 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.
- 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.

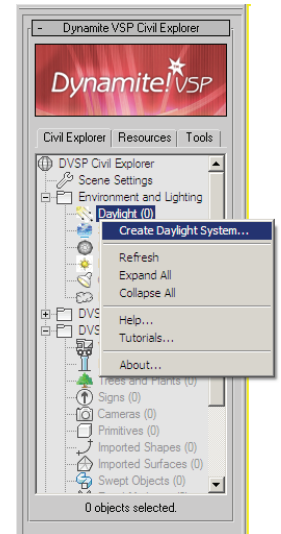


Figure 11 – A comparison of before (left) and after (right) adding a mental ray daylight system to a scene. Note that the use of a daylight system provides a much more believable result. The inclusion of shadows particularly adds a sense of three dimensional depth to the resulting image.

Setting the time of day and geographic location

Make sure that the sun icon is selected in the 3ds Max Design viewport, and open the Motion Tab in the 3ds Max Design Command Panel. Use the Time group of controls to help determine the time of day and date that you wish to simulate (see below). It is a good idea to change the default time of midday to either mid-morning or mid-afternoon to create more interesting shadows across your scene.

Finally, press the Get Location button to define the correct angle of sunlight into your scene given the chosen time of day and date.

Additionally, 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.

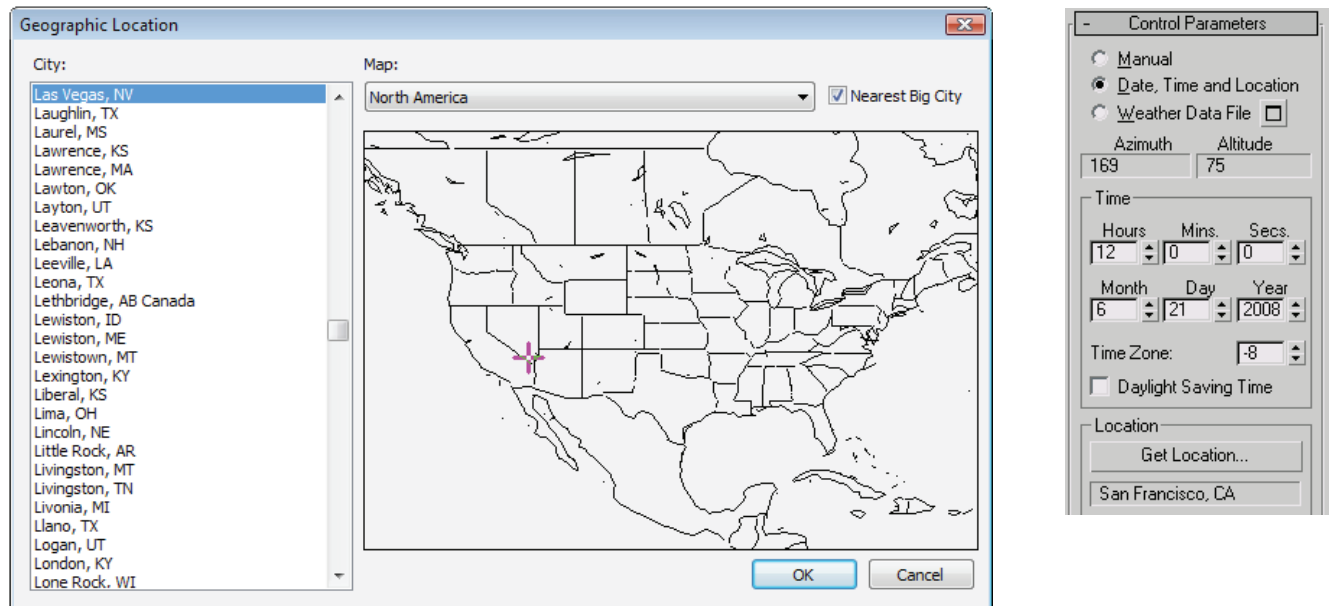


Figure 12 - Setting the Geographic Location of the Daylight System to control the way in which it lights the scene



Figure 13 - 8:30am, September 21st, Amsterdam



Figure 14 - 12:00pm, September 21st, Amsterdam



Figure 15 - 3:00pm, September 21st, Amsterdam



Figure 16 - 3:00pm, September 21st, Sydney

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 (mr) Photographic Exposure Control is automatically activated. The parameters of the exposure control can be adjusted by selecting the Exposure Control node in the Dynamite VSP Civil Explorer panel.

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



Figure 18 - 3:00pm, 21st September, Sydney. EV = 14.25



Figure 19 - 3:00pm, 21st September, Sydney. EV = 15.00



Figure 20 - 3:00pm, 21st September, Sydney. EV = 13.50

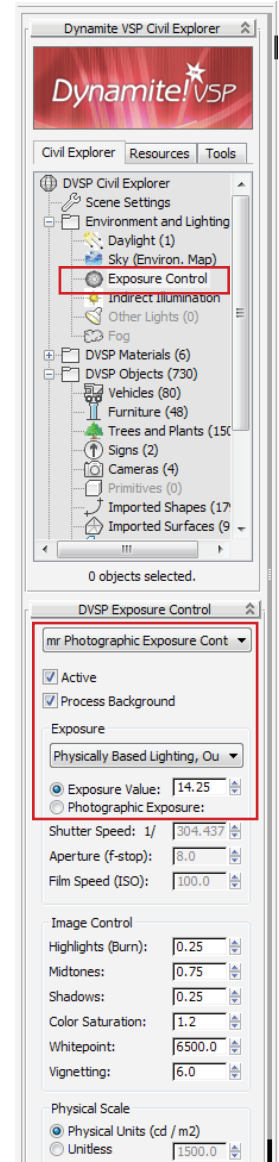


Figure 17 - Controlling Exposure from the Dynamite VSP Civil Explorer panel

Step 4 - Rendering

Rendering is generally the final process in creating a 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.

Render settings are applied in the 3ds Max Design Render Scene dialog, which may be accessed by selecting the Rendering > Render Setup from the pull down menus 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 which 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, which 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 increase 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 (Rendering > Print Size Assistant).

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 later.

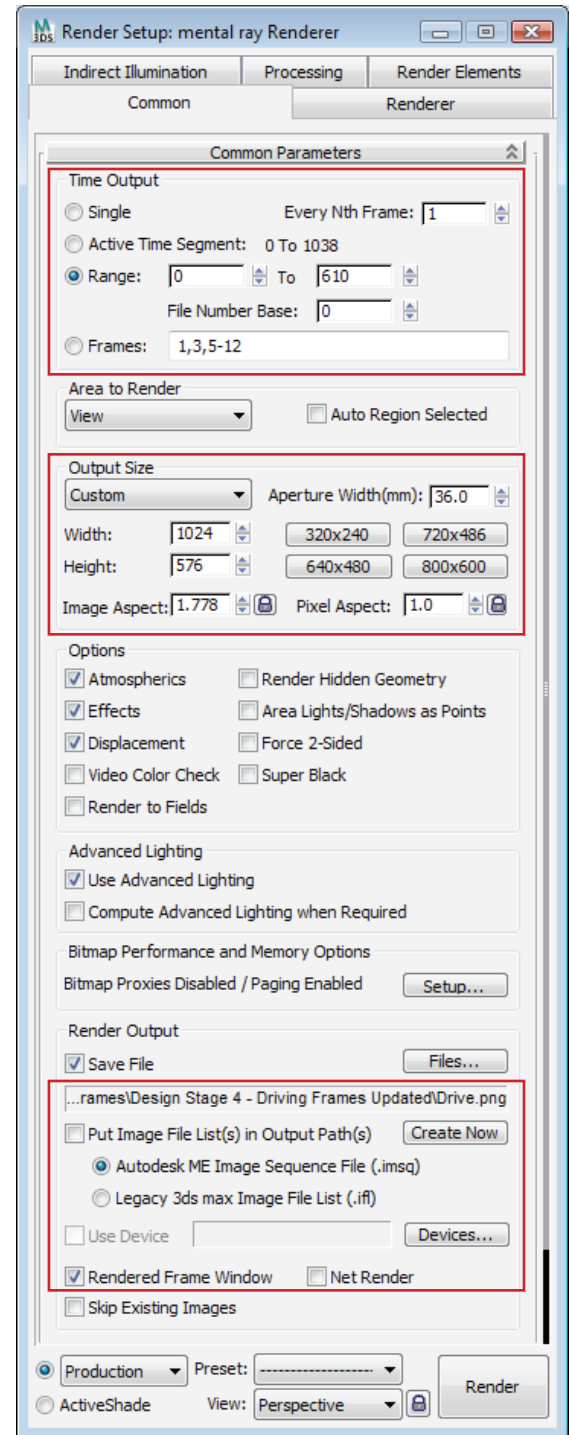


Figure 21 - The 3ds Max Design Render Scene Configuration Dialog

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.

Dynamite VSP retains a permanent reference back to any imported Dynamite VSP Exporter files from which AutoCAD Civil 3D content has been derived. This provides the ability for Dynamite VSP 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 Dynamite VSP Exporter file.

In Dynamite VSP, the Imported Object Manager panel (Dynamite VSP > Imported Object Manager) may then be opened 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 Object(s).

Dependencies built into a Dynamite VSP 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.

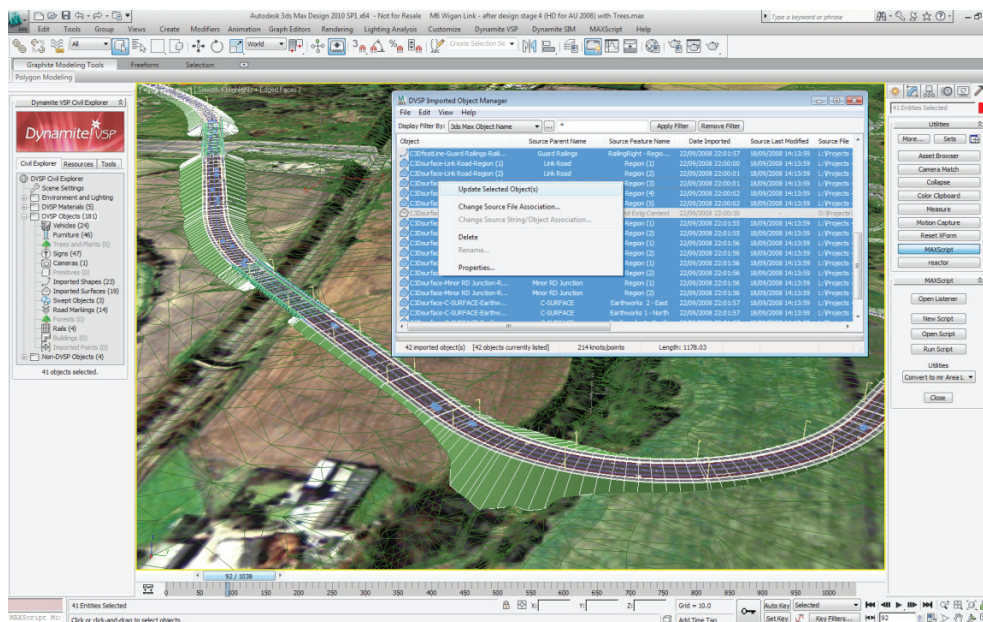


Figure 22 - Using the Dynamite VSP Imported Object Manager to update previously imported Civil 3D design elements

Tips and Best Practice 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 Dynamite VSP. The Dynamite VSP Exporter 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 Dynamite VSP Exporter file.

Hide Boundaries

In any AutoCAD Civil 3D model, the existing ground surface which 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 cut-outs applied (or hide boundaries) for all areas in which new roads or design surfaces have been defined.

If hide boundaries are not generated, parts of the design which fall below the existing ground surface will not be visible in the visualization. Currently, the generation of hide boundaries in AutoCAD Civil 3D is a manual process which must be re-applied by the user each time the design is modified.

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.

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 Dynamite VSP.

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.

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.

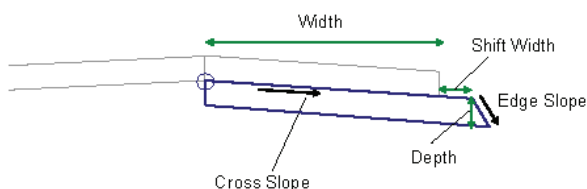


Figure 24 - The GenericPavementStructure Subassembly

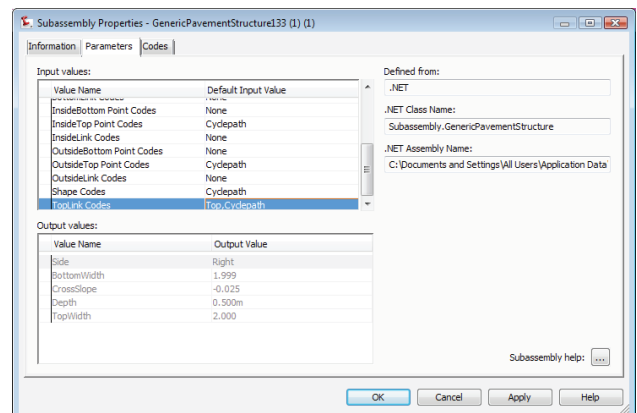
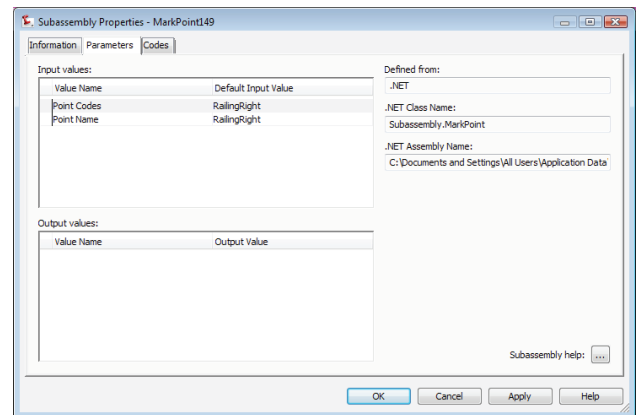
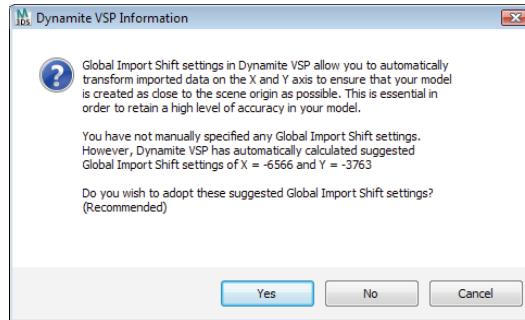


Figure 23 - GenericPavementStructure Subassembly Properties showing the use of user-definable link codes

Tips and Best Practice in Autodesk 3ds Max Design & Dynamite VSP

Understanding Global Import Shift settings in Dynamite VSP

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. Dynamite VSP 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 Dynamite VSP, 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

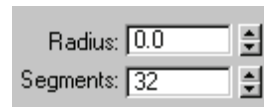
Only import parts of the civil design from AutoCAD Civil 3D that are directly required for visualization purposes in 3ds Max Design. This helps keep the geometric complexity of the scene to a minimum at all times.

Use mental ray Consistently

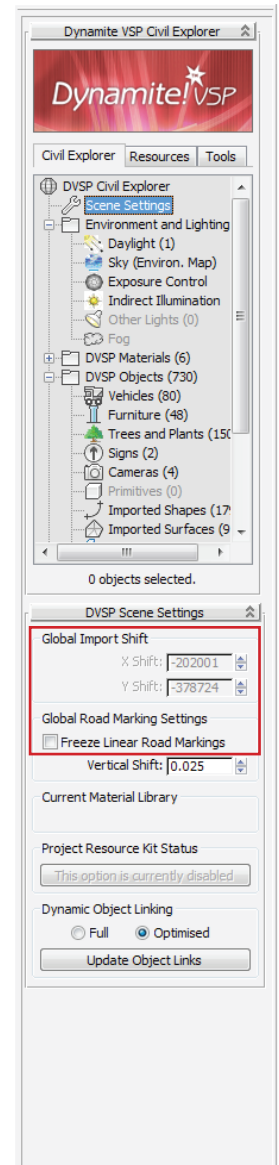
To get the best rendered results from 3ds Max Design, it is recommended to use the mental ray renderer. However, when rendering with mental ray, optimum results can be achieved by also using Arch&Design materials and Pro-Materials, exposure controls, and daylight systems.

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 Dynamite VSP and 3ds Max Design: the dimensions and position of objects.



- 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
- **Most importantly** - 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 Dynamite VSP
- 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

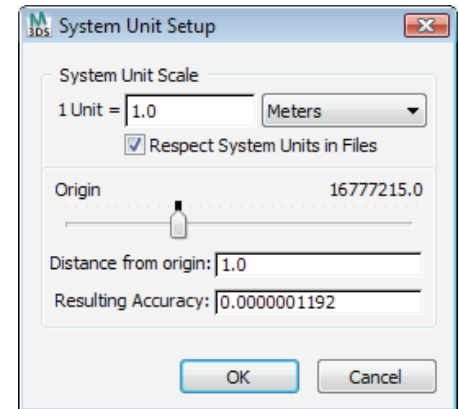
Make sure that you are aware of the current System Unit setting before you start working in 3ds Max Design, and match these against the current units of your AutoCAD Civil 3D project. Don't confuse System Units with 3ds Max Design

Display Units – which don't affect the true scale of the visualization. System Units can be set by selecting Customize > Units Setup > System Unit Setup.

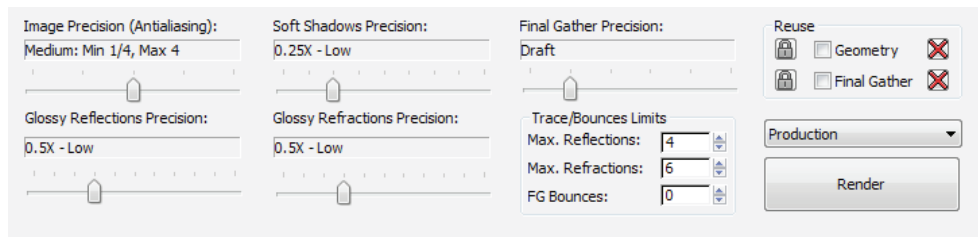
Set Project Folder in 3ds Max Design

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

When you start 3ds Max Design for the first time, the default project folder is \\My Documents\\3dsmax\\, but the Set Project Folder option may be used to specify a different location. The project folder may also be set from the Asset Tracking Dialog > Paths menu. Using a project folder causes 3ds Max Design to automatically create a series of dedicated folders for holding project related information: scene files, 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 Practice for faster rendering



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. These controls can have a huge effect on rendering times, so 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 (see 3ds Max Design Terminology Guide on page 30). 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 only increase to a higher quality setting if the quality of the image is inadequate.

For faster and 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 only increase these values if the quality of the resulting image is inadequate. Do the same for Glossy Reflection, Soft shadow, and Glossy refraction precision.

For faster and draft rendering, use “Draft” Final Gather Precision

These controls provide a range of quick preset solutions for final gathering Precision (see 3ds Max Design Terminology Guide on page 30). 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 only increase to a higher quality setting if the quality of the image is inadequate.

About the Author

Bruce Harfield

Bruce Harfield is the founder of 3AM Solutions (UK) Limited, and the original driving force behind the development of Dynamite VSP.

Before founding 3AM Solutions (UK) Limited, Bruce gained over fifteen years of experience in the civil engineering industry, specializing in the field of highway design using a range of 3D modeling and drawing applications.

Acquired by Autodesk in January of 2010, Dynamite VSP is one of the world's leading design visualization tools developed specifically for civil engineers, with a growing user base spanning 19 countries.



External Links

Autodesk 3ds Max Design Home Page
<http://www.autodesk.com/3dsmaxdesign>

AutoCAD Civil 3D Home Page
<http://www.autodesk.com/civil3d>

Civil Visualization Extension Home Page
<http://www.autodesk.com/civilvis>

3AM Solutions Civil Visualization Community
(includes Civil Engineering Oriented Video Tutorials)
<http://www.3am-solutions.co.uk/community/>

Dynamite VSP User Group @ LinkedIn
<http://www.linkedin.com/groups?home=&qid=2259822>

World File Format Specification
http://en.wikipedia.org/wiki/World_file

White Paper: Using 3ds Max and mental ray for Architectural Visualization
http://images.autodesk.com/adsk/files/mental_ray_white_paper.pdf

White Paper: Daylight Simulation in 3ds Max Design 2009: Getting Started
http://images.autodesk.com/adsk/files/3dsmax_started.pdf

Jamie's Jewels: 3ds Max Design User Newsletter
<http://www.3am-solutions.co.uk/community/userblog/category/C45/>

Appendix A

AutoCAD Civil 3D Object	Description	3ds Max Design Equivalent
Alignment / Baseline	Alignment objects in AutoCAD Civil 3D generally represent 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.	Shape (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.	Shape (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 a overall cross sectional structure of a corridor object in AutoCAD Civil 3D.	Portions of editable meshes and shapes
Subassembly	Subassemblies are a 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.	Shape
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 Mesh
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/Sub-Object Material	Multi/Sub-Object materials enable different materials to be assigned at sub-object levels of your geometry. For instance, for imported corridor surfaces it's 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/sub-object material definition which 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/sub-object 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 which 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 (or Cutout 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 Dynamite VSP 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 Arch & Design materials.
UV Coordinates	When a mapped material is assigned to an object in 3ds Max Design, the object must have mapping coordinates assigned in order to help control the scale and orientation of the map as it is applied to the underlying geometry. Mapping coordinates are expressed in terms of U and V values, which refer to the object's own mapping space as opposed to the X and Y coordinates that determine an object's physical location in the scene. Dynamite VSP generally applies customizable UV mapping values automatically to all surface geometry.