

Using Autodesk® Infrastructure Design Suite for Planning and Conceptual Design

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CI4421-P As a part of the Infrastructure Design Suite PowerTrack, this class will highlight Autodesk® Infrastructure Modeler software as a central tool for use in a multidisciplinary project environment. Participants will build a realistic view of an existing site by using contextual, geospatial data and will then add information at various levels of detail to represent stages in the design process. This will range from conceptual sketches through to civil surfaces and architectural models. Once built, the model will be adapted to act as a central environment for visualizing the as-built site by referencing additional data sources, such as asset registers, as well as linking out to individual design tools and collaboration environments

Learning Objectives

At the end of this class, you will be able to:

- Use Autodesk Infrastructure Modeler to build a model representing existing conditions
- Aggregate design data from Autodesk® Revit software and AutoCAD® Civil 3D® software into a single project environment
- Link from objects in the central model out to other information sources, applications, and collaboration tools
- Add conceptual designs to a model and share the results with users of AutoCAD Civil 3D

About the Speaker

John Allen is a Technical Sales Specialist for Autodesk in Northern Europe. Based in the UK, he is responsible for driving sales and adoption of Autodesk's Civil Infrastructure and Utility solutions, focusing on planning and data management.

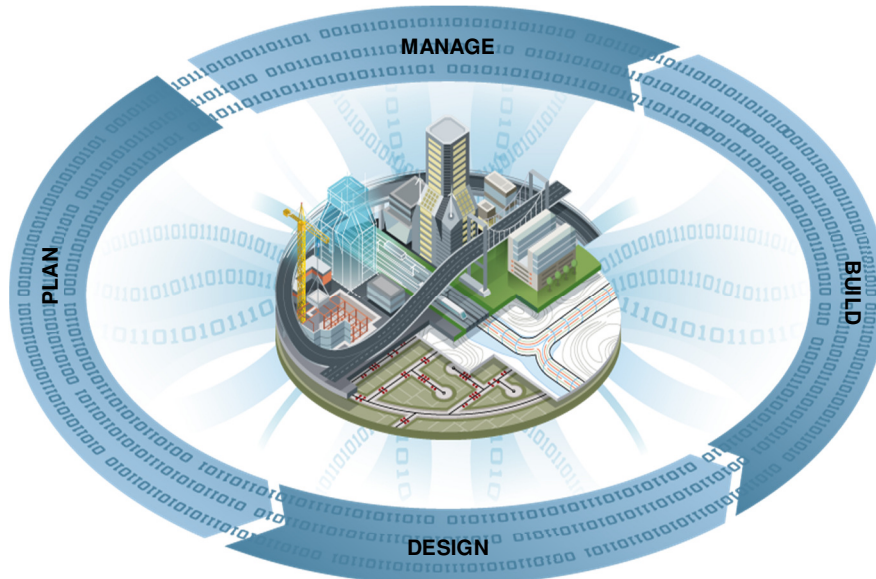
With a background in all things geospatial, he is an expert in utilizing spatial and non-spatial data to achieve results in the form of real business value for customers in industries including infrastructure development, utilities, telecommunications, retail and across the public sector.

BIM for Infrastructure

“Building Information Modeling” (BIM), introduced over several years to the architecture, engineering and construction disciplines, is a phrase and acronym that has evolved to represent something quite different to its initial purpose. BIM can mean many things to many people but a simple definition is as follows:

*BIM is the use of an **intelligent, model-based process** to gain valuable insight to improve how you **plan, design, build, and manage** buildings and infrastructure.*

Given that definition, perhaps the acronym is less important than the overall objectives. After all, many design practices do not yet “do BIM” but certainly want to reap some of the benefits the BIM process aims to achieve, be they productivity in design, efficient collaboration, reduced construction costs or effective asset management.



Recently, the scope of BIM has extended and it has also expanded into other industries and design disciplines. This has had an impact, directly or indirectly, in various areas, for example:

- **Evolution of an acronym.** Shift from “building” as a noun (i.e. “A building information model”) to a verb, meaning that BIM is now regarded as the process used throughout the planning, design, construction and management of the built environment rather than a discrete model.

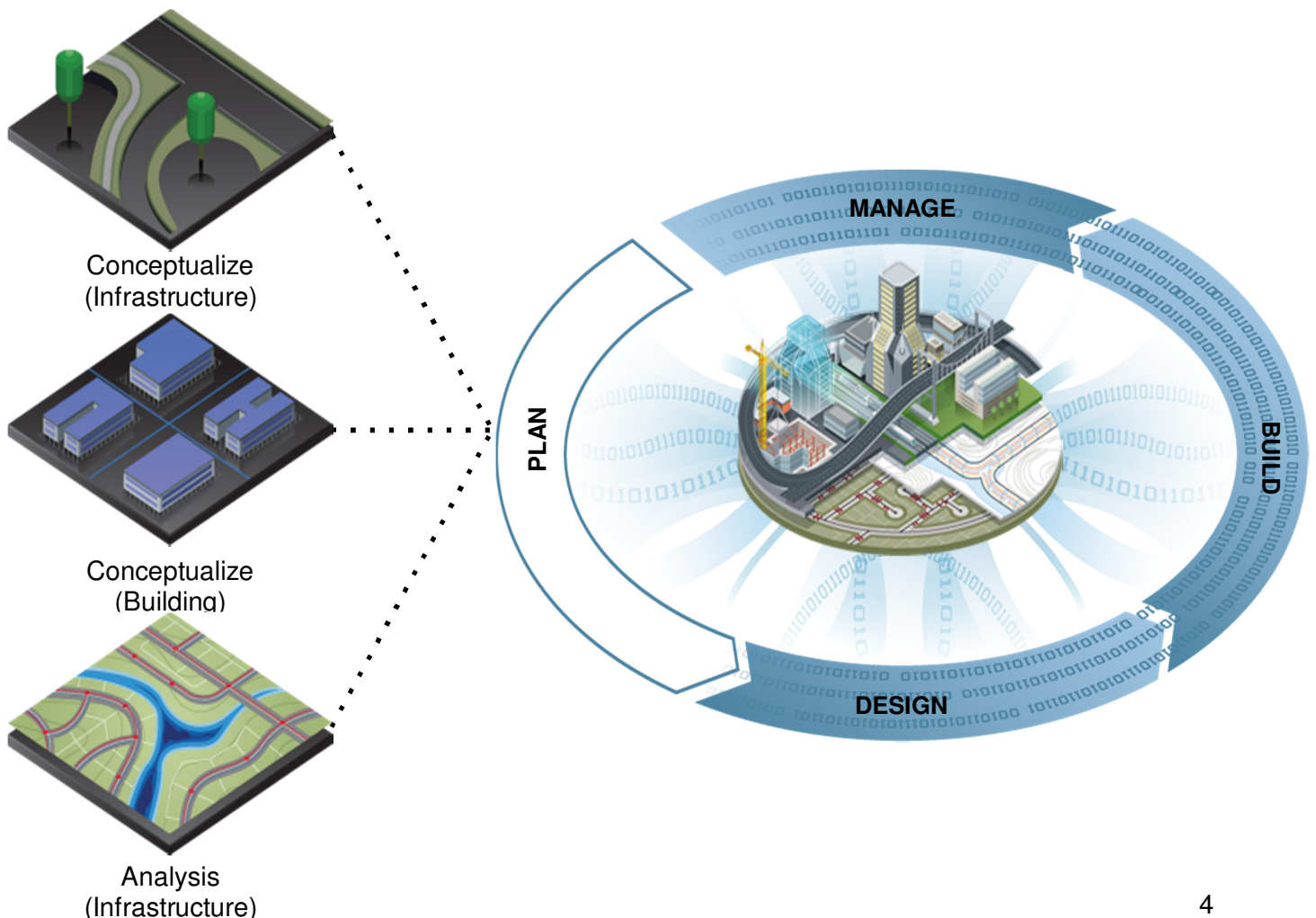
- **Migration to new disciplines.** Increased adoption in infrastructure design, primarily adopting tools such as AutoCAD Civil 3D for parametric design in land and transportation projects.
- **Emergence of the intelligent client.** BIM has been used as a tool for changing the way in which clients are able to be prescriptive about the information they receive from their supply chain to improve the construction, operation and sustainability of assets. The UK government's BIM mandate serves as an excellent example of this, details can be found here: <http://www.bimtaskgroup.org/>
- **Information exchange and a focus on the "I" in BIM.** The drivers listed above place added importance on attribution in design data, linked in a structured manner to the geometric model. In the same way as object related metadata (e.g. Materials) enables quantity estimation, additional attribute such as "date constructed" will help in the future maintenance of an asset.
- **GIS/CAD integration.** A welcome side effect of the emergence of BIM has been an increase in discussions between the CAD community and those focusing on Geographic Information Systems (GIS). Geospatial data is an important input into planning and design activities so an understanding of this technical integration is important, as is the use of data maintenance disciplines often utilized by GIS professionals, adapted for use in a time constrained, project environment.
- **Broader BIM community.** As a result of the expanded footprint of BIM in terms of new disciplines and extended scope, a much broader range of professionals has become involved BIM. As a result, more tools are required to provide technology that is fit for purpose at each stage of the BIM process.

Autodesk Infrastructure Modeler overview

Autodesk Infrastructure Modeler (AIM) is a key solution to support many of the developments listed above. It provides:

- Integration of disparate data types, including GIS data, CAD drawings and 3D models to easily create a combined model of existing and/or proposed conditions as a base for design.
- Tools for creating conceptual designs in accurate geographic context, without the need for engineering expertise.
- Communication options and sharing design ideas with stakeholders.

As such, AIM is a solution that can be used at the early stages of a design process, using a combination of existing information and design workflows that illustrate conceptual designs. Crucially, this information can then be passed to other professionals, such as civil engineers, to add design expertise and standards to the drafted concepts.



Technical Workflow

This document is not intended as a step by step guide to using AIM. For resources to support you in getting started with the software, reference:

- Online training:
<http://autodesk.rguidelibrary.com/Library.spr?username=aimcustomerpublic>
- Product Wiki:
[http://wikihelp.autodesk.com/enu?adskContextId=aimhelp&product=Infrastructure Modeler&release=2013&language=enu](http://wikihelp.autodesk.com/enu?adskContextId=aimhelp&product=Infrastructure%20Modeler&release=2013&language=enu)
- Various Autodesk blogs including:
 - <http://atlandsend.typepad.com/>
 - [http://fromthegroundup.typepad.com/from the ground up/](http://fromthegroundup.typepad.com/from_the_ground_up/)
 - <http://autodesk.typepad.com/bimtoolbox/>

However, it will explain the core components of the workflow presented in this lecture, including:

- Creating a base model
- Generating Proposals
- Sharing proposals and design data

Creating a base model

One of AIM's core strengths is the ability to consume disparate data types into a single model. This can include, structured and unstructured data types, geographically referenced and "flat" data, 2D plans and 3D models.

The preference for creating base models should be to use geographically referenced data types (terrain files, imagery, GIS vector layers) as the software can utilize coordinate information to layer data correctly.

Base data sources vary according to region but in general comprise of a mix of publically held information, commercially available data and proprietary information such as survey, models etc.

Spatial data

- Terrain
- Aerial / satellite imagery
- Building footprints

CAD drawings

- Utility networks
- Floor plans

3D models

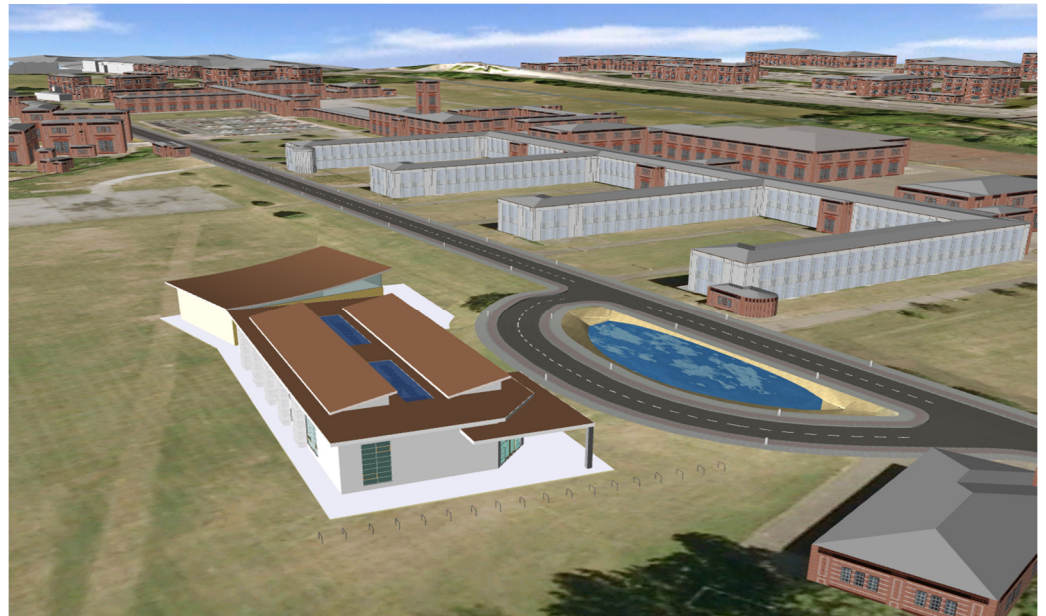
- Architectural models
- External 3D content

Design data

- Transport links
- Utility networks

New data

- Sketched proposals
- Attribution



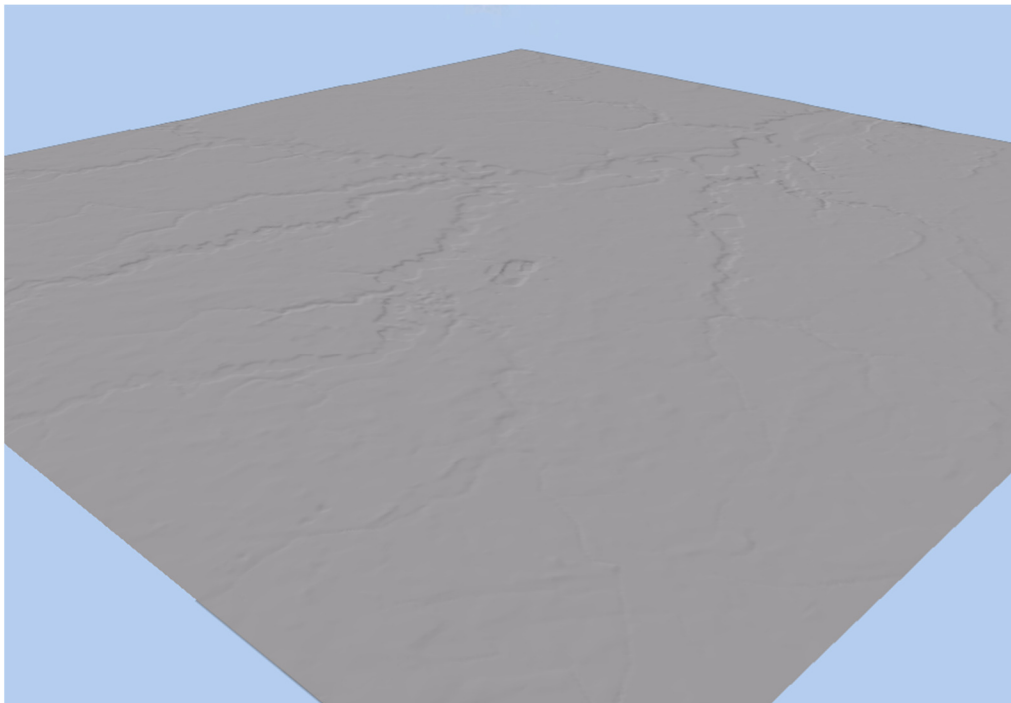
The example workflow demonstrated in this lecture uses a variety of data for Greater Millsboro in Delaware, USA. This will be used to form a picture of existing conditions in the area, which will be used as a base to evaluate multiple design proposals for a new river crossing.

The following section will summarize the settings used when importing each layer but in general the key components to consider when importing data are:

- Data type (format, source, vintage etc)
- Native coordinate system of the data to locate the data on the earth's surface
- Any attributes (columns in the source data) to be used in the AIM model, e.g. height, land use.
- Classification (e.g. buildings, terrain, roads etc)

Terrain

The first data set used is a terrain model. To open this, a Terrain Data Source is created, referencing a geo-referenced digital terrain model (.TIF file) for the area. With terrain data, there is little to configure other than the coordinate system, which in this case is DE83. The terrain appears in 3D as follows:

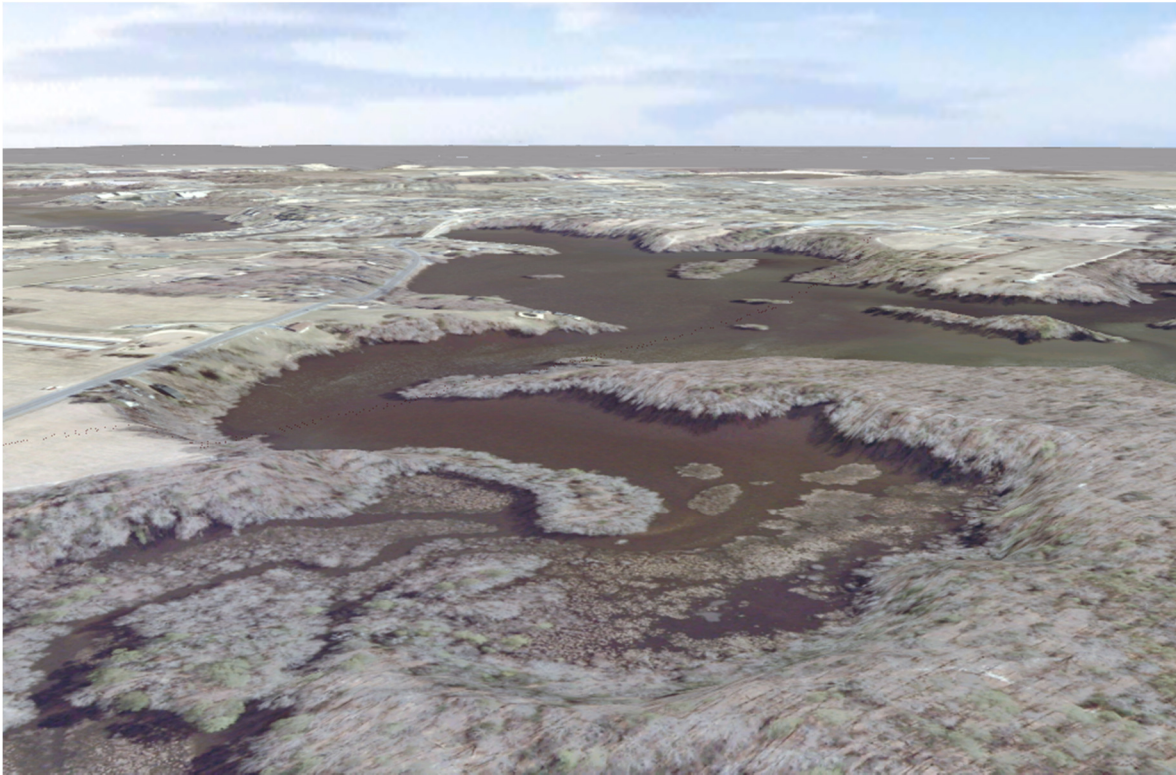



Imagery

Aerial photography can then be draped over the image. Note that in this case the imagery is contained in multiple, tiled images. As such it is best to connect to multiple files simultaneously

rather than having to handle each file separately. In this example, the imagery is contained in JP2 files, which are supported by XML files in the same directory to provide the geo-referencing.

The software detects these files and automatically tiles and locates the images, so only the coordinate system (DE83) needs to be defined. The draped image appears as below.



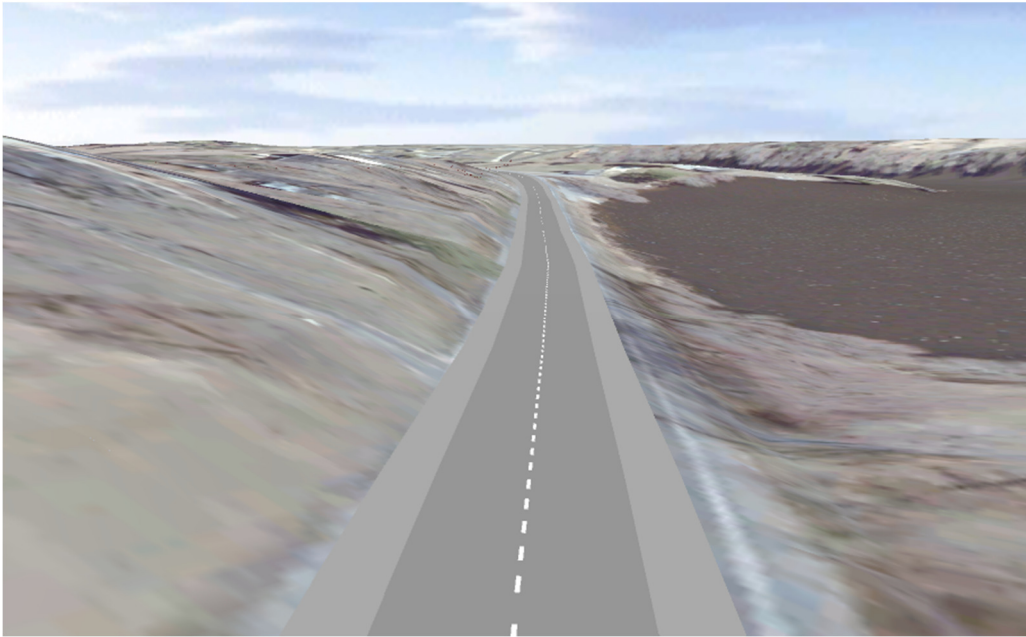
TIP! It can often occur that different data types cover different areas so you may wish to limit the extents of the model displayed in AIM. To do so, go to Model Settings in the  application menu, uncheck “Use Entire Model” and define the new extents, using either a bounding box or user-defined polygon. In this case, this setting could be used to clip the model to the extents of the aerial imagery.

Roads

Road data often comprises 2D center lines, which AIM can drape onto the terrain and display using pre-compiled display models. To achieve the view needed for this exercise, the following settings are used:

- Coordinate system: HARN/MD.DE
- Drape on terrain
- TYPE field (road classification column) configured as the User Data field in AIM

The road data appears as follows, using a common style for all roads:

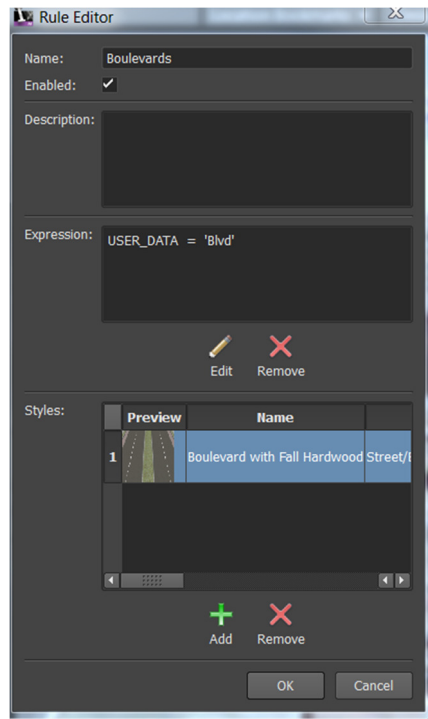


TIP! Displaying data correctly can be a case of trial and error if you do not know the data you are using. For example, you may not be sure of the coordinate system. If this is the case, it is a good idea to use AutoCAD Map 3D (or the Planning and Analysis workspace in AutoCAD Civil 3D) to validate the data as it displays data quicker than AIM, which tiles the data for smooth navigation. This is also helpful if you want to interrogate the attribute data to see which columns would be useful in your AIM model. In this case the geometries and data table for the Roads data is displayed below in AutoCAD Map 3D. The TYPE column contains useful data on road categories.

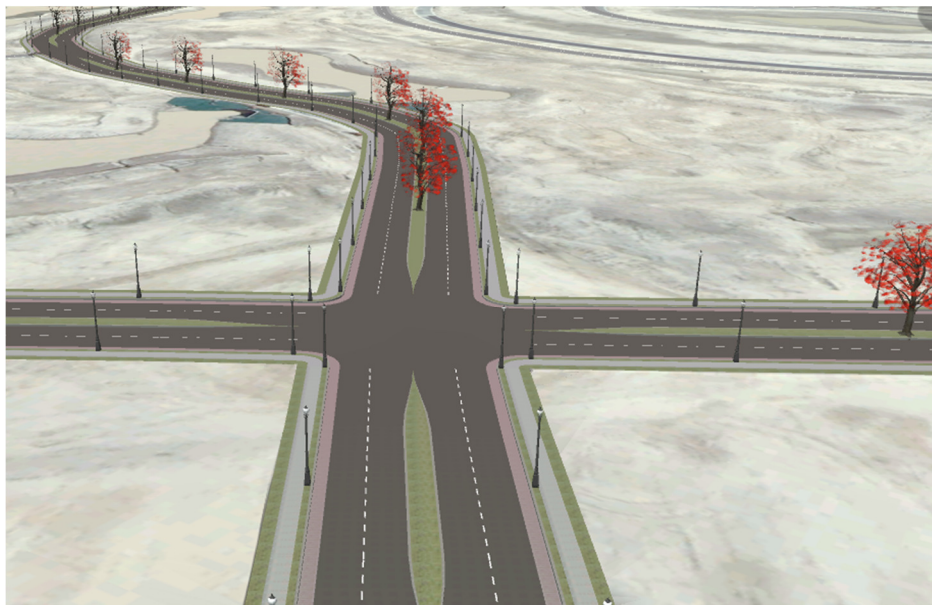
S_T_ADD	PREFIX	PRETYPE	NAME	TYPE	SUFFIX	FCC	POSTAL_L	POSTAL_R	NAME_TY
Null>	<Null>	<Null>	Connecting	<Null>	Null>	A60	19966	19966	R
5434	N	<Null>	Oak	Dr	Null>	A41	19966	19966	R
8151	<Null>	<Null>	Fox Run	Rd	Null>	A41	19966	19966	R
5586	<Null>	<Null>	Bertha Cam	Rd	Null>	A41	19947	19947	R
5954	<Null>	<Null>	Country Me	Dr	Null>	A41	19966	19966	R
4998	<Null>	<Null>	Zoar	Rd	Null>	A41	19947	19947	R
4201	<Null>	<Null>	Whispering	Ln	Null>	A41	19947	19947	R
Null>	<Null>	<Null>	Blackberry	Rd	Null>	A41	19945	19945	R
5116	<Null>	<Null>	Blueberry	Ln	Null>	A41	19945	19945	R
2613	<Null>	<Null>	Hickory Hill	Rd	Null>	A41	19966	19939	R
3237	<Null>	<Null>	Hickory Hill	Rd	Null>	A41	19966	19966	R
1460	<Null>	<Null>	Hickory Hill	Rd	Null>	A41	19966	19966	R

Style Rules

It is possible to apply styles based on attributes in the data. In this case the settings below are used to display Boulevards (defined using the “Bldv” abbreviation in the source data) with a specific style:

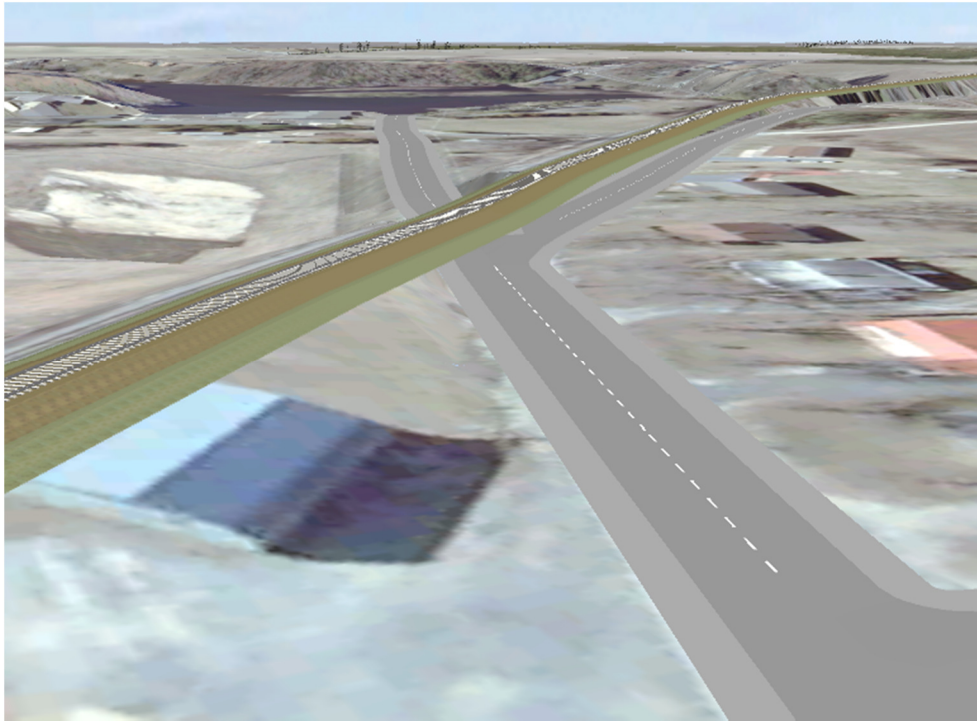


This results in the display below.



Rail

Railway lines are configured in a similar way to roads. However, in this case it works well to set a level elevation for rail data rather than draping it on the terrain, as it appears unrealistic to see railway lines following rapidly changing terrain. The elevation is set to 25m in this example and the data appears as below. Note the difference in behavior between the draped roads and flat rail.



Parcel data

The final data set used contains 2D polygons representing land parcels. This will be imported as Coverage Areas in AIM and will reference attribute data to highlight high value land, to be avoided in the development of new roads. In this case the data was pre-filtered in AutoCAD Map 3D but this can also be fulfilled during the import process in AIM.

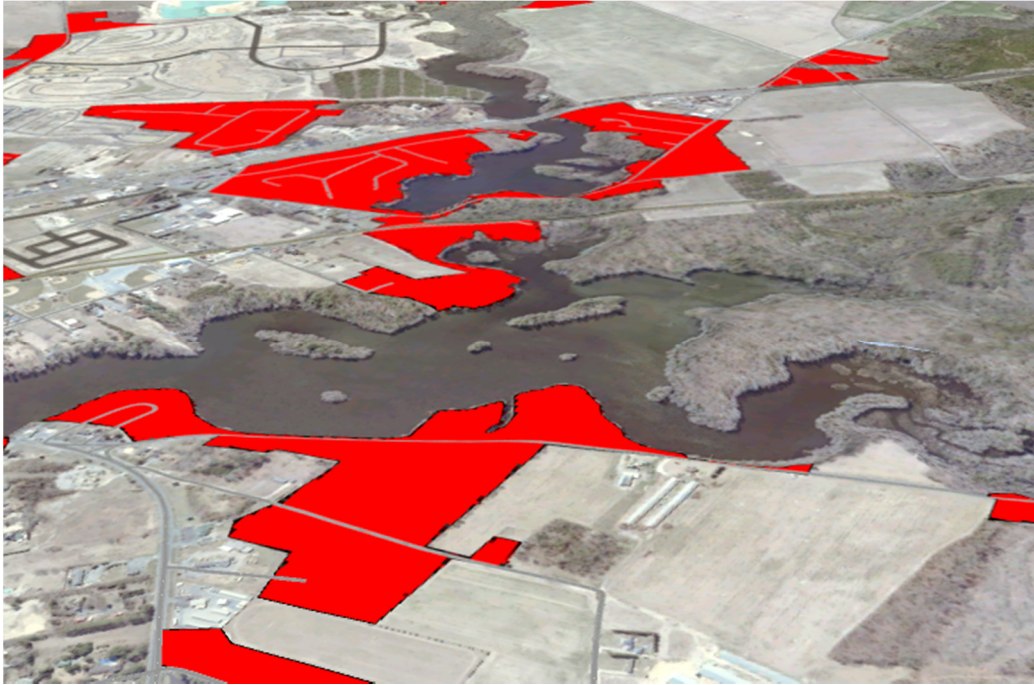
The data was filtered to only show parcels with the word “dwelling” in the classification column, The syntax for this is **<LANDUSECOLUMN> LIKE '%dwelling%'**

To import the data in AIM the following settings should be used:

- Drape on terrain
- Coordinate system: DE83

- LandUse07 field (parcel classification column) configured as the User Data field in AIM
- Tooltip set to %User Data% to reference the parcel data

The model is displayed as follows:



Generating Proposals

A key feature of AIM is the ability to generate designs on the base model. The proposals feature is used for this as it allows the user to make changes to the model without affecting the master model or other proposals.

Note that it is important to create a new proposal for each design alternative as this makes the model easier to manage and share with other stakeholders.

In this example, three proposals will be created to ease traffic congestion on the existing river crossing. These are:

1. Widen existing bridge and connecting roads
2. New tunnel to north
3. New bridge to south

Proposal 1: Widen existing bridge and connecting roads

This proposal is very easy to create as it simply involves changing the properties of the existing road objects. By dragging the City Highway style from the Style Palette onto the desired roads, the model is changed to display as follows:



Clearly this is not desirable as the road widths cause an issue in the built up area around the existing bridge. The access route also cuts through a high value parcel as shown below:

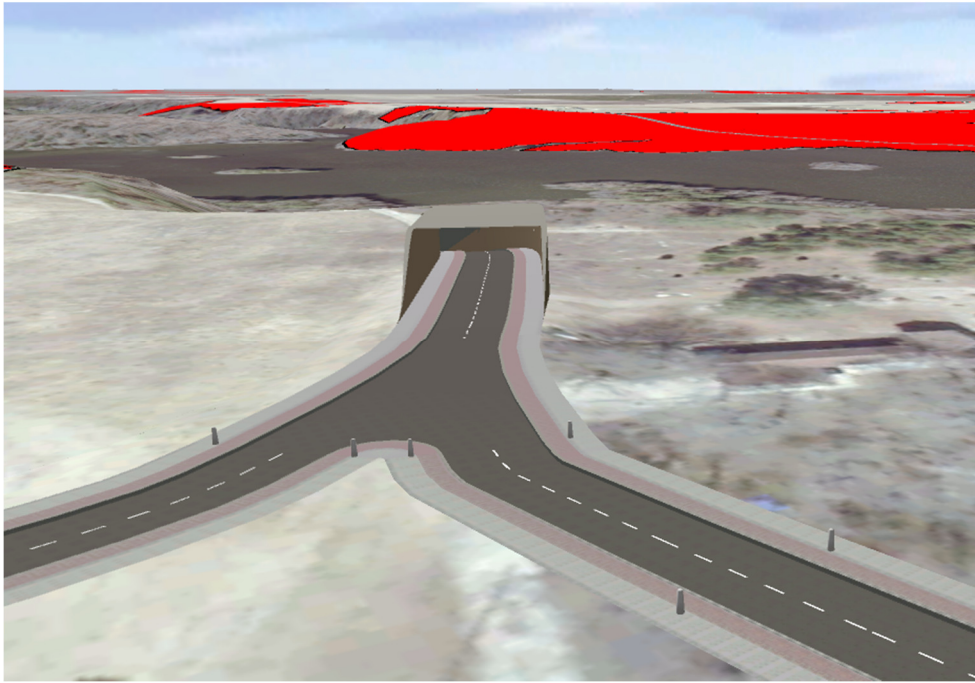


Proposal 2: Tunnel to North

The second proposal requires the use of the drawing toolbar to create a new road using the Tunnel style. This is sketched onto the existing road network as follows:



The nodes of the tunnel can then be dragged to appear below the surface, and the ends of the roads can be modified to create smooth junctions as follows:

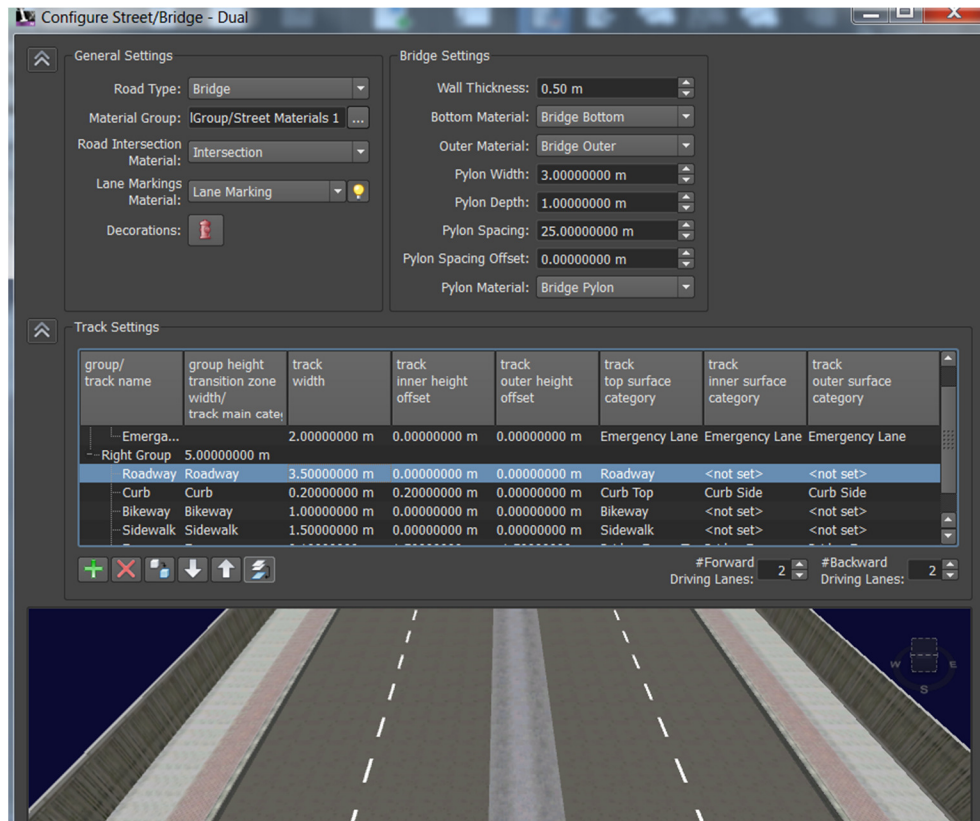


A potential issue with this proposal is cost. AIM can give an early indication of this using the terrain statistics tool as below:



Proposal 3: New Bridge to south

This proposal also involves the creation of a new road, this time with a bridge style. The road style editor can be used to modify the existing style, in this case to change the default style to 2 lanes each way and add emergency lanes. The configuration dialog is as below:



This can be repeated to create a style for the adjoining access roads.

To create the new road network there are 3 steps as follows:

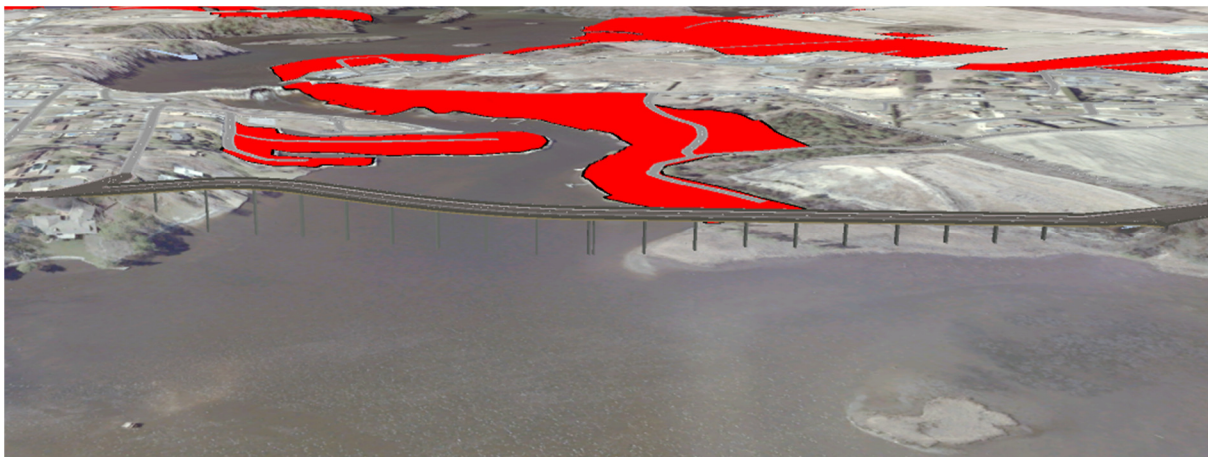
- a. Sketch access road on the North bank of the river



- b. Change the style of the roads to the south of the river



c. Sketch the new bridge

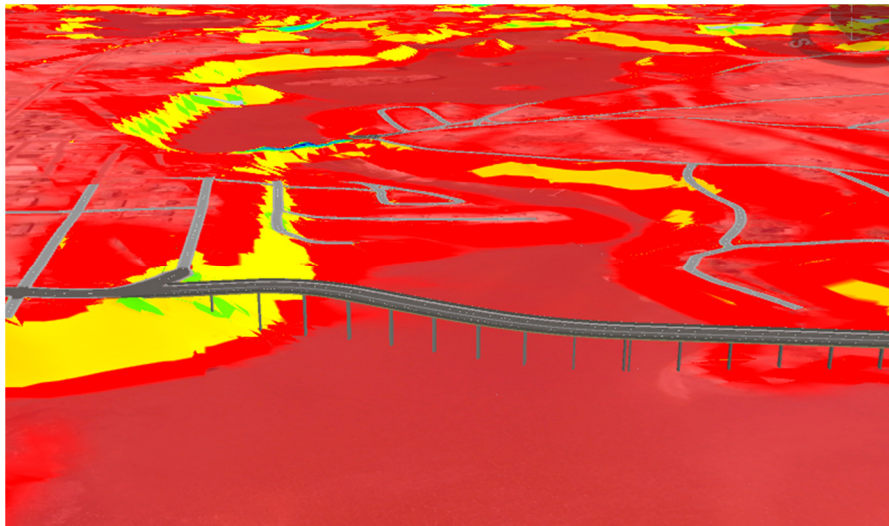


In this case it should be assumed that proposal 3 is the preferred option so this will be the focus for the rest of the lecture.

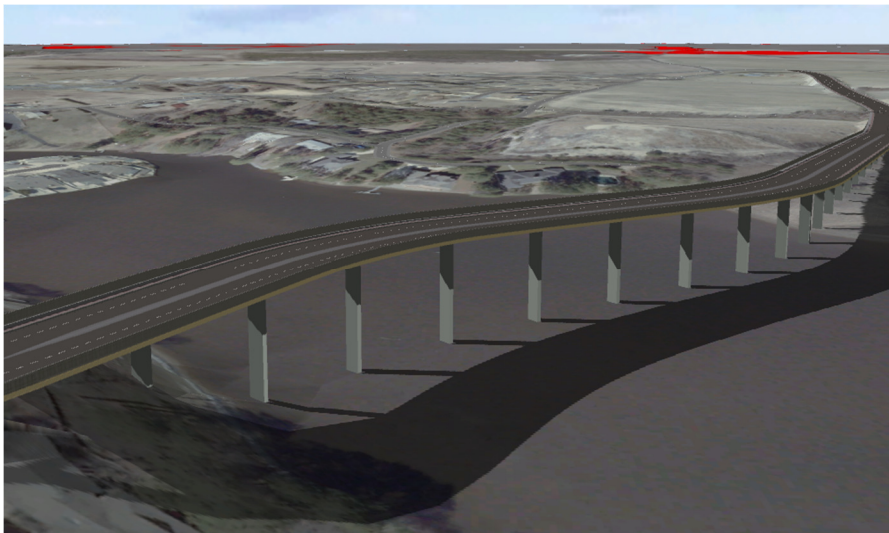
Enhanced display and analysis

Having created the conceptual design, it is necessary to evaluate it. AIM has several analytical and display capabilities. AIM's analytical capabilities apply display settings depending on the data used in the model to aid in decision making during project feasibility assessments. Examples include:

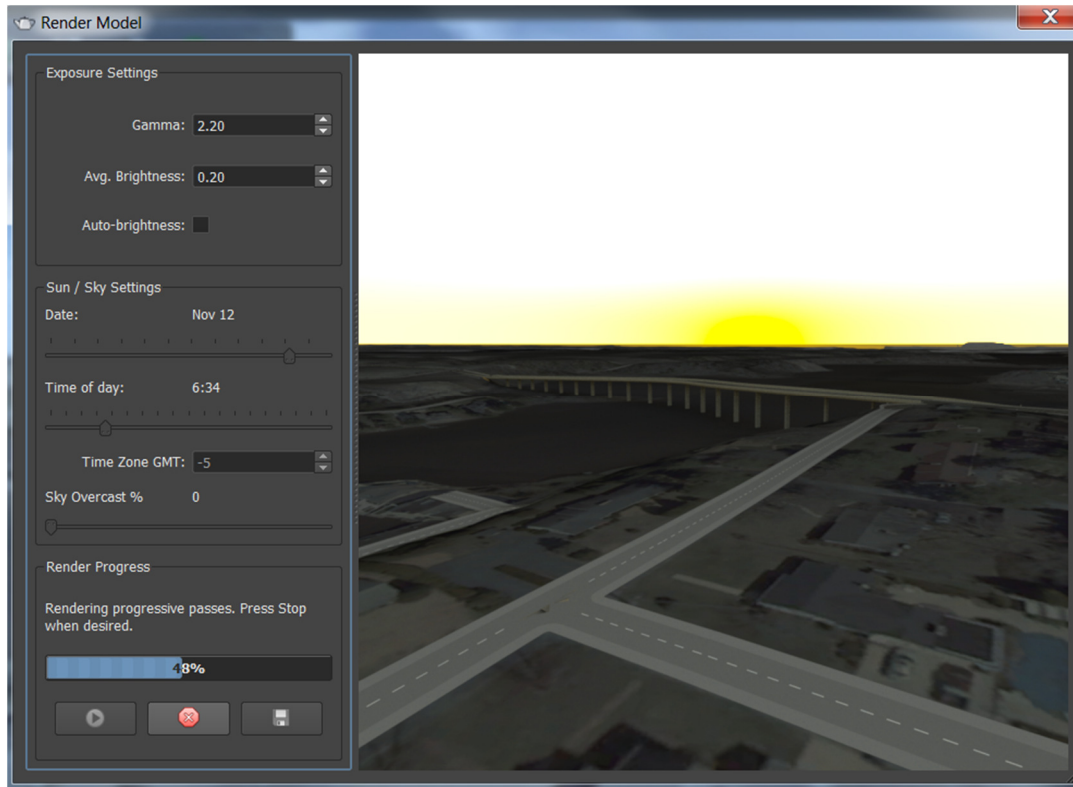
- Terrain analysis (slope, elevation, aspect)



- Sun / shade analysis (geographically accurate and with control over date / time)



AIM also has in-built rendering capabilities, which can be used to create enhanced, rendered views of the model without the need to export to dedicated rendering software.



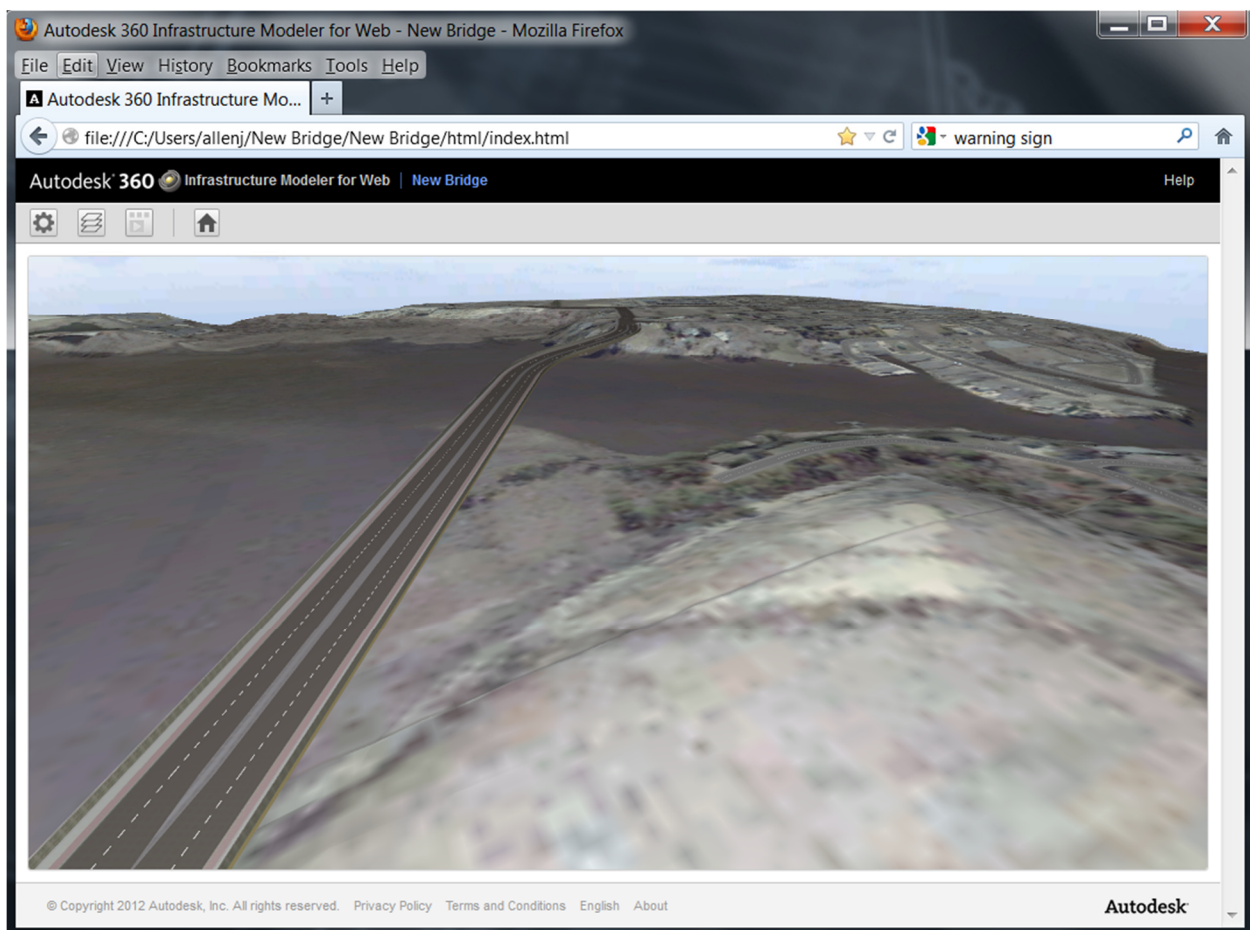
AIM can also be used to generate model snapshots as well as video fly-throughs.

Sharing AIM models and Data

Crucial to the BIM principle is the ability to share data created at any stage of the process and that this information should be accessible as a base for other project stakeholders. In this case, the model should be shared with colleagues in master planning as well as civil engineers and the client.

For sharing the model view with the client (or any interested party), it is possible to publish a section of the model (a “scenario”) to the AIM 360 cloud service, which stores the model and makes it accessible to users from a web and mobile (iPad) interface.

The screenshots below show the bridge proposal published to the web and mobile.





For more technical users, it is possible to share AIM data for use in other applications.

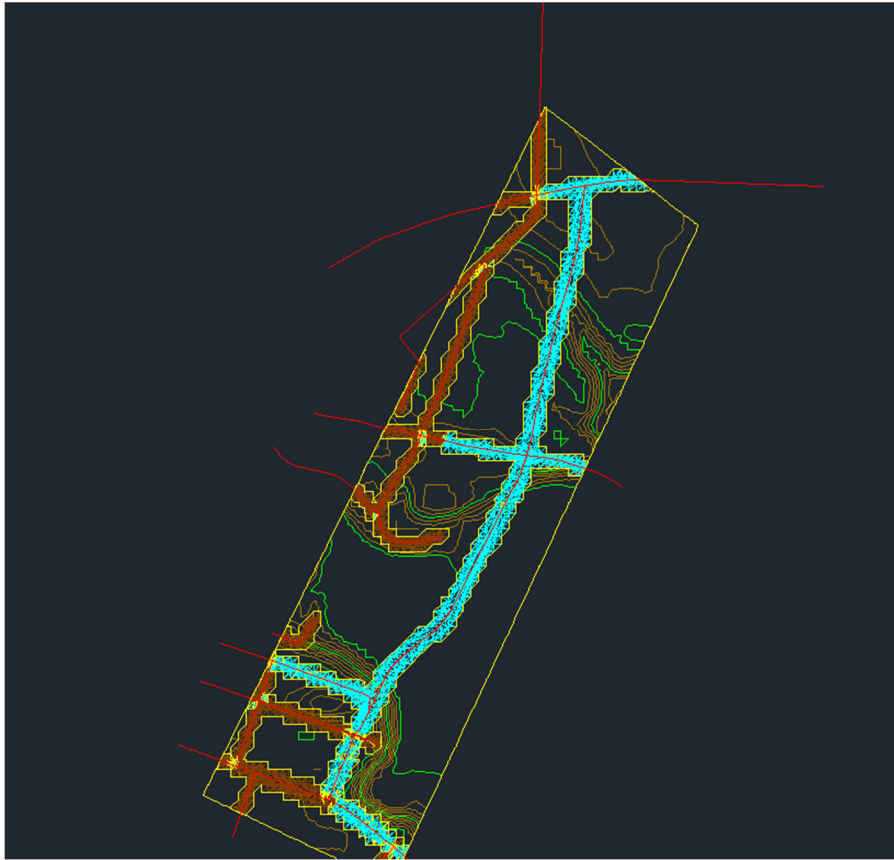
AutoCAD Map 3D

Data can be created in AIM and then consumed and edited in AutoCAD Map 3D, using SQLite (the format used by AIM for storing the model) as the central data format. Simply refresh the model to view changes made in other products.

AutoCAD Civil 3D

Can also consume the SQLite data directly as it is built on AutoCAD Map 3D.

It is also possible to pass data between AIM and AutoCAD Civil 3D using IMX, which contains design geometries as well as terrain data and can be used as a base for detailed design work. The IMX file for the bridge proposal is shown below in AutoCAD Civil 3D.



Autodesk Revit

Import Revit models as FBX to view detailed architectural models in accurate spatial context.

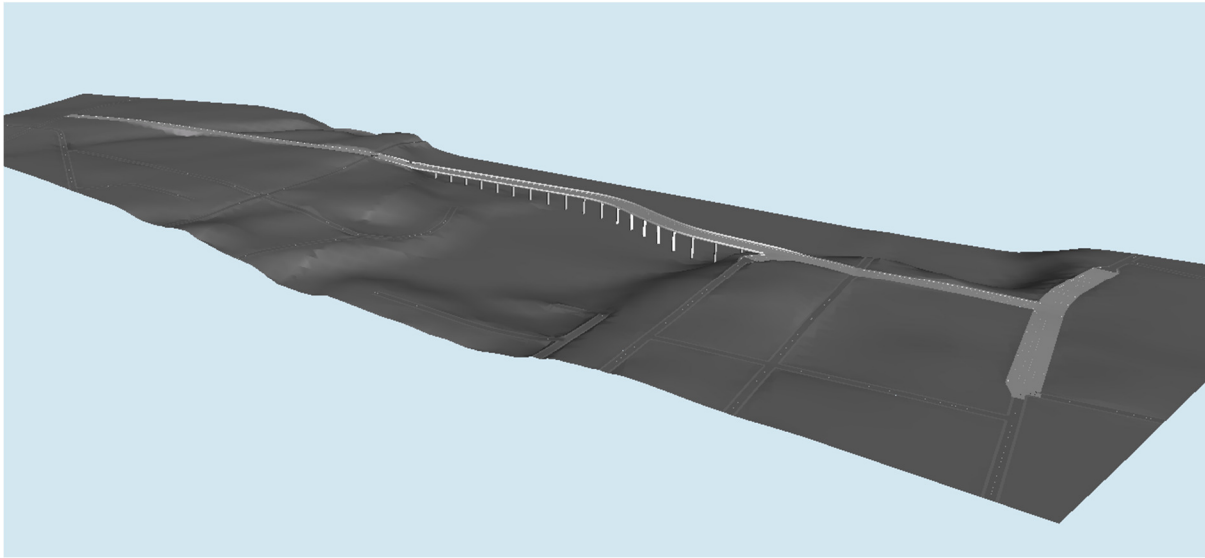
3DS Max Design

There is a “send to 3DS Max Design” option in AIM that can be used to export the model for more advanced rendering.

It is also possible to import models as 3DS to view detailed architectural models in accurate spatial context in AIM.

Autodesk Navisworks

Export sections of the AIM model to FBX for use in Navisworks as shown below.



Many of these integration points will be shown in the later sessions in the Infrastructure Power Track, which will progress the project from the conceptual design stage that has been the focus of this session.

The later sessions will also highlight the ways in which the AIM model can be updated as the project progresses, with more proposals being added to incorporate more detailed design data (e.g. road and bridge structure).

Enjoy AU 2012!

John Allen