AUTODESK UNIVERSITY 2014

Using InfraWorks 360 for an infrastructure project in the cloud.

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CV5631-P

Coordinators of Building Information Modeling (BIM) and CAD from COWI will show how the company has been using InfraWorks 360 software and the cloud to collaborate, and how the projects model of the new E16, the single biggest contract for a road project that the Norwegian Public Roads Administration has ever announced. The team at COWI took a new approach by using InfraWorks 360 software for the main visual model in an infrastructure project. This experience has given the team many valuable benefits, which contributed to optimizing the design. The main goal of this class is to share some of the methods that the COWI team used. The team used InfraWorks 360 software in the initial phase of the project and then decided to use the power of the software and the cloud to perfect and convey the design as the project moved on. The process started with importing data in different formats into the model, sketching the road in InfraWorks 360 software to end up with a precise infrastructure design in InfraWorks 360. This is an infrastructure cloud-project in InfraWorks 360, from start to end—the COWI way.

Figure 1. Vorma bridge

Learning Objectives

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

- Gain knowledge about how a full infrastructure project can be conducted in InfraWorks 360 software.
- Learn how to utilize geographic information systems (GIS) in the early parts of the design process.
- Learn how to get precise road data into InfraWorks 360.
- Learn how to communicate your design to your clients through the cloud.

About the Speakers

Frode Sætre

Frode Sætre is a landscape architect working at COWI. Working as a landscape architect in a multidisciplinary firm has given Frode the opportunity to work with a wide range of projects. Combined with his interest in 3D and BIM, these tasks have given him a beneficial understanding of digital interaction between the different disciplines and their platforms. Frode holds a master's degree from the Norwegian University of Life Sciences in Ås, Norway. He was also an exchange student at California Polytechnic State University, San Luis Obispo, California.

Frode also has the role as CAD-coordinator for COWI Oslo, working with implementing BIM-strategies into infrastructure and landscape projects.

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Gjermund Dahl

Gjermund Dahl is a road planner in COWI. He has a Bachelor in Engineering from Østfold University College and Master of road and land planning from the Norwegian University of Science and Technology, before starting in COWI in 2009. In many of COWI's large infrastructure projects he is a BIM-coordinator and has been responsible for the preparation of collaboration models, procedures and quality assurance of model deliveries. He has also gained many experiences on the use of 3D models in the construction phase.

Gjermund represents roads in COWI's BIM for infrastructure network. There, he works with internal training, development, project structures and participation in relevant fora. He has been involved in the revision of the Norwegian Public Roads Administration BIM manual.

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COWI

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The E16 project, Nybakk to Slomarka

The new E16 is a 4 lane, 32 km long highway situated in the east of Norway. It is the single biggest contract for a road project The Norwegian Public Roads Administration has ever announced. The project is in a preliminary stage, which has a 10% cost accuracy. Our delivery includes a zoning plan and a BIM-model. In this course we will show how we used the BIM-model throughout the project, communicating with our client, stakeholders and colleagues.

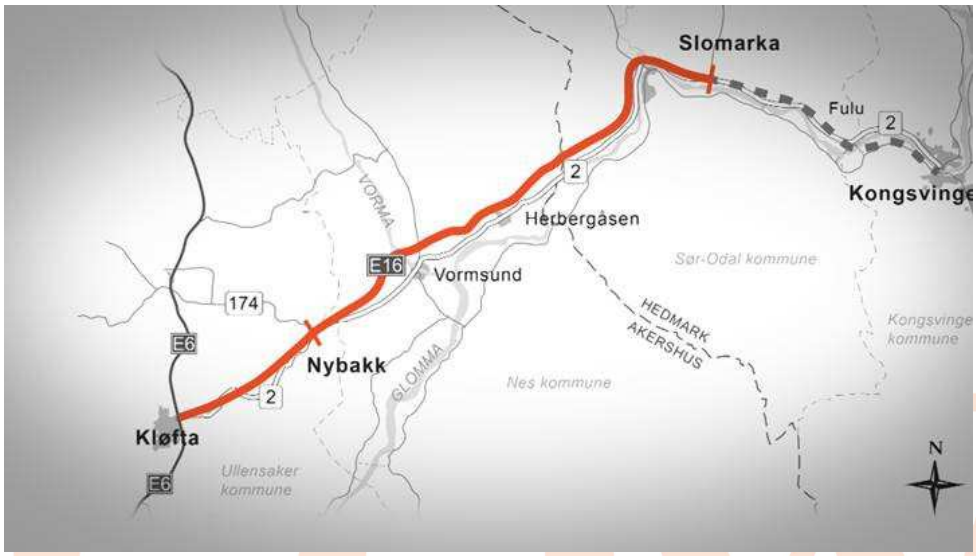


Figure 2. Project area

Gain knowledge about how a full infrastructure project can be conducted in InfraWorks 360 software

The Process

The process working with the model can be divided into 3 parts.

- *Existing situation model*
- *Conceptual design model*
- *Preliminary design model (10% +/- cost accuracy)*

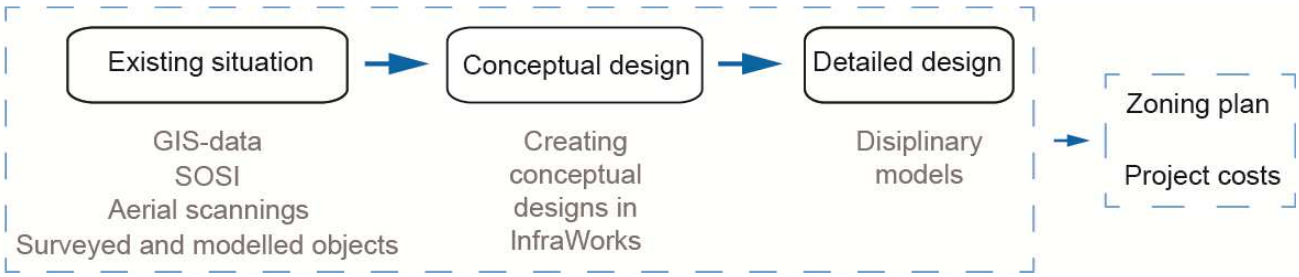


Figure 3. These three stages of the model, made the basis for the zoning-plan and project costs.

Existing situation model

In the first meeting with our client, 3 weeks after the project was won, we showed a model with the existing conditions of the project area, and the road that was planned in an earlier stage. Already then the process of planning the new road started in a 3D-environment with the client. The existing model contained many of the preconditions for the project, as natural environment, flooding and geotechnical analyses etc. By getting the preconditions of the project visualized, a good basis was made for the decision-making that was to come.

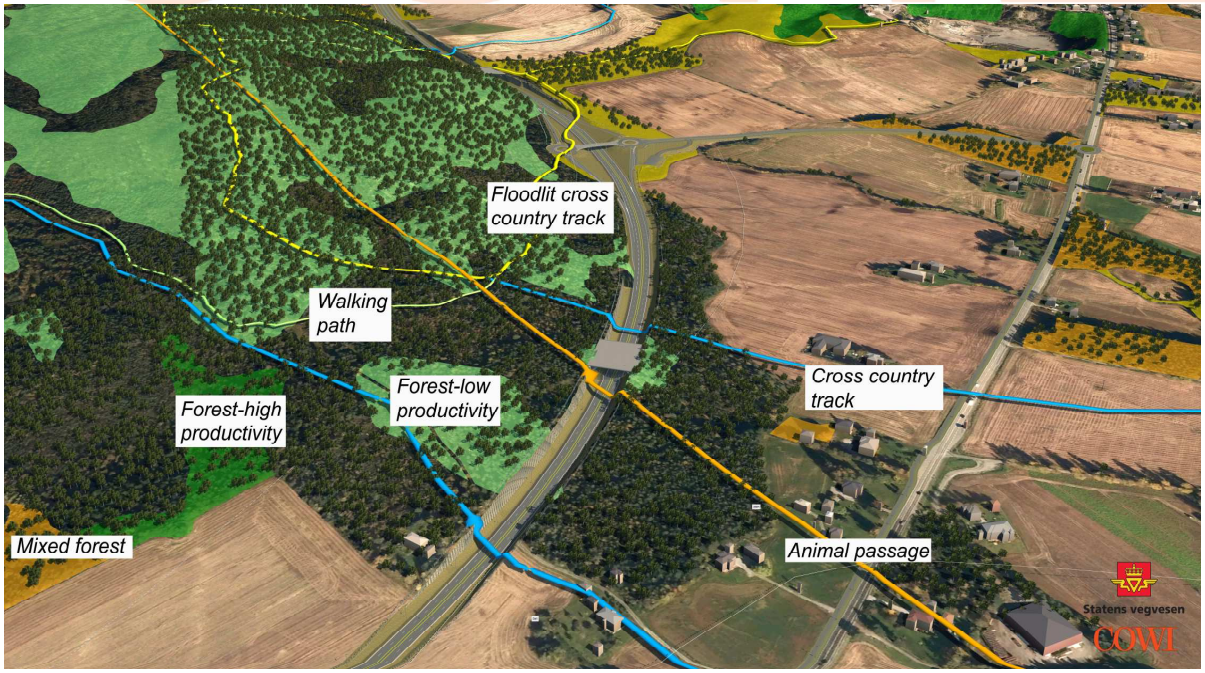


Figure 4. Vizualizing GIS information

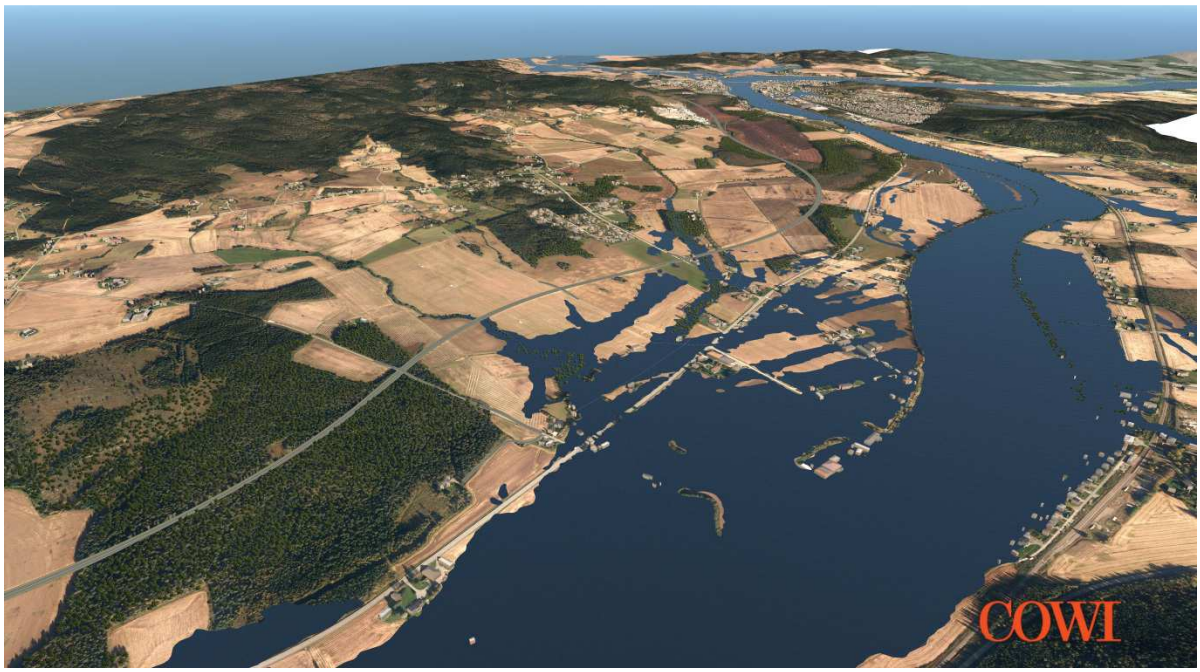


Figure 5. Planning the road to avoid future flooding

Figure 6. Earlier proposed road divides the properties

Formats used for importing data to the existing situation model

	JPG/JPW	.IMX	.SDF	.SHP	.DWG	.FBX
Terrain						
Contour lines			X			
TIN-surface		X				
LandXML		X				
Surface boundary				X		
Aerial photo	X					
Buildings						
Outline buildings				X		
Roof edge line			X			
Vegetation			X	X		
Construction						
Solids					X	X
Water/drainage						
Solids					X	
Lines and points			X		X	

Conceptual design model

The model was used for drafting proposals together with both the client and stakeholders. The model was brought to meetings and different options and proposals were discussed and changed during the meetings. The different proposals were then synced with the rest of the COWI design-team and refined before the next meeting. As parts of the model started to finish, the design-team started working on these parts and refined them from concept to detailed design.

Figure 7. Consept road conflicts with golf course

Figure 8. Conseptual construction design

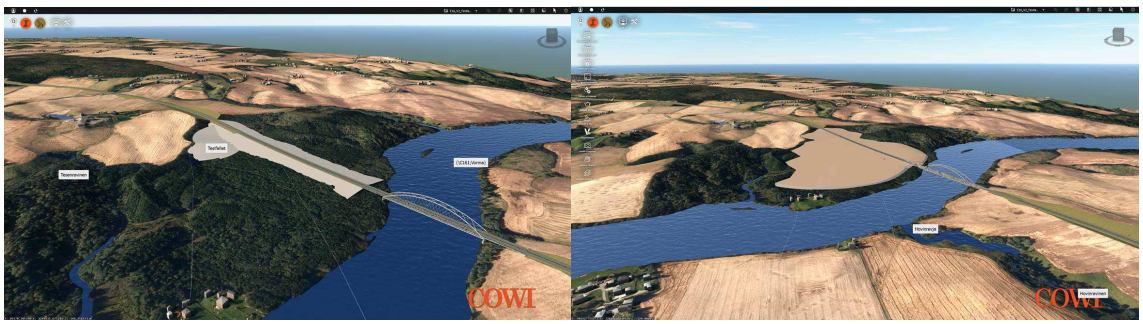


Figure 9. Conceptual model. Re-use of cultural land. Stability improvments

Detailed design model

The detailed design model was made on the basis of disciplinary models. Each discipline made their model in their preferred software, and then imported this into InfraWorks. The goal was to make a model that would show the detailed design of the project.

- *Roads, drainage, water, electrical, geotechnical used Novapoint software*
- *The Landscape architects used Autodesk Civil3D.*
- *Bridge used both Novapoint, Autodesk Civil3D and AutoCAD Architecture*

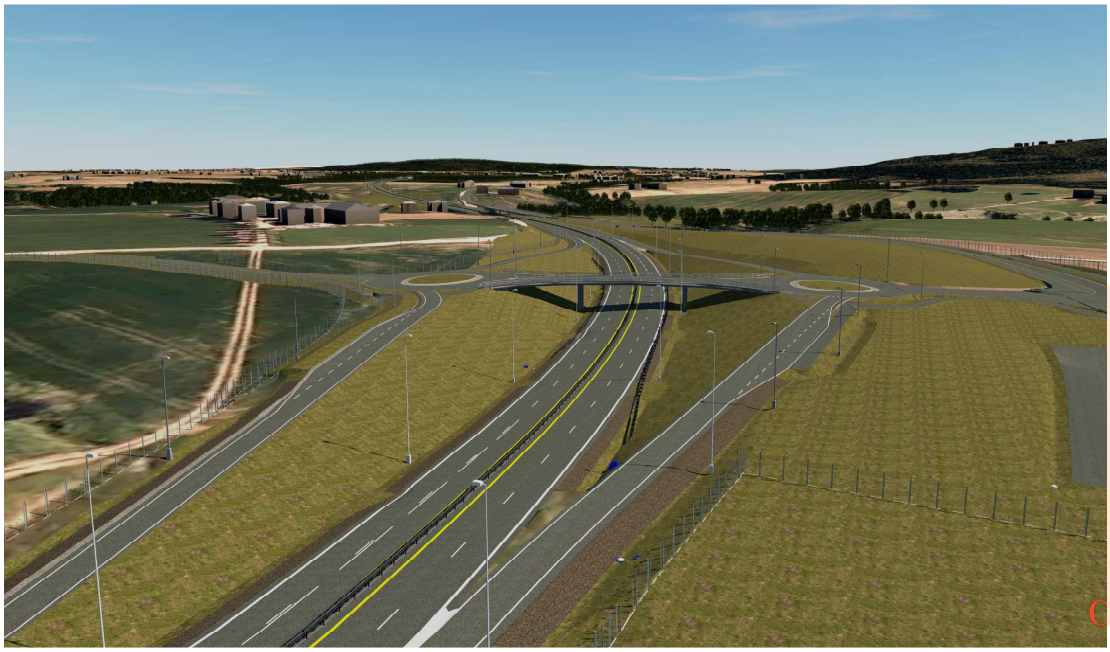


Figure 10. Detailed design model. Intersection

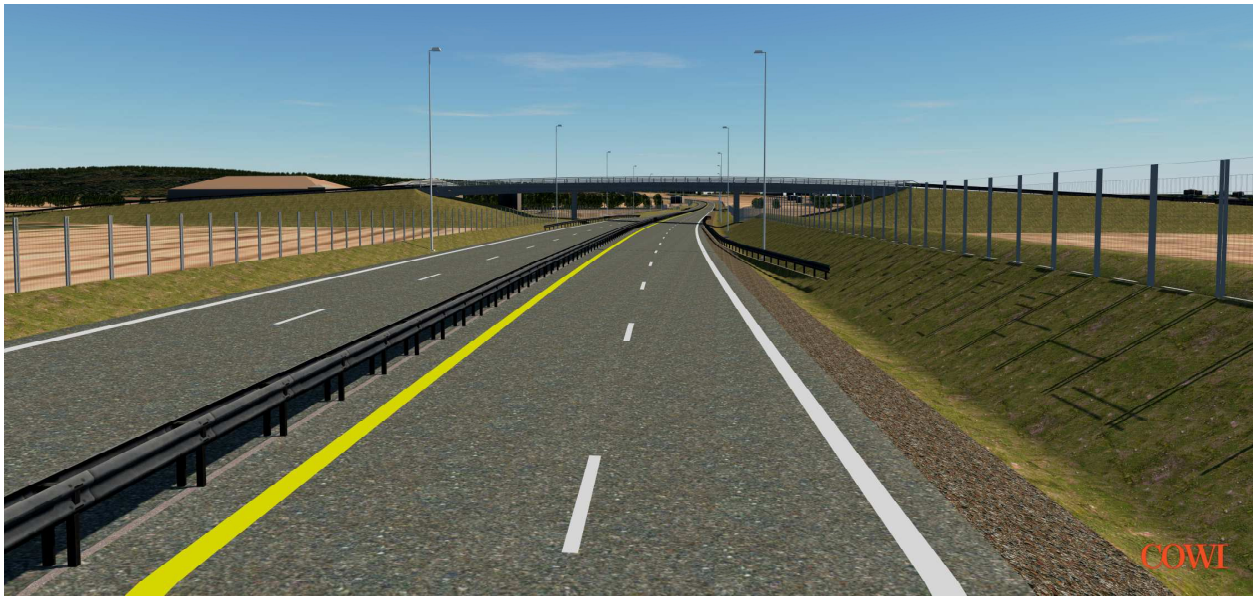


Figure 11. Detailed design model. Model from a drivers view

Formats used for importing disciplinary models:

	.IMX	.SDF	.SHP	.DWG*	.FBX*
Roads					
Alignment	X	X			
Terrain TIN	X				
Civil3D corridor	X				
LandXML	X	X			
Surface boundary			X		
Landscape					
Terrain TIN	X				
Surface boundary			X		
To make objects (points or lines)		X			
3D Objects					X
Construction					
Solids				X	X
Water/drainage					
Solids					

* Material attached in AutoCAD before exporting to .FBX

Learn how to utilize GIS in the early parts of the design process

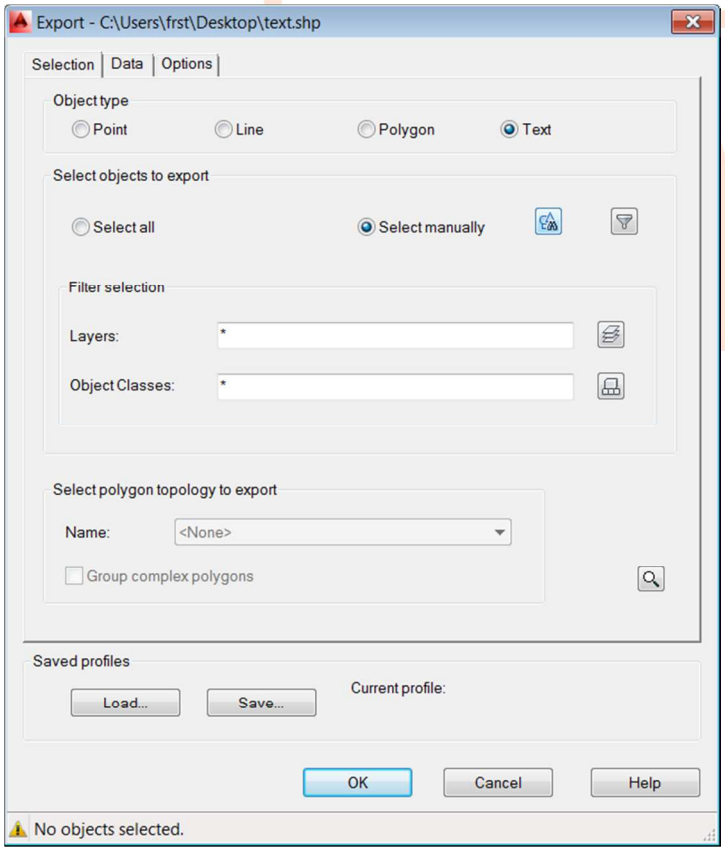
We were able to import and visualize many different kinds of GIS-data. One of the most beneficial methods was to import GIS data to visualize names of places and profile numbering on the road. This was done by doing the following:

Using hyperlinks for text in InfraWorks

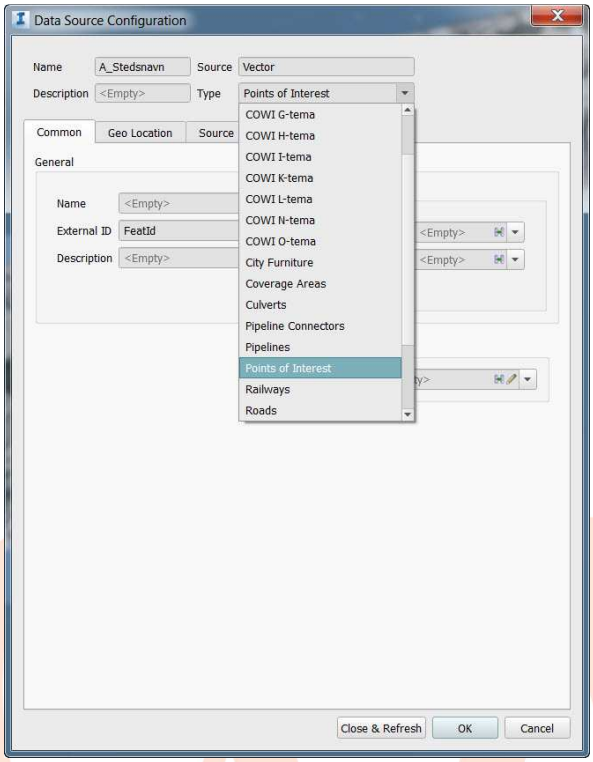
Showing the station text of the road and names of places was important for place recognition in the model. This was done by importing text into InfraWorks, using the following method:

1. *Use the command **MAPEXPORT** in AutoCAD/Civil 3D to make a .shp file.*

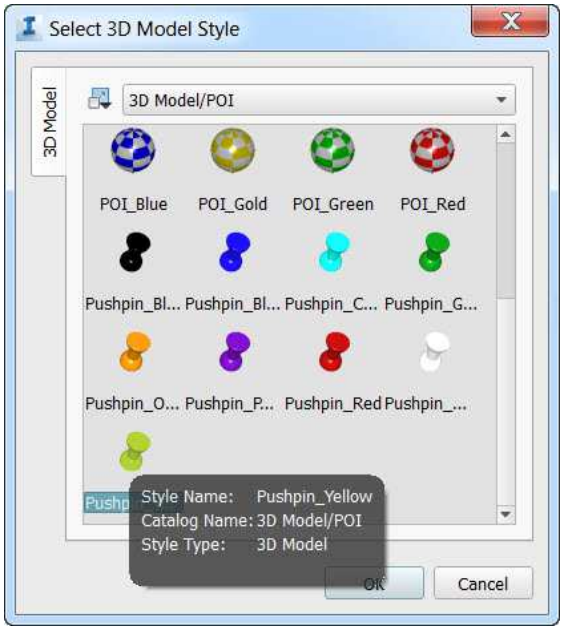
- *Object type: Text*
- *Select your text manually*
- *Press OK to export. You now have a .shp file to import to InfraWorks.*



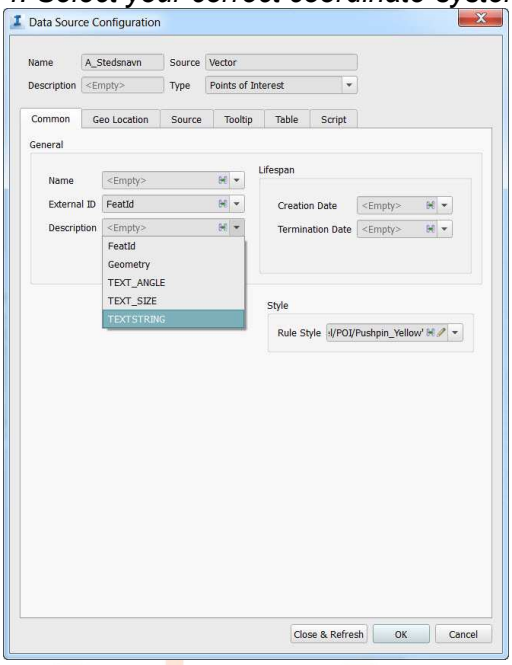
2. Import .shp file to InfraWorks as "Point of Interest"



3. Pick a style for the "Point of interest" (this can be removed later)



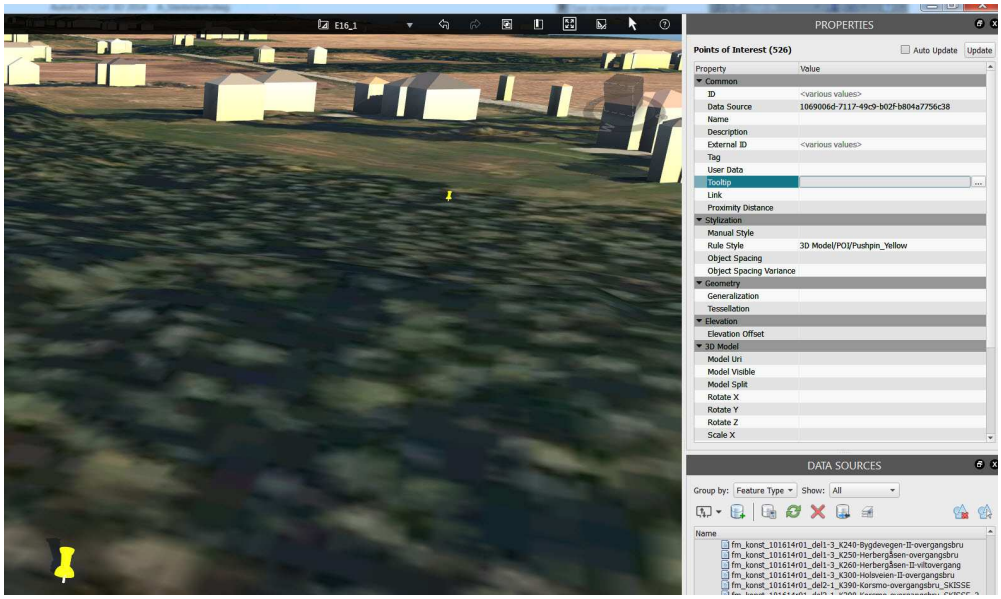
4. Select your correct coordinate-system and choose “TEXTSTRING” as description



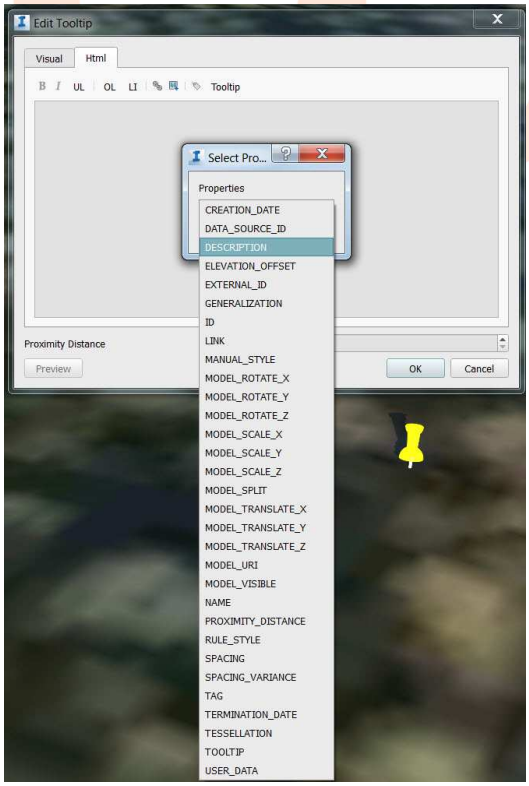
- *Press Close&Refresh*

5. Select the “Points of interest” that you now have created

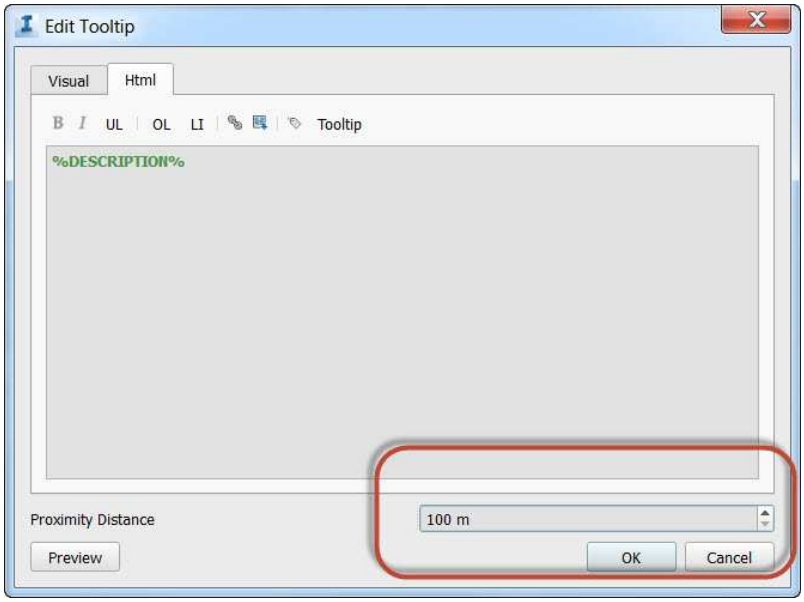
6...and go to the features "Tooltip" in the properties menu



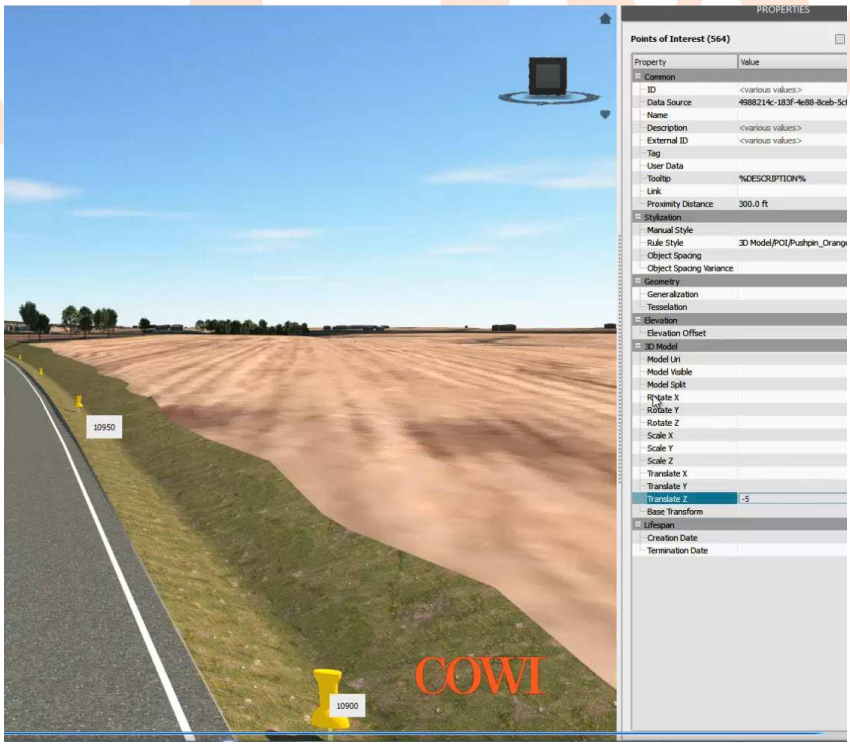
7. In "Edit Tooltip", go to Html and press "Insert property" and select "Description"



8. Set the "Proximity Distance" for how close you want to be, before the text shows.



9. Select features and translate z-value to a negative value to hide the point marks



Categorising your imported data

We added custom categories in model explorer. Then we imported all the 3D models to the different categories. By doing this we were able to turn off, highlight and select the different imported models. Example: We placed disciplinary models for constructions on COWI K-theme and all drainage models on COWI G-theme.

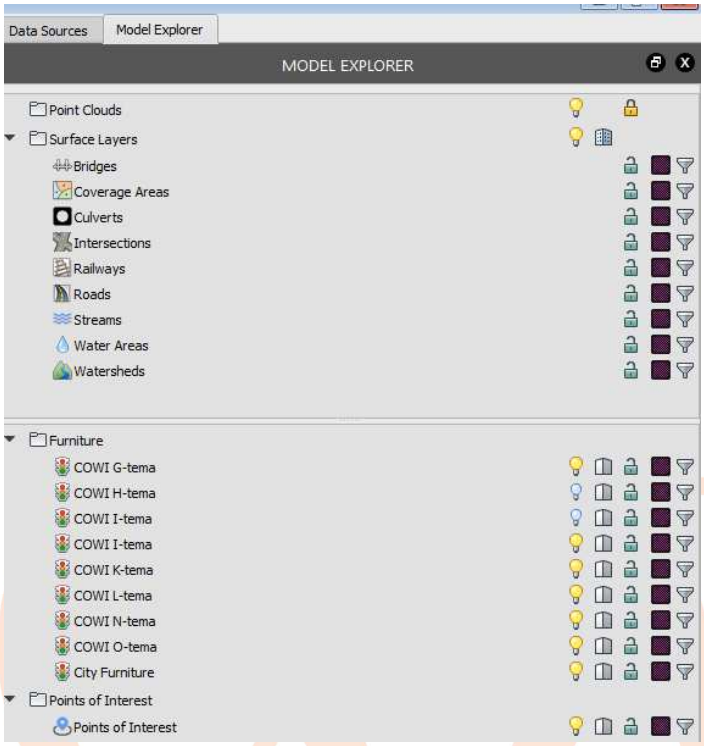


Figure 12. Example of categories

Getting 3D-dwg models from 2D data

We were able to use InfraWorks to make 3D dwg models of existing situation and disciplinary models. When the InfraWorks model includes terrain and road geometry we can drape 2D lines and points to the surface, insert 3D objects and export to AutoCAD through FBX.

Two examples:

- Import 2D polylines, representing pipelines to InfraWorks. Drape them -2,0 meters below the surface and add a pipeline-style. Then export this to FBX before importing to AutoCAD.

- Import 2D/3D polylines representing rail guard. Drape them to road the surface and add a road style just containing rail. Then export to FBX before importing to AutoCAD.

By doing this we can deliver more detailed DWG models using styles and object in InfraWorks.

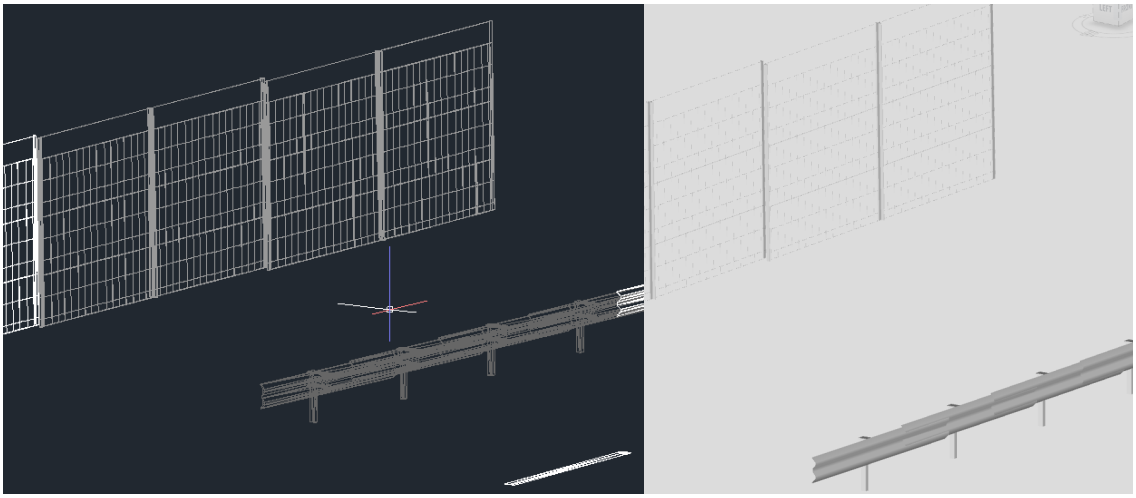


Figure 13. Railguard and wildlife fence in AutoCAD and Navisworks

Learn how to get precise road data into InfraWorks 360 software

Disiplinary models/detailed design

LandXML import

The road planners used Novapoint software. Therefore we needed to import this detailed road design into InfraWorks using a different method than road planners using Civil3D. This method also would apply to other software with LandXML surface export possibilities.

1. Export out LandXML file from your design tool, in this case Novapoint.
2. Import your LandXML in to Civil3D. The surface in your LandXML file becomes TIN surfaces. Rename surfaces if necessary.
3. Export the surface to IMX.

In our case we also wanted correct surface textures on the road geometry. Therefore we extracted the surface boundaries and imported them as coverage areas.

1. Extract surface border on the TIN surface in Civil 3D.
2. Select the boundary polylines and close them. Map export from AutoCAD. Export as .shp.
3. Select boundaries and select object type Polygon (Figure 14. Selection). Select treat closed polylines as polygons. (Figure 15a. Polygons).
4. Select hyperlink under objects properties to view the surface name in InfraWorks. (Figure 15b Hyperlink)

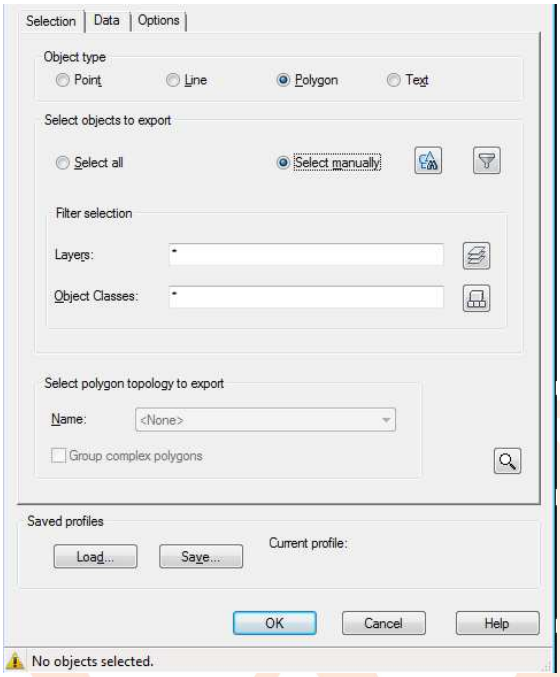


Figure 14. Selection

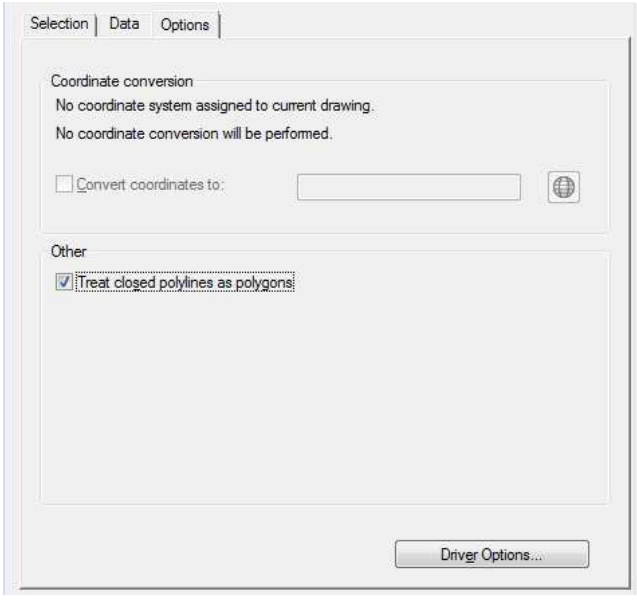


Figure 15a Polygons

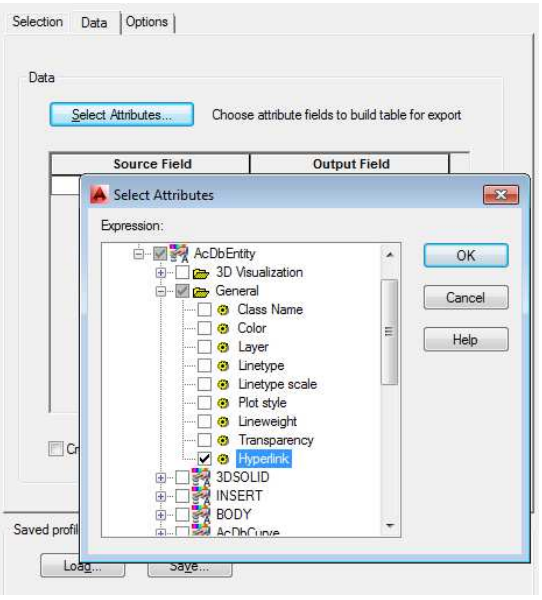


Figure 15b Hyperlink

5. Import the .imx and the .shp to InfraWorks.
.imx as Terrain
.shp: as Coverage areas. Convert polylines to polygons and drape to surface. You may use scripts to assign the correct surface style and properties based on the TIN surface names.

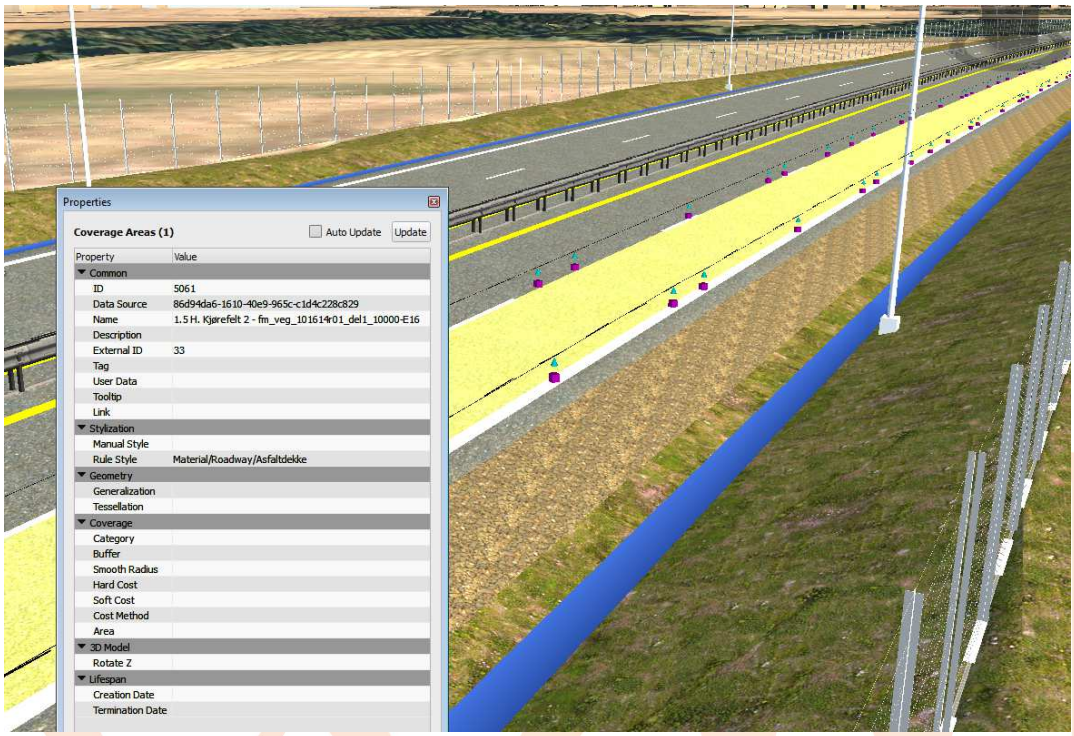


Figure 16. TIN-name in properties

FBX-Material attach

In some cases we didn't want our new terrain to be a part of the terrain imported to InfraWorks as .imx. This could f. example be around bridges, where a terrain imported with .imx would overlap with the construction.

In these cases we would import the terrain with a .fbx-file. The terrain would then be independent from the InfraWorks-terrain, and not overlap the construction.

Figure 17. Detailed design model. Wildlife crossing. Imported terrain as FBX

We used the command "material attach" in Civil 3D to assign materials to the .fbx-terrain. Explode the TIN-surface to 3D-faces before assigning materials.

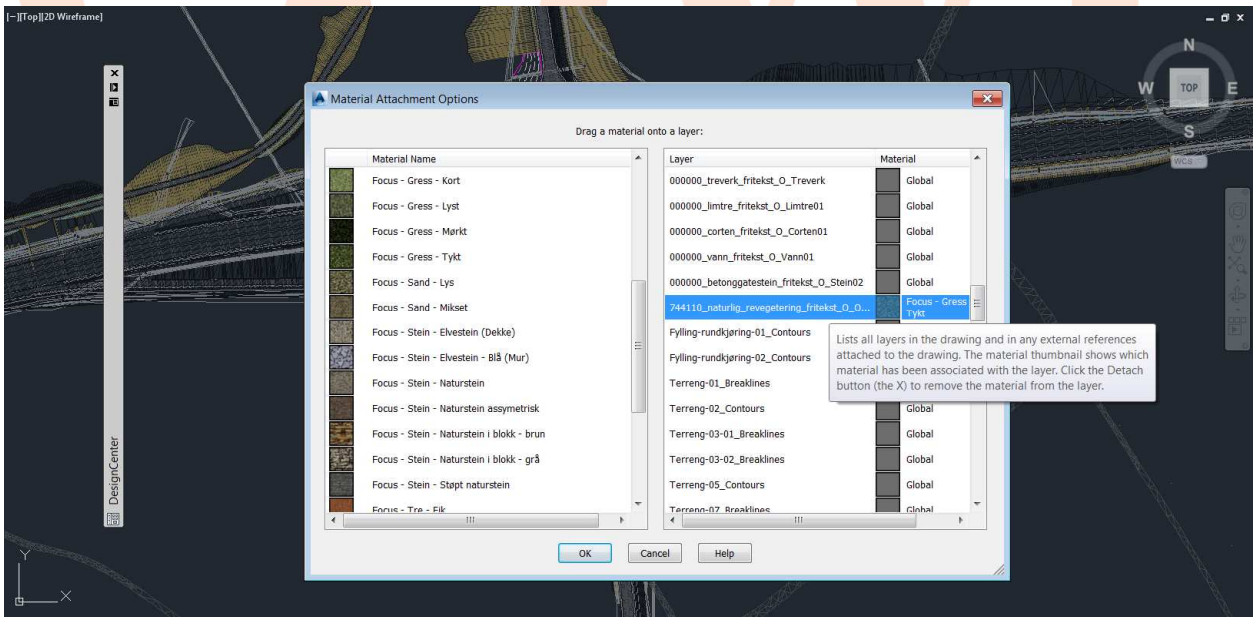


Figure 18. Using material attach in Civil 3D

Visualize equipment

From 2D polylines we could vizualise road equipment like railguards by using InfraWorks road styles, only containing 3D-objects. Remove all road groups (see example below). Then use decorations to place objects along the imported polyline path.

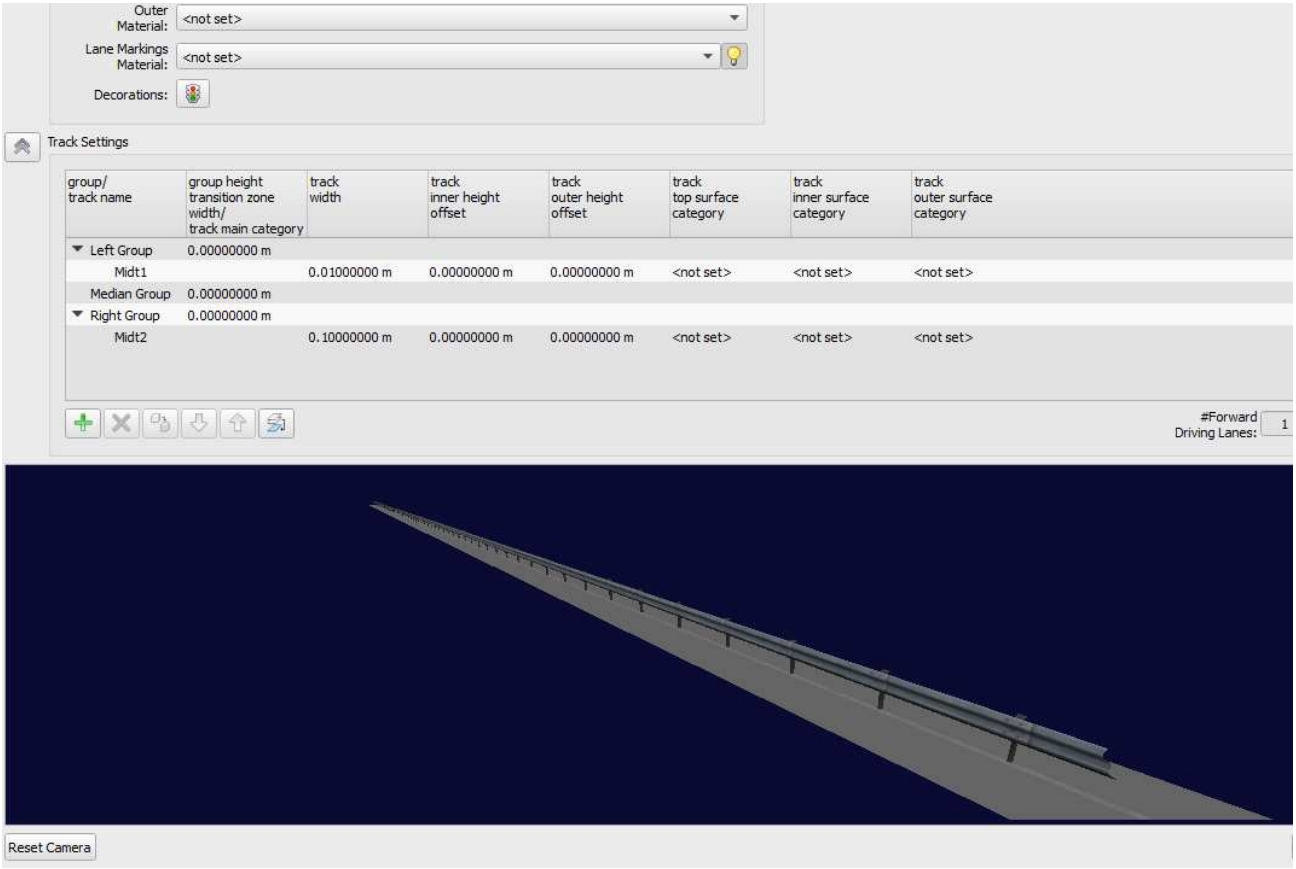


Figure 19. Editing road style

Figure 20. Rail guard road style

Learn how to communicate your design to your clients through the cloud

Success factors:

- *The client should have access to a cloud-connected model.*
- *Use the model actively in meetings.*
- *Sync back meeting requests and changes (as fast as possible) after the meeting, so the work can continue at the office.*
- *Use proposals actively for evaluating different designs. Show the consequences for the different solutions.*

Free viewer

In BIM projects The Norwegian road administration requires the consultant to deliver a free viewer model. Initially we wanted to deliver this by using scenarios for web-browser or IPad and share the models in the cloud. After some testing it became quite obvious that this was not satisfactory. The project was too big to break up in small pieces, the styles did not convert properly and the overall look was not as good as in the InfraWorks desktop version. The final solution became a combination of using InfraWorks and NavisWorks.

A combination of terrain model from InfraWorks and disciplinary models from DWG files makes a good free collaboration model for us and the client. The terrain surface is made by exporting the ground model in InfraWorks to .FBX.

In similar complex projects to the E16 we therefor recommend too use NavisWorks as a free viewer until a free desktop viewer for InfraWorks is available.

Figure 21. Model shown in NavisWorks

Any barriers?

When using the full potential of InfraWorks you need to consider how many in your project team gets access to the model. In our project there were only 7 people of approximately 60 members who had 360 access. We recommend as a minimum that the project manager, disciplinary leaders, BIM coordinator and some designers have access.

We recommend pushing the use of the cloud model to our client and sub consultants. Our experience is that we can do more decisions in shorter time and give the client a better and faster basis for making design-decisions.

We also recommend using enough time teaching your project manager to use InfraWorks. The project manager is the person who is the most engaged with the client and should therefore use the model when communicating. There will be less and less need for bringing the CAD-monkey to meetings.

Project links:

http://static-dc.autodesk.net/content/dam/autodesk/www/products/autodesk-infraworks/docs/pdf/adsk_customer-story_cowi_en_no.pdf

https://www.youtube.com/watch?v=I_6xIZ-P3LE

https://www.youtube.com/watch?v=XH_PHRtcSxw

https://www.youtube.com/watch?v=02xBdsqWiH0

https://www.youtube.com/watch?v=W1WgPXSyfDI