This guide is intended to help with reviews of supplemental design data based on OpenRoads software. Supplemental design data is often used by contractors for Automated Machine Guidance (AMG). The reviewer is expected to know how to use MicroStation and have a basic understanding of OpenRoads tools.

Confirm that the required supplemental Design Data Files are available.

Supplemental design data is sometimes missing a required file. Review the CADD standard guidance on Final Plan Delivery – Supplemental Design Data, section 2.14, http://www.dot.nd.gov/manuals/design/caddmanual/caddmanual-ord.pdf#page=40

When reviewing files, also check to see if all files are current. Have addendums required model changes?

The deliverable files can be classified in 5 groups; a narrative summary file, alignment files, surface files, general reference drawings, and the roadway model files.

Create a folder to review Supplemental Design Data

Some of the supplemental data cannot be reviewed directly. Intermediate files will need to be created for an independent review. These intermediate files are also an excellent way to document and point out concerns with the models.

Create a segregated folder to review the Supplemental Design Data. Copy the Supplemental Design Data into this folder. A separate folder will help organize and maintain the file relationships used during a review.

Review aaReadMe File

The aaReadMe.docx file should summarize the supplemental design data for the contractor. The alignment index should be clear and consistent with the data provided. Explanations for extra or missing files should be provided. The aaReadMe file should explain which alignments were used for modeling.

If the technical support reviewer has difficulties finding and identifying needed information, the contractor may also have this same problem. If clarifications are needed ask the designer to revise the aaReadMe document.

Review Cross Sections

The cross sections are used to cross reference surface and model details. If the cross sections are not correct, the model is probably incorrect. Make sure the cross sections match the typical sections and the design drawing. Ensuring the plans are correct, including cross sections, will simplify the model review. Reviewers need to be cognizant of the possibility that both the model and cross sections are incorrect.

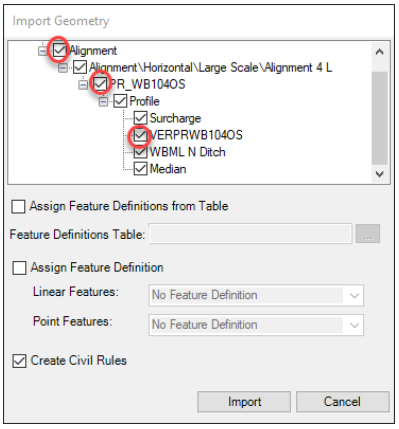
Import XML Data

The supplemental design data includes both native proprietary (dgn) and non-proprietary exported files (xml). Some of the native proprietary files contain the same information in different formats such as an alignment in a dgn or xml file. Since the xml data is created from the native formats, both the export process and the actual data can be reviewed by reimporting the xml data. The xml data can be imported into a new dgn file and the original dgn file can be referenced and compared. There are two types of xml imports; alignments and surfaces.

Import XML Alignment Data

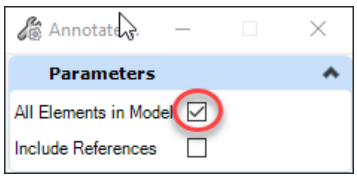
Within the folder that was created for the review, create a new 2D drawing for importing the xml alignment data. Remember to use CADD Standard file name so that the applicable standard tasks are easily accessible (example, DS_Align_XML_Import.dgn). In the example a file name suffix was used to help explain contained information.

The Import Geometry tool is in "OpenRoads Modeling (workflow) > Geometry (tab) > General Tools (panel) > Import/Export > Import Geometry". Access the Import Geometry tool and select the xml file with alignment information. Within the Import Geometry dialog box, select the horizontal alignment and profiles to be imported. There are selection boxes in the top panel. Typically, all information should be imported and reviewed.



After the alignment information is imported, the MicroStation view may need to be fitted to see the alignment.

The alignments are imported without the applicable annotation group. Add alignment element annotation to assist with the review. This tool is in "OpenRoads Modeling (workflow) > Drawing Production (tab) > Annotations (panel) > Element Annotation > Annotate Element". If multiple alignments are imported, they can all be annotated at once with the "All Elements in Model" option.



The original alignment dgn files can now be referenced to the imported alignments and compared. The following are some potential problems to look for.

- All applicable horizontal and vertical alignments may not have been exported to an xml file. Compare the imported xml files to what is documented in the aaReadme.doc alignment key. Are any alignments as xml missing?
- The xml file may have been stored as a report xml file. Xml files for reports don't import with the Import Geometry tool.
- Alignments may have been edited, the dgn and xml versions may be different.

Import XML Surface Data

Most projects should have 3 different surfaces; top of finished surface, top of base surface, and the dirt grade surface. The surface information should be posted in 2 different formats: dgn and xml files. The following is a summary of the surface files.

- Exst - Existing Grade
    - Exst_Alt – Existing Grade that is not used for existing primary vertical alignment. Used when bridges are present.
- T - Top of finished grade
- B1 - Top of base aggregate
- DG - Top of dirt grade

This review focusses on xml surface files. Many contractors use the xml file. If the xml file is good the terrain file is probably good. The best way to review the xml file is to import it into MicroStation and visualize it.

Create a new 3D drawing within the review folder. Remember to use CADD Standard file name so that the applicable standard tasks are easily accessible (example, Terrain_XML_Import.dgn). In the example a file name suffix was used to help explain contained information. If the project has interim – work zone traffic control surface files, 2 separate terrain files may be desirable. There are separate levels for the different surface layers, but there aren't level distinctions between interim terrains and final design terrains.

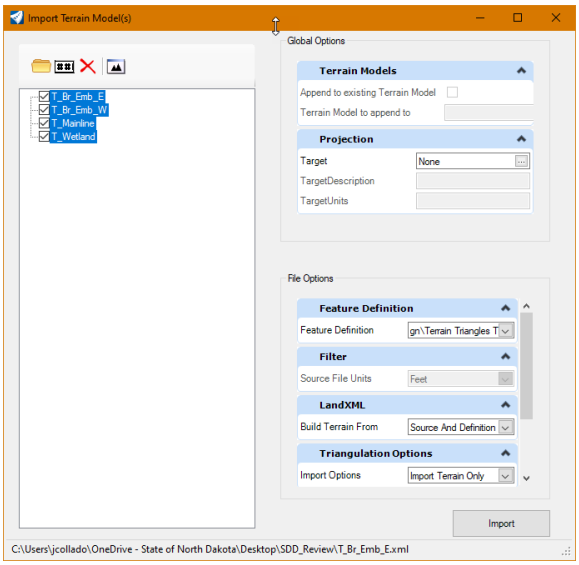
Use the terrain create "From File" tool to import a surface from the xml file (OpenRoads Modeling [workflow] > Terrain [tab] > create [panel] > From File) . This tool will prompt you to select a surface file. You may need to set the "Files of type" filter to LandXML (*.xml).

Multiple surface files can be processed at one time. However it is usually easier to process files of one surface layer (feature type) separately. This will allow you to set the feature type correctly.

Typically, surface xml files are created in the same Geographic Projection that they are used. Therefore, the Projection Target should be "None".

Set an applicable feature definition. Unlike alignment xml files, the surface xml files do not track the feature definition. This will need to be manually selected. A version of a "Triangle" feature definition is usually best for reviewing purposes (example: Terrain\specified\Design\Terrain Triangles T [top]). The Boundary feature definitions don't show the triangles.

Select the Import button. The "Fit View" tool may need to be used to change view extents.



Repeat the Import XML Surface data procedures for all surfaces to be reviewed.

Review the surfaces in 3D

After importing the xml files (recreating the terrains), the individual triangles can be reviewed for errors. These errors can be classified in 2 groups; Functional and Detailed.

The functional errors can be reviewed without knowing about specific elevations. These errors stick out because they defy general functions of properly designed surfaces. Roadway model surfaces should look like a roadway and functional errors just don't look right. Examples of functional errors include;

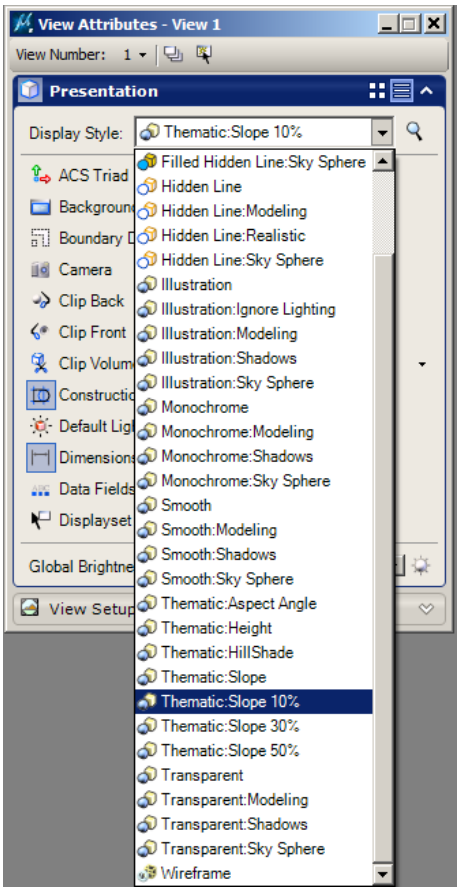
- Terrain spikes - triangles that have an extremely long side length or vertices with extremely different elevation than adjacent vertices.
- Terrain Bumps - These problems are similar to terrain spikes, but they are not as obvious. A terrain bump might only be visible with a near zoom perspective. Roadway surfaces are more traversable in some directions versus others. Example, surfaces for roadway pavement are traversable in the longitude direction. There shouldn't be bumps in the longitudinal direction.
- Crossing surfaces – The top surface should be above the base surface and the base surface should be above the dirt grade.
- Exterior Triangles - Some surfaces triangulate more than they should on the edges. These edge triangles don't represent the desired surface because they go beyond boundary vertices.
- Triangle density should address critical sections (horizontal cardinal points, external control points, and maximum curve cord heights). If there are problems with triangle density, there may be problems with the corridor template drop interval or corridor design stage.

Detailed errors are determined by spot checking individual terrain vertices and comparing them to the plans.

Reviewing terrains will typically require the use of level display tools, display styles and view controls. Different combinations of these tool settings will be required. Usually there are multiple ways to view a terrain problem. This guide provides an overview of the tools needed but not a required viewing method.

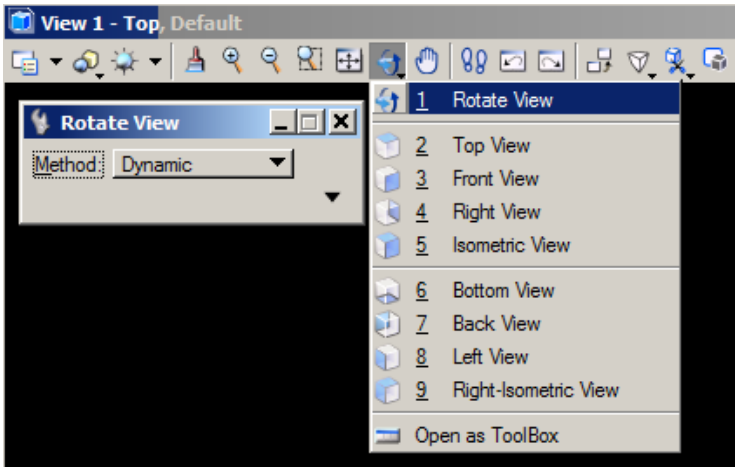
The terrain drawing being reviewed may contain multiple terrain surfaces. Use level display to turn on and off adjacent terrains as needed to compare and contrast surfaces as needed.

Use multiple display styles to look for functional errors. The display styles can be changed within the "View Attributes" tools.



- Wireframe – Default display style
- Smooth – Use this tool with lighting to contrast smooth and rough terrain areas.
- Illustration – Both opaque triangles and wire frame edges are displayed at the same time.
- Thematic: Slope – Use to view slopes based on a color theme. The Slope 10% is good for the part of the surface dealing with pavements because these slopes are typically from 0-10%. The Slope 30% is good for reviewing in-slopes because they are typically from 0-30%. The display style slope 50% will cover a broad perspective on most project slopes.

Rotate the 3D view of the terrain surface for multiple perspectives. Rotating a View by the "Dynamic" method will allow the view perspective to be changed at variable rates while providing a continuous view. Rotating a view dynamically can make spotting terrain errors easier.



Section 5.6 of the NDDOT CADD manual discusses "Corridor Modeling Requirements". The following are additional considerations to review.

- Exterior Triangles that don't accurately represent surfaces should be removed. Boundaries in terrains may need to be defined in terrains to adequately reflect desire gaps and edges.
- Terrain anomalies within the roadway pavement and under it (base and dirt grade) should be eliminated or thoroughly documented.
- Identifying terrain areas where approximations and missing data is acceptable. Example, when should an approach be modeled? Approximations and missing data may need to be discussed with NDDOT management at a preliminary design meeting.

After the project has been reviewed for functional errors, it should be reviewed in closer detail by examining vertices. It is not practical to review them all. Spot checking individual cross sections is recommended. Start by picking one random cross section and then compare every model vertex for that section. Civil Labeler tools will help with this endeavor. See section 5.18 of the NDDOT CADD Standards Manual "Text Favorites and Labels". The "Civil Labels > Design > Plan > Stationing > Sta Os El 07" tool can be used to label specific vertices. Note the roadway alignment will need to be referenced into the terrain dgn in order to document station and offset.

There is not a set number of cross sections to spot check by comparing it to the surfaces. The following is a recommendation. Review one cross section every 2 miles as a starting point. For every error, compare additional locations. Discuss errors with the designer.

Review Break Lines and Meshes in 3D

Designers use the break lines to create their surfaces. Some contractors like to use the break lines to create their own surfaces. Potentially the meshes could also be used as an AMG reference.

Model break lines and component meshing should be in the RDM drawings. Note there may be multiple RDM drawings for one project. If there are multiple RDM drawings, it may be helpful to review RDM data that is referenced together. The drawing 200XS* is a potential drawing that has multiple RDM files referenced together. Another option would be to create an interim RDM drawing that references the others.

Within the drawings used to review the terrains created from the xml file, reference the RDM drawings. Use level display tools to compare only the break lines from one surface to that specific surface. Typically there are 3 Groups of break lines within an RDM drawing.

- The top break lines are on levels with a T_ prefix.
- Most base break lines are on levels with a B1_ prefix.
- The dirt grade break lines are on levels with a DG_ prefix.

Examples

- The information on the levels "Terrain T" and "T_*" should be compared.
- The information on the levels "Terrain B1" and "B1_*" should be compared.
- The information on the levels "Terrain DG" and "DG_*" should be compared.

The break lines should be coincident with their respective surface. View the appropriate level combinations in 3D. Break lines should not go above or below the surface. Look for important break lines that are missing. If there are discrepancies, compare locations with cross section data. Look for break lines assigned to the wrong surface. Contractors might rely on the break line prefix and not discover a bad assignments until it has caused problems. Discuss errors with designers.

In a similar manner of comparing break lines to surfaces. The meshes should also be compared to the surfaces. However some meshes represent a volume and only part of the mesh surface may be coincident with the terrain surface. Use level display to compare individual component meshes with terrain surfaces. This type of review requires frequently turning on and off levels in order to compare and contrast the meshes and surfaces.

Most elements of a RDM drawing are either break lines or component meshes. The "DNC" break lines (levels) can be disregarded.

Review Other General References

The supplemental design data contains data that is not directly required for AMG. However they are important drawing for cross referencing project details. These drawing include; Design.dgn, RW_Bndry.dgn, Topog.dgn. Confirm that these drawing are the current version used to prepare the plans. A detailed review of these drawing has usually been completed during the contract plan review. Additional review of these drawings is not typically needed unless modeling conflicts are encountered.