

8.14 3D ENGINEERED CONSTRUCTION SURVEYING (3DECS)

The Resident Engineer or Project Manager needs to determine early in the design of a project whether the project is a good candidate for CDOT to provide 3D modeling information to Contractors. With this information Contractors can gain efficiencies in bidding the work. They can also gain efficiencies during construction by not needing as much staking and by providing the data directly to an automated machine or to a machine operator.

The Project Special Provision *Revision of Section 102 Project Plans and Other Data* is where the design team will modify the contract to let the Contractors know that CDOT will be providing 3D modeling electronic data for use during construction.

Criteria for consideration of whether a project would be a good candidate include the following:

1. Project needs to have a large amount of earthwork or paving,
2. A new alignment,
3. A CDOT approved existing topographic survey, or
4. A CDOT approved Project Control Diagram.

Conditions that limit or would exclude the use of providing 3D modeling data are:

1. Widening with narrow strip additions,
2. Designs, such as overlays, which are not based on an existing Digital Terrain Model (DTM),
3. Designs that do not exist in a 3D digital environment. (Overlay, write-up job or projects without survey data needed.),
4. Structures,
5. Intersections,
6. Projects that are under a tree canopy, in narrow canyons, or next to tall buildings that interfere with GNSS signals. (This limitation only applies when GNSS is used to position equipment.), or
7. Design difficulties that would prevent the creation of an accurate and complete DTM.

CDOT's Standard Specifications Section 625 and 629, along with CDOT's Survey Manual, provides specifications for control, preliminary, and construction surveys that shall be followed for any 3DECS performed for CDOT by CDOT surveyors, consultant, surveyors, or contractor surveyors.

8.14.1 DESIGN CONSIDERATIONS

1. 3D Modeling Quality Assurance:

CDOT has developed a Quality Assurance document which serves as a guide to be used by the project team to carefully examine and perform quality checking on project data as the data is produced during each stage of the design phase of the project. This guide is available to CDOT staff to be implemented on all design projects using InRoads and specifically for 3D engineered modeling for construction projects. Please use the link below to access the document:

<https://www.codot.gov/business/designsupport/cadd/cadd-workflows/v8i-ss2/wf-ir-18/view>.

2. Data Density for 3D Engineered Models

Template Drop Intervals:

- a. Everywhere along the alignment (Except complex design areas) - 10-foot intervals,
- b. Complex design areas (Intersections, etc.) – one-foot intervals,
- c. Additional template drops should occur at:
 - i. Event Points defined in the horizontal alignment.
 - ii. External Control Points - (Point Control, location where multiple corridors interact, locations where the proposed alignment tie with the existing alignment, Parametric Constraint, template transition, superelevation transition stations, and End Condition Override Stations).
- d. When generating cross sections, use the same interval, event points, and external control points that were used in Roadway Designer to model the design surface.

3. Electronic Deliverables:

- a. LandXML files generated from the InRoads alg files (Proposed H&V), Existing dtm file, and the proposed dtm files.

Note: The creation of LandXML files is covered in *Workflow IR 17 – Exporting A LandXML File*

- b. MicroStation dgn files containing proposed horizontal alignments, existing triangulated surface features, and proposed triangulated surface features.

- c. AutoCAD dwg files converted from the above MicroStation files will also be provided.
- d. Control diagram and file projection.
- 4. File Naming Convention:
CADD Drawing Files (dgn/dwg)
 - a. Proposed Horizontal Alignment – JPC#DES_Alignment##.dgn
 - b. Proposed Vertical Alignment - JPC#DES_Profile##.dgn
 - c. Existing Surface Features - JPC#SURV_Topo##Scale##.dgn
 - d. Proposed Surface Features - JPC#DES_Model##.dgn

Note: AutoCAD files use the same naming conventions with the dwg file extension replacing dgn.
- 5. Proposed Geometry:
 - a. InRoads alg file – JPC#DES_Description.alg - The description should be a brief version of the project description.
 - i. Horizontal Alignment – Route number_Usage. (i.e. SH75_Mainline, SH75_Rt Point Ctrl, Drive Stn 10+74 Lt, ...)
 - ii. Vertical Alignment – Use the same as its parent horizontal alignment with a usage descriptor if more than one vertical is there.
- 6. Surfaces:
 - a. InRoads Design Surface - JPC#DES_Route Number-Usage.dtm (12345DES_SH75_Mainline, 12345DES_SH75_SW On Ramp,...)
 - i. In the event that there are multiple surfaces along a single route, Station extents should be included in the name (i.e. SH75_Mainline1+25-5+73).
 - b. InRoads Existing Surface – JPC#SURV_Existing##.dtm or the current ROW/Survey naming convention.

