3.7 Roadway Design Deliverables

A) Introduction

Civil 3D is the roadway design software used for surveying and roadway design work at Caltrans. The survey and roadway design portion of a project is to be completed by Caltrans employees using Civil 3D. Consultants may use any roadway design software of their choosing. However, submitted electronic files must be submitted in the appropriate electronic files per Caltrans standards.

MicroStation is and remains the standard drafting software for design presentation of all advertised project plan sheets. Caltrans uses MicroStation to design details, typical cross sections, title sheet and traffic handling, landscape and electrical systems sheets.

The purpose of this section is to specify the deliverables from design and the acceptable formats for these deliverables.

B) Roadway Alignments

Roadway alignments are used to define the horizontal path of a highway or roadway. Most roadway alignments at Caltrans consist of straight-line sections that connect tangentially to circular curve sections. The roadway alignment is directional in that a stationing or length is recorded from the beginning of the alignment to the end. Surveyors and engineers build the roadway using these alignments. Further discussion and Caltrans design policy on horizontal alignments can be found in Chapter 200 of the *Highway Design Manual.*

http://www.dot.ca.gov/hq/oppd/hdm/pdf/english/chp0200.pdf.

New alignments are created in Caltrans' roadway design software, Civil 3D by Caltrans employees.

As well as being shown in the advertised project plans (MicroStation DGN file format), horizontal alignments will be delivered in one or all the following formats;

1. 2012 or 2016 Civil 3D drawing file
2. LandXML file
3. Readable Horizontal Alignment report file

C) <u>Vertical Alignments</u>

The vertical alignment is the mathematical definition of the vertical path of a horizontal alignment of the highway or roadway. The vertical alignment is always associated with a horizontal alignment and consists of tangent sections (grades) that connect tangentially to parabolic vertical curve sections. It is defined by vertical points of intersection (VPI's) that are in turn defined by the horizontal alignment stationing and elevation. The vertical alignment is drawn in profile view that has stationing along the horizontal axis and elevation along its vertical axis. The vertical alignment is needed by surveyors to set the elevation of the roadway. Further discussion and Caltrans design policy on vertical alignments can be found in Chapter 200 of the *Highway Design Manual*.

http://www.dot.ca.gov/hq/oppd/hdm/pdf/english/chp0200.pdf

As well as being shown in the advertised project plans, vertical alignments will be delivered in one or all of the following formats;

1. 2012 or 2016 Civil 3D drawing file
2. LandXML file
3. Readable Vertical Alignment report file

D) <u>Alternate Design Techniques and Digital Design Models</u>

While cross section design methods lend themselves well for roadway design, site design or three dimensional (3D) design techniques may be useful for other types of civil facilities. Site design techniques are available that will let the user define the elevation along the path of a shape, specify parameters of cut/fill slopes, and work with existing terrain surfaces to extend slopes from the path of the shape. The end result is a set of points and break lines that are used to create a proposed surface. Engineers are familiar with digital terrain models (DTM's) that are used to define existing topography and three-dimensional mapping of existing terrain. There is now the capability to construct, from design cross sections and site design tools, digital design models (DDM) that represent a construction model of the proposed design project. These are used to generate contours and help determine earthwork volumes. Examples of additional facilities that can be designed with these techniques include:

- Bridge fill cone areas

- Intersections with multiple layout lines that require more detailed information than slope stake listings can provide

- Building pads

- Retention ponds

- Berms, dikes & levees

- Stockpiles & borrow pits

- General landscaping and contour grading

- Parks

- Parking lots

Automated Machine Guidance (AMG) may be an option for some projects. AMG can reduce the amount of staking notes, but still needs to be based on the correct California Coordinate System (CCS) and datum.

These type of design features may still need to be drawn as a construction detail in the advertised project plans, but digital design models can augment the information provided to the contractor. DDM are to be delivered in one or all of the following formats;

1. 2012 or 2016 Civil 3D drawing files
2. LandXML file

E) **Design Cross Sections**

Design cross sections are developed from the roadway design software as typical sections at specific station intervals within a given station limit range. In Civil 3D the cross-sections are derived from the corridor model that is created when the design templates are applied to the profile grade line and against the existing ground.

Design cross sections are an integral part of the design and construction staking processes. They are needed by the engineer to help determine structural roadway volumes and right of way impacts or requirements. Surveyors and construction engineers utilize the design cross sections and the resulting slope stake listings throughout the construction of the project.

Design cross-sections and ancillary information (i.e. layout lines, defined survey chains, etc.) will be delivered in the following formats;

1. 2012 or 2016 Civil 3D and/or MicroStation V8 design file
2. Portable Document Format, PDF file
3. LandXML file for the design corridors
4. Readable Slope stake notes
5. Earthwork volume reports

It is imperative that design cross sections, slope stake notes, and volume reports are delivered from the same roadway design model for each of the above deliverables for consistency and accuracy within each specific project.

F) <u>Design Presentation of Project Plans</u>

The design presentation of all advertised project plans must be completed using MicroStation and submitted in DGN file format. A Design Memorandum, dated September 19, 2014, signed by Timothy Craggs states that MicroStation is the Caltrans' official drafting software. This includes As-Built plans as well as project plans for all projects (large or small) on the state highway system (SHS) regardless of the funding source or sponsoring agency.

Regardless of the roadway design software used, all pertinent information (i.e. existing topo, alignment information, profiles, superelevation diagrams, drainage systems, landscape design, etc.) must be included in the appropriate MicroStation DGN files for submittal of the final project plans. For further information on development of project plans, see Section 3.8 "Master Files" of the *CADD Users Manual* and the *Plans Preparation Manual*.