

GEOSPATIAL REQUIREMENTS

Bridge Design needs to interface with input information from Caltrans Land Surveys, and Caltrans Roadway Design.

Bridge Design delivers the bridge / structure model to Caltrans Structure Construction, Land Surveys, and Roadway Design. Below is the list of relevant software tools.

Discipline	Bridge / Str. Model Input / Output	Software
Caltrans Land Surveys	Input	Trimble Business Center (TBC) Trimble Connect
Caltrans Roadway Design (including Land Surveys)	Input	Autodesk Civil-3D (Trimble Business Center (TBC)) (Trimble Connect)
Caltrans Structure Construction Land Surveys Roadway Design	Output	Trimble Business Center (TBC) Trimble Connect Trimble Access Autodesk Civil-3D

Below are the Geospatial Requirements:

1. Units

US Survey Foot: For use with the North American Datum of 1983 (NAD83) and/or CCS83

International Foot: For use with the North American Terrestrial Reference Frame of 2022 (NATRF2022) and/or CCS2022.

IF UNIT IS NOT IMPLEMENTED - ERROR: The difference between International Foot Unit and the US Survey Foot Unit can cause a discrepancy and/or shift in location of approximately 12 ft in easting and about 3 ft in northing.

2. California Coordinate System / Datum / Epoch:

Bridge design software must correctly implement CCS zones and the associated datums, realizations, and epochs used by Caltrans, since State Law and the Caltrans Survey Manual require the use of the CCS.

The Project Coordinate System Settings that the Caltrans Surveyors and Caltrans Structure Construction use in TBC (see Figure 2) need to transfer directly to the bridge design software tool.

2a. Starting a Design Model: A bridge model starts with a roadway alignment, digital terrain model, and digital design surface from Civil-3D on the CA

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Coordinate System (CCS). The Bridge Design Software must be able to consume this input and maintain the CCS geospatial location.

2b. Modeling Existing Structures: To model existing structures, bridge design will need to use a combination of as-built plans and survey deliverables including point clouds. The Bridge Design Software must be able to consume the input and maintain the CCS geospatial location.

2c. Record Modeling / As-Built Structures: To model the structure as-built post construction, bridge design will need to use survey deliverables including point clouds. The Bridge Design Software must be able to consume the input and maintain the CCS geospatial location.

IF NOT IMPLEMENTED - ERROR: The resulting distortion depends on the project site's topography and location. The distortion maps are available here for California (sample is shown in Figure 1):

<https://geodesy.noaa.gov/pub/SPCS/DistortionMaps/>

For example in Figure 1, one of the linear distortion values shown at the topographic surface is 200ppm. This is equivalent to 20 cm / km or ~12.7 inch / mile.

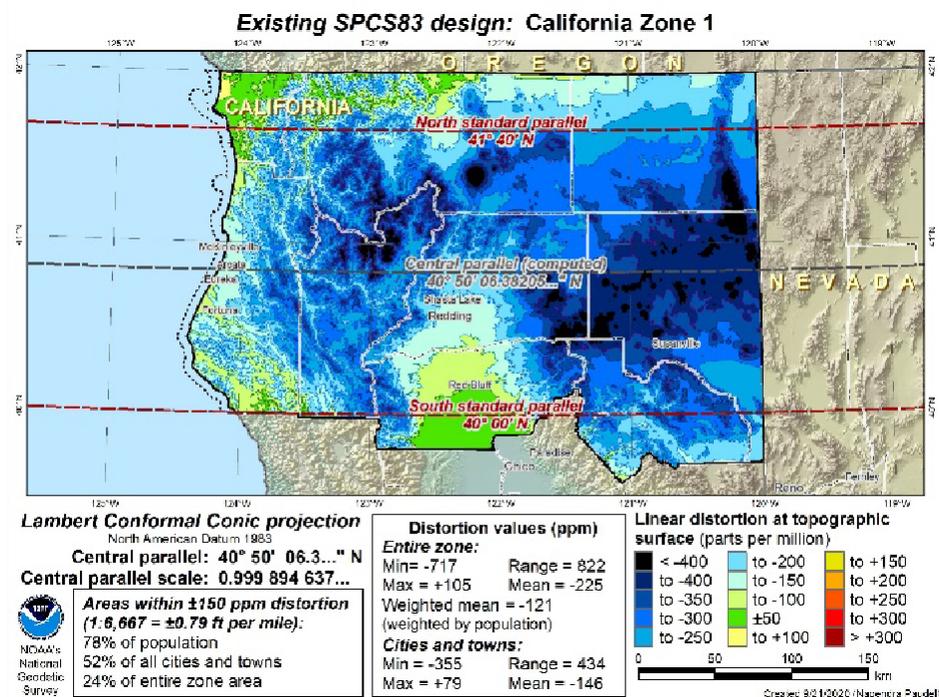


Figure 1: Example of Distortion Map for California Zone 1. Source: <https://geodesy.noaa.gov/pub/SPCS/DistortionMaps/>

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The condition to use “California Coordinate System” is mentioned in the Caltrans Survey manual as shown below:

“Section 8817 of the Public Resources Code requires that all new surveys and new mapping projects, which use State Plane Coordinates, must use the California Coordinate System of 1983 (CCS83). CCS83 is based on NAD83.”

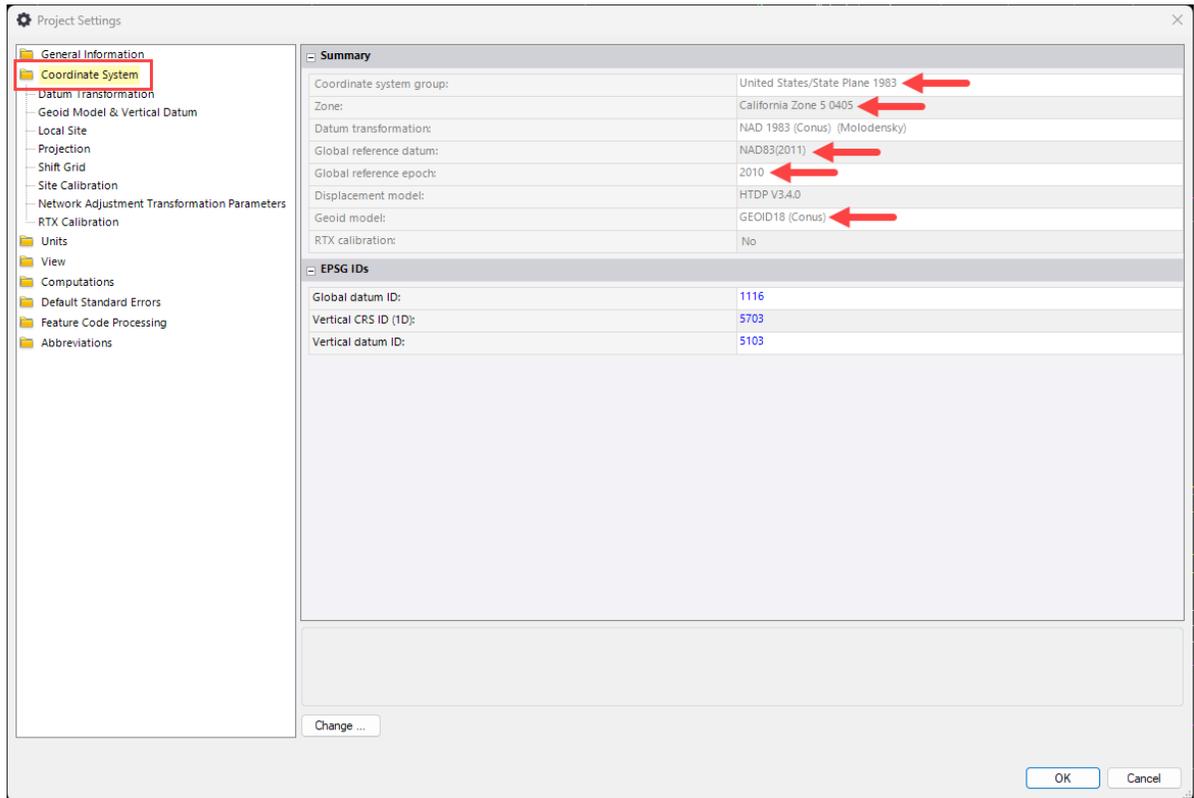


Figure 2: Trimble Business Center – Sample Project Settings

3. Import Survey Control Points in Bridge Design Software

Bridge engineers must begin with project control points from the project surveyor. Each bridge or structure model must use four points that “Bound the Structure.” Three are required and the fourth is a check.

“Bound the Structure:” Select control points that are closest to the structure and distributed as evenly as possible around the structure. Idealized examples for a Bridge and an Earth Retaining System are shown in Figure 3 and Figure 4, on Page 4. A project example is shown in Figure 5 and Figure 6, on Page 5.

Include these points in the model so the structure’s location can be verified in Trimble Access or any software that imports the model.

TBC or Trimble Connect must link to the Bridge Design Software.

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Designers must import control directly from the Survey Control Deliverable. The software must place a small object at each control point during import. Designers then select the four points that bound the structure. These Four Points will be called "Reference Points" in the Designer's BIM model as shown in Figure 7, on Page 5.

Project control may update during construction. Keeping the live connection between TBC or Trimble Connect and the Bridge Design Software ensures accuracy throughout design and construction.

IF NOT IMPLEMENTED -- ERROR: Control points help prevent location errors when models are imported or exported to other software or field equipment.

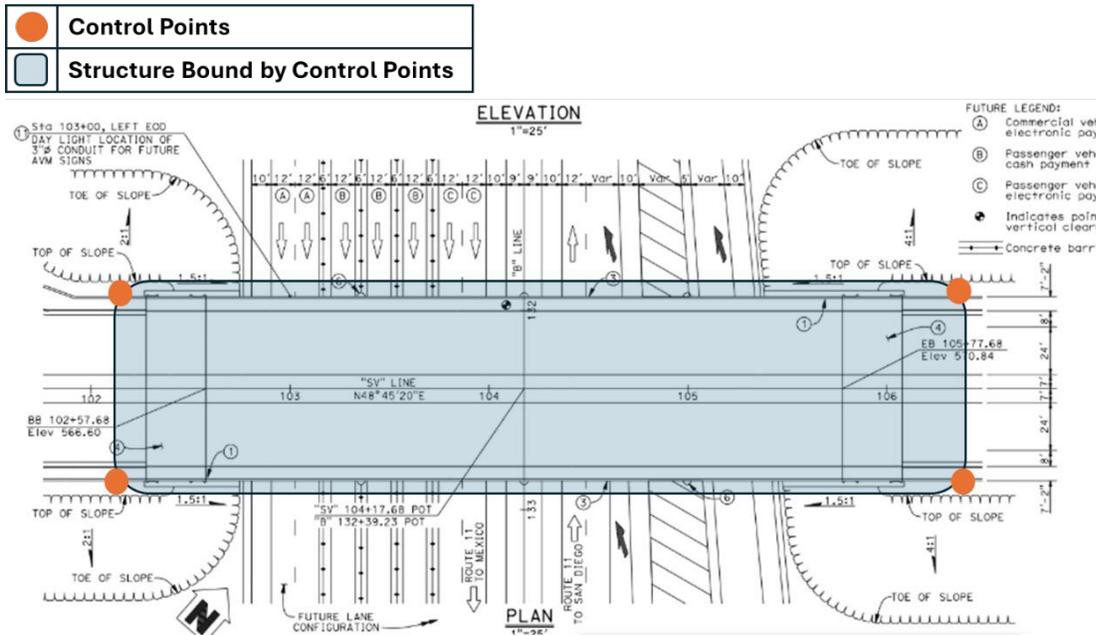


Figure 3: "Bounding the Structure" – Bridge Idealized

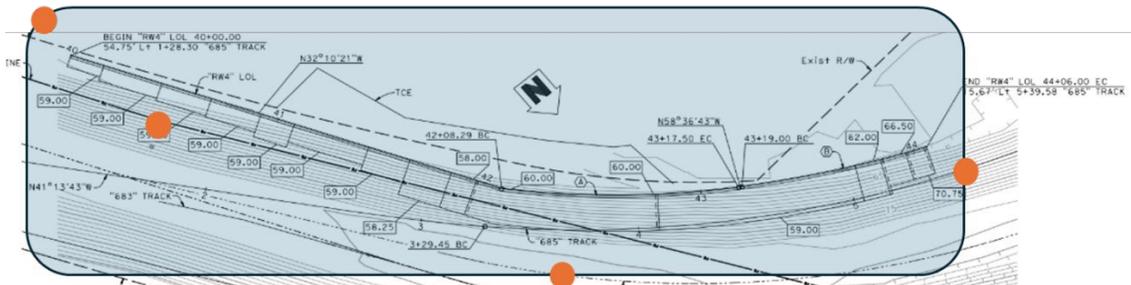


Figure 4: "Bounding the Structure" – Retaining Wall Idealized

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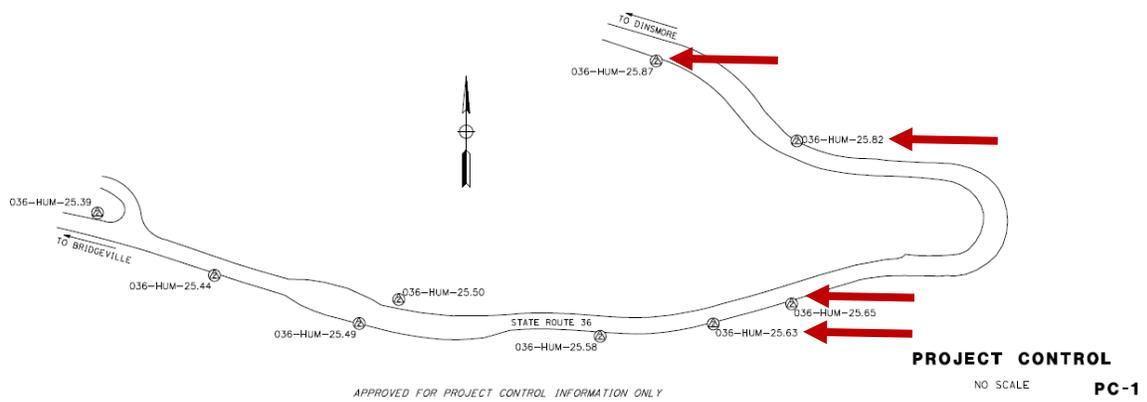


Figure 5: The Four Control Points that bound the Structure – Project Control Sheet

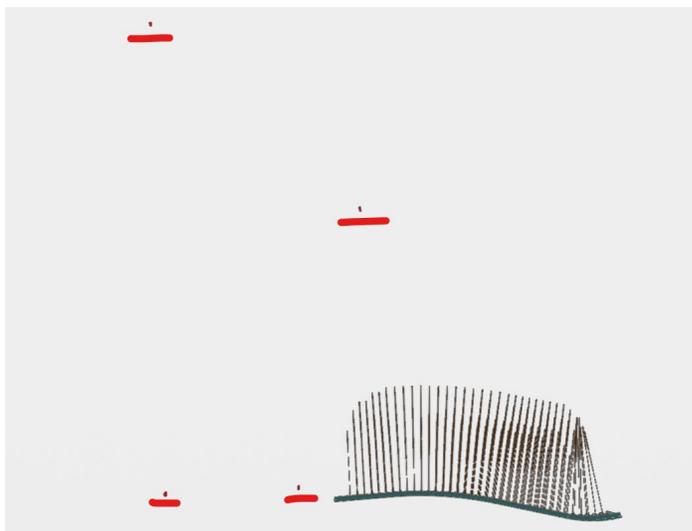


Figure 6: 3D model of Structure and Geometry of 4 Reference Points included in the Model file

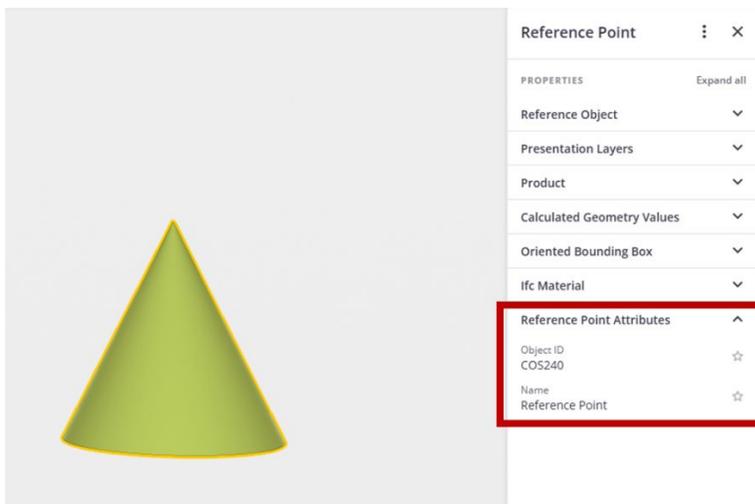


Figure 7: The Bridge Design Software places a geometric object (in this case a cone) at the location of the control point. This is called a "Reference Point" as shown in the attributes of this geometric object.