Americans with Disabilities Act (ADA) Surveys

Guidelines for Engineering and Construction Surveys of ADA Facilities

Department of Transportation
Division of Right of Way and Land Surveys
Office of Land Surveys
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Table of Contents

INTRODUCTION

In August 2006, the Californians for Disability Rights, Inc., and the California Council of the Blind filed a class action lawsuit against the California Department of Transportation in the United States District Court, Northern District of California, claiming violations of Federal and State laws caused by Caltrans' alleged failure to install and/or maintain curbs and sidewalks that allow reasonable access for all persons with mobility and/or vision disabilities. In June 2010, Caltrans reached a settlement agreement with the lawsuit plaintiffs.

The settlement agreement noted that Caltrans needs to allocate $1.1 billion over a period of thirty years towards compliance. The funds will come from the State Highway Operation and Protection Program (SHOPP) in annual commitments as described below:

- $25 million FY's 2010-2014
- $35 million FY's 2015-2024
- $40 million FY's 2025-2034
- $45 million FY's 2035-2039

In December 2015 and January 2016, Caltrans headquarters, through Value Management Strategies Inc., conducted two Value Analysis Study workshops focusing on Americans with Disabilities Act (ADA) issues.

- **Workshop 1 – "Goals, Initial Assessment and Solutions" (December 9-11 2015)**
- **Workshop 2 – "Solutions and Implementation" (January 12-14, 2016)**

The results from the workshops was the identification of 29 ADA-related issues which needed to be addressed. One of the issues was the lack of guidance in the Caltrans Survey Manual (CSM) for pavement surveys of non-compliant ramps and staking of compliant ramps during construction.

ENGINEERING SURVEYS

Current Policy – Caltrans Surveys Manual, Chapter 11 (Engineering Surveys) provides standards, procedures, and general information for performing conventional engineering surveys. Chapter 11 describes the roles and responsibilities before, during, and after an engineering survey.

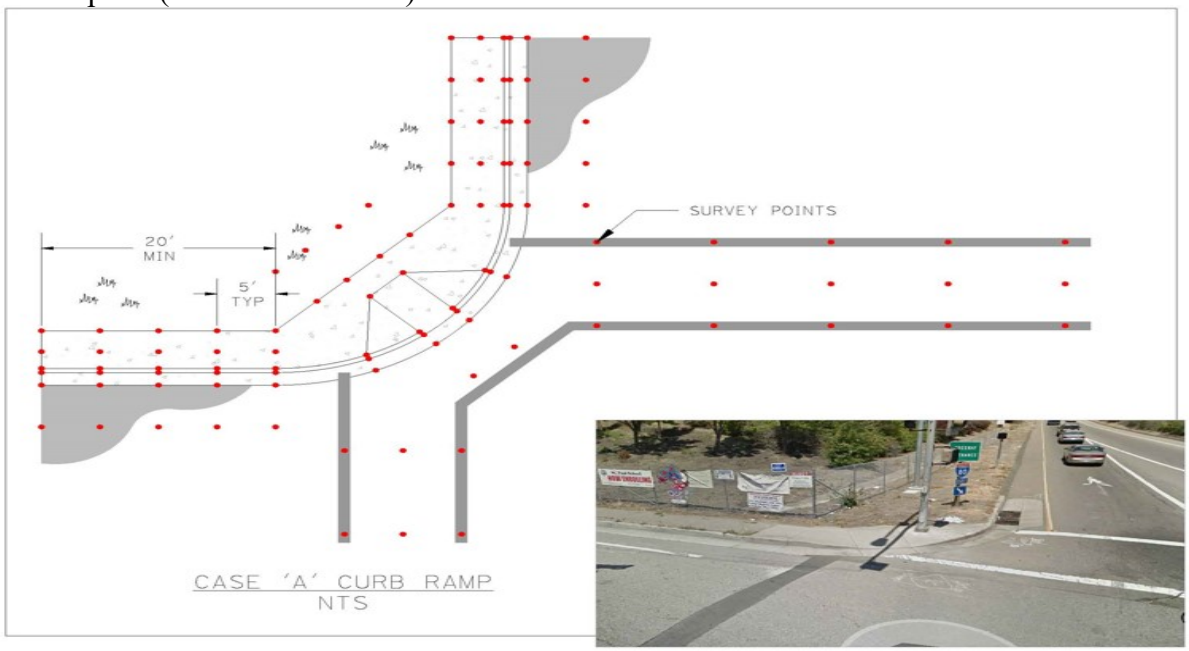
Chapter 11 covers topographic surveys, pavement elevation surveys, utility surveys, oil and gas pipelines, water and sewer lines, overhead lines, underground lines, railroads, archeological site/environmentally sensitive area surveys, monitoring surveys, and vertical clearance surveys. The chapter also provides guidance on accuracies required for the specific surveys.

ADA facility surveys can generally be classified as pavement elevation surveys. The survey methods are similar for both and the horizontal and vertical accuracies are the same. However, the amount of information needed by the engineer to determine if a compliant ramp can be built within existing conditions, is significantly more than a conventional pavement elevation survey.

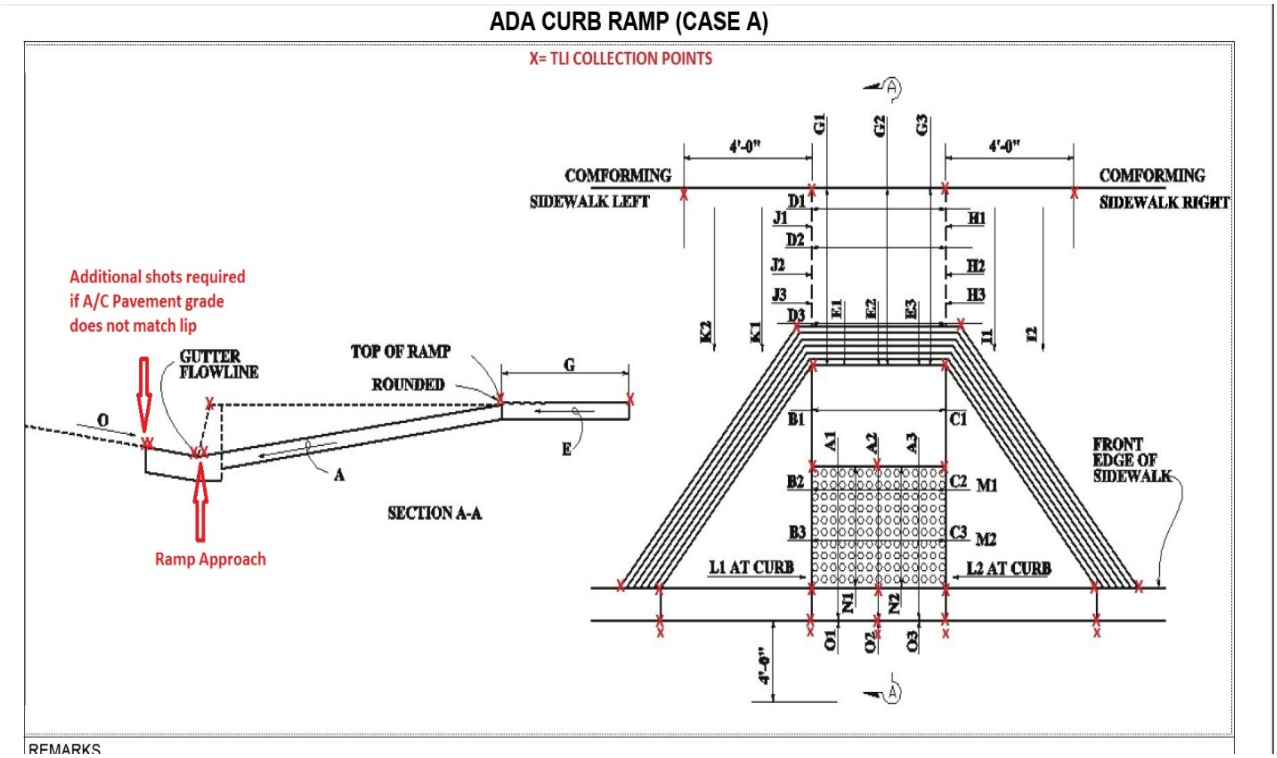
In order for the Design Engineer to successfully design an ADA compliant ramp in existing conditions, Surveys must provide a detailed existing conditions field survey (Example 1).

The picture and diagram show an existing non-compliant ramp and the densification of the existing conditions survey. This is the approach to ADA surveys District 04 has adopted. As shown the survey shot sections are approximately five feet apart.

Example 1 (utilities not shown)



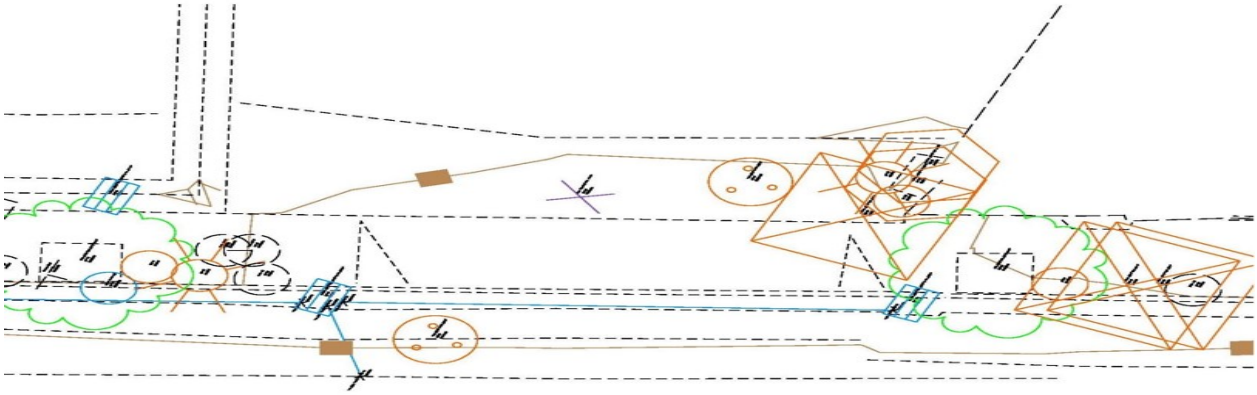
Example 2



The diagram above (Example 2) is the District 08 approach. District Surveys provides the Party Chief with diagrams based on the type of curb ramps to be surveyed. The diagram provides precise guidance to the Survey Crew on where topography shots should be taken.

When planning an ADA facility survey there are three primary areas of focus:

1. Determine whether the existing ramp is compliant or non-compliant.
2. Collecting survey field data sufficient to determine conform locations for removal and replacement of non-compliant ramps.
3. Any affected utilities must be accurately identified and located (See Example 3 below).



Example 3

The picture and the drawing above (Example 3) show a typical survey of a mid-block ramp. As shown, the utility locations would make re-location determination difficult. Additional accurate positional data should be provided. Accurate location of existing utilities will assist in the determination of whether re-location of existing utilities will be necessary in order to construct the compliant facility (See Example 4).

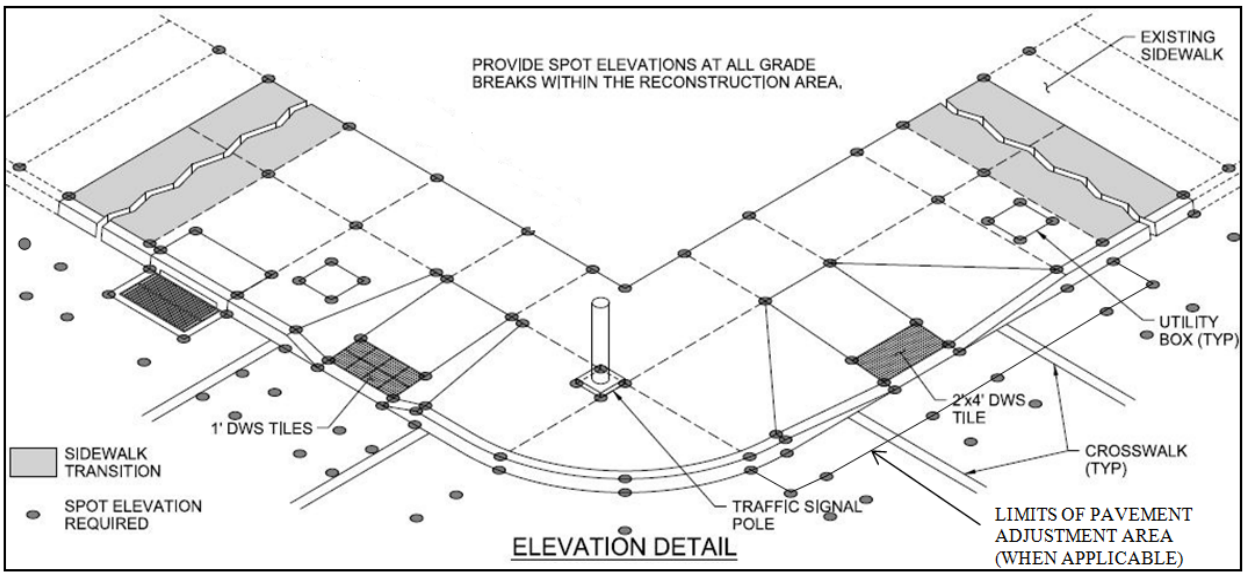
Until there are significant improvements to the way utilities are depicted in CADD drawings, it may be prudent for the Party Chief to use generic topo codes[1] and / or take pictures and provide

[1] ftp://cadd.dot.ca.gov/OLS_FTP/Caltrans.fcl/TopoCodes/

distance ties to the utilities from the ramp or some other clearly defined positon (flowline of curb). If there are existing buildings within the survey area, the building face, corners and finished floor elevation should be collected.

Example 4

Drawing courtesy of the Pennsylvania Department of Transportation (DOT)



Accuracy Standard: Per the Caltrans Surveys Manual, Chapter 11, (Engineering Surveys) data points located on paved surfaces or any engineering fixed works should be located within ±0.03 foot horizontally and ±0.02 foot vertically. Due to the density of the shots and the slope tolerances required for compliance, the field surveyor should use all due diligence to minimize vertical error (see page 6 of 14 "Recommendations"). RTK is not to be used for ADA ramp surveys.

Methodology:

Total Station Survey System (TSSS)

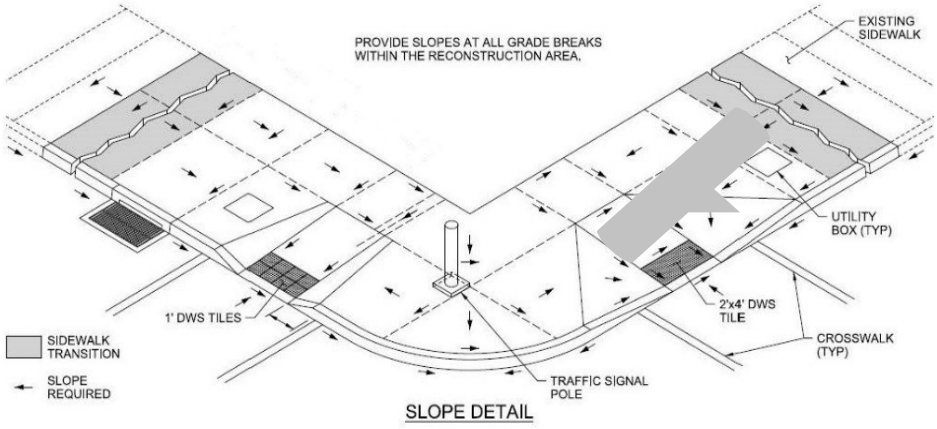
TSSS data collection is the most common method for capturing engineering survey data. In the past minimal shots were taken on existing ramps and returns.

The TSSS data collection for an ADA facility should address the specific topography information needed by Design Engineer. The drawing above depicts the minimum number of shots required by the Pennsylvania DOT when using TSSS procedures. This is similar to the District 04 densification with the exception of the utility locations.

The Office of Land Surveys (OLS) recommends that District Surveys discuss the scope of the ADA survey with the Design Engineer. Each facility will come with its own issues and will require different levels of densification. Providing the Design Engineer on the existing slopes and existing utilities within the confines of the non-compliant facility (See Example 5) is critical.

Example 5

Drawing courtesy of the Pennsylvania Department of Transportation



Recommendations

- Instrument occupied control should be within 150’ of the facilities being surveyed.
- Every effort should be made to set control to avoid using multiple setups for a single ramp.
- Control elevations should be run with digital level.
- The control must be in the adjusted traverse. Control set by resection should not be used.
- A Single prism should be used.
- The rod should be supported to assure it is plumb while taking shots
    - Rod bubble should be checked prior to beginning the survey.
- HT and HI measurements need to be checked after each facility surveyed.
- The total station vertical index and horizontal collimation should be checked at least each day and depending on conditions, at each setup.

Stationary Terrestrial Laser Scanning

Stationary Terrestrial Laser Scanning (STLS) refers to laser scanning applications that are performed from a static vantage point on the surface of the earth. The basic concept is similar to that used in total station instruments; using the speed of light to determine distance. However, there are significant differences in laser light wavelength, amount and speed of point data collected, field procedures, data processing, error sources, etc. Laser scanning systems collect a massive amount of raw data called a "point cloud."

Since a laser scanner is capable of scanning features over long distances, and the accuracy of the scan data diminishes beyond a certain distance, care should be taken to ensure that the final dataset does not include any portion of point cloud data whose accuracy is compromised by measurements outside the useful range of the scanner.

Pavement analysis scans to identify issues such as surface irregularities, ADA ramp slopes, utility locations, and drainage need to achieve the same accuracy as conventional surveys (0.03' Horizontal, 0.02' Vertical). In order to achieve those accuracies, OLS has the following recommendations:

Recommendations

- The control must meet the 2cm network accuracy and third order vertical accuracy. (Chapter 5 CSM).
- The occupied control should be within 100' of the ADA facility.
- The occupied control must be in the adjusted traverse. Control set by resection should not be used.
- A minimum of two targeted control points (BS/FS) should be used for each setup.
- A "fine" scan must be performed.
- All debris must be removed from the curb flowline and on or near the ramp.
- Utilities which may not be clearly visible in the scan should be located using conventional total station survey methods.


ModelSpace: Clean Copy of Unified Copy of ModelSpace1 : ModelSpace1 View1
File Edit Selection View Viewpoint Create Object Edit Object Tools User Apps Help
scn8
224
scn6
scn5
scn7
Nothing selected.
N, E, El
ModelSpace: Clean Copy of Unified Copy of ModelSpace1 : ModelSpace1 View1
File Edit Selection View Viewpoint Create Object Edit Object Tools User Apps Help
SEBASTOPOL
BUSINESS CENTER
scn5
Nothing selected.
N, E, El

Mobile Terrestrial Laser Scanning (MTLS)

MTLS method for acquiring data for ADA facilities is used when the replacement of the ramps is part of a larger roadway improvement project, or the number of ramps makes using MTLS the most efficient and effective process for collecting the data.

District 11 has been using MTLS for ADA projects. The following recommendations are based on their experience:

- The acquisition rate, vehicle speed and range should be sufficient to collect points at a high density. The vehicle cannot pick up the features dense enough if it is further than about 1.5 lanes away. Across the street is typically too far.
- Plan the data collection for the slowest time of the day. Be aware of any peak traffic times and research local bell schedules and other unique vehicle/foot traffic situations that might occur.
- For most intersections it is necessary to drive both the highway/ramp and the cross-street or drive parallel to the return.
- Avoid turning too tightly in the MTLS vehicle, which may cause an inside scan line to run "backwards", which might cause an issue in certain processing situations.
- Parallel and overlapping scans should be registered so that they align together within tolerances.
- MTLS control should be set at the beginning and end of each planned run, at each intersection and elsewhere as appropriate. 1500' horizontal target spacing is inadequate for the MTLS vehicle speeds common in for this work.
- Since pull boxes and manhole lids are difficult to read in the scan and accompanying photos, utilities should be measure by conventional or RTK (as appropriate) methods unless both the location and type can be determined without this supplemental data. It is quicker and easier to simply measure and code any features which might be difficult to accurately determine from the cloud/photo.
- Culvert flowlines should always be measured unless there is certainty that the drainage will not be impacted.
- All debris in the gutters, back of sidewalk or elsewhere should either be removed or the obscured feature(s) should be collected with conventional total station observations. These lines should start and end where the feature is open for MTLS data so that conformance can be verified
- Survey control that was used for target observations should be left behind that is sufficient to stake the improvements and conform to the collected data.
- Field crews should measure validation shots, such as paint strip corners or other obvious features, at each corner. These points should be described sufficiently to avoid confusion in the office.

KEY TAKEAWAYS – In collecting data for ADA facilities, the procedures are basically the same as they are for typical engineering surveys, it is the amount of data collected that separate's ADA facility surveys from typical engineering surveys.

CONSTRUCTION SURVEYS

Current Policy – Caltrans Surveys Manual, Chapter 12 (Construction Surveys) provides staking standards for Caltrans and consultant surveyors on transportation projects. Chapter 12 is included in any construction contract that will require staking. Section 12.5-8 details staking intervals and horizontal and vertical staking tolerances for curb stakes. Included in this section is curb returns. The number of stakes set for a curb return is proportional to the length of the return at the flowline. If, for example, the length of the return at the flowline is greater than 20', then the contractor is entitled to stakes at the BCR, ¼Δ, ½Δ, ¾Δ, and ECR.

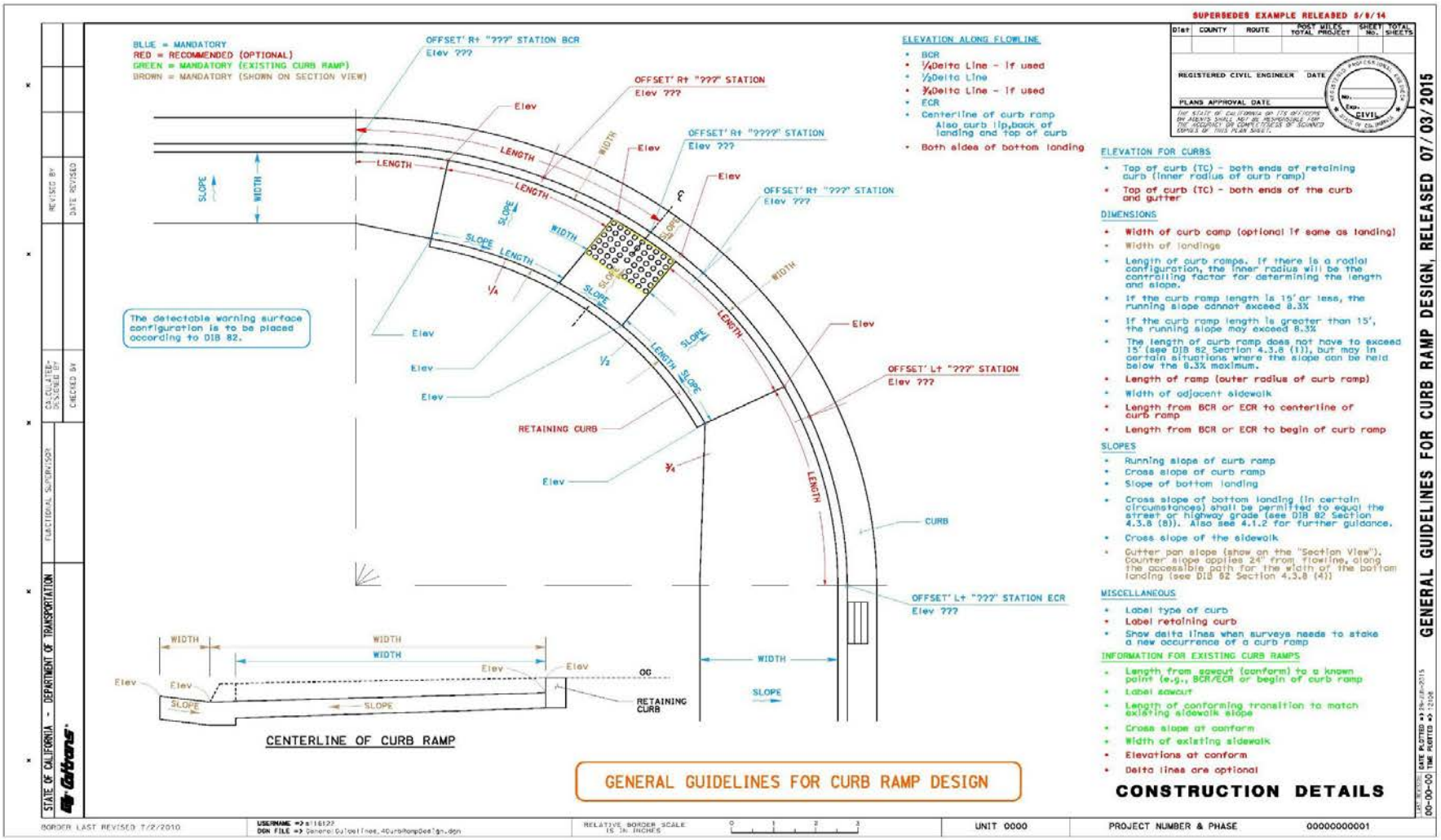
If possible, the construction staking should be done using the same control as the design survey. Staking for ADA ramps will require additional stakes in most cases. The Division of Design has updated Design Information Bulletin (DIB) 82. The new release is 82-06. The bulletin provides pedestrian accessibility guidelines for highway projects to District Design staff. In addition to DIB 82-06, Headquarters CADD unit has developed general guidelines for curb ramp design (see below).

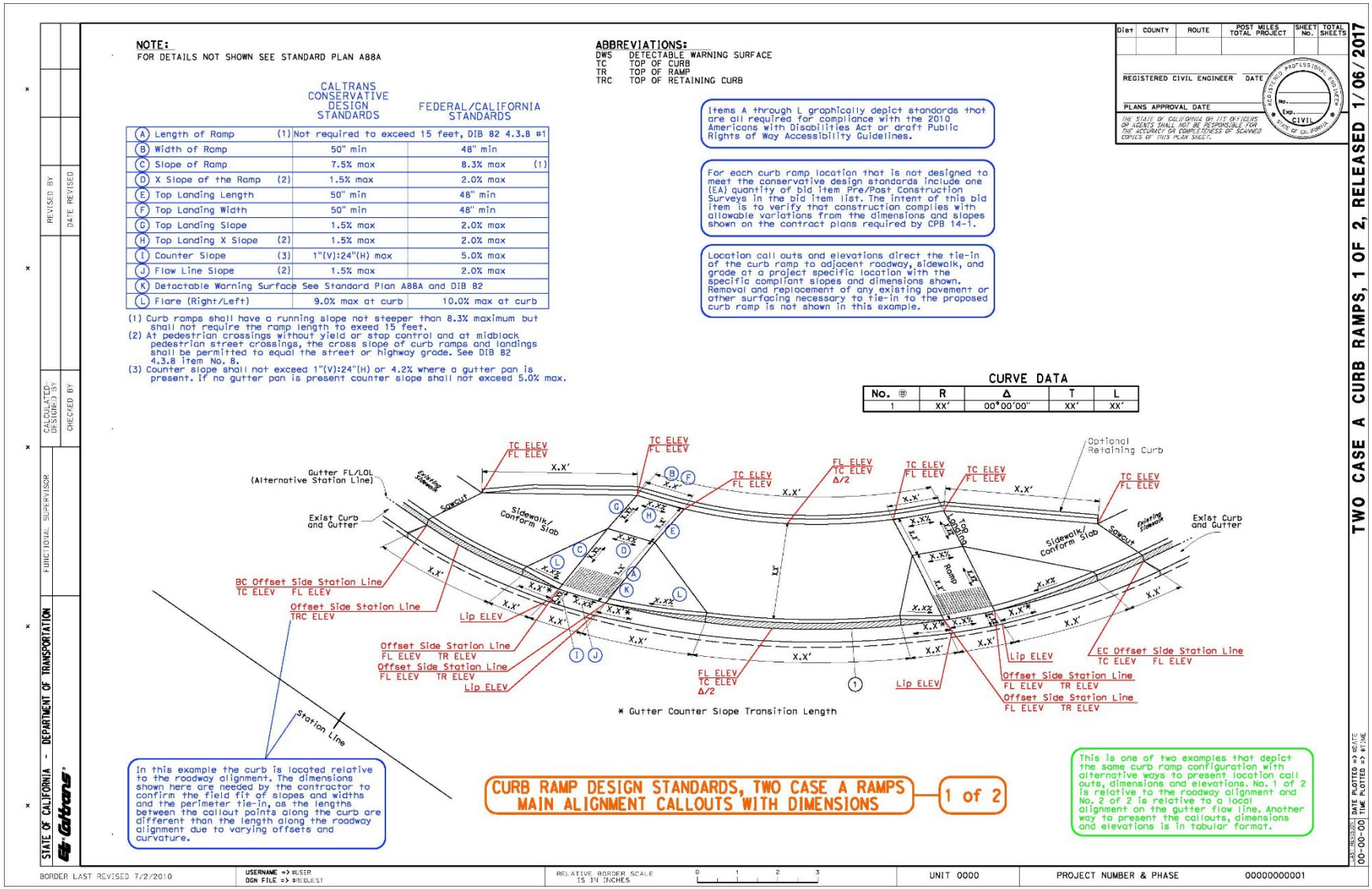
Stake density will depend primarily on the amount of information provided by the Design Engineer. At a minimum, the BCR, ECR, 1/2Δ and centerline of the ramp should be staked per the example on page 13 "General Guidelines for Curb Ramp Design" Mandatory. Additional stakes may be set if requested, however it is recommended that the maximum locations staked should be 1/4Δ's edges of ramp at flowline and edges of ramp at landing. Surveys may be asked to stake angle points on retaining curb if the design calls for it.

Typically, construction stakes are set by station/offset from a defined alignment. Per the CADD Manual revision, the Design Engineer has two options when developing the ADA facility design. The first option is to tie the facility(s) to the centerline alignment. This becomes an issue for surveys. All points tied to the centerline alignment will be normal (90°) to the alignment. For mid-block ramps in tangents this is not a problem. However, most curb ramps are in a curve. Since Surveys does not stake actual locations, but set reference stakes, providing a radial reference stake based on ties to the centerline alignment will only be possible at the BCR and ECR of the curb return.

The second option for the design engineer is to tie the ramp to a local alignment, in most cases the flowline of the curb. This option is preferred by Surveys. It allows us to set radial reference stakes by adding or subtracting the reference distance to the offset distance. If the designer used the centerline alignment option, then the recommendation from OLS is for Survey office staff to create local alignments (flowline) for each ramp.

CADD Construction Detail Examples




NOTE:
FOR DETAILS NOT SHOWN SEE STANDARD PLAN A88A
ABBREVIATIONS:
DWS DETECTABLE WARNING SURFACE
TC TOP OF CURB
TR TOP OF RAMP
TRC TOP OF RETAINING CURB
CALTRANS CONSERVATIVE DESIGN STANDARDS
FEDERAL/CALIFORNIA STANDARDS
(A) Length of Ramp (1) Not required to exceed 15 feet, DIB 82 4.3.8 #1
(B) Width of Ramp 50" min 48" min
(C) Slope of Ramp 7.5% max 8.3% max (1)
(D) X Slope of the Ramp (2) 1.5% max 2.0% max
(E) Top Landing Length 50" min 48" min
(F) Top Landing Width 50" min 48" min
(G) Top Landing Slope 1.5% max 2.0% max
(H) Top Landing X Slope (2) 1.5% max 2.0% max
(I) Counter Slope (3) 1"(V):24"(H) max 5.0% max
(J) Flow Line Slope (2) 1.5% max 2.0% max
(K) Detectable Warning Surface See Standard Plan A88A and DIB 82
(L) Flare (Right/Left) 9.0% max at curb 10.0% max at curb
(1) Curb ramps shall have a running slope not steeper than 8.3% maximum but shall not require the ramp length to exeed 15 feet.
(2) At pedestrian crossings without yield or stop control and at midblock pedestrian street crossings, the cross slope of curb ramps and landings shall be permitted to equal the street or highway grade. See DIB 82 4.3.8 item No. 8.
(3) Counter slope shall not exceed 1"(V):24"(H) or 4.2% where a gutter pan is present. If no gutter pan is present counter slope shall not exceed 5.0% max.
Items A through L graphically depict standards that are all required for compliance with the 2010 Americans with Disabilities Act or draft Public Rights of Way Accessibility Guidelines.
For each curb ramp location that is not designed to meet the conservative design standards include one (EA) quantity of bid item Pre/Post Construction Surveys in the bid item list. The intent of this bid item is to verify that construction complies with allowable variations from the dimensions and slopes shown on the contract plans required by CPB 14-1.
Location call outs and elevations direct the tie-in of the curb ramp to adjacent roadway, sidewalk, and grade at a project specific location with the specific compliant slopes and dimensions shown. Removal and replacement of any existing pavement or other surfacing necessary to tie-in to the proposed curb ramp is not shown in this example.
CURVE DATA
No. R Δ T L
1 XX' 00°00'00" XX' XX'
Gutter FL/LOL (Alternative Station Line)
Existing Sidewalk
Sawcut
Exist Curb and Gutter
Sidewalk/ Conform Slab
TC ELEV FL ELEV
FL ELEV TC ELEV Δ/2
Optional Retaining Curb
Top Landing
Ramp
BC Offset Side Station Line TC ELEV FL ELEV
Offset Side Station Line TRC ELEV
Lip ELEV
Offset Side Station Line FL ELEV TR ELEV
EC Offset Side Station Line TC ELEV FL ELEV
* Gutter Counter Slope Transition Length
Station Line
In this example the curb is located relative to the roadway alignment. The dimensions shown here are needed by the contractor to confirm the field fit of slopes and widths and the perimeter tie-in, as the lengths between the callout points along the curb are different than the length along the roadway alignment due to varying offsets and curvature.
CURB RAMP DESIGN STANDARDS, TWO CASE A RAMPS MAIN ALIGNMENT CALLOUTS WITH DIMENSIONS
1 of 2
This is one of two examples that depict the same curb ramp configuration with alternative ways to present location call outs, dimensions and elevations. No. 1 of 2 is relative to the roadway alignment and No. 2 of 2 is relative to a local alignment on the gutter flow line. Another way to present the callouts, dimensions and elevations is in tabular format.
Dist COUNTY ROUTE POST MILES TOTAL PROJECT SHEET No. TOTAL SHEETS
REGISTERED CIVIL ENGINEER DATE
PLANS APPROVAL DATE
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.
REVISED BY
DATE REVISED
CALCULATED-DESIGNED BY
FUNCTIONAL SUPERVISOR
CHECKED BY
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
TWO CASE A CURB RAMPS, 1 OF 2, RELEASED 1/06/2017
BORDER LAST REVISED 7/2/2010
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RELATIVE BORDER SCALE IS IN INCHES
UNIT 0000
PROJECT NUMBER & PHASE 00000000001
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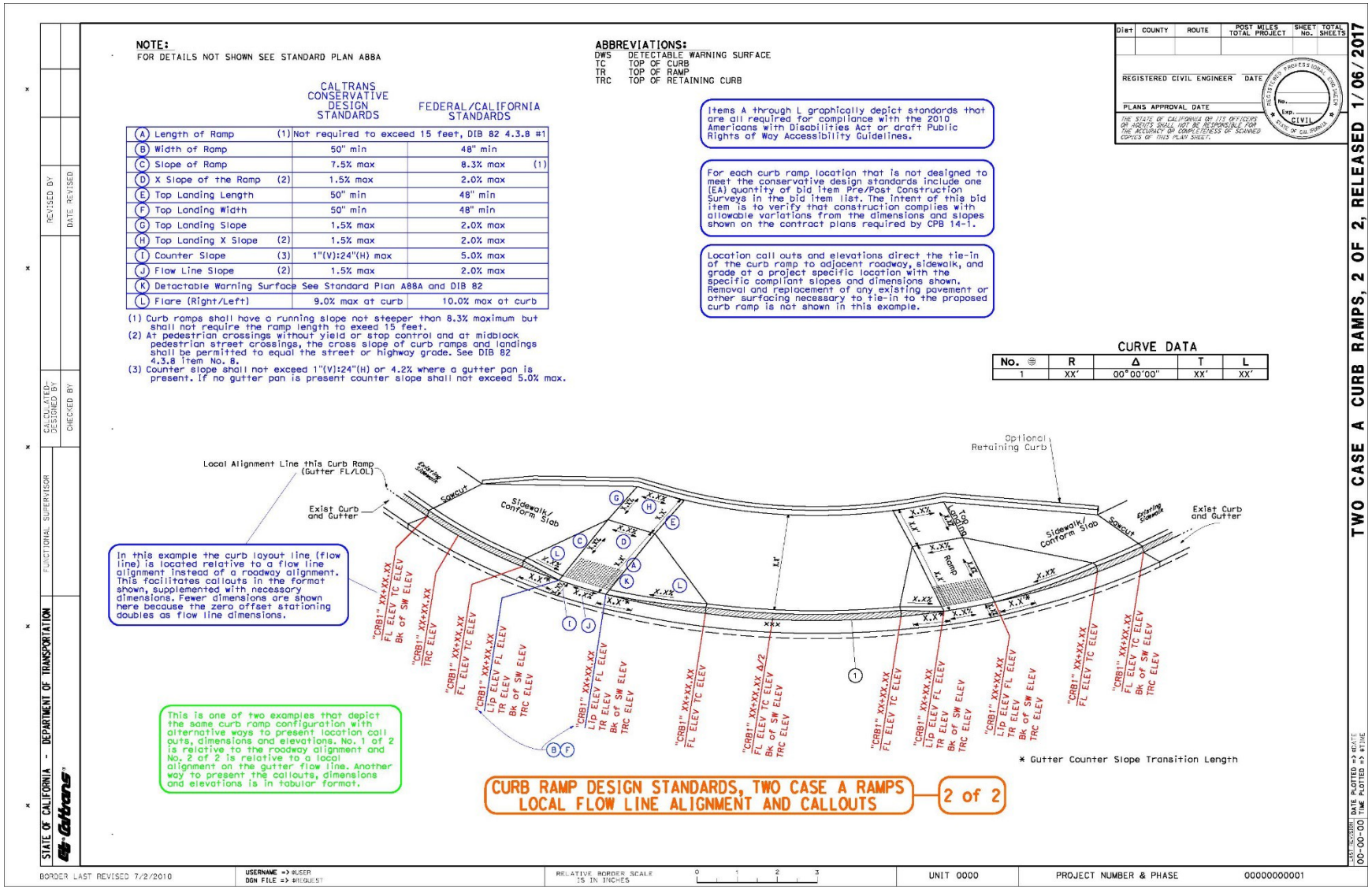
TIME PLOTTED => $TIME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TC TOP OF CURB
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TRC TOP OF RETAINING CURB
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FEDERAL/CALIFORNIA STANDARDS
(A) Length of Ramp (1) Not required to exceed 15 feet, DIB 82 4.3.8 #1
(B) Width of Ramp 50" min 48" min
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(D) X Slope of the Ramp (2) 1.5% max 2.0% max
(E) Top Landing Length 50" min 48" min
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(H) Top Landing X Slope (2) 1.5% max 2.0% max
(I) Counter Slope (3) 1"(V):24"(H) max 5.0% max
(J) Flow Line Slope (2) 1.5% max 2.0% max
(K) Detectable Warning Surface See Standard Plan A88A and DIB 82
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Items A through L graphically depict standards that are all required for compliance with the 2010 Americans with Disabilities Act or draft Public Rights of Way Accessibility Guidelines.
For each curb ramp location that is not designed to meet the conservative design standards include one (EA) quantity of bid item Pre/Post Construction Surveys in the bid item list. The intent of this bid item is to verify that construction complies with allowable variations from the dimensions and slopes shown on the contract plans required by CPB 14-1.
Location call outs and elevations direct the tie-in of the curb ramp to adjacent roadway, sidewalk, and grade at a project specific location with the specific compliant slopes and dimensions shown. Removal and replacement of any existing pavement or other surfacing necessary to tie-in to the proposed curb ramp is not shown in this example.
CURVE DATA
No. R Δ T L
1 XX' 00°00'00" XX' XX'
Local Alignment Line this Curb Ramp (Gutter FL/LOL)
Exist Curb and Gutter
Existing Sidewalk
Sidewalk/ Conform Slab
Gutter
Optional Retaining Curb
Top Landing
Ramp
In this example the curb layout line (flow line) is located relative to a flow line alignment instead of a roadway alignment. This facilitates callouts in the format shown, supplemented with necessary dimensions. Fewer dimensions are shown here because the zero offset stationing doubles as flow line dimensions.
This is one of two examples that depict the same curb ramp configuration with alternative ways to present location call outs, dimensions and elevations. No. 1 of 2 is relative to the roadway alignment and No. 2 of 2 is relative to a local alignment on the gutter flow line. Another way to present the callouts, dimensions and elevations is in tabular format.
* Gutter Counter Slope Transition Length
CURB RAMP DESIGN STANDARDS, TWO CASE A RAMPS
LOCAL FLOW LINE ALIGNMENT AND CALLOUTS
2 of 2
Dist COUNTY ROUTE POST MILES TOTAL PROJECT SHEET No. TOTAL SHEETS
REGISTERED CIVIL ENGINEER DATE
PLANS APPROVAL DATE
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.
REGISTERED PROFESSIONAL ENGINEER No. EXP. CIVIL STATE OF CALIFORNIA
REVISED BY DATE REVISED
CALCULATED-DESIGNED BY CHECKED BY
FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
TWO CASE A CURB RAMPS, 2 OF 2, RELEASED 1/06/2017
LAST REVISION DATE PLOTTED => !DATE
00-00-00 TIME PLOTTED => !TIME
BORDER LAST REVISED 7/2/2010
USERNAME => $USER
DGN FILE => $REQUEST
RELATIVE BORDER SCALE IS IN INCHES
0 1 2 3
UNIT 0000
PROJECT NUMBER & PHASE
00000000001

CONCLUSION

The Caltrans Surveys Manual (CSM) provides basic guidance for the engineering and construction surveying for ADA facilities. The editors of the CSM through the years have tried to provide guidance for District Surveys without stifling innovation by dictating absolutes.

Over the years, Caltrans has developed institutions designed to increase communication between functional units involved in project development. We have developed checklists and flow charts. By far, the most effective institution is the Project Development Team (PDT). The PDT gives District Surveys the opportunity to work with Design and the PDT on the data collection needs as well as provide guidance on the design for project construction.

ADA facility projects may require Surveys to use significantly more resources for the design and construction surveys. Caltrans Surveys program will be constantly challenged to innovate and deliver the ADA facility surveys cheaper and faster. This can be accomplished through the use of good planning, a trained workforce, and application of appropriate technologies.

The key actions to take related to this Survey Information Bulletin are as follows

- Ensure sufficient Surveys involvement in the Project Development Team (PDT).
- Work through the Project Manager and Design Engineer to develop a plan for the additional resources that ADA projects require.
- Pre-survey meeting with Design to determine the extent of the ADA facility surveys.
    - Determination of which facilities are known to be non-compliant and which facilities will need to be surveyed to make the compliant / non-compliant determination.
    - Accurate location of utilities within the conform limits of the facility (typically 20’ either side).
    - Work with the design engineer to promote the most economical and efficient design for construction staking.
- Surveys attendance at pre-construction meetings to determine staking density and possible pre/post surveys of ADA facilities.