

Public Rights of Way Assessment Process (PROW-AP)

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Reasons for Assessment of Sidewalks

Assess existing conditions

Determine compliance with
guidelines

Identify obstructions and hazards

Prioritize reconstruction

Users of Detailed Sidewalk Data

Sidewalk Planners

Designers

Engineers

Contractors

Inspectors

Sidewalk Assessment Process (SWAP):

Introduced in FHWA publication...

Designing Sidewalks and Trails for
Access

Conducted using paper data forms

Tape Measure

Smart Level

SWAP

Data collection along sidewalk
segments

Element Data

Curb Ramps

Driveway Crossings

Medians

Pork-chops etc.





SWAP

Tedious

Time Consuming

Bending and squatting – 10-20x per sidewalk element and on sidewalk segments



BRIGHT TRANSITIONS

Project #: 216-2

Date: 4/27/09

Street Name: OLVA WEST Segment Name: * Distance: 233'9"

* N COUNTY ROAD TO MICKLAND

N

N

S

S

E

E

W

W

9/16" 0.56

SWAP Error Potential

Smart level in wrong units

Smart level on hold

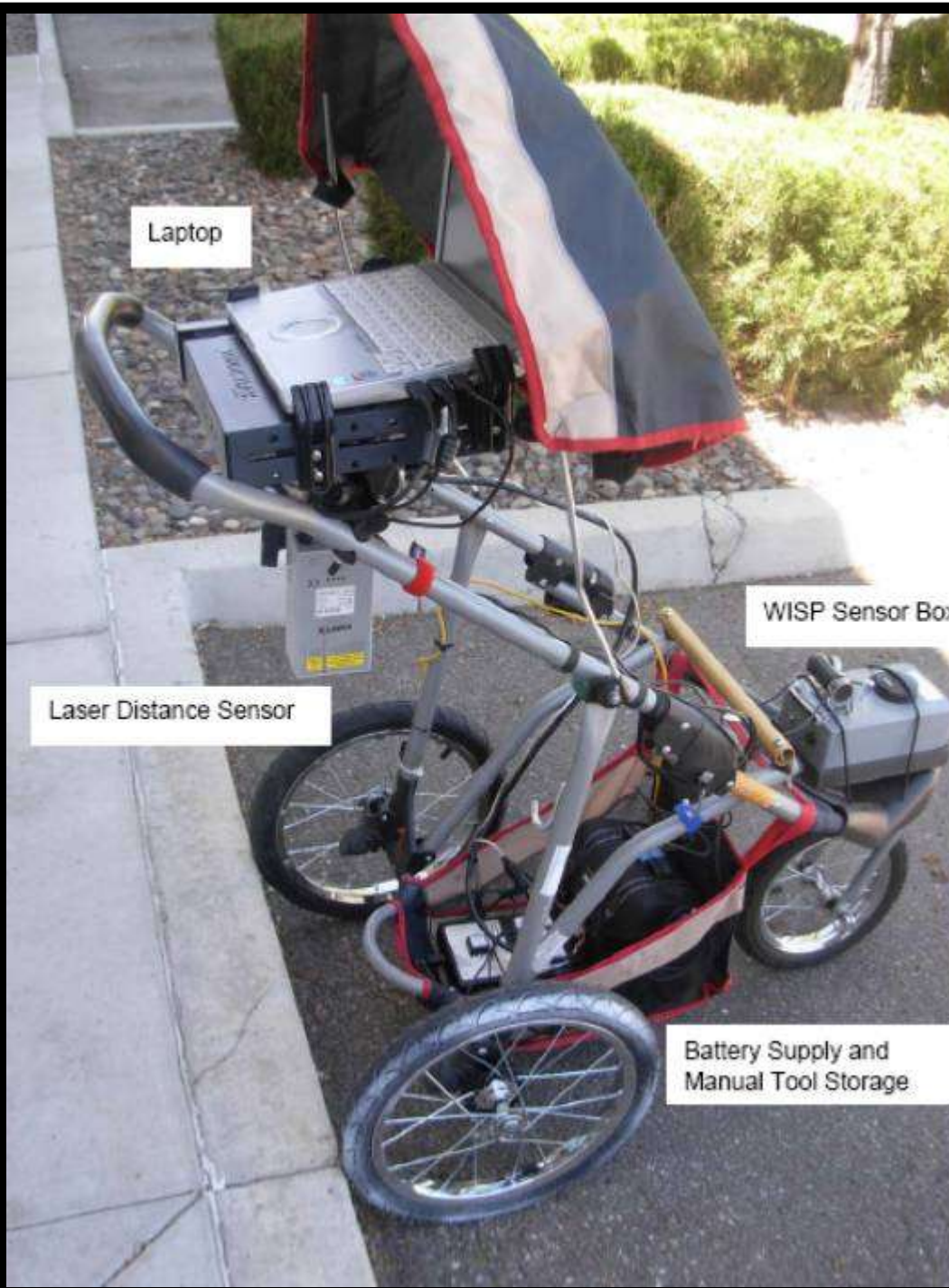
Misreading of smart level

Data recording errors

Data entry error

PROW-AP Phase I Project Main Objectives

- Automatic measurement of trip hazards using laser technology
- Develop user interface software screens with SQL database
- Develop and test methodologies for conducting the PROW-AP
- Demonstrate GIS sidewalk layer software interface specifications



Laptop

Laser Distance Sensor

WISP Sensor Box

Battery Supply and
Manual Tool Storage

PROW-AP Hardware

Dual reed distance collection

Camera for recording images

Grade and cross slope sensors

External battery power supply

Laptop computer interface



PROW-AP Hardware

Jogging stroller data collection
vehicle

Laser technology for height transition
measurements

GPS with USB interface

Cradle to carry mini roll-a-wheel

Measurement of Transition Height

Laser sensor

Enter desired height detection

Audio and visual alarm

Back up cart and determine
maximum transition height

Keystroke input to record

Benefits of Automatic Height Measurement

Detecting upheavals missed in SWAP

Fast and efficient identification of hazards

Record GPS position of each upheaval

Identify and prioritize for grinding and reconstruction

PROW-AP Laser Sensor Specifications

2 mm height accuracy

Detect heights to 8" curb

Operator speed of 3ft/sec

Measures any surface type

Variety of lighting conditions/colors
and angles

Records in 13-22% less time than
using profile gauge

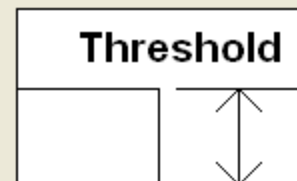
Proximity Sensor Settings Dialog



The Proximity Settings page is under construction. Please pardon the clutter. Thanks for your patience.

Transition Height or Depth (Live Data):

Set the Threshold to the minimum height/depth of Surface Transition Heights for which you would like to be notified.



Threshold (minimum height or depth detected):

With the cart on a flat surface, select [Zero Offset].

Zero Offset

Offset:

Post-Filter Gain:

OK

Cancel

Transition Height Capture

- 1) Press [Begin Recording].
- 2) Proceed by strolling along the sidewalk to be assessed.
- 3) When the sensor detects a Transition Height greater than the set Threshold, you will be alerted with an audible tone.
- 4) If this is a true Transition Height, the tone will continue. Click [Record Station] to add current readings to the database.
- 5) Click [Pause Recording] when forced to move from your intended path, putting the distance counter on hold.
- 6) When you reach the end of the assessment, click [End Recording] to close this window.

Thresh. Height	Distance	Transition Height
0.25	0.0	0.00

	Distance	Trans. Hgt.
1		
2		
3		
4		
5		
6		
7		
8		

Mute

Begin Recording

Pause Recording

End Recording

Settings

Transition Height Capture

- 1) Press [Begin Recording].
- 2) Proceed by strolling along the sidewalk to be assessed.
- 3) When the sensor detects a Transition Height greater than the set Threshold, you will be alerted with an audible tone.
- 4) If this is a true Transition Height, the tone will continue. Click [Record Station] to add current readings to the database.
- 5) Click [Pause Recording] when forced to move from your intended path, putting the distance counter on hold.
- 6) When you reach the end of the assessment, click [End Recording] to close this window.

Thresh. Height	Distance	Transition Height
0.25	12.3	0.24

	Distance	Trans. Hgt.
1	6.9	0.49
2	12.3	0.24
3		
4		
5		
6		
7		
8		

Mute

Record Station

Pause Recording

End Recording

Settings

PROW-AP Pilot Data Collection

Verified accuracy of data in lab

Repeatability of SWAP and
PROW-AP

Repeatability of assessment process

Compatibility of SQL data structure
with agency GIS information
systems

PROW-AP Software

Automatic report generations

SQL data export capability

High accuracy digital filtering to
speed up data collection of grades
and cross-slopes

PROW-AP Software Modules

Smart file naming

Calibration check and recalibration
procedures

Feature recording (e.g. bench, bus
stop, etc)

PROWAP - Public Rights of Way Assessment Process

Use Trimble GPS

Declination
Adjustment

14° 16' E

[NOAA Magnetic Declination Calculator](#)

Sidewalk Elements

Sidewalk Features

Surface Profiler

Stoll Data Collection

Merge GIS and GPS Data

Create Point or Line Name



Street:

Start (or)
Cross Street:

End Cross
Street:

Assessors
Name:

- N
- W E
- S
- N
- W E
- S

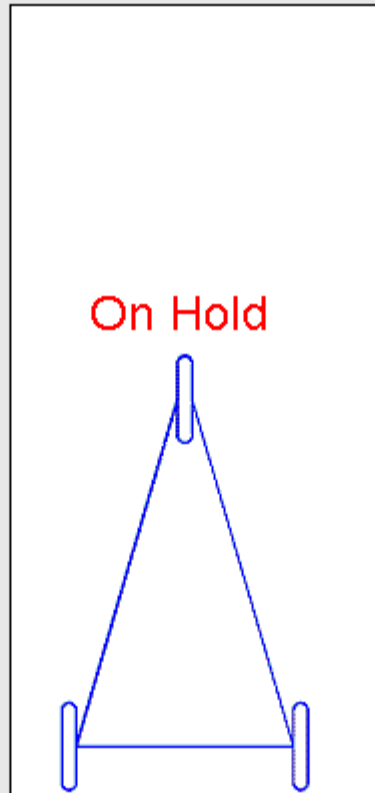
Smart Name:

Distance Calibration

Distance Calibration Verification:

- 1) Measure a known distance from the start line to the finish line.**
- 2) Set the rear wheels on the start line.**

Select [Start Position].



Start Position

Magnet Count **8** Whl. Dia. **1.25**

Max. Dist. Range **200**

Calibration Distance: **50** Feet

Select to Calibrate

Distance Traveled **-0.0**
Reset

Done

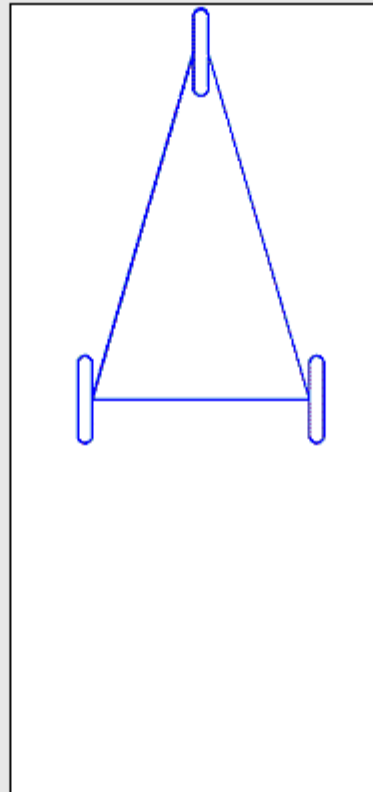
Cancel

Distance Calibration

Roll from the start line to the finish line.

Select
[Finish Line]

Select
[Reset]
any time you need to
zero the
"Distance Traveled".



Finish Line

Magnet Count **8** Whl. Dia. **1.25**

Max. Dist. Range **200**

Calibration Distance:
50 Feet

Select to Calibrate

Distance Traveled **49.9**
Reset

Done

Cancel

Distance Calibration

Calibration checking is now complete.

Compare the known distance with the reading being displayed. If "Distance Traveled" is not within your desired tolerance of the "Calibration Distance", select [Select to Calibrate].

Select [Check Again] to repeat this process.

Calibration
is
Complete

Check Again

Magnet Count **8** Whl. Dia. **1.25**

Max. Dist. Range **200**

Calibration Distance:
50 Feet

Select to Calibrate

Distance Traveled **49.9**

Reset

Done

Cancel

Tilt Sensor Calibration

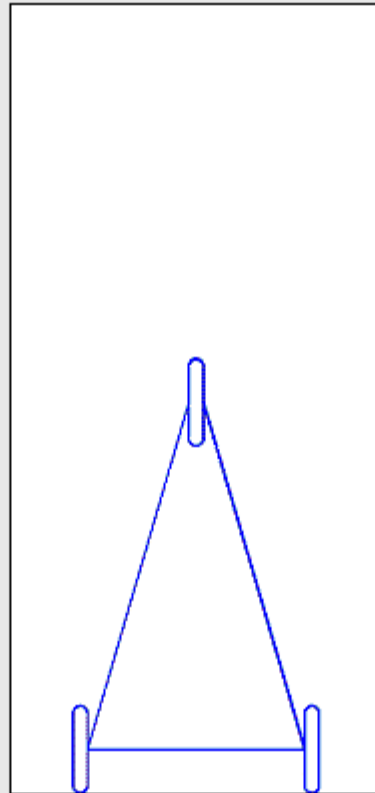


Tilt Calibration Verification:

Set the data collection vehicle in the starting position.

Select [Check Grade].

Check Distance Calib



Check Grade

Grade

0.6 %

X-Slope

-1.9 %

Select to Calibrate

Tilt sensor data from Sensor Instrumentation Package Label:

Ensure these numbers match your box!

X Axis (mV/deg)

34.793

Y Axis (mV/deg)

34.959

Cancel

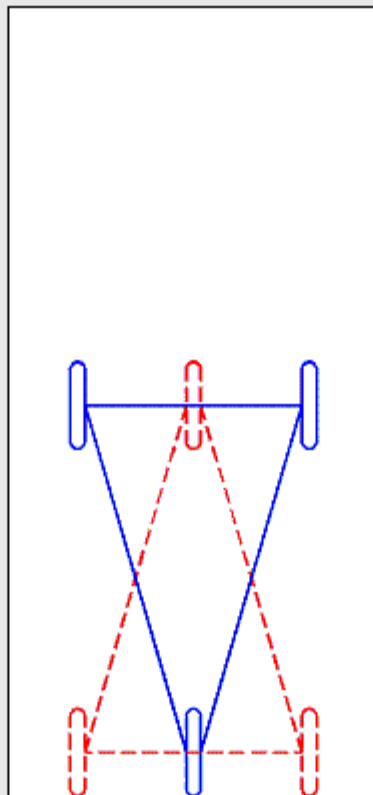
Tilt Sensor Calibration

Rotate the vehicle 180° so the rear wheels straddle the original front wheel location and the front wheel sits between the original rear wheel locations.

The Grade should be $-0.6\% \pm 0.3\%$.

If it is, select [Check X-Slope]. Otherwise, select [Select to Calibrate].

Check Distance Calib



Check X-Slope

Grade

-0.4 %

X-Slope

1.2 %

Select to Calibrate

Tilt sensor data from Sensor Instrumentation Package Label:

Ensure these numbers match your box!

X Axis
(mV/deg)

34.793

Y Axis
(mV/deg)

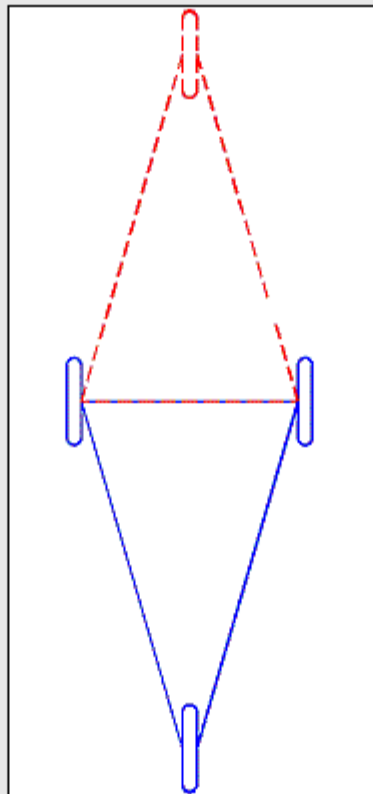
34.959

Cancel

Tilt Sensor Calibration

Roll the vehicle forward until the rear wheels return to the starting position. The X-Slope should be $2.0\% \pm 0.3\%$. If it is, select [Finish Checking]. Otherwise, select [Select to Calibrate].

Check Distance Calib



Finish Checking

Grade

-0.4 %

X-Slope

1.2 %

Select to Calibrate

Tilt sensor data from Sensor Instrumentation Package Label:

Ensure these numbers match your box!

X Axis
(mV/deg)

34.793

Y Axis
(mV/deg)

34.959

Cancel

PROW-AP Software Modules

Smart file naming

Calibration check and recalibration
procedures

Feature recording (e.g. bench, bus
stop, etc)

PROWAP Sidewalk Feature Capture

Grade: -0.1

X-Slope: 2.4

Please Select Feature Type

Bench

Bus Stop Landing

Bus Stop Shelter

Please Select Feature Type

Welcome the Sidewalk Feature Capture Dialog!

1) Click [Calibrate] to verify sensor calibration.

2) Select an Element Type from the drop-down menu

3) Name the Element

Type of element - Street it is on -

Side of street n/s e/w - cross street -

side of cross street n/s e/w

(to next cross street and side of cross street, if this is a segment) -

initials of operator - year - month - date

PROWAP Sidewalk Feature Capture

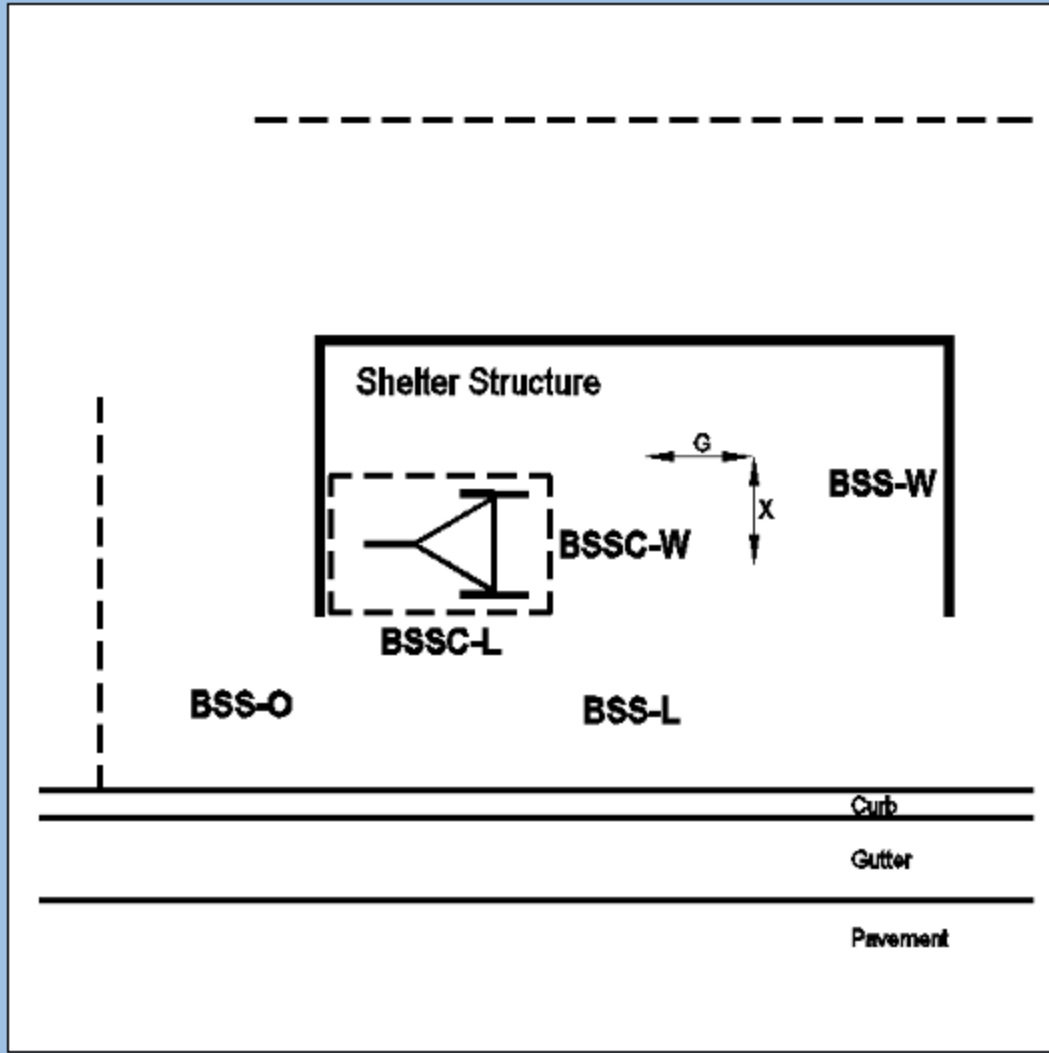
Show GPS Status Grade: -0.1

Check Calibration X-Slope: 2.3

Bus Stop Shelter

Applegate Ballfield BSS1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSSC				
BSS	-- N/A --	-- N/A --		
BSS-O	-- N/A --	-- N/A --	-- N/A --	



PROWAP Sidewalk Feature Capture

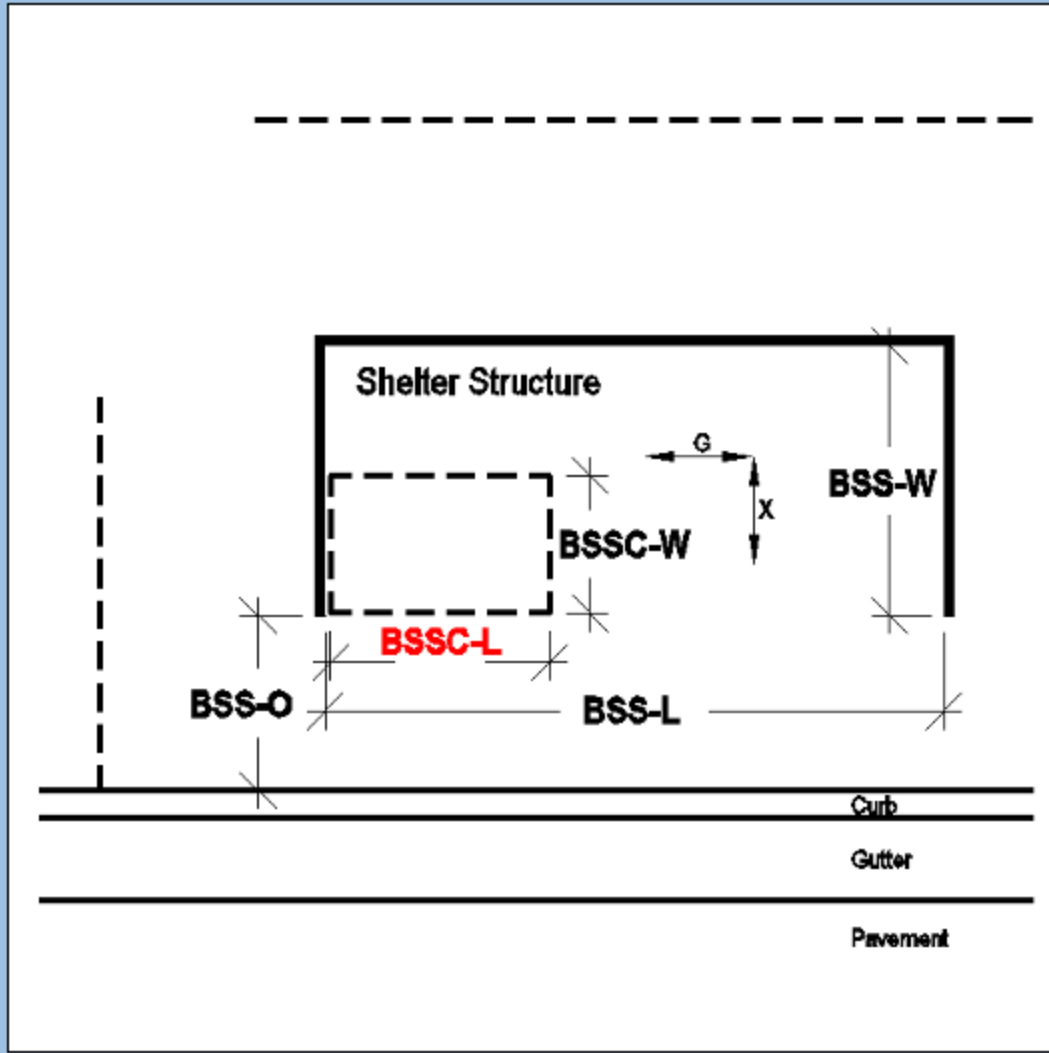
Show GPS Status Grade: -0.1

Check Calibration X-Slope: 2.3

Bus Stop Shelter

Applegate Ballfield BSS1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSSC	-0.1	2.3	49	
BSS	-- N/A --	-- N/A --		
BSS-O	-- N/A --	-- N/A --	-- N/A --	



PROWAP Sidewalk Feature Capture

Show GPS Status

Grade: -0.1

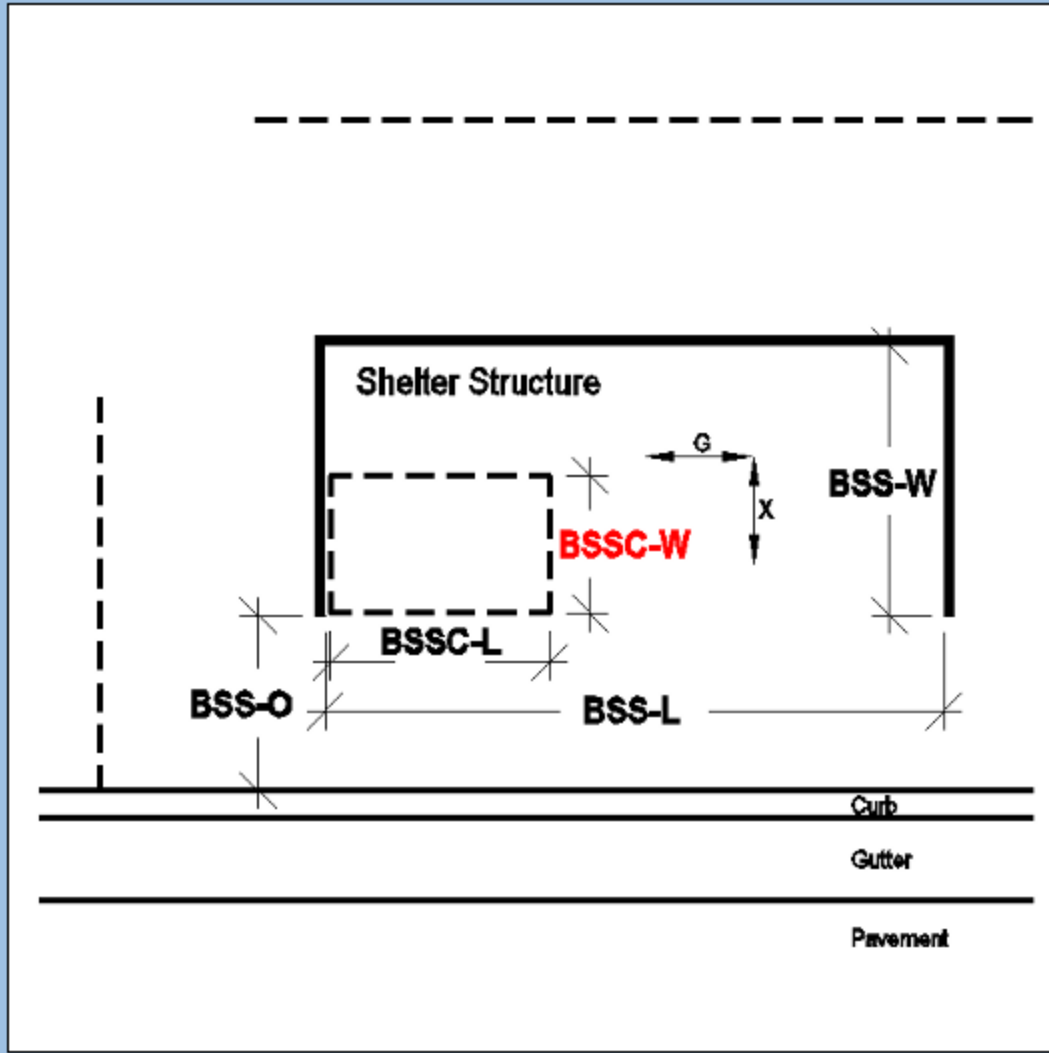
Check Calibration

X-Slope: 2.3

Bus Stop Shelter

Applegate Ballfield BSS1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSSC	-0.1	2.3	49.0	37
BSS	-- N/A --	-- N/A --		
BSS-O	-- N/A --	-- N/A --	-- N/A --	



PROWAP Sidewalk Feature Capture

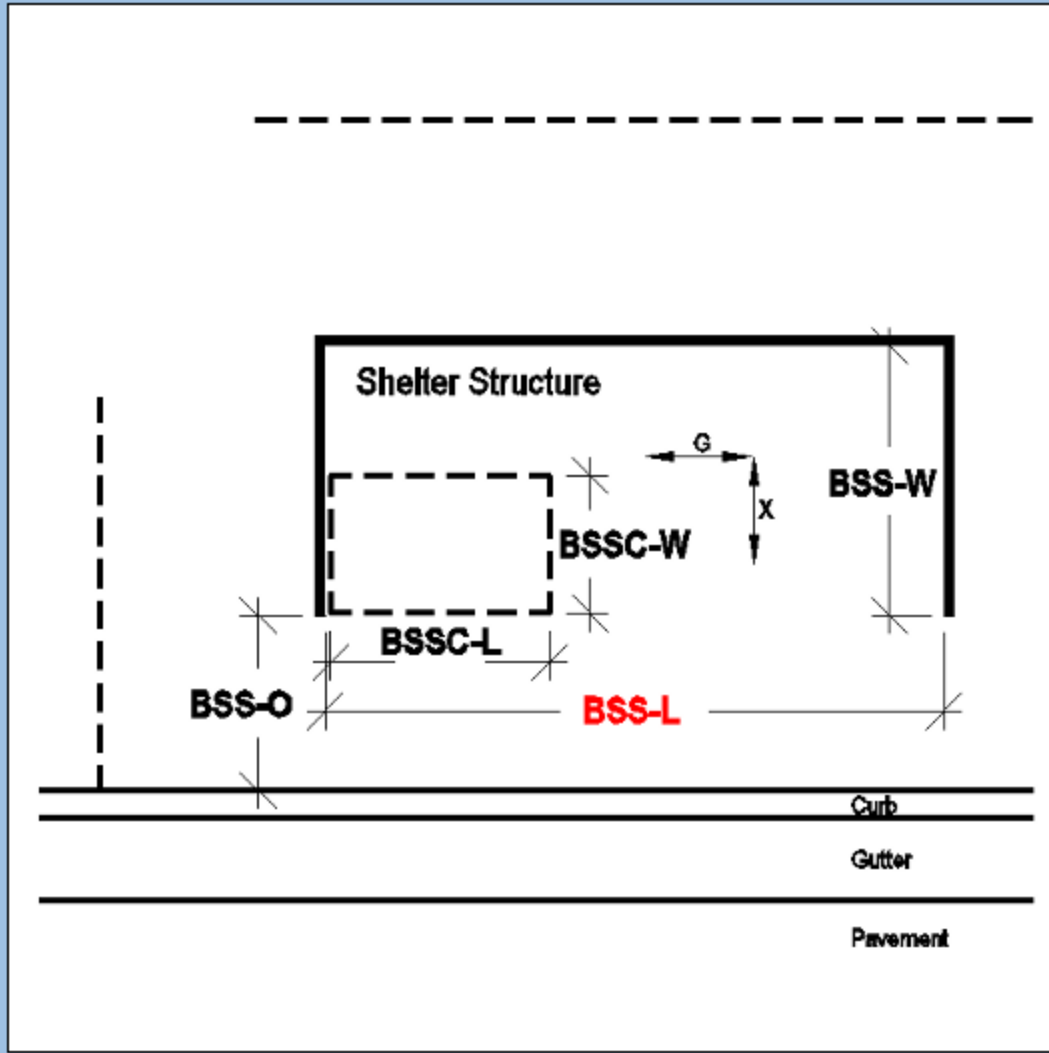
Show GPS Status Grade: -0.1

Check Calibration X-Slope: 2.3

Bus Stop Shelter

Applegate Ballfield BSS1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSSC	-0.1	2.3	49.0	37.0
BSS	-- N/A --	-- N/A --	124	
BSS-O	-- N/A --	-- N/A --	-- N/A --	



PROWAP Sidewalk Feature Capture

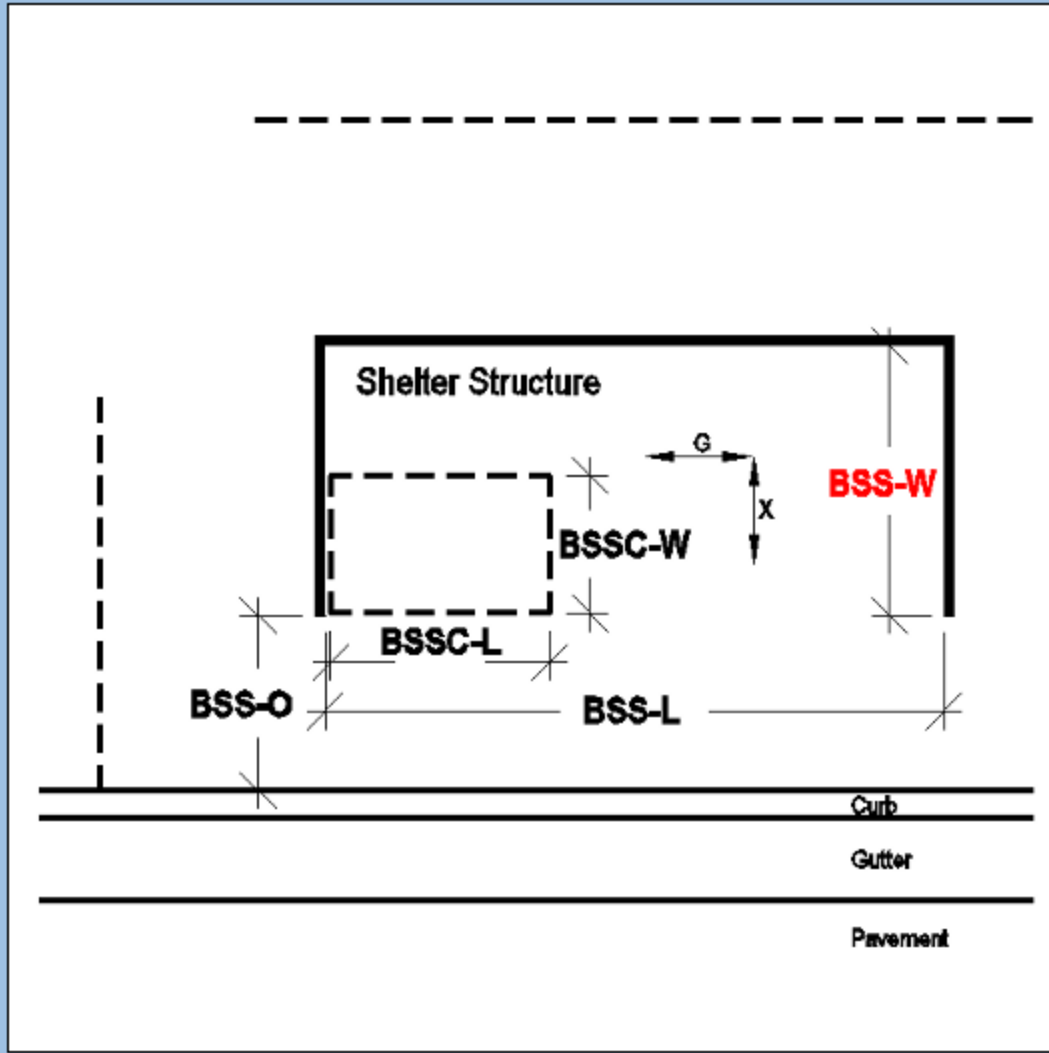
Show GPS Status Grade: -0.1

Check Calibration X-Slope: 2.3

Bus Stop Shelter

Applegate Ballfield BSS1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSSC	-0.1	2.3	49.0	37.0
BSS	-- N/A --	-- N/A --	124.0	56
BSS-O	-- N/A --	-- N/A --	-- N/A --	



PROWAP Sidewalk Feature Capture

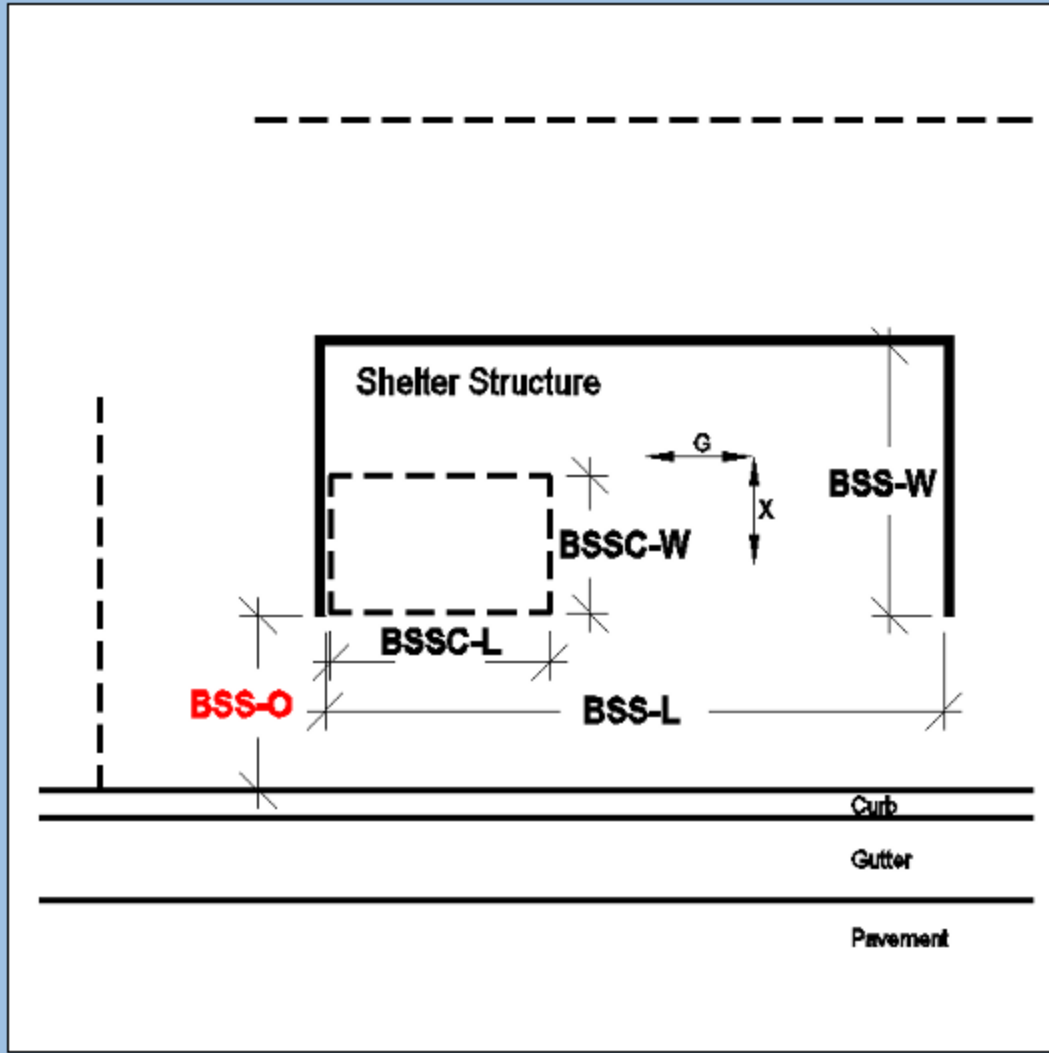
Show GPS Status **Grade:** -0.1

Check Calibration **X-Slope:** 2.3

Bus Stop Shelter ▾

Applegate Ballfield BSS1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSSC	-0.1	2.3	49.0	37.0
BSS	-- N/A --	-- N/A --	124.0	56.0
BSS-O	-- N/A --	-- N/A --	-- N/A --	42



PROWAP Sidewalk Feature Capture

Show GPS Status

Grade: 0.7

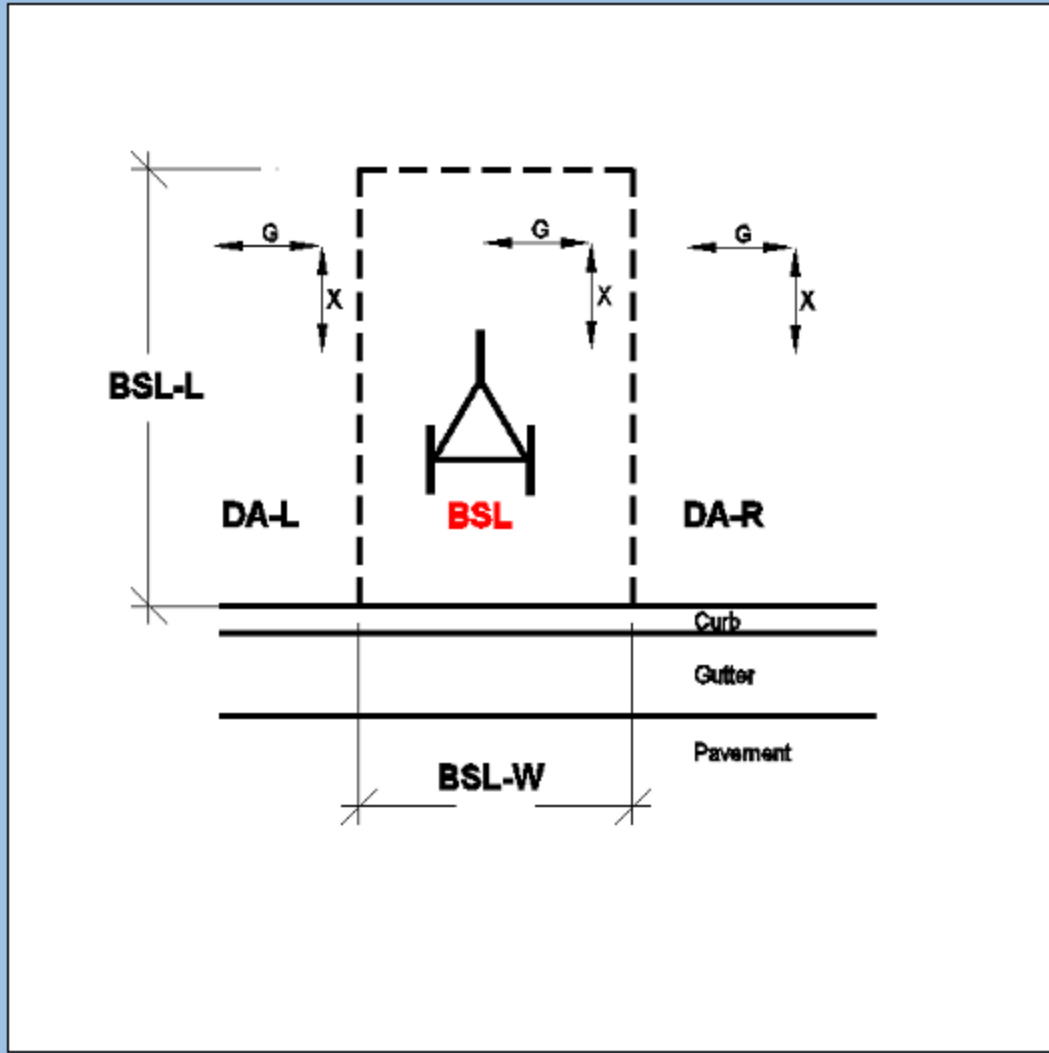
Check Calibration

X-Slope: 2.4

Bus Stop Landing

Applegate Ballfield BSL1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSL				
DAL			-- N/A --	-- N/A --
DAR			-- N/A --	-- N/A --



PROWAP Sidewalk Feature Capture

Show GPS Status

Grade: 0.7

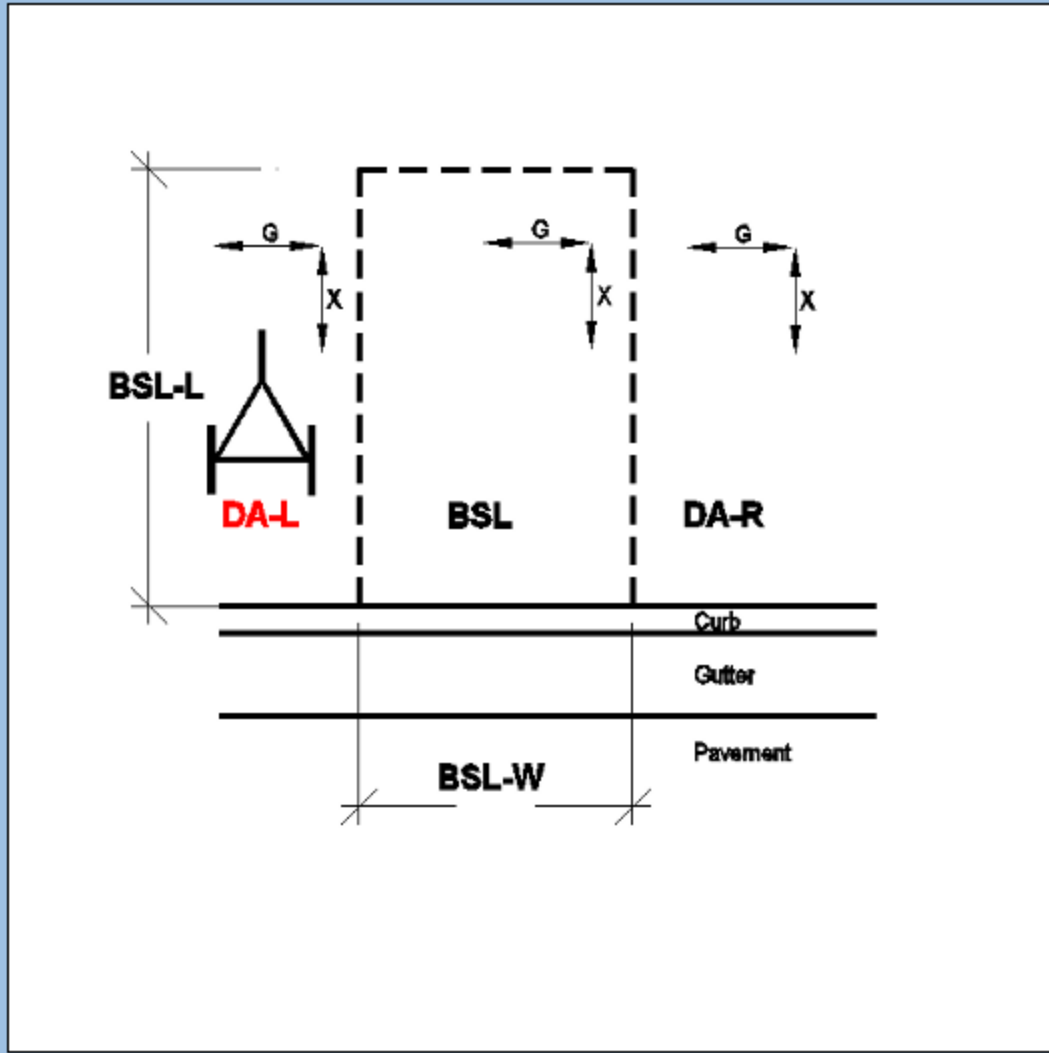
Check Calibration

X-Slope: 2.4

Bus Stop Landing

Applegate Ballfield BSL1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSL	0.7	2.4		
DAL			-- N/A --	-- N/A --
DAR			-- N/A --	-- N/A --



Capture

<-

Skip

Save

Cancel

PROWAP Sidewalk Feature Capture

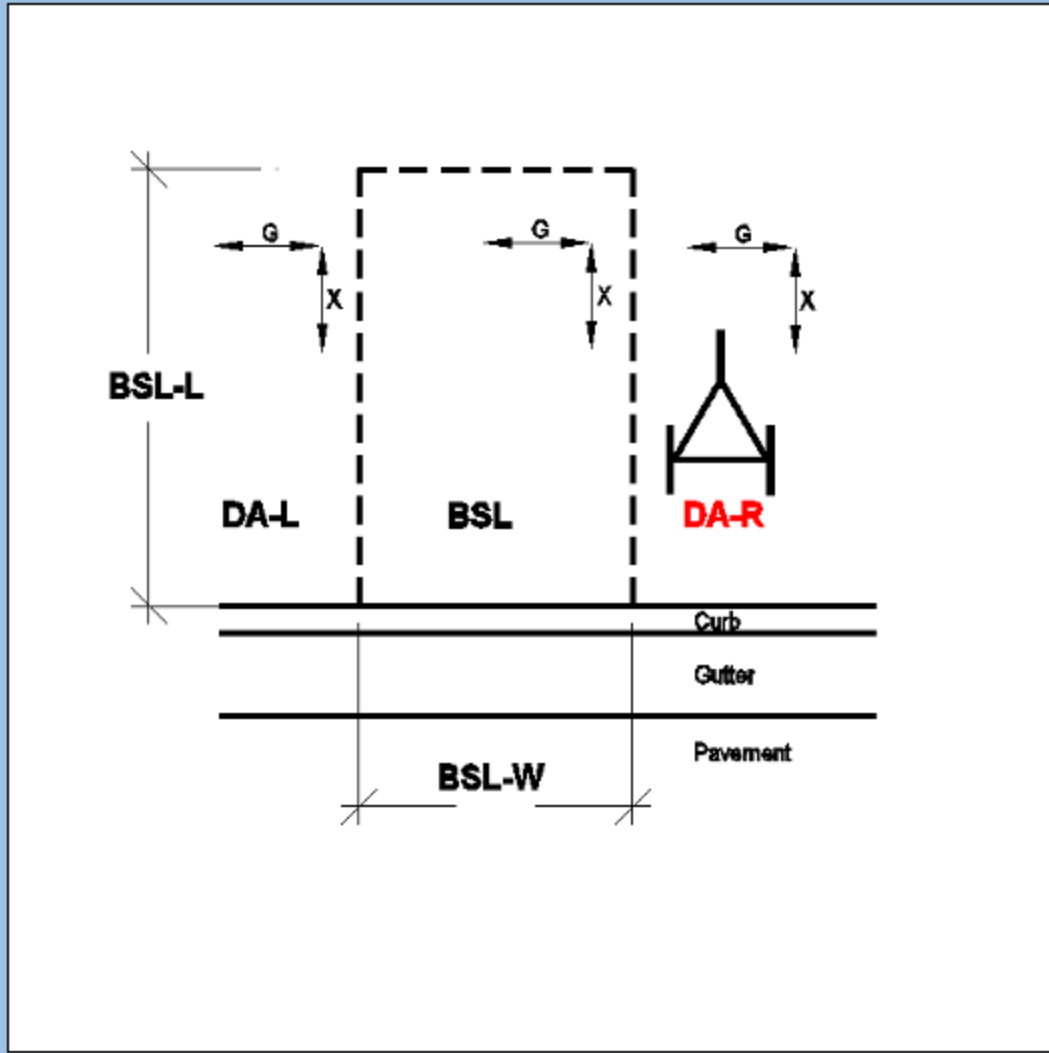
Show GPS Status Grade: -0.1

Check Calibration X-Slope: 2.3

Bus Stop Landing

Applegate Ballfield BSL1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSL	0.7	2.4		
DAL	0.7	2.4	-- N/A --	-- N/A --
DAR			-- N/A --	-- N/A --



PROWAP Sidewalk Feature Capture

Show GPS Status

Grade: -0.1

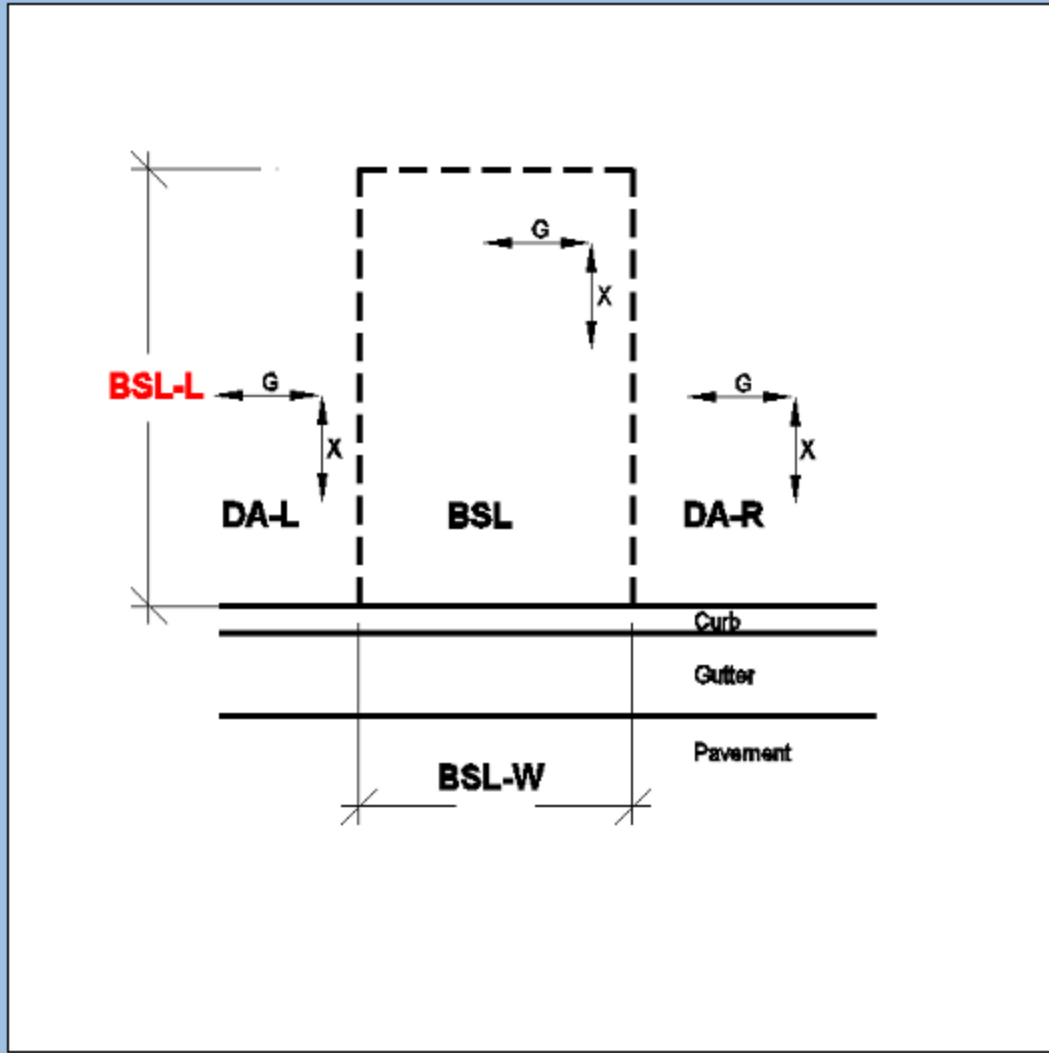
Check Calibration

X-Slope: 2.3

Bus Stop Landing

Applegate Ballfield BSL1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSL	0.7	2.4	96.0	
DAL	0.7	2.4	-- N/A --	-- N/A --
DAR	-0.1	2.3	-- N/A --	-- N/A --



PROWAP Sidewalk Feature Capture

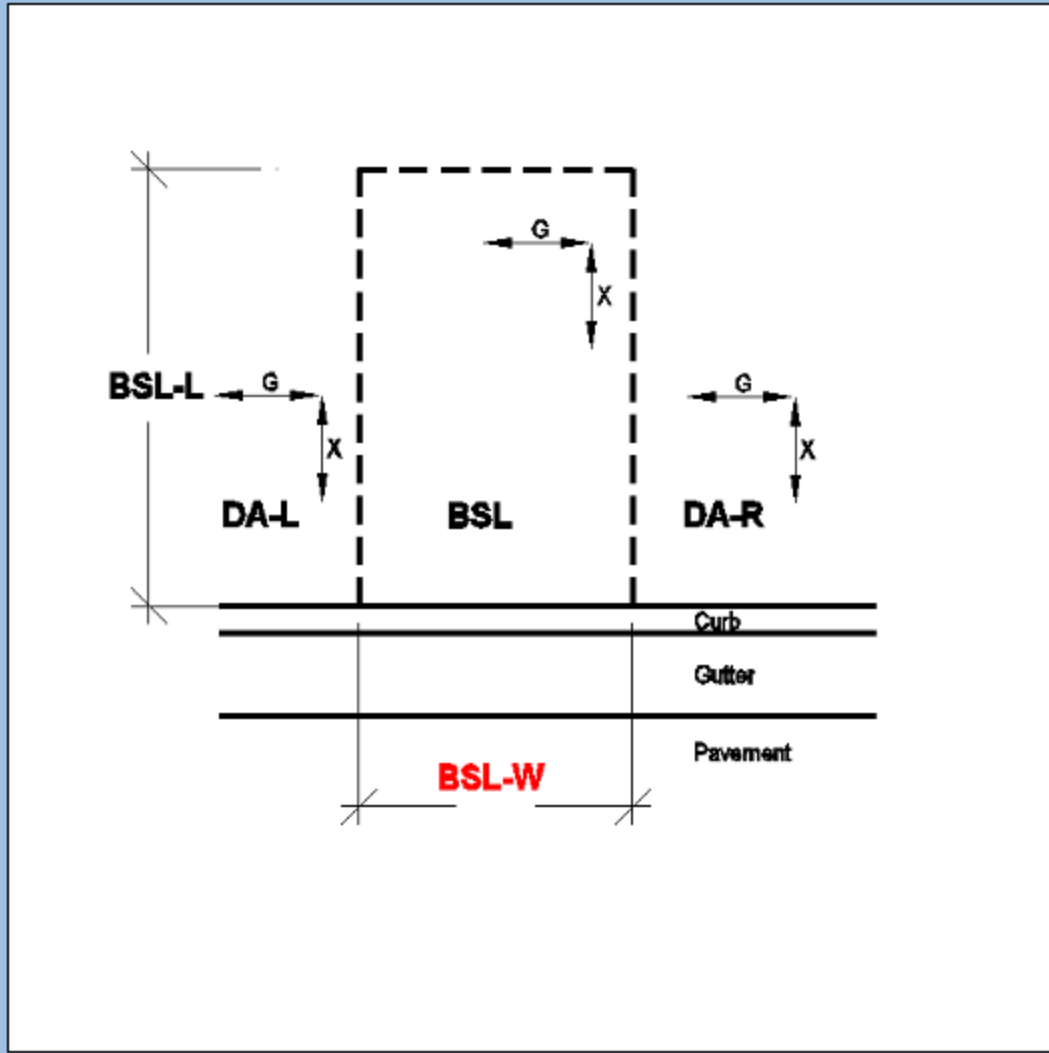
Show GPS Status Grade: -0.1

Check Calibration X-Slope: 2.3

Bus Stop Landing

Applegate Ballfield BSL1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BSL	0.7	2.4	96.0	49
DAL	0.7	2.4	-- N/A --	-- N/A --
DAR	-0.1	2.3	-- N/A --	-- N/A --



PROWAP Sidewalk Feature Capture

Show GPS Status

Grade: 0.7

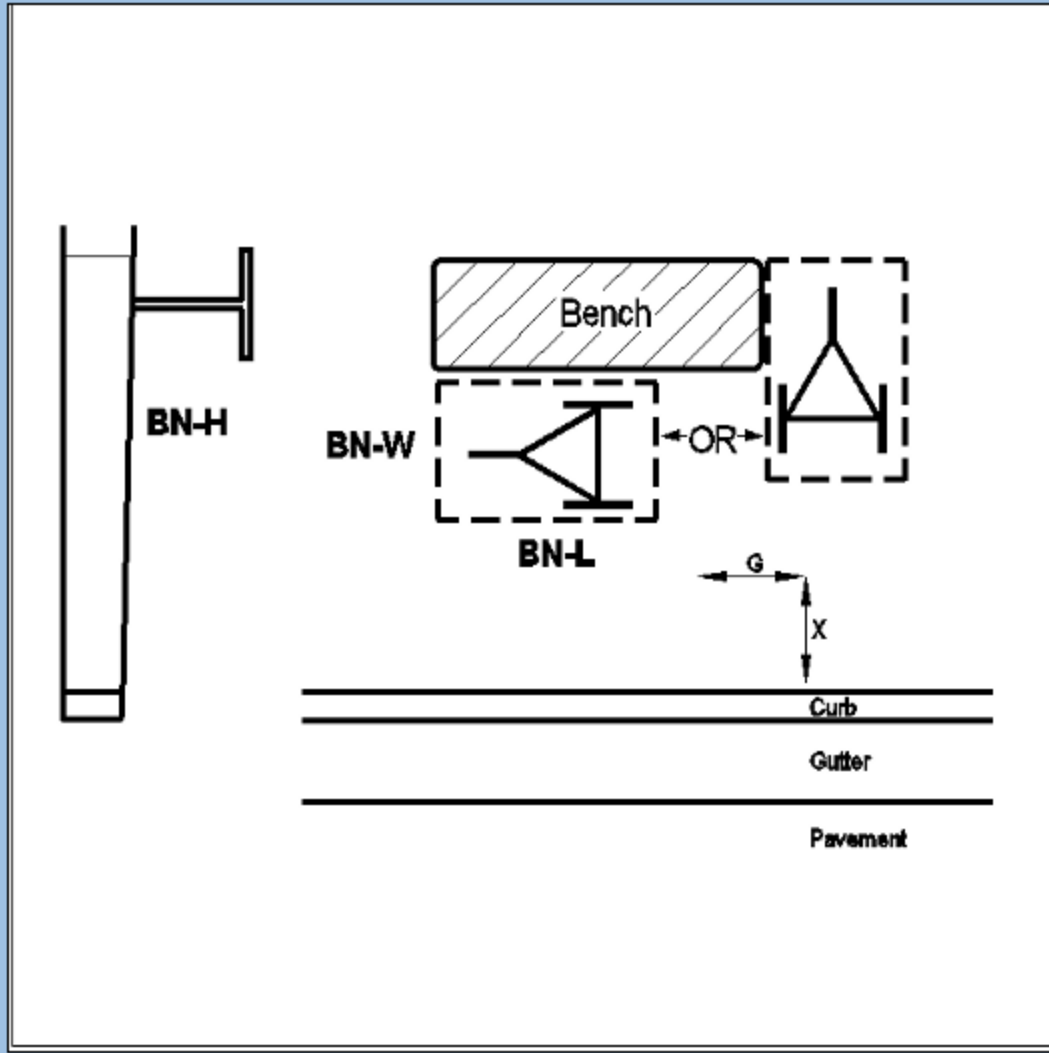
Check Calibration

X-Slope: 2.4

Bench

Applegate Ballfield BN1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BN				
BN-H	-- N/A --	-- N/A --		-- N/A --



PROWAP Sidewalk Feature Capture

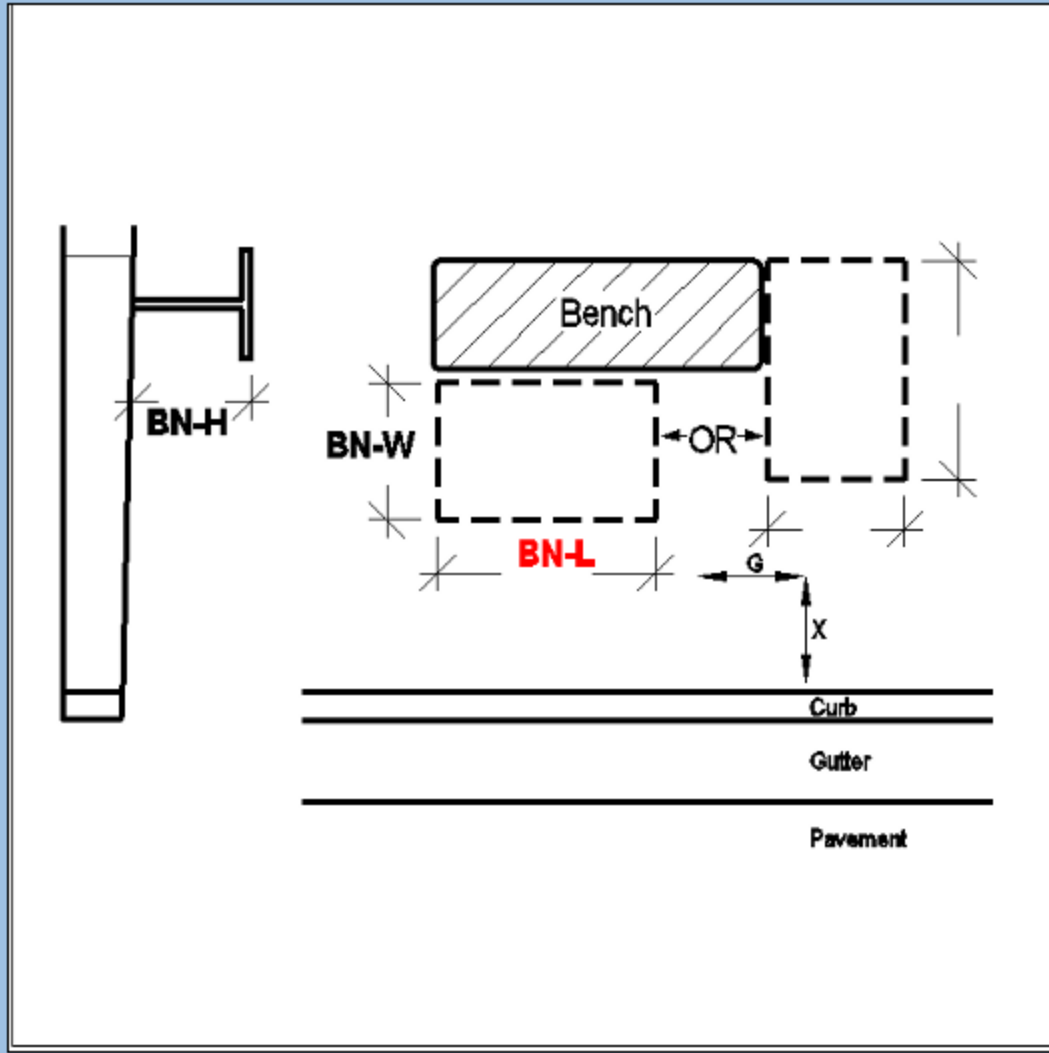
Show GPS Status Grade: 0.7

Check Calibration X-Slope: 2.4

Bench

Applegate Ballfield BN1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BN	0.7	2.4	49	
BN-H	-- N/A --	-- N/A --		-- N/A --



PROWAP Sidewalk Feature Capture

Show GPS Status

Grade: 0.7

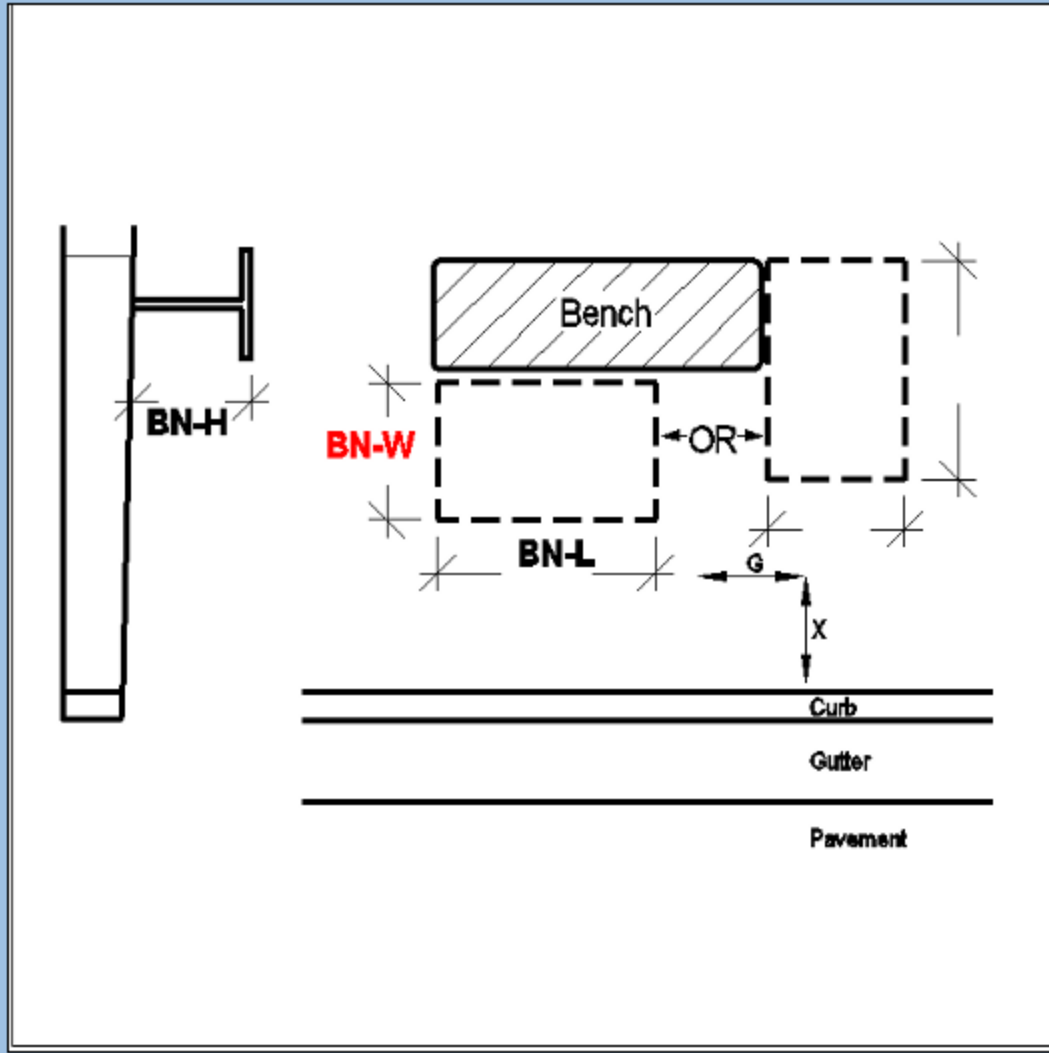
Check Calibration

X-Slope: 2.4

Bench

Applegate Ballfield BN1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BN	0.7	2.4	49.0	37
BN-H	-- N/A --	-- N/A --		-- N/A --



Capture

<-

Skip

Save

Cancel

PROWAP Sidewalk Feature Capture

Show GPS Status

Grade: 0.6

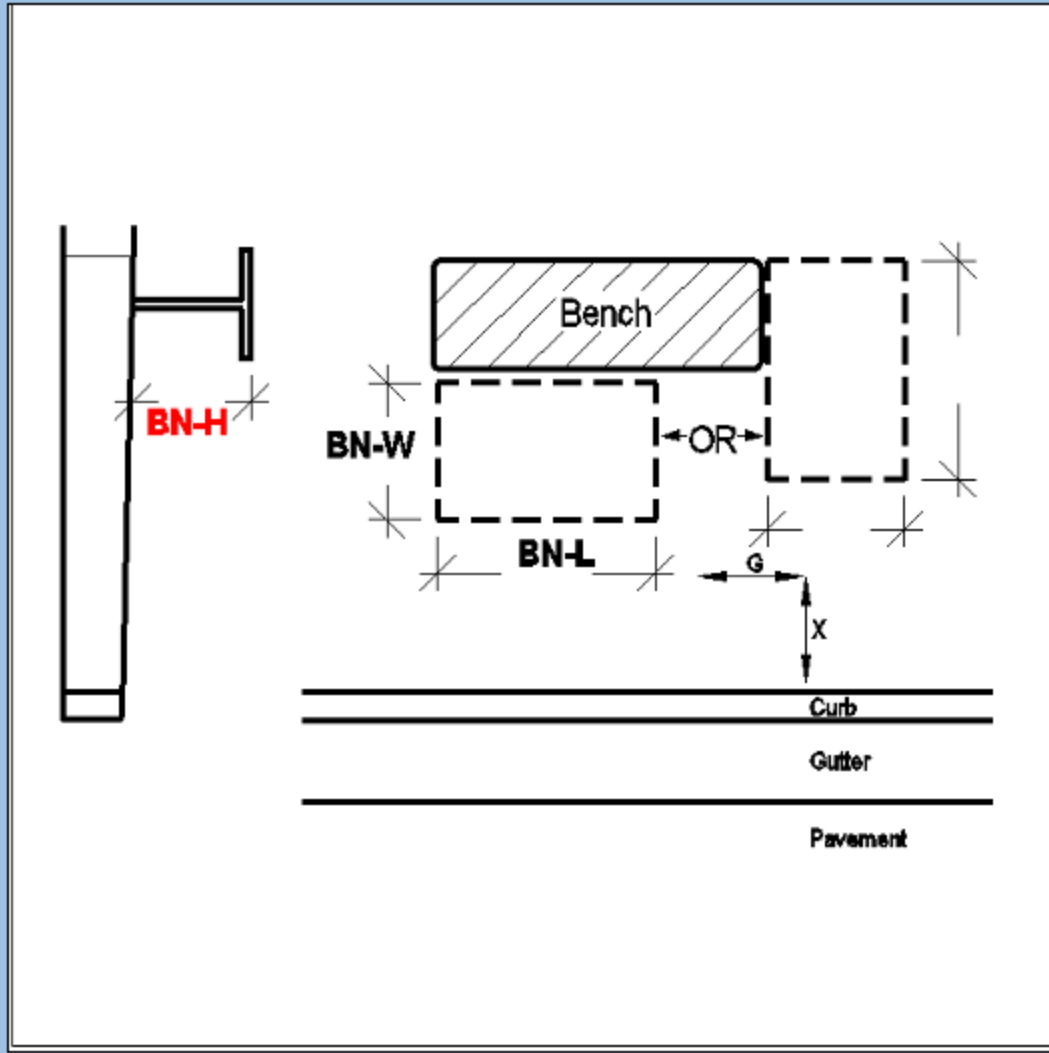
Check Calibration

X-Slope: 2.4

Bench

Applegate Ballfield BN1 BC 2009-05-19

	Grade	X-Slope	Length	Width
BN	0.7	2.4	49.0	37.0
BN-H	-- N/A --	-- N/A --	28	-- N/A --



Capture

<-

Skip

Save

Cancel

PROW-AP Software Modules Continues

Element recording (e.g. curb ramps,
driveway crossings)

Transaction height recording



PROWAP Sidewalk Element Capture

Show GPS Status

Grade:

off-line

Check Calibration

X-Slope:

off-line

Please Select Element Type

Diagonal Curb Ramp

Perpendicular Crossing

Please Select Element Type

Welcome the Sidewalk Element Capture Dialog!

1) Click [Calibrate] to verify sensor calibration.

2) Select an Element Type from the drop-down menu

3) Name the Element

Type of element - Street it is on -

Side of street n/s e/w - cross street -

side of cross street n/s e/w

(to next cross street and side of cross street, if this is a segment) -

initials of operator - year - month - date

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture

<-

Skip

Save

Cancel

PROW-AP Data Exports

SQL data structure

Trimble Pathfinder Office

Into GIS Software

Into CAD Software

Excel

PROW-AP Data Exports

GPS reading output at each
measurement location

Automated summary report
generation

PROW-AP Testing Conducted

Sidewalk segments

Sidewalk elements

Diagonal curb ramps

Driveway crossings

Parallel roadways

PROW-AP Segment Testing

51 unique sidewalk elements
identified

Repeated measurements on the
same segment

Different assessors on the same
location

**Last Station Recorded****Copy Surf. Data ->****Tread Width:****Surface Category:****Surface Type:****Distance:****Grade:****Cross Slope:****Current Station To Record**

48

in

Set MCW

Paved

Concrete

Distance

Measurement

is on hold.

12.2

3.7

Record Station

Add Features

Return Home

Distance Hold

Manual Entry

View Data

Alarm Settings

Calibration

New Segment

Current Segment:

CC PW Main 1st to 2nd 2009-05-1

Outslope**Check Outslope Direction**

<- Left

Right ->

Vehicle Orientation **Forwards** **Backwards**

Show Camera Preview

Compass Heading:

° True

GPS Location and Status**Lat:****Lon:****Apprx. Err:****Elev:**

Error: Garmin GPS is not connected

**Last Station Recorded**

48 in

Paved

Concrete

0.0 Ft

12.2 %

3.7 %

Copy Surf. Data ->**Tread Width:****Surface Category:****Surface Type:****Distance:****Grade:****Cross Slope:****Current Station To Record**

in

Set MCW

10.3 Ft

0.0 %

-0.0 %

Record Station**Add Features****Return Home****Distance Hold****Manual Entry****View Data****Alarm Settings****Calibration****New Segment****Current Segment:**

CC PW Main 1st to 2nd 2009-05-1

Outslope**Check Outslope Direction**

<- Left

Right ->

Vehicle Orientation **Forwards** **Backwards****Show Camera Preview****Compass Heading:** ° True**GPS Location and Status****Lat:****Lon:****Apprx. Err:****Elev:**

Error: Garmin GPS is not connected

Sidewalk Access Summary Info

Carson City

Washington St

Wash. N Roop to Valley JV 2009-04-21

Assessment Date:

Agency: Public Works

State: Nevada

County: _____

Trail Length: 0.1 mi (0.2 km) Trail Type: _____

Elevation: Gain: 6.3 ft (1.9 m)

Loss: 2.7 ft (0.8 m)

Typical Grade: 1.2% Maximum Grade: 8.5%

Typical Cross Slope: 4.2% Maximum Cross Slope: 17.0%

Typical Tread Width: 48.0 in (121 cm) Minimum Tread Width: 30.0 in (76 cm)

Sidewalk Segment Station Data for 33 Maximum Grades

Nevada-> Carson City-> Public Works-> Washington St-> Washington N Roop to Valley BC 2009-04-21
 Report Type: Max Grade

	Seg. Number	Station Location	Station Length	Cumul. Length	Cumul. Percent	Tread Width	X-Slope (%)	Grade (%)	Surface Category	Surface Type	Lat.	Lon.
1	179	740.9	1.5	1.5	0.2	48.0	-5.0	-8.5	Paved	Concrete	39.168509	-119.763564
2	179	738.9	1.9	3.4	0.5	48.0	-0.9	-8.3	Paved	Concrete	39.168507	-119.763557
3	179	742.3	1.0	4.4	0.6	48.0	-9.1	-7.8	Paved	Concrete	39.168507	-119.763571
4	179	5.7	1.5	5.9	0.8	48.0	-0.8	7.5	Paved	Concrete	39.169016	-119.761208
5	179	358.3	0.2	6.1	0.8	48.0	-13.5	7.5	Paved	Concrete	39.168510	-119.762201
6	179	702.7	1.2	7.3	1.0	48.0	-12.6	7.4	Paved	Concrete	39.168503	-119.763425
7	179	4.2	1.4	8.7	1.2	48.0	0.2	7.0	Paved	Concrete	39.169018	-119.761205
8	179	701.6	1.1	9.8	1.3	48.0	-13.2	5.6	Paved	Concrete	39.168504	-119.763423
9	179	3.1	1.1	10.9	1.5	48.0	-1.6	5.6	Paved	Concrete	39.169023	-119.761206
10	179	671.1	1.1	12.0	1.6	48.0	-4.5	-5.3	Paved	Concrete	39.168507	-119.763319
11	179	144.5	1.1	13.2	1.8	48.0	-0.1	-5.2	Paved	Concrete	39.168764	-119.761565
12	179	703.9	1.0	14.2	1.9	48.0	-8.7	5.1	Paved	Concrete	39.168506	-119.763425
13	179	357.1	1.1	15.3	2.1	48.0	-14.8	5.1	Paved	Concrete	39.168510	-119.762198
14	179	174.4	0.7	16.0	2.1	48.0	-8.7	4.4	Paved	Concrete	39.168706	-119.761639
15	179	358.5	1.1	17.0	2.3	48.0	-8.9	4.3	Paved	Concrete	39.168515	-119.762205
16	179	7.2	1.5	18.5	2.5	48.0	-1.1	4.2	Paved	Concrete	39.169015	-119.761212
17	179	173.3	1.1	19.6	2.6	48.0	-8.4	4.1	Paved	Concrete	39.168709	-119.761632
18	179	324.2	1.0	20.7	2.8	48.0	-8.6	-3.9	Paved	Concrete	39.168506	-119.762072
19	179	323.2	1.0	21.7	2.9	48.0	-4.9	-3.8	Paved	Concrete	39.168503	-119.762067
20	179	738.2	0.8	22.5	3.0	48.0	-1.4	-3.2	Paved	Concrete	39.168505	-119.763547
21	179	619.9	28.2	50.6	6.8	48.0	-2.8	3.1	Paved	Concrete	39.168488	-119.763130
22	179	743.4	0.0	50.6	6.8	48.0	-7.8	-3.1	Paved	Concrete	39.168508	-119.763579
23	179	145.6	1.5	52.1	7.0	48.0	-8.6	-2.8	Paved	Concrete	39.168763	-119.761563
24	179	314.7	8.5	60.6	8.2	48.0	-4.9	-2.8	Paved	Concrete	39.168522	-119.762035
25	179	670.4	0.8	61.4	8.3	48.0	-2.1	-2.8	Paved	Concrete	39.168496	-119.763301
26	179	673.3	1.4	62.7	8.4	48.0	-8.8	2.6	Paved	Concrete	39.168508	-119.763325
27	179	648.1	22.3	85.0	11.4	48.0	-2.3	2.6	Paved	Concrete	39.168495	-119.763227
28	179	687.2	14.4	99.5	13.4	48.0	-11.7	2.5	Paved	Concrete	39.168517	-119.763366
29	179	674.7	12.5	112.0	15.1	48.0	-10.4	2.4	Paved	Concrete	39.168512	-119.763327
30	179	704.0	1.1	113.0	15.2	48.0	-4.0	2.1	Paved	Concrete	39.168516	-119.763432
31	179	325.3	0.7	113.7	15.3	48.0	-12.2	-2.3	Paved	Concrete	39.168507	-119.762077
32	179	175.0	0.8	114.5	15.4	48.0	-6.3	2.3	Paved	Concrete	39.168703	-119.761642
33	179	596.1	23.8	138.3	18.6	48.0	-2.6	2.2	Paved	Concrete	39.168494	-119.763041

PROW-AP Segment Testing

Typical grades and cross slopes
were within 0.5%

Maximum grades and cross slopes
were within 2.0%

Identified slight variations in the
assessment process

PROW-AP Measurement Intervals Recorded

Center of every sidewalk panel

Every 2nd, 3rd, and 4th panel

Using judgment

Using smart feedback

PROW-AP Measurement Interval Results

Smart Feedback section with
PROW-AG thresholds

Grade 8.3%

Cross Slope 2%

Alarm Settings



Enable Alarms and Set Alarm Thresholds

Grade

Alarm Enabled

Limit (%)

Limit Type

- Amount of Change
- Absolute Percent

Cross Slope

Alarm Enabled

Limit (%)

Limit Type

- Amount of Change
- Absolute Percent

Distance

Alarm Enabled

Feet

Outslope to Inslope Changes

Alarm Enabled

Done

Cancel

PROW-AP Sidewalk Element Measurement

5 Curb Ramps and 5 Driveway
crossings measured with SWAP
and PROW-AP

Measured by 5 different assessment
coordinators without experience

20 – 25% time savings noted

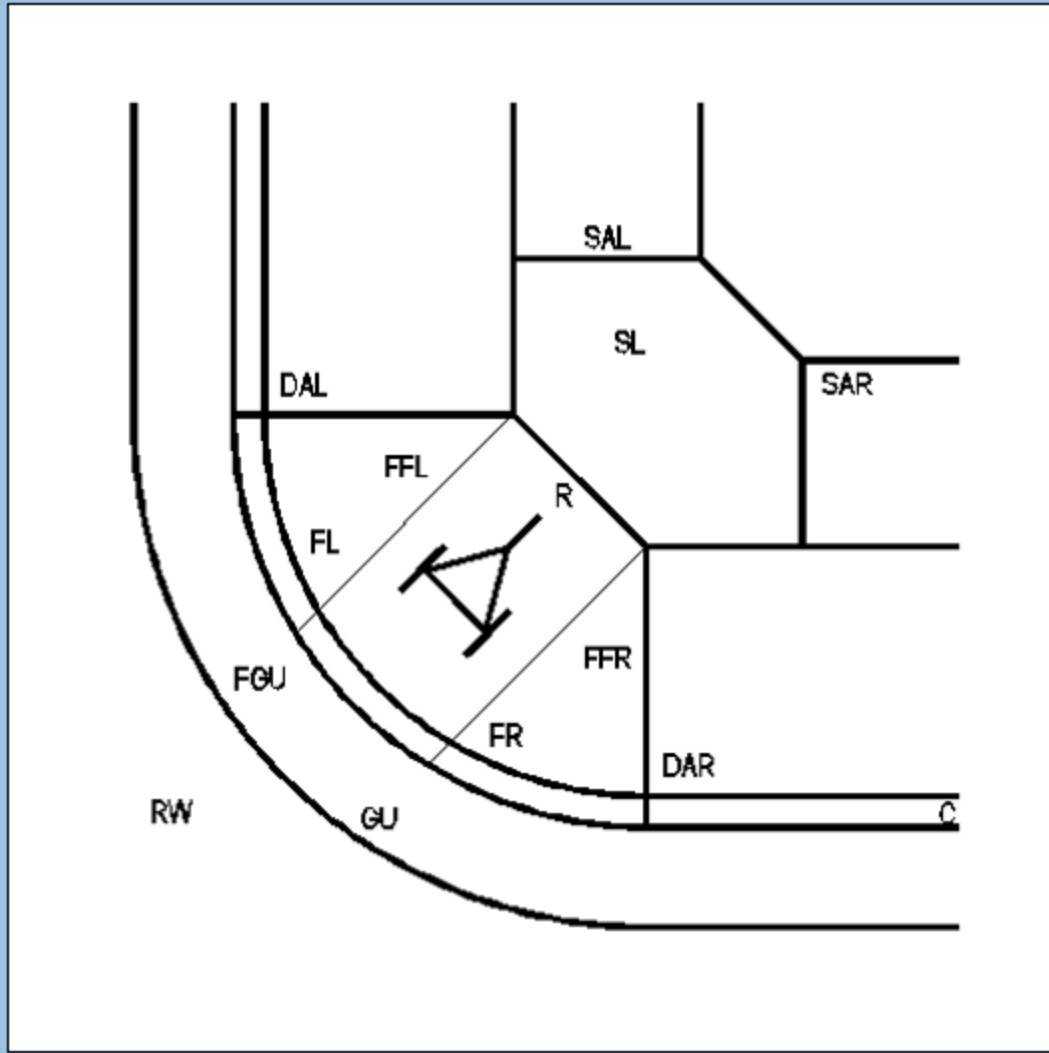
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** -0.6

Check Calibration **X-Slope:** 1.7

Diagonal Curb Ramp ▾

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R				
SL				
SAR			-- N/A --	
DAR			-- N/A --	
FFR			-- N/A --	-- N/A --
FFL			-- N/A --	-- N/A --
DAL			-- N/A --	
SAL			-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture <- Skip Save Cancel

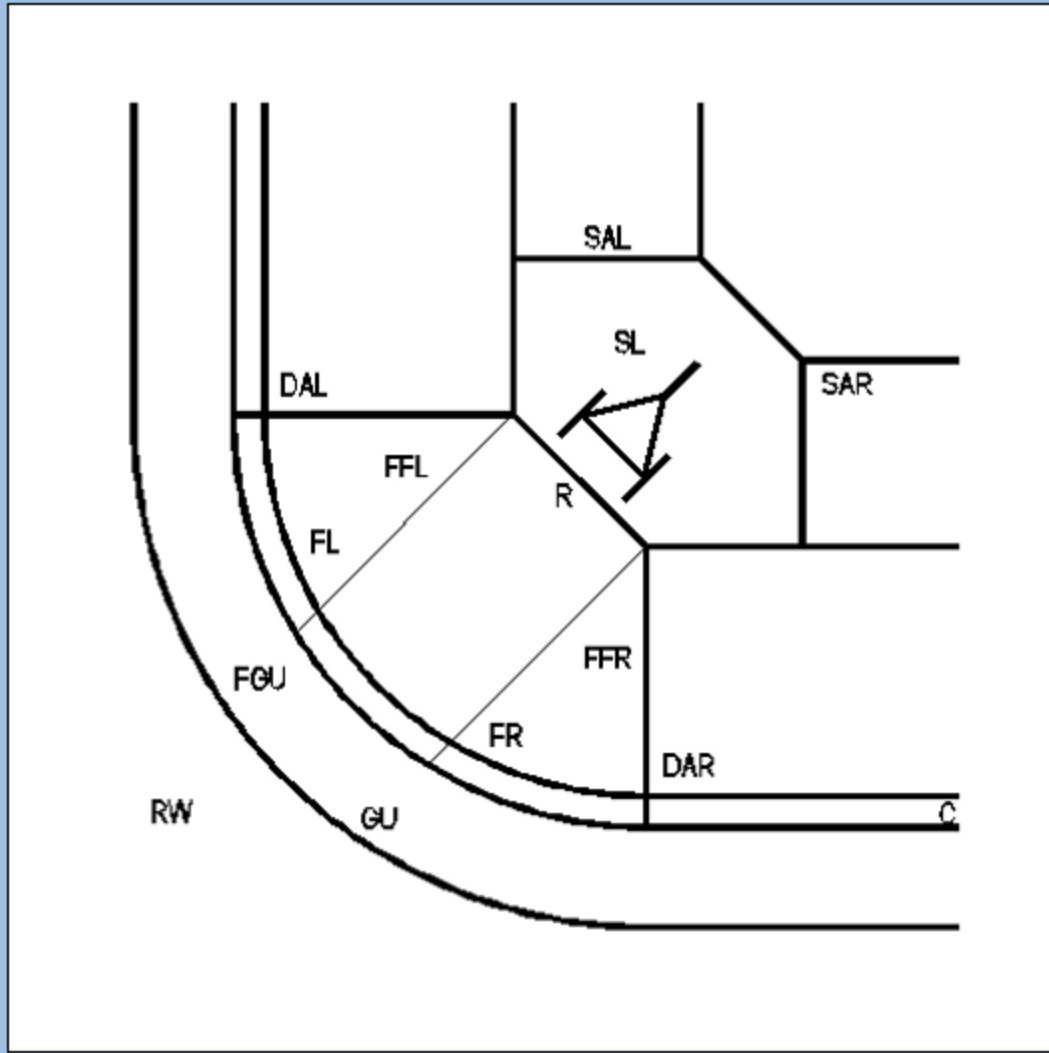
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** -0.2

Check Calibration **X-Slope:** 2.4

Diagonal Curb Ramp

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL				
SAR			-- N/A --	
DAR			-- N/A --	
FFR			-- N/A --	-- N/A --
FFL			-- N/A --	-- N/A --
DAL			-- N/A --	
SAL			-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture <- Skip Save Cancel

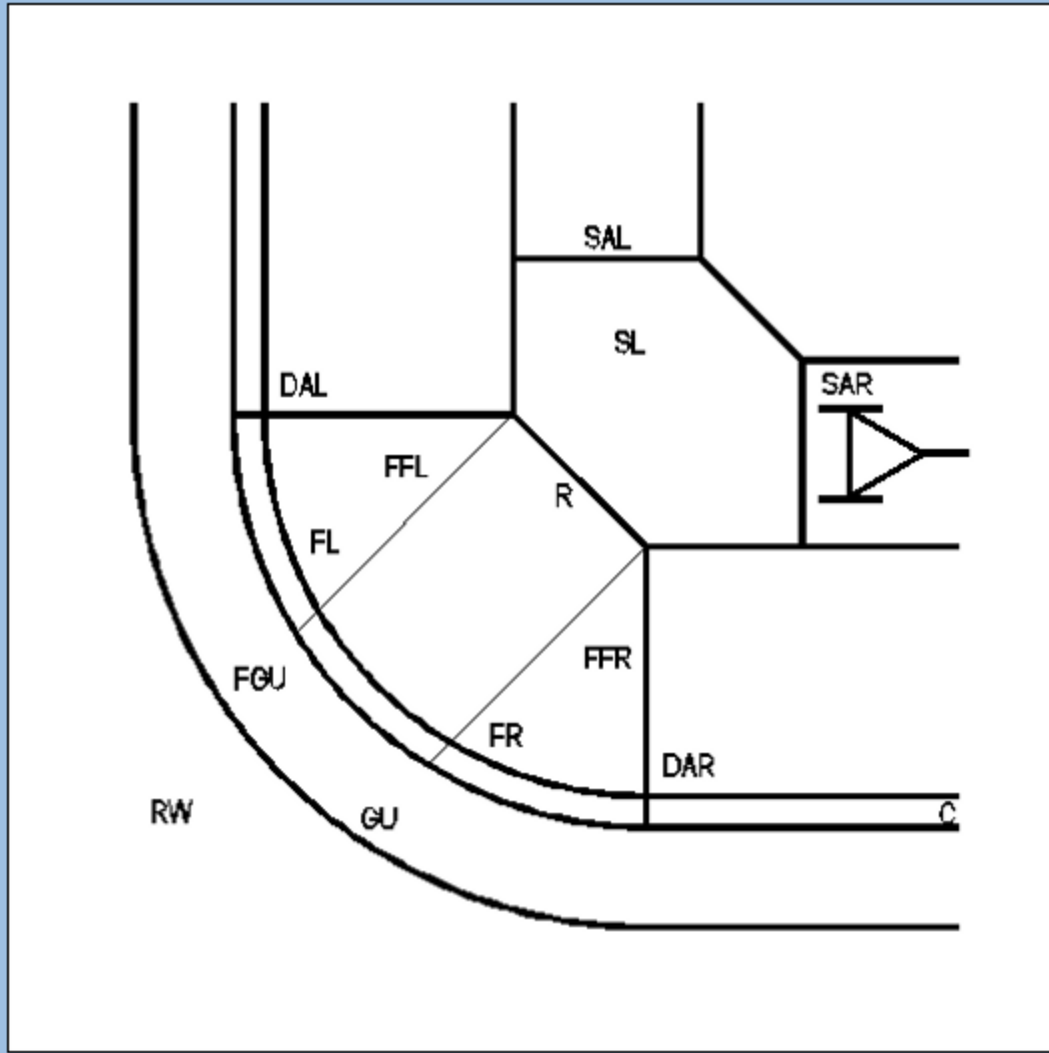
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** -1.9

Check Calibration **X-Slope:** -0.4

Diagonal Curb Ramp

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR			-- N/A --	
DAR			-- N/A --	
FFR			-- N/A --	-- N/A --
FFL			-- N/A --	-- N/A --
DAL			-- N/A --	
SAL			-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected



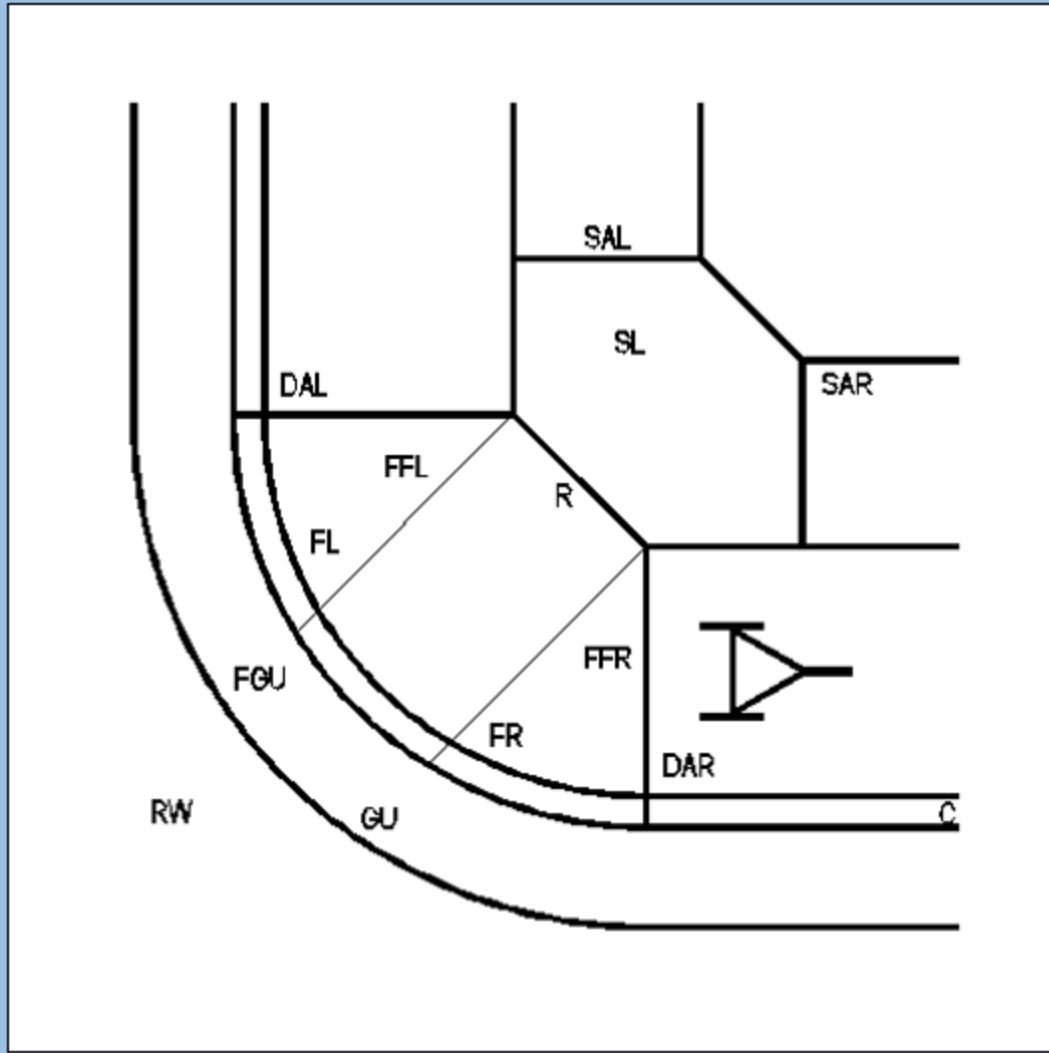
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** -0.6

Check Calibration **X-Slope:** 1.7

Diagonal Curb Ramp

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR	2.0	0.1	-- N/A --	
DAR			-- N/A --	
FFR			-- N/A --	-- N/A --
FFL			-- N/A --	-- N/A --
DAL			-- N/A --	
SAL			-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture <- Skip Save Cancel

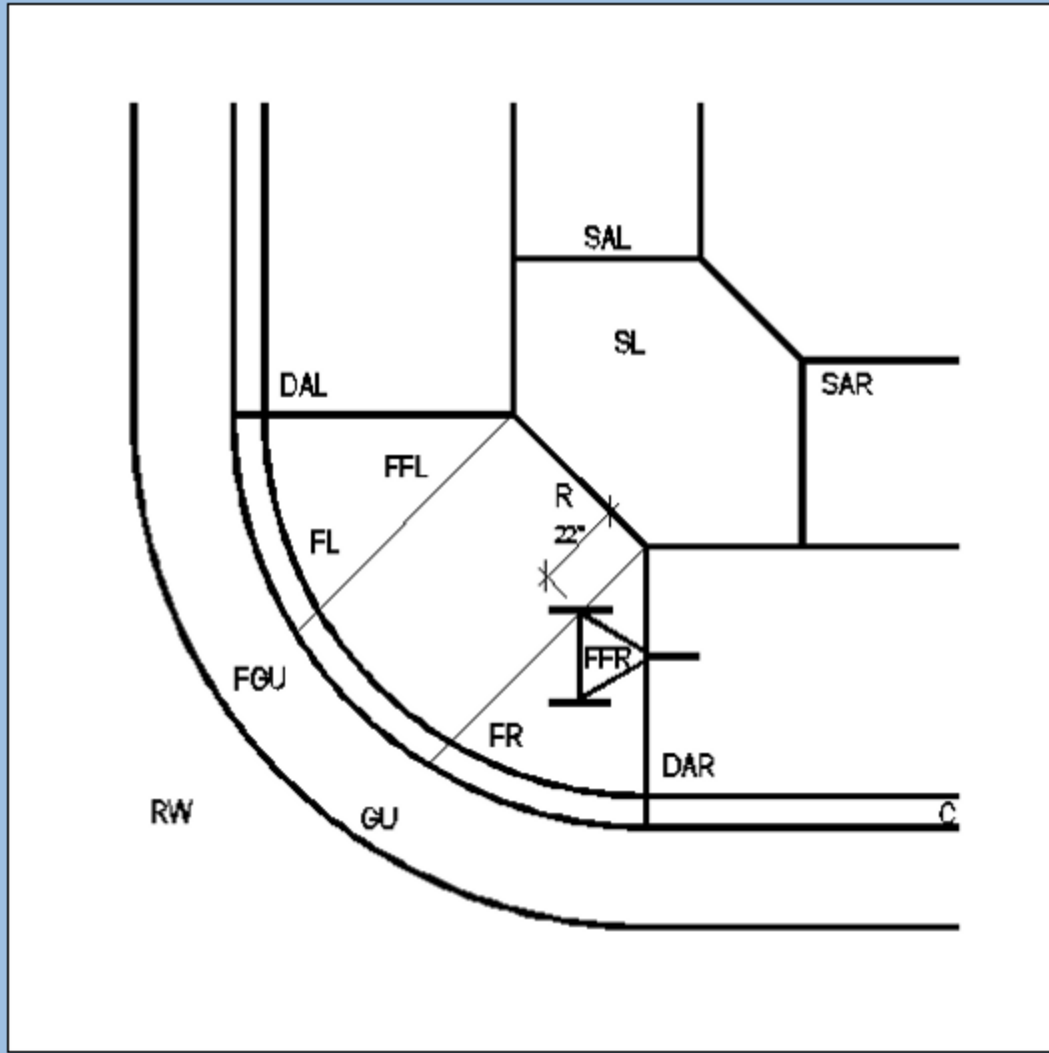
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** 8.4

Check Calibration **X-Slope:** -10.9

Diagonal Curb Ramp

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR	2.0	0.1	-- N/A --	
DAR	-0.6	1.7	-- N/A --	
FFR			-- N/A --	-- N/A --
FFL			-- N/A --	-- N/A --
DAL			-- N/A --	
SAL			-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture <- Skip Save Cancel

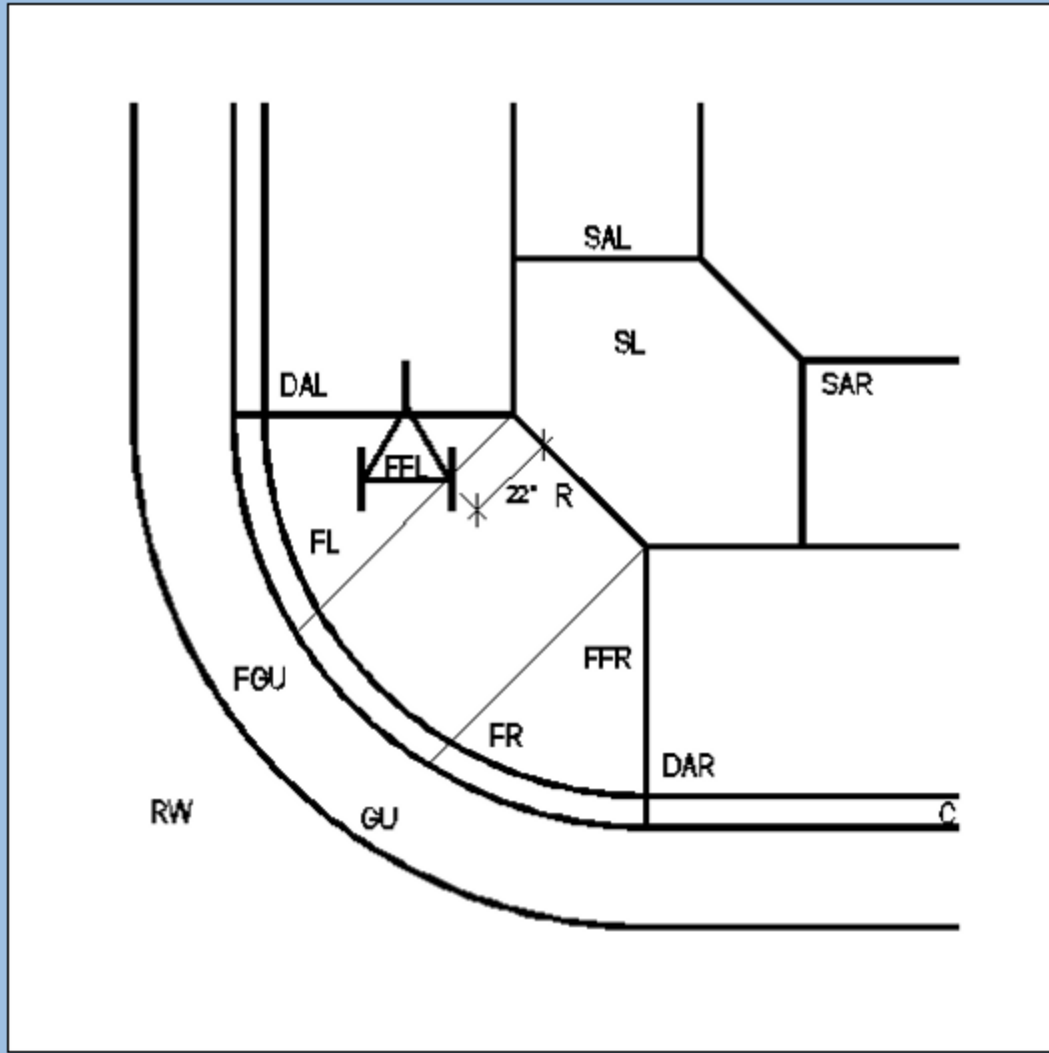
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** 12.4

Check Calibration **X-Slope:** 16.1

Diagonal Curb Ramp ▾

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR	2.0	0.1	-- N/A --	
DAR	-0.6	1.7	-- N/A --	
FFR	8.4	-10.9	-- N/A --	-- N/A --
FFL			-- N/A --	-- N/A --
DAL			-- N/A --	
SAL			-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected



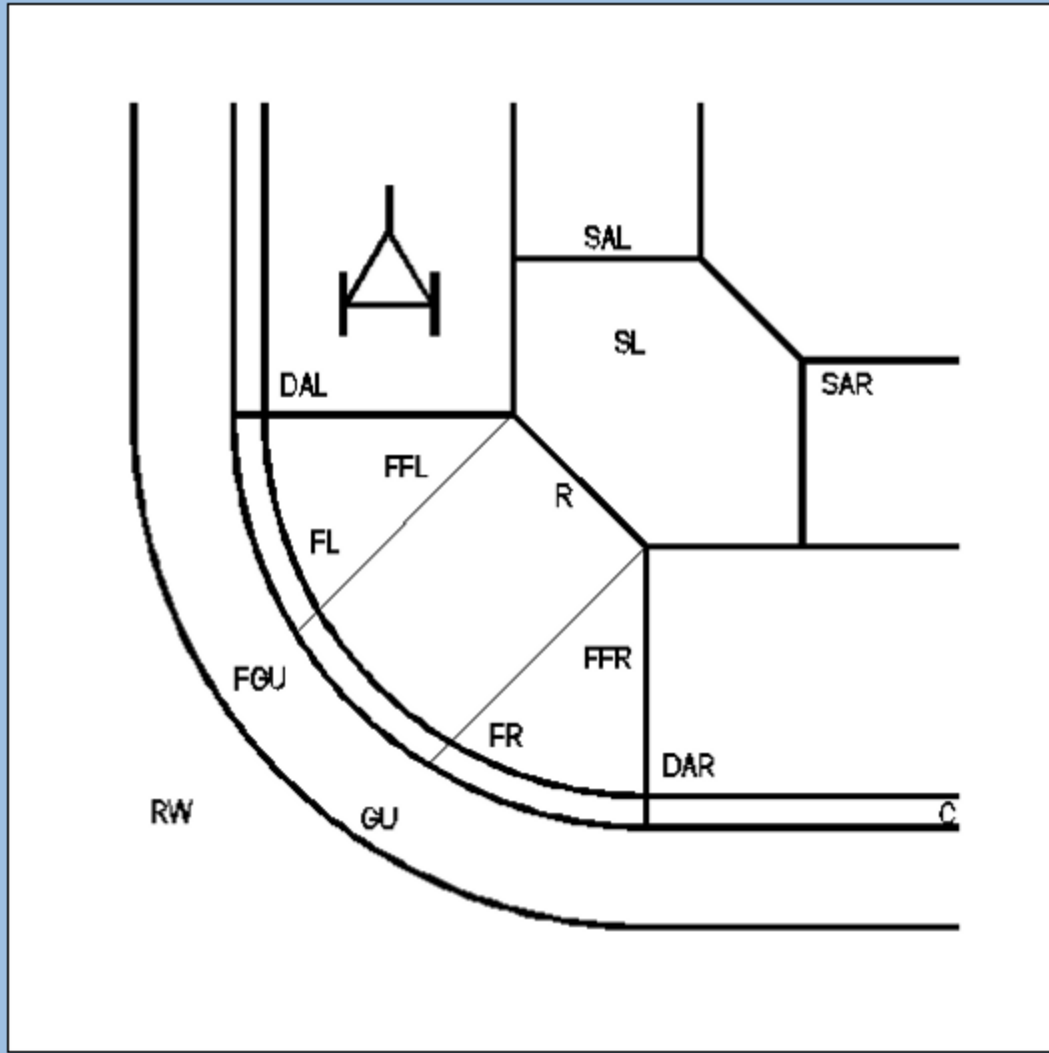
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** -0.2

Check Calibration **X-Slope:** 2.1

Diagonal Curb Ramp

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR	2.0	0.1	-- N/A --	
DAR	-0.6	1.7	-- N/A --	
FFR	8.4	-10.9	-- N/A --	-- N/A --
FFL	12.4	16.1	-- N/A --	-- N/A --
DAL			-- N/A --	
SAL			-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture <- Skip Save Cancel

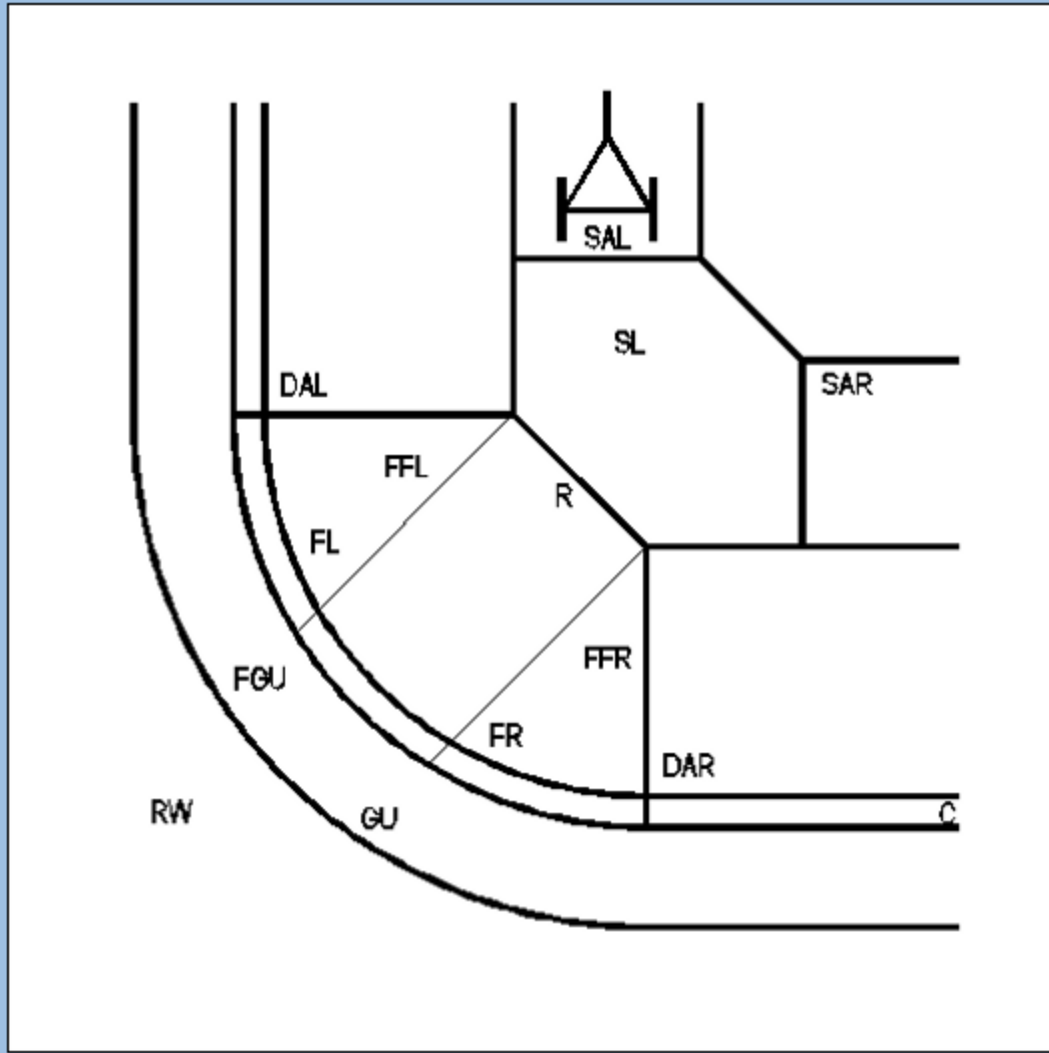
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** 2.0

Check Calibration **X-Slope:** 0.1

Diagonal Curb Ramp ▾

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR	2.0	0.1	-- N/A --	
DAR	-0.6	1.7	-- N/A --	
FFR	8.4	-10.9	-- N/A --	-- N/A --
FFL	12.4	16.1	-- N/A --	-- N/A --
DAL	-0.1	2.2	-- N/A --	
SAL			-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

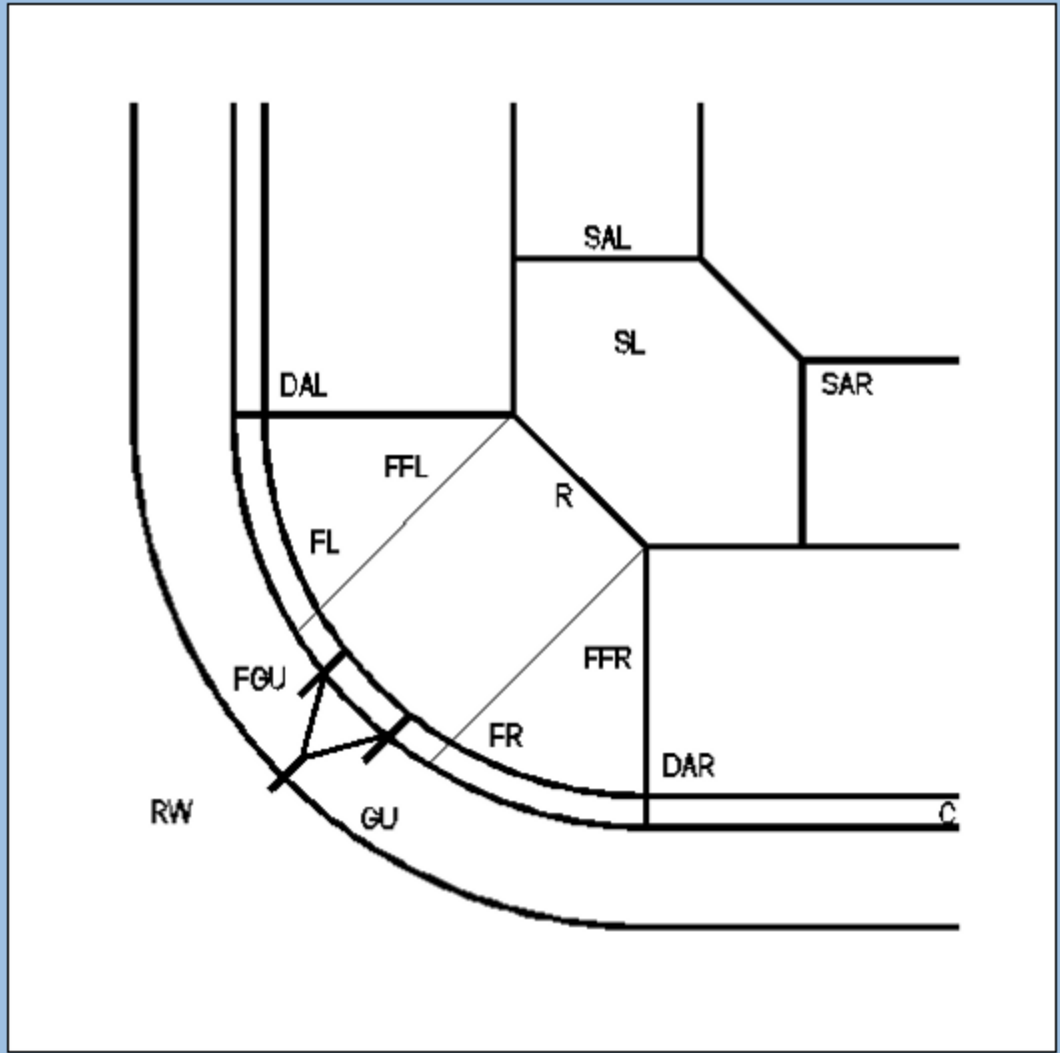
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** 9.7

Check Calibration **X-Slope:** 2.4

Diagonal Curb Ramp ▾

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR	2.0	0.1	-- N/A --	
DAR	-0.6	1.7	-- N/A --	
FFR	8.4	-10.9	-- N/A --	-- N/A --
FFL	12.4	16.1	-- N/A --	-- N/A --
DAL	-0.1	2.2	-- N/A --	
SAL	2.0	0.1	-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture <- Skip Save Cancel

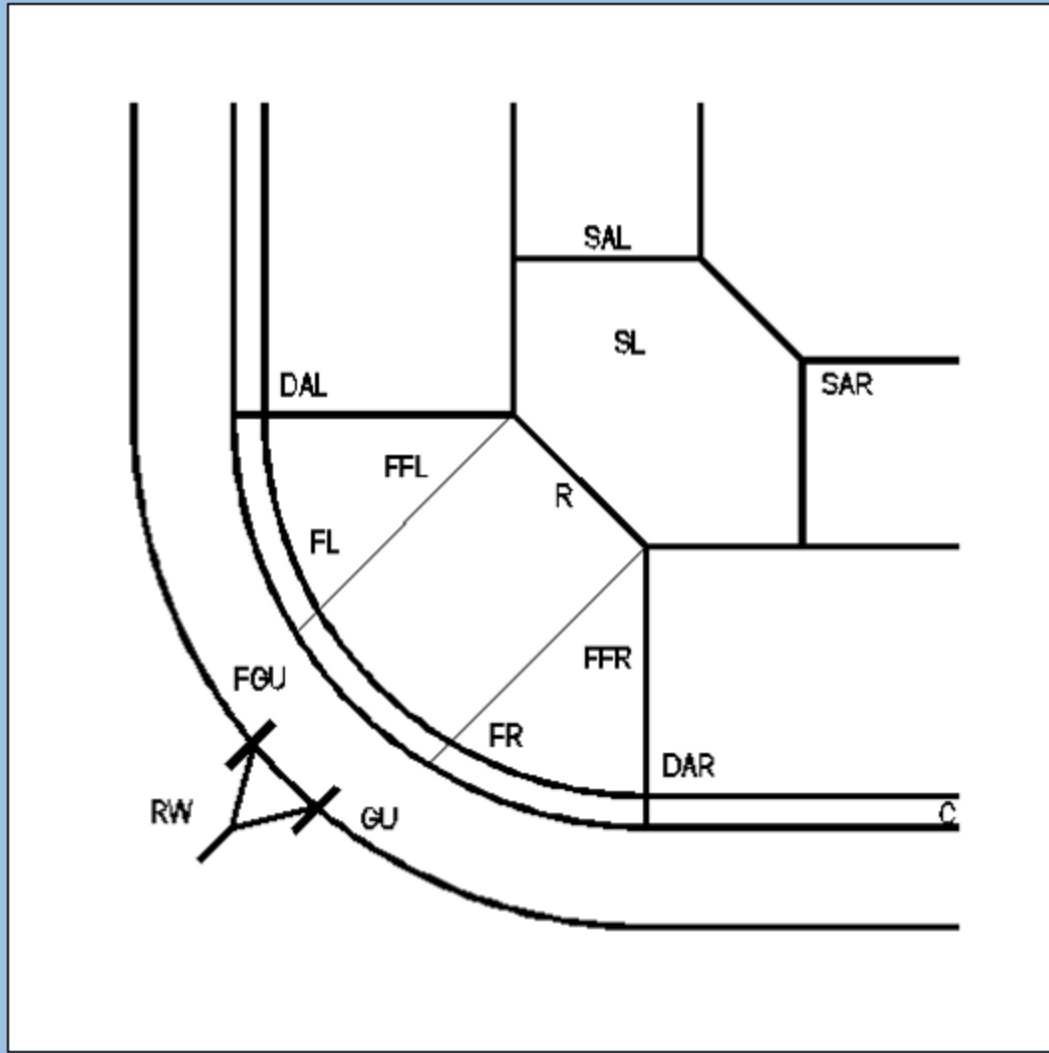
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** 5.2

Check Calibration **X-Slope:** 2.4

Diagonal Curb Ramp ▾

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR	2.0	0.1	-- N/A --	
DAR	-0.6	1.7	-- N/A --	
FFR	8.4	-10.9	-- N/A --	-- N/A --
FFL	12.4	16.1	-- N/A --	-- N/A --
DAL	-0.1	2.2	-- N/A --	
SAL	2.0	0.1	-- N/A --	
FGU	9.6	2.4	-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

PROWAP Sidewalk Element Capture

Show GPS Status

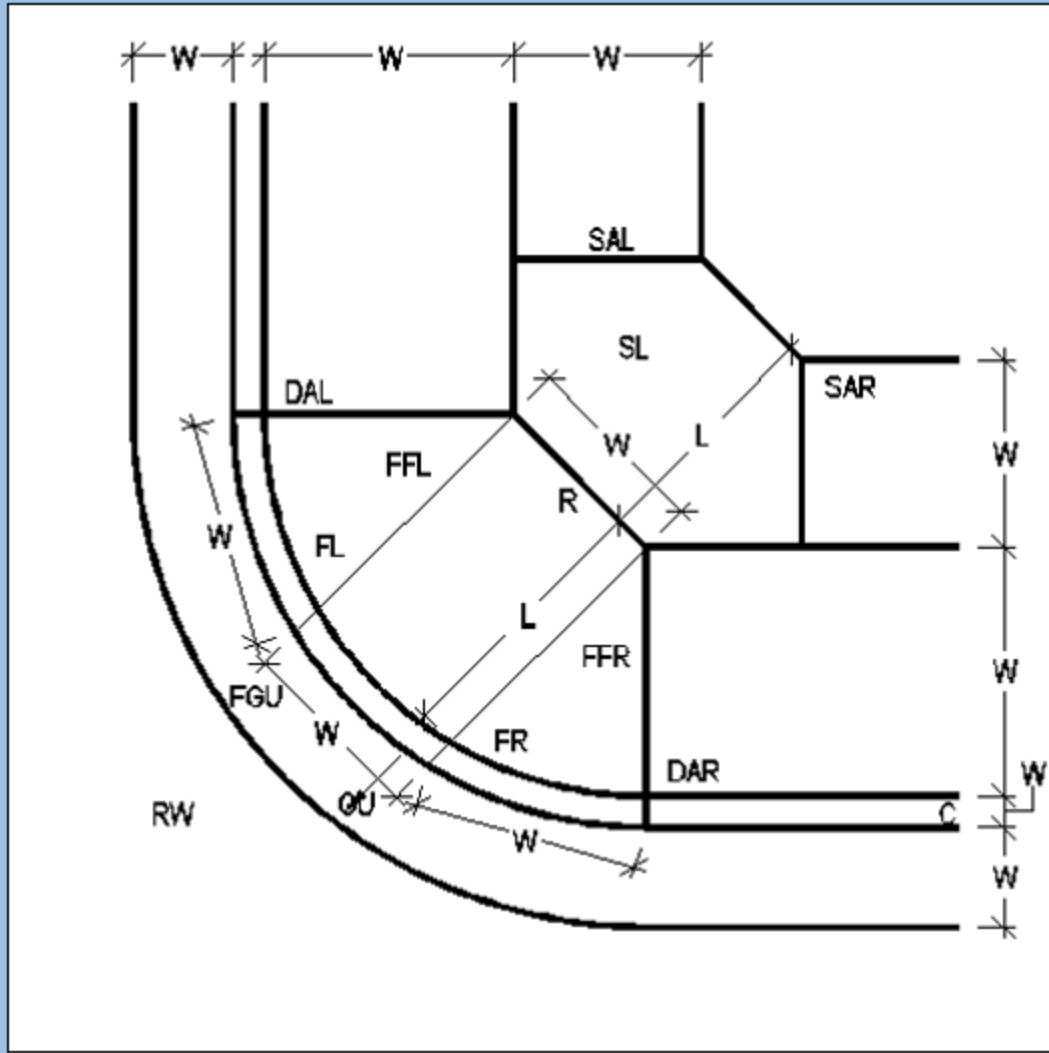
Grade: 5.2

Check Calibration

X-Slope: 2.4

Diagonal Curb Ramp

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR	2.0	0.1	-- N/A --	
DAR	-0.6	1.7	-- N/A --	
FFR	8.4	-10.9	-- N/A --	-- N/A --
FFL	12.4	16.1	-- N/A --	-- N/A --
DAL	-0.1	2.2	-- N/A --	
SAL	2.0	0.1	-- N/A --	
FGU	9.6	2.4	-- N/A --	-- N/A --
RW	5.2	2.4	-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture <- Skip Save Cancel

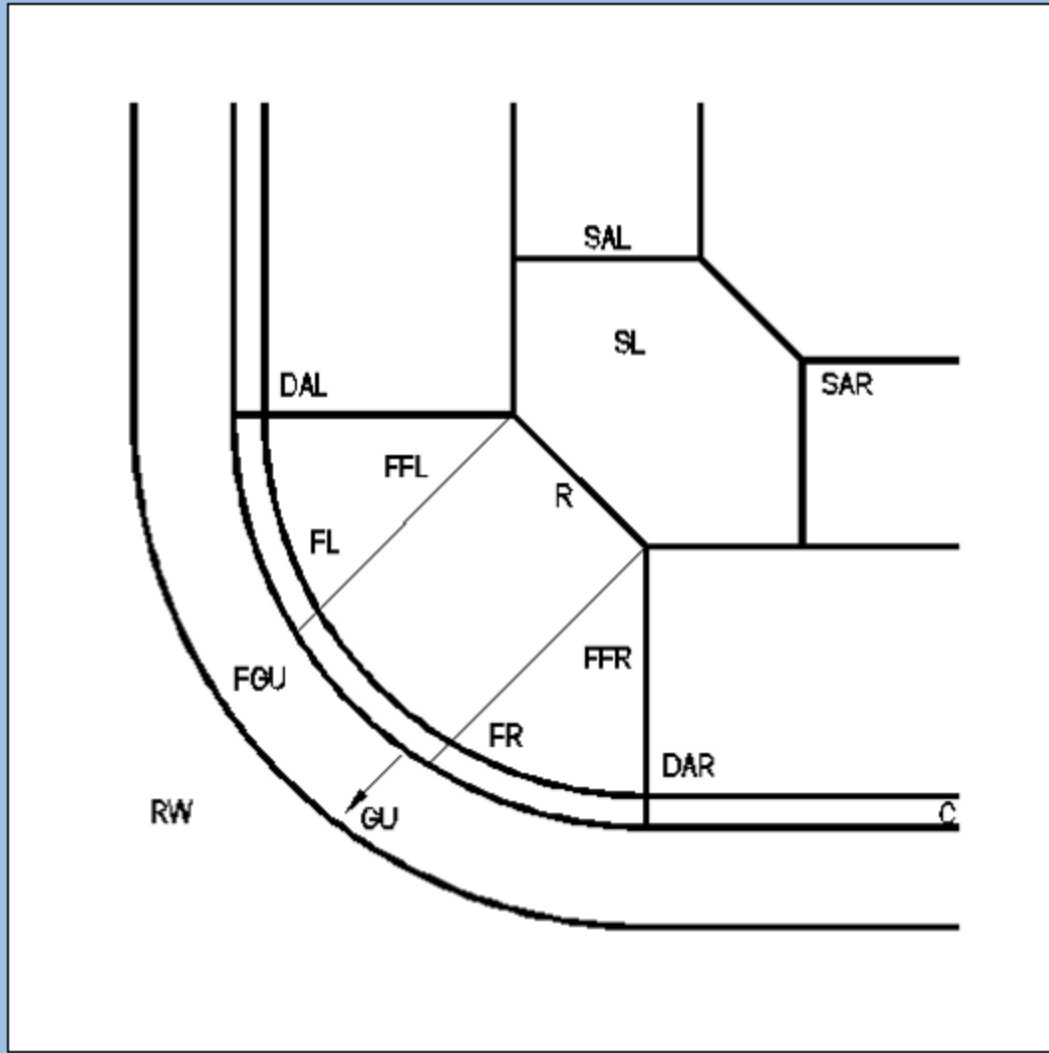
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** 5.1

Check Calibration **X-Slope:** 2.4

Diagonal Curb Ramp ▾

Main N 1St E BC 2009-05-19



	Grade	X-Slope	Length	Width
R	10.4	2.6		
SL	-1.9	-0.4		
SAR	2.0	0.1	-- N/A --	
DAR	-0.6	1.7	-- N/A --	
FFR	8.4	-10.9	-- N/A --	-- N/A --
FFL	12.4	16.1	-- N/A --	-- N/A --
DAL	-0.1	2.2	-- N/A --	
SAL	2.0	0.1	-- N/A --	
FGU	9.6	2.4	-- N/A --	-- N/A --
RW	5.2	2.4	-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	0.0

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture <- Skip Save Cancel



PROWAP Sidewalk Element Capture

Show GPS Status

Grade:

off-line

Check Calibration

X-Slope:

off-line

Please Select Element Type

Diagonal Curb Ramp

Perpendicular Crossing

Please Select Element Type

Welcome the Sidewalk Element Capture Dialog!

1) Click [Calibrate] to verify sensor calibration.

2) Select an Element Type from the drop-down menu

3) Name the Element

Type of element - Street it is on -

Side of street n/s e/w - cross street -

side of cross street n/s e/w

(to next cross street and side of cross street, if this is a segment) -

initials of operator - year - month - date

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture

<-

Skip

Save

Cancel

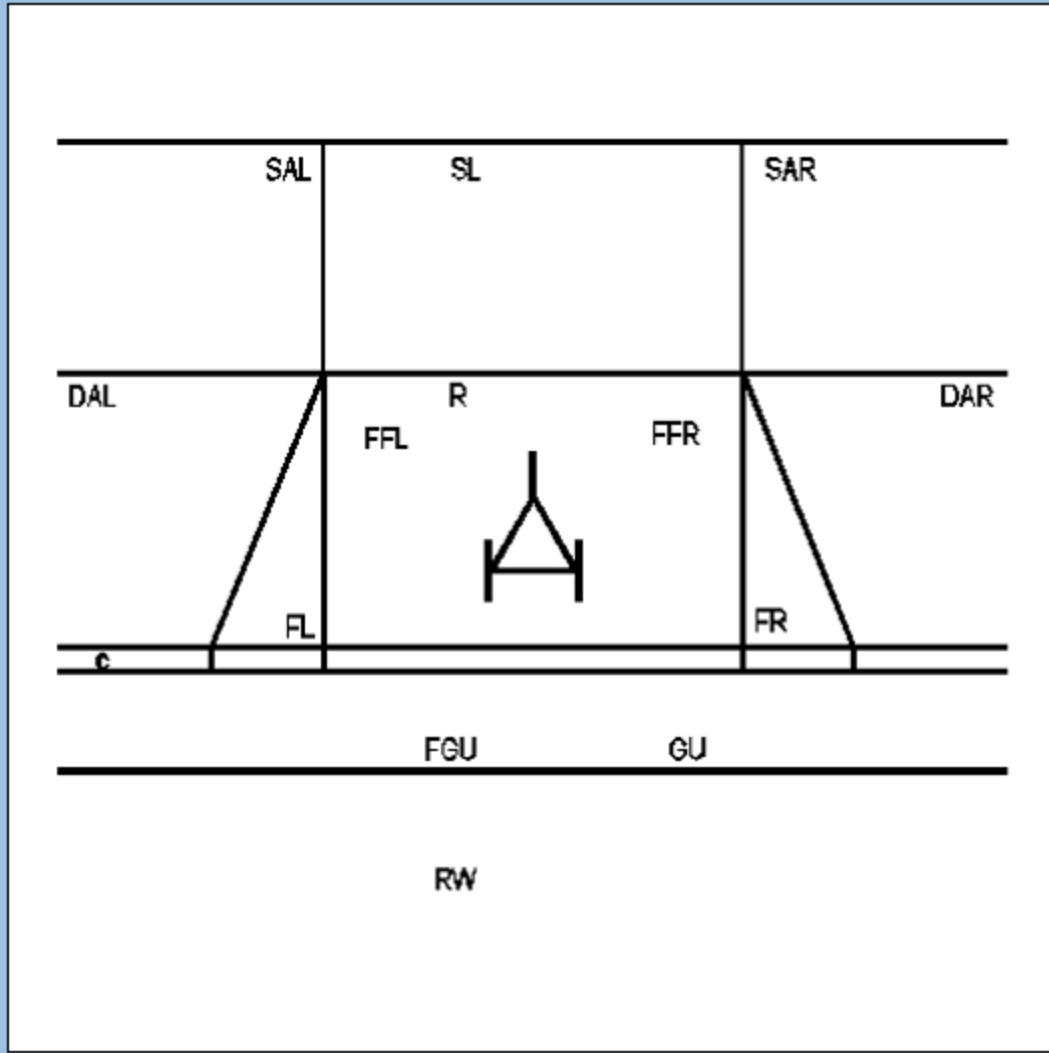
PROWAP Sidewalk Element Capture

Show GPS Status **Grade:** 13.4

Check Calibration **X-Slope:** 2.5

Perpendicular Crossing

Main N 1st to 2nd BC 2009-05-19



	Grade	X-Slope	Length	Width
R				
SL				
SAR			-- N/A --	
DAR			-- N/A --	
FFR			-- N/A --	-- N/A --
FFL			-- N/A --	-- N/A --
DAL			-- N/A --	
SAL			-- N/A --	
FGU			-- N/A --	-- N/A --
RW			-- N/A --	-- N/A --
C	-- N/A --	-- N/A --	-- N/A --	
FR		-- N/A --	-- N/A --	
FL		-- N/A --	-- N/A --	
GU			-- N/A --	

Garmin GPS Status:

Error: Garmin GPS is not connected

Capture <- Skip Save Cancel

Sidewalk Element Data for Curb Ramps

Diagonal ID	1	2	3	4	5	6	7
Diagonal Name	DC Washing	CR Washing	CR1 Washing	CR2 Washing	CR3 Washing	CR4 WASHING	CR5 Washing
Longitude	-119.761191	-119.763543	-119.763571	-119.762874	-119.762717	-119.762043	-119.761998
Latitude	30.1690250	30.1685294	30.1683475	30.1683828	30.1684005	30.1683021	30.1683775
Elevation	4653.61523	4652.63088	4670.05509	4656.12158	4659.62646	4658.0127	4666.17324
R_Grd	1	11.0			16.2	2.7	
R_Slp	0	-0.4			1.3	1.5	
R_Len	53	48			48		
R_Wd	60	35			64		
SL_Grd		-2.8	4.1	3.5			2.1
SL_Slp		0.6	-0.1	0.2			-1.5
SL_Len		258		60			48
SL_Wd		48		60			48
SAR_Grd							
SAR_Slp							
SAR_Wd							
DAR_Grd	7.7	-0.6	0.8	3.3	2.6	1.5	-0.5
DAR_Slp	-1.5	-1.6	-0.3	-5.2	-7	-0.0	-1.6
DAR_Wd	53	48	56	48	48	48	
FFR_Grd	6.5	7.2			7.7		
FFR_Slp	-0.4	-4.2			-11.3		
FFL_Grd		10.1			5.7		
FFL_Slp		6.8			11.3		
DAL_Grd		0.8	-3.0	5.7	-0.2	-0.3	2.3
DAL_Slp		3.5	3	4.4	2.2	3.2	2.6
DAL_Wd	53	50	56	48	48	48	
SAL_Grd							
SAL_Slp							
SAL_Wd							
FCU_Grd	5.1	1.5	18.5	4.7	3.7	12.5	14.6
FCU_Slp	-0.5	0.2	-3.3	-1.2	-0.7	-2.4	2.1
RW_Grd	4.4	3.9	12.4	12.5	11.2	6.2	7.3
RW_Slp	0.4	-2.8	-5.3	0.7	-2.5	-3.0	0.8
C_Wd	6	6	6	6	6	6	6
FR_Grd		7			7		
FR_Wd		33			42		
FL_Grd		7.1			7		
FL_Wd		33			42		
GU_Grd	5.8	1	3	7.5	3.1	1.6	3.1
GU_Slp	0.6	0.6	3	1.2	0.9	4.6	1.6
GU_Wd	18	22	15	18	18	14	16
StartTime	13:18:19	14:09:13	15:00:47	15:34:13	15:39:48	16:20:06	16:37:27
EndTime	13:37:17	15:17:41	15:30:56	15:39:16	15:54:07	16:35:35	16:42:40

Sidewalk Element Data for Driveway Crossings

Perpendicular	1	2	3	4	5	6	7	8
Perpendicular	DC1 Washing	DC2 Washing	DC1 Washing	DC1 WASHING	DC2 WASHING	DC3 Washing	DC4 Washing	DC5 Washing
Longitude	-119.761596	-119.762121	-119.763050	-119.762485	-119.762293	-119.761786	-119.761703	-119.761516
Latitude	39.1687428	39.1685384	39.1685145	39.1684092	39.1683944	39.1684324	39.1685105	39.168604
Elevation	4667.05382	4669.17383	4668.52832	4669.31399	4646.92072	4667.41016	4653.07568	4683.20215
R_Grd	0	14.4	11.5	12.5	10.4	12.4	11.7	9.2
R_Slp	-1.2	-1.4	-2.0	0.7	0.4	-0.6	-0.1	-0.4
R_Len	352		380.4	48	165	240	178	48
R_Wd	60	48	48	202	48	48	48	182
SL_Grd	1.3	13.6	2.9	1.5	6.3	3	5.6	2.7
SL_Slp	-1.5	1	-0.6	1.2	0.3	-2	-0.5	-1.9
SL_Len						240	178	
SL_Wd				170	180			
SAR_Grd		22.4						
SAR_Slp		2.1						
SAR_Wd								
DAR_Grd	0.2	0	-1.0	1.7	2.8	-2.6	-0.2	-0.8
DAR_Slp	-2.1	-5.2	-2.8	-2.7	-1.6	-4	-2.3	-1.6
DAR_Wd	60	48	48	48	48	48	48	48
FFR_Grd	0.8	3.2	4.2	6.2	1	4.7	4.3	2.7
FFR_Slp	-3.9	-9.9	-2.4	-12.2	-6.1	-11.6	-7.6	-4.3
FFL_Grd	1.2	6.3	6.7	4.8	2.6	6.7	5.7	5.9
FFL_Slp	1.6	13.2	12.3	11.5	9.6	10	10.3	7.7
DAL_Grd	-0.2	0.8	2.4	-0.2	1	4.2	2.8	1.1
DAL_Slp	3.2	3.3	3	2.8	2	1.4	1.3	0.3
DAL_Wd	60	48	48	48	48	48	48	48
SAL_Grd			0.8					
SAL_Slp			1.4					
SAL_Wd			119					
FCU_Grd	13.6	7.4	12.1	6.5	9.6	10.9	13.7	17.3
FCU_Slp	-0.8	0.3	3.2	-0.4	-0.2	-0.4	0.1	-0.3
RW_Grd	13.1	8.2	7.2	12.9	9.3	9.6	8	6.9
RW_Slp	-1	0.6	1	-1.1	-1.1	1.5	0.7	1.2
C_Wd	6	6	6	6	6	6	6	7
FR_Grd	13.9	11.3	9.3	10.4	5.9	12	8.1	6.4
FR_Wd	34	32	25	0.032	48	36	42	32
FL_Grd	11.8	13.8	13.9	11.2	5.4	11	13	11.2
FL_Wd	30	34	33	32	48	36	40	34
GU_Grd	9.9	8.2	4.9	2.7	5	4.2	10.8	4.5
GU_Slp	1	1	2.6	0.9	1	0.2	0.2	0.5
GU_Wd	17	17	17	18	18	18	16	16
StartTime	13:38	13:56	14:15	15:56	16:13	16:43	16:56	17:02
EndTime	13:53	14:06	14:45	16:11	16:27	16:55	17:01	17:09

PROW-AP Assessment of Segment and Roadway

Highway 395 closure and
measurement of grade

Parallel sidewalk measured with
PROW-AP

Quickly allowed comparison of
grades

Designed for GIS Compatibility

Points – Features – Elements

Lines – Sidewalk corridors

Sidewalk symbol font library



Carson City
GIS Division
3505 Butte Way
Carson City, NV 89701
(775) 887-2355

E Washington St

GIS

E. Washington St
N. Roop St - N. Valley St

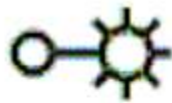


GIS

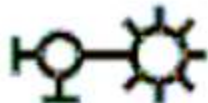
E. Washington St
N. Roop St - N. Valley St



Bench



Light



Light with
two
pedestrian
signal
actuators



Parallel
curb
ramp



Curb
ramp
with
return
curbs



Curb
ramp
with
flares



Driveway
crossing with
setback
landing

Creation of Shape Files

Use CAD software to process data

- AutoCAD Map
- Microstation

Or bring data into GIS software using scripts written for the data

- ArcMap with ArcInfo

i Identify ? X

Identify from: <Top-most layer>

Diagonal Curb Ramp
CR5 Washington S Wa

Location: 2,290,536.135 14,734,063.968 Feet

Field	Value
FID	6
Shape	Point
Diagonal_I	7
DiagonalNa	CR5 Washington S Walsh E JV 2009-04-21
Longitude	-119.761898
Latitude	39.168377
Elevation	4666.1699
R_Grd	0
R_Slp	0
R_Len	0
R_Wd	0
SL_Grd	2.1
SL_Slp	-1.5
SL_Len	48
SL_Wd	48
SAR_Grd	0
SAR_Slp	0
SAR_Wd	0
DAR_Grd	-0.5
DAR_Slp	-1.6
DAR_Wd	0
FFR_Grd	0
FFR_Slp	0
FFL_Grd	0

Identified 1 feature



■ Less Than 0.2% Slope
■ Greater Than 0.2% Slope
Drive Cross & Ramp
● Greater Than 0.2% Slope
 Photo From
 June 2006

GIS
 E. Washington St
 N. Roop St - N. Valley St

City of
 Council
 306 East
 Council
 Council
 730-227-2335

City of Council
 306 East Council
 Council
 730-227-2335

- Diagonal Curb Ramp
- Drive Cross & Ramp
- Street Centerline
- Parcel Boundary
- Water Assets
- Photo Grouping

Attributes of Diagonal Curb Ramp

FID	Shape *	Diagonal I	DiagonalNa	Longitude	Latitude	Elevation	R Grd	R
4	Point	5	CR3 Washington S Anderson E JV 2009-04-21	-119.762717	39.1684	4658.6299	16.2	
1	Point	2	CR Washington N Valley E JV 2009-04-21	-119.763543	39.168529	4662.6299	11.9	
5	Point	6	CR4 WASHINGTON S WALSH W CL 2009-04-21	-119.762042	39.168392	4658.0098	2.7	
0	Point	1	DC Washington N Roop W JV 2009-04-21	-119.761191	39.169026	4653.6201	1	
2	Point	3	CR1 Washington S Valley to Roop JV 2009-04-21	-119.763571	39.168347	4670.96	0	
3	Point	4	CR2 Washington S Anderson W JV 2009-04-12	-119.762874	39.168383	4656.1201	0	
6	Point	7	CR5 Washington S Walsh E JV 2009-04-21	-119.761898	39.168377	4666.1699	0	

Record: 1 Show: All Selected Records (2 out of 7 Selected) Options



1 inch = 100 Feet

Legend

- Diagonal Curb Ramp**
 - Green Square: Less Than 0.2% Slope
 - Red Square: Greater Than 0.2% Slope
- Drive Cross & Ramp**
 - Red Circle: Greater Than 0.2% Slope
- Street Function**
 - Red Line: Arterial Road
 - Black Line: Collector Road
 - Grey Line: Local Street
 - White Line: Rural Boundary

GIS
E. Washington St
N. Roop St - N. Valley St

Photo Name
3/11/06

Compatibility with Different Levels of GPS

Garmin GPS 18 with USB – using
during Phase I development

Trimble Pathfinder compatibility
verified for integration of sub-meter
GPS equipment or survey grade
GPS

PROW-AP Municipality Benefits

Complete, efficient and objective

Improves planning, design and
construction

Cost-effective

Faster turnaround of data

PROW-AP Municipality Benefits continued....

Prevention of liability

Reduction in complaints

Reduce need to reconstruct

Eliminate High Cost of Reconstruction

Planning

Design

Demolition and removal

Layout and Farming

Concrete

Verification

PROW-AP Public Benefits

Increases pedestrian safety and access

Improved pedestrian infrastructure

People have a safe environment to get more exercise than driving

People save money not driving

PROW-AP Benefits

75-80% less personal time required

Automatic data recording

Less physical stress and fatigue

No hard paper copies

Increased data accuracy

PROW-AP Development Partners

Nevada Department of
Transportation

Carson City Public Works
Department

City of Reno and Sparks

Nevada Department of Transportation

Dennis J. Coyle - NDOT ADA coordinator

Edgar Olivera - NDOT sidewalk designer

Steve Lani - NDOT Resident Construction
Engineer

Eric Glick - ADA coordinator and past
Bike Pedestrian Coordinator for NDOT

Carson City Public Works Department

Patrick Pittinger - Transportation
Manager

Matt Forest - GIS coordinator

Rob Fellows - Senior Project Manager

City of Reno and Sparks

Alan Felker - Assist Civil Engineer -
Reno Access Advisory advisor.

Organized a workshop with 39
attendees in Reno where PROW-AP
was presented.

Alan Barney - Capital Projects - Senior
Engineer Tech - ADA work team

Other Experts

Donald Meeker - Meeker and Associates Inc - Symbol and Font Graphics Expert – intent to develop a true type font for sidewalk environment

Yvonne Barns - GIS & Cartographic Service - Mountain Mapping - Project consultant

Acknowledgement

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*Working toward universal access
through research, design & education*