

# Los Angeles Sidewalk Assessment Project

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## Sidewalk Cross-Slope Data Verification

### AIM:

Sidewalk Cross-slope data was compared to survey data collected by the East Los Angeles College Civil Engineering team to verify accuracy.

### BACKGROUND:

The Bureau of Engineering for the City of Los Angeles faces the challenge of assessing over 11,000 miles of sidewalks that conform to Federal ADA standards. The ubiquity rover equipped with a leveler was developed to aid in assessing the sidewalks. It measures the running and cross slope of the sidewalk as well as GPS coordinates.

### METHOD:

After the civil engineers surveyed the sidewalk on the California State University Los Angeles Campus, the rover was taken out to measure the measured points. The rover was placed in the sidewalk's center close to points the civil engineer team measured. The angle was read and recorded at each point. The rover was positioned over the center of the point to ensure the best angle measurement.

A slope analysis was done using the data collected by the survey team to verify the accuracy of the measurement taken by the rover. The XYZ coordinates provided by the survey team were used to calculate the cross-slope angle at the various points measured. The distance between two points along the cross-slope and the difference in height between the points were used to calculate the run and the rise, respectively.[1]

$$\text{rise/run} = \Delta y / \Delta x$$

The arctangent of the rise over run gives the angle of the slope. The results were given in radians, so it was converted to an angle by multiplying them by  $180/\pi$ . [2] This result was used to compare against the measurements taken by the rover.

$$\tan^{-1}(\Delta y / \Delta x) = \theta$$

**Results:**

The difference between the measured data collected and the survey data was measured using absolute error and percentage error. Some of the measurements taken by the survey team had a rise of zero, indicating no change in elevation between points, so the percentage error calculator was modified to account for this.

$$\text{Absolute Error} = |\text{Measured angle} - \text{True Angle}|$$

$$\text{Percentage Error} = \text{Absolute Error} / |\text{True Angle}|$$

or

$$\text{Absolute Error} / 1 + |\text{True Angle}| \text{ (if true angle was zero)}$$

These are the results from the 2- 4 feet points with the calculated error where the rover passed over and took measurements:

2.0 to 4.0			Difference between measured and calculated angle							
(z4-z2)	(x4-x2)	rise/run	Measured Degrees -Degree Converted							
Rise	Run	Slope	ArcTan conversion	Degree Convert	1st y-slope		11/07/2023 y-slope			
					Absolute Error	Percentage Error	Absolute Error	Percentage Error		
-0.020	2.000	-0.01	-0.009999565	-0.573	0.534	93.22%	0.876	93.97%		
-0.005	2.004	-0.0025	-0.002495226	-0.143	1.422	994.62%	0.743	7.47%		
-0.015	1.871	-0.00802	-0.008018192	-0.459	0.530	115.45%	0.430	37.21%		
0.005	1.998	0.002503	0.002502968	0.143	0.144	100.70%	0.928	92.20%		
0.000	1.986	0	0	0.000	0.525	52.50%	0.010	1.90%		
0.020	2.029	0.009856	0.009856164	0.565	0.611	108.15%	1.415	130.82%		
0.005	1.973	0.002534	0.002534047	0.145	0.196	135.13%	0.786	58.18%		
0.000	2.023	0	0	0.000	0.051	5.10%	0.154	301.96%		
-0.030	1.688	-0.01777	-0.017771257	-1.018	0.967	94.99%	1.635	172.14%		
-0.035	2.002	-0.01748	-0.017481267	-1.002	0.951	94.91%	1.831	192.88%		
-0.020	1.996	-0.01002	-0.010022153	-0.574	0.523	91.12%	0.825	90.57%		
-0.020	2.012	-0.00994	-0.009937951	-0.569	0.518	91.04%	0.477	52.44%		

**Fig 1. Results from Slope Analysis**

The results of the percentage error do not show any consistent results from the measurement taken from the rover. This questions whether the measurement method needs to be modified or if a buffer is needed to account for any unevenness between the level and the rover's top. Further data collection is needed to verify whether the data suits BOE purposes.