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CURB RAMP AND ACCESSIBILITY ELEMENT UPGRADE PRIORITIZATION: A LITERATURE REVIEW AND ANALYSIS OF MULTI-STATE SURVEY DATA

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Abstract: Curb ramps are a universally beneficial element of the built environment, providing improved access for all users. The Americans with Disabilities Act (ADA) requires compliant ramps to be installed with new construction or when a facility is altered. The large quantity of ramps and other facilities that must be upgraded to achieve full compliance, coupled with limited budgets, often requires states to prioritize ramps for retrofit over time. Users with varying disabilities might prioritize curb ramp improvements differently. This study assessed the state of the practice for prioritizing curb ramp upgrades and retrofits. A background review of national standards and guidance related to curb ramps was conducted. Prioritization processes for similar accessibility elements, including sidewalks and accessible pedestrian signals, were gathered through a literature review. State representatives were contacted through an email survey to identify existing prioritization processes for curb ramps. Americans with Disabilities Act Accessibility Guidelines and Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way provide similar standards and guidelines for accessibility. Three studies found that pedestrians with vision disabilities found domed surfaces most detectable, although users with mobility disabilities experienced negative safety and negotiability impacts with detectable warning surfaces. Compliance with accessibility standards and citizen requests were most commonly used for prioritization at the state level; localities were more likely to consider proximity to pedestrian generators and transit. These findings provide a foundational resource for agencies developing or revising prioritization processes for curb ramp retrofits.

Keywords: barrier-free design, pedestrian areas, persons with disabilities, retrofitting, strategic planning.

Introduction

Curb ramps are universally beneficial; it is not only people with disabilities who have improved access when curb ramps are implemented. People with strollers, carts, luggage, and runners and pedestrians enjoy improved access with curb ramps. A study of pedestrians in Sarasota, Florida, showed that nine out of 10 “unencumbered pedestrians” at a shopping mall went out of their way to use a curb ramp (Blackwell, 2017). Though small compared to some large-scale transportation projects, curb ramps play a large role in making transportation facilities available and accessible for all users.

Title II of the Americans with Disabilities Act (ADA) outlines requirements for existing and new facilities operated by a public entity (U.S. Department of Justice, 2010b). The ADA also requires public entities with over 50 employees to develop an ADA Transition Plan. The plan should contain a list of physical barriers in the entity’s facilities, a detailed description of how the barriers will be removed, and a schedule for taking necessary steps towards compliance. Subpart D of Title II of the ADA provides specific requirements for improving facilities and becoming compliant (U.S. Department of Justice, 2010b). For facilities that were previously compliant with the 1991 ADA Standards for Accessible Design, there is no requirement to be compliant with the 2010 ADA Standards for Accessible Design until the facility is altered, at which point it must comply with 2010 standards. If strict compliance with the standards is not feasible, the maximum level of compliance possible should be achieved. If a new facility is constructed, it should be accessible by 2010 standards.

From the perspective of a person who has a disability, a missing curb ramp is essentially a missing link in the sidewalk network. However, people with different sorts of disabilities might prioritize improvements differently. For example, although a wheelchair user might prefer any ramp over no ramp, someone who is blind but ambulatory might prefer a curb without a ramp over a curb ramp without truncated domes because the curb is cane-detectable. The large quantity of ramps and other facilities that must be upgraded to achieve full ADA compliance, coupled with limited budgets, often requires states to prioritize ramps for retrofit over time.

Methodology

A background review of standards and guidance related to curb ramps was undertaken to obtain relevant information regarding ADA guidelines and requirements, including ADA Accessibility Guidelines and Public Right-of-Way Accessibility Guidelines.

A literature review was undertaken to obtain relevant information regarding curb ramps. This review included studies of how people with visual and mobility impairments interact with curb ramps and studies of prioritization processes for similar facilities such as sidewalks and accessible pedestrian signals.

State DOTs and localities have developed various approaches to create prioritization processes based on curb ramp inventories included in their ADA transition plans. Representatives of all 50 state DOTs and the District of Columbia DOT were contacted through the AASHTO Research Advisory Committee to assess what methods other states were using to prioritize curb ramp retrofits.

Because no research studies directly addressing the curb ramp prioritization process were found, ADA transition plans were reviewed for several counties, cities, and towns to identify examples of priorities each entity incorporated into its process. The search for ADA transition plans was conducted to find a diverse selection of localities, geographically and by population size. Transition plans that did not include a curb ramp prioritization process were excluded.

Results

Background Review of Standards and Guidance

National standards and guidance related to curb ramps were reviewed. Two sets of design guidelines exist at the federal level for implementing accessibility requirements: the ADA Accessibility Guidelines (ADAAG) (United States Access Board, 2004) and the Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG) (United States Access Board, 2011).

ADA Accessibility Guidelines

The ADA of 1990 prohibits discrimination against individuals with disabilities. Title II of the ADA applies specifically to state and local government programs and services, with different requirements for existing and new facilities (U.S. Department of Justice, 2010b). ADAAG outlines specific requirements for designing buildings and facilities to comply with the ADA and is the basis for the regulations enforced by the U.S. Departments of Justice and Transportation (United States Access Board, 2004). ADAAG was first published in 1991 and was the foundation for the 1991 ADA Standards for Accessible Design. An updated ADAAG was published in 2004 and was adopted as part of the 2010 ADA Standards for Accessible Design (U.S. Department of Justice, 2010a). ADAAG contains specifications for curb ramps, including running, cross, and counter slopes; flared sides; width; and landings.

Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way

PROWAG (United States Access Board, 2011) has been adopted as a set of design standards by many localities and state DOTs, but the federal government has not yet adopted them as enforceable standards. Like ADAAG, PROWAG covers curb ramps and many other elements in the public right of way, such as accessible pedestrian signals, street furniture, and on-street parking. Specifications for curb ramps in PROWAG relate to running, cross, and counter slopes; flared sides; width; and turning space. Table 1 shows the design guidelines for curb ramps outlined in PROWAG vs ADAAG.

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Table 1. PROWAG vs ADAAG Physical Specifications for Curb Ramps.

Element	**ADAAG Specification**	**PROWAG Specification**
Location	Provided wherever an accessible route crosses a curb	*Shall connect the pedestrian access routes at each pedestrian street crossing*[a]
Running Slope	1:12 (8.3%) maximum	5% minimum, 8.3% maximum
Cross Slope	1:48 (2.1%) maximum	2% maximum
Clear Width	36 in minimum	*1.2 m (48 in) minimum*
Surface	Firm, stable, and slip resistant	Firm, stable, and slip resistant
Sides of Curb Ramps	Flared sides 1:10 (10%) maximum slope	Flared sides 10% maximum slope
Top Landing	Minimum 36 in clear length, clear width at least as wide as ramp, excluding flared sides	*Minimum 1.2 m (4 ft) x 1.2 m (4 ft) Running slope not greater than 2%*
Counter Slope	1:20 (5%) maximum	5% maximum
Clear Space	4 ft x 4 ft within marked crossings, if present, and outside of active traffic lanes[b]	1.2 m (4 ft) x 1.2 m (4 ft) within the width of the pedestrian street crossing and wholly outside of the parallel vehicle travel lane

ADAAG = Americans with Disabilities Act Accessibility Guidelines; PROWAG = Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way.
[a] Specifications that are different across ADAAG and PROWAG are in italics
[b] Only specified for diagonal curb ramps

Literature Review

The literature review results cover a range of topics related to curb ramps, including how people with visual and mobility impairments interact with curb ramps and prioritization processes for sidewalks and accessible pedestrian signals (APS).

How People with Disabilities Interact With Curb Ramps

Much of the research surrounding curb ramps have focused on the effectiveness of detectable warning surfaces (DWSs) and how people with visual and mobility impairments interact with different surface types. Four studies were reviewed. One looked at the built environment and barriers for adults with mobility disabilities, and three analyzed the detectability and negotiability of DWSs and the perception of these surfaces by people with visual and mobility impairments. These interactions could inform the design of a prioritization process for curb ramp improvements.

Barriers in the Built Environment. A study performed in King County, Washington, involved 35 participants over age 50 who used assistive mobility devices (Rosenberg, Huang, Simonovich, & Belza, 2013). Participants wore a GPS tracking device for three days and then were interviewed about their built environments, particularly about trips recorded via GPS. Participants frequently noted that curb ramps were often only on one side of the road or were not present at all crossings along the sidewalk, resulting in them having to travel on the road until curb ramps were available. The condition of curb ramps was also important; broken or steep ramps were avoided. Some participants indicated that the DWS was helpful but also slippery when wet. Overall, interviewees agreed that the presence of curb ramps promoted mobility.

Detectable Warning Surfaces. The Federal Transit Administration published a study in 1994 evaluating DWSs for detectability by visually impaired users and negotiability by physically impaired users (Bentzen, Nolin, Easton, Desmarais, & Mitchell, 1994).

In that study, blind participants tested 13 DWSs, which varied in dome size and spacing, for detectability underfoot. The 12 commercially available options were detected underfoot in at least 95% of the trials; a surface that was not commercially available was only detected in 88% of the trials. The study concluded that DWSs with a range of dome sizes and spacings varying from ADAAG specifications could still be highly detectable. Four of the surfaces, representing extreme cases of detectability, were tested again for detectability with a cane. Three surfaces were detected in 100% of the trials; the remaining surface was detected in 98% of trials. It was concluded that surfaces readily detectable underfoot are also readily detectable by users with a long cane.

Forty participants with physical disabilities tested the relative safety and negotiability of 9 detectable surfaces compared to a brushed concrete ramp. Participants used a variety of mobility aids; 7 participants did not use an aid. The surfaces with small, widely spaced, horizontally and vertically aligned domes resulted in the fewest difficulties for those using travel aids. In addition, users of wheeled devices experienced fewer cases of wheel entrapment with horizontally and vertically aligned domes than with diagonally aligned domes. Given the negative impact on safety and negotiability experienced by physically disabled users, the authors recommended that the installed DWS (surface with truncated domes) should be limited in width to no more than required for visually impaired users.

A 1995 study tested 7 DWSs of varying materials for detectability and negotiability (O'Leary, Lockwood, Taylor, & Lavely, 1995). Fifty-two participants with visual impairments tested the detectability of the surfaces. Most used a cane, guide dog, or sighted guide; some used multiple aids, while others did not use an aid at all. Participants found domed surfaces far more detectable than aggregate surfaces. Participants most often identified black concrete and yellow composite domes as "very easy" or "easy" to detect.

In that study, six participants with mobility impairments tested the same 7 DWSs for negotiability using their mobility aids (wheelchairs, crutches, canes, or human assistants). Domed surfaces were least preferred, and some participants indicated that they would avoid any domed surfaces when travelling. All participants indicated that lateral domes (corduroy) made movement unstable, and aggregate surfaces were the easiest to manoeuvre.

Another study looked at the impact of truncated dome detectable warnings on travellers using wheelchairs (Lee, 2011). Twenty-one participants, using either a manual or a power wheelchair, rated the safety and negotiability of 3 ramps: one with no DWS, one with squarely aligned domes, and one with diagonally aligned domes. Preferences of manual wheelchair users were split between squarely aligned truncated domes and ramps without domes. Power wheelchair users had a strong preference for the ramp without domes. Diagonal domes were least preferred by more than half of the participants. A statistically significant increase in effort was observed when manual wheelchair users went up ramps with diagonally aligned domes compared to ramps with squarely aligned domes.

In summary, literature on how people with disabilities interact with curb ramps confirmed that people with different sorts of disabilities might prioritize improvements differently. Three studies found that although adding domed surfaces to curb ramps was beneficial or even critical for pedestrians with visual impairments, it could be detrimental to ramp negotiability and manoeuvrability for pedestrians with mobility impairments. At the same time, installation details can matter: trials that compared squarely-aligned domes and diagonally-aligned domes emphasized the importance of using squarely-aligned domes for negotiability with wheeled mobility aids. The absence of curb ramps in good condition at all crossings along a route creates a gap in the network for people with limited mobility.

In the years since these studies were conducted, there have been many technological innovations, such as smart canes and apps, that assist travellers with disabilities. That being said, the authors know of no research that suggests that the way people with disabilities interact with the physical features of curb ramps has changed markedly in the intervening years.

Prioritization Processes

Although no studies were found that directly addressed prioritization processes for curb ramp improvements, researchers identified studies of, summaries of, and tools for prioritization processes for related pedestrian infrastructure elements: sidewalks and APS.

Sidewalk Prioritization Processes. Five prioritization processes for sidewalks were reviewed. Each uses different methods to determine which sidewalk segments should be improved first. The methods use a wide range of data sources, from generalized information about a site to specific data collected for the prioritization process.

In 2013, researchers at Georgia Tech collected sidewalk quality data around the City of Atlanta's Midtown neighbourhood using an automated tablet-based system they developed through an Android™ app, Sidewalk Sentry™ (Frackelton, 2013). The app collected GPS-enabled video data as well as information from the accelerometer and gyroscope in the tablet, which was attached to a manual wheelchair. Student researchers and community volunteers recorded sidewalk data for an area covering over 659 roadway miles. A weighted ranking system was proposed in which the data from the app would be combined with pedestrian activity data and demographic data to prioritize projects based on a pedestrian potential index (PPI) and a pedestrian deficiency index (PDI). The PPI assessed variables including pedestrian activity, population density, and transportation mode share. The PDI included sidewalk width and pedestrian crash density. This method eliminated sidewalk-width data points that represented "no sidewalk"; the author indicated that future analyses should include absent sidewalks, which could improve the accuracy of the prioritization.

Another Georgia Tech app, Sidewalk Scout™, allowed users to input measurements of sidewalks, curb ramps, bus stops, and crosswalks (Boyer, Walls, Dyess, Greenwald, & Guensler, 2018). Raw data from Sidewalk Scout™ and Sidewalk Sentry™ were aggregated in GIS and assigned to sidewalk segments using a semi-automated process. The sidewalk asset management system compared raw sidewalk data with ADAAG requirements to determine compliance for each element. The researchers developed a Sidewalk Prioritization Index (SPI) that prioritized sidewalk links across three categories: safety, mobility, and accessibility. Each category was further broken down into factors such as locations of pedestrian injury, employment district, and presence of an obstruction in the sidewalk. These factors were then weighted based on input from over 1,000 survey respondents to reflect community interests accurately. Final rankings were determined by summing the scores for each factor within each of the three categories and averaging the category scores. The final score for each sidewalk segment was ranked to determine which segments should be the highest priority.

The City of Falls Church, Virginia, created a sidewalk prioritization process that required data about the surrounding area and the physical condition of the sidewalks (City of Falls Church, 2012). The city identified five priority areas in which to categorize the sidewalks:

- Public input requests
- Sidewalks along transit routes and primary routes to Metrorail stations
- Sidewalks in commercial corridors
- Sidewalks along primary and secondary safe routes to schools and the park connectivity plan
- All other sidewalks

Within each of the five priority areas, the sidewalks were ranked based on an ADA compliance score, the number of obstacles along the segment, and the number of noncompliant driveways within the segment. The ADA compliance score was calculated as the length of deficiencies on the sidewalk segment (measured in feet), divided by the length of the sidewalk segment (measured in feet).

Deficiencies were determined based on variances from ADAAG requirements. The final score used to rank the sidewalks was calculated by summing the compliance score and the scores determined from Table 2, based on the characteristics of each sidewalk segment.

Table 2. Point System for Ranking Sidewalk Projects, City of Falls Church, Virginia.

Criteria	Score	Measurement
Obstacles	10	Every obstacle that reduces sidewalk width to <36in
Driveways	20	5 or more noncompliant driveways[a]
	10	3-4 noncompliant driveways
	5	1-2 noncompliant driveways

[a] A noncompliant driveway was characterized by a sidewalk with a cross-slope greater than 2 percent

The City's Transition Plan (City of Falls Church, 2012) indicated that the scores were used as guidance for developing a repair schedule. The Plan encouraged the repair of entire lengths of a given street rather than upgrading individual segments that may not create a continuous accessible path.

The City of Charlotte, North Carolina, had a sidewalk prioritization method in its 2017 Charlotte WALKS: Pedestrian Plan (City of Charlotte Department of Transportation, 2017). Eligible sidewalk projects were ranked based on proximity to pedestrian traffic generators, safety factors, connectivity with other sidewalks, cost, and proximity to disadvantaged populations. Ranking criteria and point values could be changed over time, resulting in the reprioritization of the projects. Sidewalk projects that presented unique circumstances, such as high traffic volumes or speeds, accessibility to transit, or pedestrian safety concerns, could be exempted from the ranking process altogether and moved to the top of the priority list.

Using the Absent Sidewalk Prioritization Model (Anderson, 2018), a study prioritized 2,349 miles of missing sidewalks in San Antonio, Texas. This model used four indices that were developed with input from a focus group: a Policy Score, a Demographic Score, a Pedestrian Attractor Score, and a Pedestrian Safety/Health Score. These four indices, taken together, encompassed a total of 27 criteria. The Policy Score was comprised of two binary elements: location of the missing sidewalk within Regional Centers (areas targeted for improvement to facilitate the rapid growth of the city) and within Corridors (major connections between the Regional Centers) (City of San Antonio, n.d.). The Demographic Score included elements such as residential population density, median household income, and the number of persons with disabilities. The Pedestrian Attractor Score included the proximity to schools, parks, government offices, healthcare facilities, and retail establishments. The Pedestrian Safety/Health Score captured pedestrian crashes and injuries and the street's functional classification. Each index was weighted equally in determining the final score for each sidewalk segment, which was used for prioritization. The author suggested that a future model could incorporate a gap analysis scoring sidewalk segments based on the length of continuous sidewalk that would result if constructed.

Thus, several U.S. examples of sidewalk prioritization processes have been developed to support decisions regarding improvements when funds are limited. Each process employed a unique combination of sidewalk characteristics, including ADA compliance, adjacent land uses, and pedestrian crashes. Several methods used spatial data, such as population density or proximity to employment areas. Although the specifics of these prioritization processes differed, as would be expected given differences in local budgetary, political, and physical constraints, they all classified data elements into categories (variously named indices, priority areas, and ranking factors) to recognize the importance of accounting for multiple criteria in determining priorities for sidewalk construction and improvement. These efforts could be mirrored in the development of a curb ramp prioritization process, as similar data would inform the need for curb ramps, which would also benefit from prioritization based on multiple categories of data.

APS Prioritization Processes. Two methods were reviewed that provided processes for prioritizing the installation of APS.

In 2003, VDOT published guidelines developed for its Northern Virginia District in response to a request for APS at an intersection in Falls Church (Arnold & Dougald, 2003). These guidelines were established with guidance from VDOT, FHWA, the Virginia Department for the Blind and Visually Impaired, and the blind/visually impaired community. When evaluated, intersections were assigned points based on the following characteristics:

- Configuration of intersection
- Width of crossing
- Posted speed limit on the street to be crossed
- Heavy right-turn volumes that affect crossing
- Free flow right-turn lane that affects crossing
- Leading or exclusive pedestrian phases; mid-block exclusive pedestrian signals
- Proximity of intersection to pedestrian generators or attractors
- Requesting party's need is related to work or school
- Length of time intersection has been waiting for funding
- Other special traffic and mobility conditions

Six of the characteristics were binary and awarded points for the presence of that element. The remaining points were assigned based on the crossing width, posted speed limit, proximity to pedestrian attractors, and time in queue. The sum of all of these scores could be used to prioritize crossings for a given fiscal year or a long-range plan.

In 2007, NCHRP published the APS Prioritization Tool, which uses observable characteristics of individual crosswalks and intersections to determine the crossing difficulty for blind pedestrians (Harkey, Carter, Barlow, & Bentzen, 2007). Scores calculated with this tool can be ranked, with the highest score representing the highest priority, to determine where investment in APS should be made or prioritize funding allocations for a given year. An intersection is evaluated and assigned tiered point values based on the following characteristics:

- Type of intersection
- Type of signalization
- Proximity to transit
- Proximity to facility for visually impaired, including libraries, schools, and rehabilitation centres for the blind
- Distance to major pedestrian attraction

The scores for each factor are summed to determine the score for an intersection. After scoring the intersection, each crosswalk is evaluated individually. Crosswalks are evaluated and assigned tiered point values based on the following characteristics:

- Crosswalk width
- Speed limit
- Crosswalk geometry
- Pedestrian signal control
- Vehicle signal control
- Off-peak traffic presence
- Distance to alternative APS crossing
- Location of pedestrian pushbutton
- Requests for APS

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Unlike intersection scoring, factors for crosswalk geometry, pedestrian signal control, vehicle signal control, and the pedestrian pushbutton location can have multiple selections. The crosswalk score is determined by summing the points assigned for each factor. The intersection score is added to the crossing score to determine the total crosswalk score, resulting in a score that accounts for the characteristics of both the crosswalk and the intersection. This tool was designed to evaluate an individual crosswalk rather than an entire intersection, as rating the intersection as a whole could dilute the score for the most critical crossing, resulting in inaccurate prioritization.

As with sidewalk prioritization processes, both of these prioritization processes for APS employ multiple evaluation criteria, from the physical characteristics of the facility in question to its proximity to various destinations. Because curb ramps, like APS, are typically located at intersections, the intersection-specific criteria present in APS prioritization processes may be particularly transferable to developing a prioritization process for curb ramps.

Limitations. Although curb ramps are an integral component of pedestrian infrastructure, none of the reviewed studies directly addressed the prioritization of curb ramp improvements. The research regarding curb ramps has primarily been focused on the detectability and negotiability of DWSs. Most of the studies focused on one user group, people with vision impairments or mobility impairments. A prioritization process would need to balance the various findings in the literature to account for all users.

All of the existing studies regarding prioritization processes focus on sidewalks or APS. Although each component is important, it is vital for a prioritization process to consider the entire pedestrian network and a pedestrian's interactions with each feature. A curb ramp prioritization process should also consider the impact of sidewalks and APS on the usability of the pedestrian network. This paper synthesizes all relevant information needed to inform a curb ramp prioritization process.

Information From Other States

Prioritization processes for curb ramps have been developed at the state and local levels.

Curb Ramp Prioritization Processes at State DOTs

The following question was distributed to state DOTs via the AASHTO Research Advisory Committee:

> What factors does your state consider when deciding which ramps to retrofit in a given year? (Examples include citizen requests, ramp condition, proximity to transit, etc.)

Fourteen states responded to the email survey. Seven states did not indicate a specific process for prioritizing curb ramp upgrades outside of planned paving projects. However, three of those states—Delaware, New Jersey, and Vermont—indicated that they prioritized citizen requests when received. Virginia's prioritization process was also reviewed (VDOT, 2019).

The criteria used for prioritization by responding states are shown in Table 3. Requests and ramp condition/compliance were the most frequently used prioritization criteria. 67% of all responding states considered citizen requests a high priority for improvement, and 47% incorporated condition/compliance data. Connectivity was only employed by states that have smaller state-maintained highway systems.

Table 3. Prioritization Criteria for Curb Ramps Reported By State DOTs.

State	Requests	Condition/ Compliance	Demand/ Pedestrian Generators	Transit	Connectivity
Illinois	Y	Y	Y	N	N
Maine	Y	Y	N	Y	Y
Massachusetts	Y	N	Y	Y	Y
Montana	Y	Y	Y	N	N
New Hampshire	Y	Y	N	N	N
South Carolina	Y	Y	Y	Y	N
South Dakota	N	Y	Y	N	N
Virginia	Y	Y	N	N	N

Y = State reported using the criterion; N = State did not report using the criterion

Curb Ramp Prioritization Processes in Counties, Cities, and Towns

Three county-level ADA transition plans were reviewed. All three plans introduced a prioritization process based on both the physical condition of the curb ramps as well as the characteristics of the ramp location. Two of the counties—Ada County, Idaho, and San Francisco County, California—utilized a matrix system that placed ramps in prioritized categories based on a combination of location and condition factors. Sacramento County implemented scoring that incorporated a rating of expected pedestrian use and an assessment of the ramp's relative compliance with state and federal standards. The criteria used for prioritization by each county are shown in Table 4.

Table 4. Prioritization Criteria for Curb Ramps Reported By Counties.

County	Requests	Condition/Compliance	Demand/ Pedestrian Generators	Transit	Connectivity
Ada County, Idaho	Y	Y	Y	Y	N
San Francisco County, California	Y	Y	Y	Y	N
Sacramento County, California	Y	Y	Y	Y	N

Y = Country reported using the criterion; N = Country did not report using the criterion

Twelve ADA transition plans were reviewed for cities and towns around the United States. Each city and town had a unique prioritization process; however, several common methods were used. Four cities and one town used a scoring system, assigning points for traits that a ramp did or did not possess, including location and condition. Five cities utilized fixed categories to prioritize ramps. Categories were considered high, medium, or low priority and were associated with certain characteristics of ramps. Ramps were sorted into categories to determine priority. Redmond, Oregon, developed a prioritization matrix combining both location and condition information to prioritize ramps (MIG, Inc., 2017). Frisco, Texas, used a system of both categories and scores to create a priority list for curb ramp upgrades (City of Frisco, 2014). The criteria used for prioritization by each city and town are shown in Table 5.

Table 5. Prioritization Criteria for Curb Ramps Reported By Cities and Towns.

City/Town	Requests	Condition/ Compliance	Demand/ Pedestrian Generators	Transit	Connectivity
Loveland, Colorado	Y	N	Y	Y	N
Mesa, Arizona	Y	Y	Y	Y	N
Frisco, Texas	Y	Y	Y	Y	N
Bellevue, Washington	Y	Y	Y	Y	N
Euless, Texas	Y	N	Y	N	N
Redmond, Oregon	Y	Y	Y	Y	Y
Shoreline, Washington	N	Y	Y	Y	N
Clayton, Missouri	Y	Y	Y	Y	N
Baltimore, Maryland	Y	Y	Y	Y	N
Portland, Oregon	Y	Y	Y	Y	Y
San Jose, California	Y	Y	Y	Y	N

City/Town	Requests	Condition/ Compliance	Demand/ Pedestrian Generators	Transit	Connectivity
Concord, Massachusetts	N	Y	Y	N	N

Y = City/town reported using the criterion; N = City/town did not report using the criterion

The information obtained from other states regarding their curb ramp prioritization processes suggests that although there is no standard practice, several states do employ multiple criteria when prioritizing curb ramp upgrades outside of planned paving projects. Citizen requests were the most frequently used criterion, followed by the ramp's physical condition, including ADA compliance. Other considerations such as proximity to pedestrian trip generators, transit, and network connectivity were each employed in at least two states.

Curb ramp prioritization processes at the local level also employed multiple criteria, but in contrast to states, pedestrian demand or proximity to pedestrian generators was the most frequently cited among localities. Citizen requests, ramp condition/compliance, and transit were each cited by all but two localities, while only two localities took connectivity into account when prioritizing curb ramp improvements. One possible explanation for localities' relatively higher use of certain categories may be data availability; for example, a locality may be more likely than a state DOT to have information about transit stops in its jurisdiction.

Given the critical role of curb ramps in a sidewalk network that is accessible for people with disabilities, expanding the consideration of connectivity in curb ramp prioritization may be beneficial. However, data availability may pose a challenge for doing so if most states and localities lack complete information about sidewalks, curb ramps, and crosswalks in a form that can be used for pedestrian network connectivity analyses.

Conclusion

- This study's findings provide a foundational resource for state DOTs, local and regional agencies, and transit agencies that are developing or revising prioritization processes for curb ramp retrofits as part of an ADA transition plan.
- ADAAG and PROWAG provide similar guidelines/standards for accessibility. PROWAG, adopted by many state and local governments, is more stringent on several criteria, such as widths of ramps and landings. One likely trade-off in using the more stringent, newer PROWAG standards is that relatively more curb ramps will not meet all criteria and will thus require retrofits, bolstering the need for a process to prioritize them.
- All states surveyed had a unique prioritization process in place as part of their ADA transition plans. Physical condition or compliance with standards was most commonly used in prioritization processes; 67% of all responding states considered citizen requests a high priority.

Local governments incorporated transit and pedestrian generators in curb ramp prioritization processes much more frequently than statewide governments. Data availability and diverse geography may pose a challenge for including such factors at a state or regional level where pedestrian infrastructure data is often incomplete.

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