

Guide for Maintaining Pedestrian Facilities for Enhanced Safety Research Report

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16. Abstract A Guide for Maintaining Pedestrian Facilities for Enhanced Safety provides guidance for maintaining pedestrian facilities with the primary goal of increasing safety and mobility. The Guide addresses the needs for pedestrian facility maintenance; common maintenance issues; inspection, accessibility, and compliance; maintenance measurers; funding; and construction techniques to reduce future maintenance.			
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Forward

The objective of this report is to document common and effective approaches and practices for pedestrian facility maintenance, as well as identify and support those topic areas where additional guidance would be valuable for agencies engaged in pedestrian facility maintenance. The information in this report will be used to inform the development of a comprehensive pedestrian facility maintenance guide that addresses a wide range of topic areas regarding maintenance policies, programs, and practices.

This report consists of two chapters. Chapter 1 presents a summary of relevant literature, e.g. design and maintenance manuals, documented policies and practices, and related reports and research, which were reviewed to identify existing guidance available at the federal, state, and local levels. Chapter 1 also includes a summary of discussions that were conducted with over 40 agencies as a means to understand and document common and successful practices and challenges to pedestrian facility maintenance.

Chapter 2 provides an expanded discussion of routine and successful practices and provides detailed examples of the latter. Topics covered include state laws and local ordinances, enforcement or compliance efforts, inventory and inspection of facilities, funding, repair techniques, seasonal maintenance, maintenance of crosswalk markings and pedestrian signals, low maintenance design and maintenance equipment.

Findings presented in this research report will be used to inform the development of the *Guide for Maintaining Pedestrian Facilities for Enhanced Safety*, the final product of this research effort.

1 | State of the Practice Research: Summary of Findings

1.1 | INTRODUCTION

Research into the state of the practice of pedestrian facility maintenance consisted of a review of the literature and select municipal programs, as well as discussions with over 40 agencies. This research has revealed routine and successful policies, programs and practices, as well as common challenges and innovative solutions.

1.2 | LITERATURE REVIEW

A literature review was conducted by searching the Transport Research International Documentation (TRID) database using the following keywords: sidewalk tripping hazards; sidewalk maintenance; snow, ice, debris, or vegetation on sidewalks and crosswalks; crosswalk markings and pedestrian signals; following up with agencies that are known by the Research Team to be proactive in the planning, design and maintenance of pedestrian facilities, and tracking down additional resources cited in primary references. The literature search primarily focused on relevant publications and studies published after 2000, although several key resources prepared before that timeframe have been included.

The literature review is organized into four categories:

- 1) National guidance and policy
- 2) State guidance and policy
- 3) Local guidance and policy
- 4) Other related research and resources

Short summaries are provided for the resources listed below. Where summaries were already available through abstracts written by resource authors, those summaries were included in their original form or were adapted to highlight the most applicable aspects of the resource. The sources below are numbered sequentially, however the order shown below should not be taken as an indication of importance of the resource. A discussion of “best available resources” follows the listing of resources.

1.2.1 | National Guidance and Policy

This section provides short summaries of the most applicable guidance and policy documents that have been produced by federal agencies or national organizations. Several documents listed below are currently under revision and new editions are likely to be published in the coming years. Documents are listed in alphabetical order.

- 1) American Association of State Highway and Transportation Officials, *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, 1st Edition, 2004.
https://bookstore.transportation.org/item_details.aspx?id=119

The purpose of this guide is to provide guidance on the planning, design and operation of pedestrian facilities along streets and highways. Specifically, the guide focuses on identifying effective measures for accommodating pedestrians on public rights-of-way. Appropriate methods for accommodating pedestrians, which vary among roadway and facility types, are described in this guide. The primary audiences for this manual are planners, roadway designers and transportation engineers, whether at the state or local level, the majority of whom make decisions on a daily basis that affect pedestrians. This guide has a very brief section on the importance of maintaining sidewalks.

- 2) American Association of State Highway and Transportation Officials, *Update of the Guide for the Planning, Design, and Operation of Pedestrian Facilities*, 1st Edition, 2010.

This report acts as the scoping document for the next update of the AASHTO Pedestrian Guide being prepared in 2012 and 2013. The authors call for the current section on pedestrian facility maintenance to be expanded to include a discussion of all pedestrian facilities, including sidewalks, surface repairs, sweeping, snow removal, curb ramps, signs and markings, signals, drainage and landscaping. For each of these activities, there should be guidance on how to approach routine, annual and major maintenance. It goes on to recommend there be guidance on what triggers maintenance (e.g. tripping hazards, smoothness, cross slope changes, etc.), how to set priorities for addressing maintenance issues and the role that ADA compliance plays in this process.

- 3) C. Quiroga and S. Turner. *Asset Management Approaches to ADA Compliance*, National Cooperative Highway Research Program (NCHRP) Project 20-07, Task 249, September, 2008

The purpose *Asset Management Approaches to ADA Compliance*, was to gather information and develop a synthesis of practices, including best practices, on the various approaches transportation agencies use to address ADA compliance issues. The synthesis covered three main topics: asset data inventory, asset condition assessment, and programming of asset improvements. To make the project manageable, the focus was on pedestrian infrastructure on the public right-of-way, including elements such as sidewalks, curb ramps, pedestrian crossings, and obstructions. The analysis did not include buildings, facilities, or transit infrastructure. The synthesis also included the

compilation of an extensive listing of asset inventory and condition data elements. The listing is intended as a preliminary menu that agencies could use as a foundation for the development of inventory programs that meet individual agency needs.

- 4) Federal Highway Administration, *Designing Sidewalks and Trails for Access – Part 1 of 2, Review of Existing Guidelines and Practices*, 1999.
http://safety.fhwa.dot.gov/ped_bike/docs/ada.pdf

Chapter 4 includes a general discussion about sidewalk maintenance and a list of common sidewalk maintenance problems. Chapter 5 includes a general discussion about trail maintenance and a list of common trail maintenance problems. This publication also provides a thorough discussion on disability rights legislation and accessibility guidelines and standards in the United States.

- 5) Federal Highway Administration, *Designing Sidewalks and Trails for Access—Part 2, Best Practices Guide*, September 2001.
<http://www.fhwa.dot.gov/environment/sidewalk2/pdf.htm>

All facilities, including sidewalks, require regular maintenance to reduce the damage caused over time by the effects of weather and use. However, many maintenance issues can be reduced if properly addressed in the planning and designing phases before construction even begins. Proper maintenance is essential to promote user safety, to ensure ease of access, and sidewalk maintenance and construction site safety to encourage the use of a designated route. The implementing regulations under Title II of the Americans with Disabilities Act require all features and equipment that are required to be accessible to be maintained in operable working condition for use by individuals with disabilities (U.S. Department of Justice, 1991a). Sections of Chapter 10, including 10.1 Facility Maintenance, 10.1.1 Assessment Techniques, 10.1.2 Sidewalk Maintenance Problems, 10.1.3 Maintenance Responsibilities, 10.2 Information Maintenance, 10.3 Citizen Reporting, provide fairly general discussion on maintenance issues. Section 10.4 Construction Safety, offers a discussion on approaches to maintaining safety for all users around road and sidewalk construction sites. Chapter 18 addresses trail maintenance.

- 6) Federal Highway Administration, *Planning Design and Maintenance of Pedestrian Facilities*, 1989.
http://katana.hsrc.unc.edu/cms/downloads/PedFacility_DesignMaintenance1989.pdf

This handbook consolidates the current state-of-the-art (in the late 1980's) pertaining to pedestrian facilities (including planning, design and maintenance). It is designed to provide up-to-date information on pedestrian facilities in one document to serve the needs of planners and engineers in the majority of cases. Includes chapter on pedestrian facility maintenance and a table that lists pedestrian maintenance concerns and related maintenance activities, but fairly general.

- 7) United States Department of Transportation Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations, 2010.

http://www.fhwa.dot.gov/environment/bikeped/policy_accom.htm

This policy statement reflects U.S. DOT's support for the development of fully integrated active transportation networks. The statement specifically addresses removing snow from sidewalks and shared-use paths: Current maintenance provisions require pedestrian facilities built with Federal funds to be maintained in the same manner as other roadway assets. State agencies have generally established levels of service on various routes especially as related to snow and ice events.

- 8) Federation of Canadian Municipalities and National Research Council. *Sidewalk Design, Construction, and Maintenance: A Best Practice by the National Guide to Sustainable Municipal Infrastructure*, 2004.

http://www.fcm.ca/Documents/reports/InfraGuide/Sidewalk_Design_Constructionand_Maintenance_EN.pdf

Based on Canadian experience and research, the reports identify the best practices to support sustainable municipal infrastructure decisions and actions for sidewalk design, construction and maintenance. The section on maintenance investigates "failure mechanisms" for sidewalks and points to four deformation problems. Four remedial techniques are provided to address sidewalks that have encountered structural problems.

- 9) L. Sandt, R. Schneider, D. Nabors, L. Thomas, C. Mitchell, and R.J. Eldridge. *A Resident's Guide for Creating Safe and Walkable Communities*, Federal Highway Administration (FHWA-SA-07-016), February 2008.

http://safety.fhwa.dot.gov/ped_bike/ped_cmunity/ped_walkguide/index.cfm

A Resident's Guide for Creating Safe and Walkable Communities is designed for local citizens and organizations that would like to learn more about how to improve

pedestrian safety in their communities. It provides basic information about the transportation planning process and how to approach local agencies about pedestrian safety issues. It provides several community success stories that highlight successful community-oriented pedestrian safety projects and programs.

The Guide also contains several user-friendly resources, including fact sheets, worksheets and sample materials. These materials can be adapted to meet the needs of a particular community or distributed to others working to improve pedestrian safety. The Guide provides a thorough introduction to pedestrian safety and includes many references to other resources and materials for those interested in more in-depth information.

- 10) Public Rights-of-Way Access Advisory Committee. Special Report: *Accessible Public Rights-of-Way, Planning and Designing for Alterations*. Washington, D.C.: 2007.

<http://www.access-board.gov/prowac/alterations/guide.htm>

Discusses alteration projects in the public right-of-way and the challenges and approaches to meeting new construction criteria to the maximum extent feasible as established by ADA.

1.2.2 | State Guidance and Policy

This section provides short summaries of applicable guidance and policy documents developed by state transportation agencies. There are many documents developed by State DOTs that mention pedestrian facility maintenance, however the resources listed below are what emerged through a web search and from the Research Team's knowledge of what state agencies are doing. Most of these documents address pedestrian facility maintenance at a relatively high level. Documents are listed in alphabetical order.

- 1) California Department of Transportation (Caltrans), *Pedestrian and Bicycle Facilities in California: A Technical Reference and Technology Transfer Synthesis for Caltrans Planners and Engineers*, July 2005.

http://www.dot.ca.gov/hq/traffops/survey/pedestrian/TR_MAY0405.pdf

This guide synthesizes information on policies, laws, programs, the planning and design process, guidelines and best practices. The Technical Reference Section includes concept sheets on pedestrian facilities and traffic calming measures. The concept sheets include descriptive text, references, and many useful pictures, graphics, and tables. Major issues addressed include: analytical tools, crossings, personal mobility devices, signals,

sidewalks, work zones and traffic calming. Maintenance-related content includes sidewalk assessment techniques, general maintenance, root protection and sidewalk surface materials.

- 2) Florida Department Of Transportation Maintenance Rating Program Handbook, *Data Collection For Maintenance Rating Program (2013)*
<http://www.dot.state.fl.us/statemaintenanceoffice/MRPHandbook2013FinalA.pdf>

Florida DOT Office of Maintenance has one of the most detailed inspection standards for a state Department of Transportation identified in this report. The manual is intended for field inspection and covers all facets of maintenance. For sidewalks, 99.5% of a sidewalk must be free of vertical misalignments greater than 1/4 inch, horizontal cracks greater than 3/4 inch, or spalled areas greater than 1/2 inch in depth, and no visible hazards. The manual has detailed instructions and photos of how measurements should be made and computed.

- 3) Maryland State Highway Administration, *Accessibility Policy & Guidelines for Pedestrian Facilities along State Highways*, December 2005.
<http://www.roads.maryland.gov/Index.aspx?PageId=80>

This design guide was developed to assist transportation engineers in designing public sidewalks and crossings to provide accessible routes, defined as continuous routes that are unobstructed and ADA compatible throughout. Pertinent information related to maintenance includes maintenance of pedestrian access during construction, including sidewalk repair/replacement.

- 4) Minnesota Department of Transportation, *Winter Parking Lot and Sidewalk Maintenance Manual*, June 2006. (revised June 2008).
<http://www.pca.state.mn.us/index.php/view-document.html?gid=13562>

The purpose of this manual is to deliver practical advice to those who manage parking lots and sidewalks. This manual outlines how jurisdictions can make proactive, cost-effective choices in winter parking lot and sidewalk management. It also focuses on how to make operations more efficient while reducing environmental impacts. A blanket approach will not work for the range of conditions Minnesota experiences; different strategies are needed for different regions and different conditions. This manual encourages the reader to continue to test, document and refine the practices from this manual.

- 5) New Jersey Department of Transportation and Voorhees Transportation Center, *Constructing, Maintaining and Financing Sidewalks in New Jersey*, 2006.
<http://policy.rutgers.edu/vtc/bikeped/reports/Sidewalks%20in%20New%20Jersey.pdf>

This research includes how sidewalks in New Jersey are constructed, maintained, reconstructed and financed. The report provides a discussion related to snow and ice removal and the role of Special Improvement Districts in maintaining sidewalks. It also includes a very brief scan on practices nationally on sidewalk maintenance. Much of the focus is on liability.

- 6) New York Department of Transportation, *Highway Design Manual*, March 2006.
https://www.dot.ny.gov/divisions/engineering/design/dqab/hdm/hdm-repository/chapt_18.pdf

Chapter 18 of the Highway Design Manual provides extensive and detailed guidelines for pedestrian facility design. These guidelines are largely conveyed through narrative; however, the chapter also includes a number of useful tables, graphs and figures. Issues addressed include: sidewalks crossings, elevation changes, bus stops and transit stations; special situations including main streets, Central Business Districts, school walking zones and mass evacuations; and pedestrian facility construction and maintenance. Compliance with ADAAG requirements is emphasized throughout.

- 7) Vermont Agency of Transportation, *Vermont Pedestrian and Bicycle Facility Planning and Design Manual*, December 2002.
<http://www.aot.state.vt.us/progdev/Publications/DocumentsPUBLICATIONS/PedestrianandBicycleFacilityDesignManual.pdf>

The *Vermont Pedestrian and Bicycle Facility Planning and Design Manual* establishes standards for the development, design, construction and maintenance of bicycle and pedestrian facilities. The manual includes chapters addressing pedestrian facilities (sidewalks, walkways, street corners, intersections and street and driveway crossings), traffic calming measures, traffic control devices and landscaping. Chapter 10 addresses maintenance at a general level, including special considerations for sidewalks and shared use paths.

- 8) Vermont Agency of Transportation, *Report on Shared-Use Path and Sidewalk Unit Costs*, November 2010.

http://www.aot.state.vt.us/progdev/sections/LTF%20Info/DocumentsLTFPages/BikePedReport%20on%20Shared%20Use%20Path%20and%20Sidewalk%20Unit%20Costs_2010_FINAL813.pdf

This report is intended to provide basic unit cost (per foot) information for bicycle or pedestrian facilities and to provide some basic bid costs for items commonly included on projects that provide improved facilities for bicycling or walking. The report builds on the results of a previous Cost Report completed in 2006. The previous report focused on updating cost estimates to be more reflective of typical bid item quantities and total project costs experienced on sidewalk and shared use path projects. This report includes those subjects but also provides more detailed information on project engineering costs, as well as new research regarding on-road bicycle lane costs.

- 9) Wisconsin Department of Transportation, *Pedestrian Best Practices Guide*, Chapter 6, 2011. (draft)

<http://www.dot.wisconsin.gov/projects/state/ped-guide.htm>

Chapter 6 of this comprehensive state pedestrian best practices guide addresses the importance of maintaining pedestrian facilities, the types of pedestrian facilities that need to be maintained, components of sound winter and year-round maintenance programs, short-term fixes for sidewalks, sidewalk replacement, sidewalk inspection and citizen involvement. Although this chapter is still in draft status, it is one of the better guidance pieces on pedestrian facility maintenance developed by a state department of transportation.

1.2.3 | Local Guidance and Policy

The resources in this section were primarily identified through discussions with transportation agencies and include a wide range of document types including policies, ordinances, regulations, plans and design guides. There are likely to be thousands of similar documents guiding the actions of municipalities in the United States. The following should be viewed as a cross-section of what exists nationally. Interestingly, many smaller communities provided some of the most helpful resources directed at property owners. Documents are listed in alphabetical order.

- 1) City of Charlotte, North Carolina, Sidewalk Program (online resource).

<http://charmbeck.org/city/charlotte/Transportation/PedBike/Pages/sidewalkrequest.aspx>

Charlotte's sidewalk program webpage provides clear information about the city's sidewalk program and how it is supported by the city's Transportation Action Plan, current sidewalk projects, contacts for individuals managing sidewalk projects, and the process for requesting a new sidewalk or sidewalk repair. A downloadable "sidewalk nomination" form is available for residents to request sidewalks on neighborhood streets. The form requires the signatures of 25% of property owners or tenants on both sides of the street in order for the city to place the sidewalk on its ranking list. Once the sidewalk nears the top of the Sidewalk Ranking List, a public meeting is held for design input, and then 60% of property owners on both sides of the street are required to sign a petition that puts the sidewalk on the Sidewalk Priority List.

- 2) City of Clive, Iowa, Sidewalk Inspection and Repair Policy.

<http://www.cityofclive.com/document-center/documents/Sidewalk%20Repair%20Policy%20PDF.pdf>

This document outlines the policies and procedures for sidewalk repair/replacement that are intended to implement city ordinances and the Code of Iowa (Section 364.12 (2d & e), which places the responsibility for the maintenance and repair of public sidewalks on the abutting property owner. The policy document clearly outlines what constitutes a sidewalk deficiency and the procedure the city follows for inspecting sidewalks, identifying deficiencies and enforcing repairs. It also includes a "how-to" guide that walks a property owner through all the steps of sidewalk repair including securing a permit, hiring a contractor, sidewalk specifications and a standard form that residents are to use for notifying the city about who is to perform the repair work and the scope of work.

- 3) City of Corvallis, Oregon, Sidewalk Safety Program (online resource).

<http://www.ci.corvallis.or.us/index.php?option=content&task=view&id=519&Itemid=457>

The program page has a number of resources that provide guidance and city procedures pertaining to sidewalk construction and maintenance. The Guidelines for Public Sidewalk and Driveway Repairs document outlines conditions requiring repair or construction. It also provides alternative approaches that may be used to repair sidewalks affected by adjacent tree roots. The Sidewalk Marking Code and Conditions Requiring Grind or Replacement is a stand-alone document that provides criteria and detailed specifications for sidewalk grinding and replacement. The program page also provides a link to the city's municipal code section pertaining to sidewalk improvements. Chapter 2.15 of the city's code very clearly establishes property owners'

duties for maintaining sidewalks, procedure for noticing the owner when repairs are required, and penalties for not fulfilling the city's requirements. If repair work is done by the city, the city will provide the owner a report containing an itemized statement of costs, including actual administrative costs. If the owner neglects to pay repair costs the city may charge 10% interest beginning 30 days from service of notice and ultimately put a lien on the property.

- 4) City and County of Honolulu, Hawaii, Concrete Sidewalk Maintenance Program.
<http://www1.honolulu.gov/dfm/road/sidewalkmaintenanceprogramplanfinal.pdf>

This document discusses responsibility for sidewalk maintenance (abutting property owner unless damage is due to city action or street tree), lists sidewalk maintenance criteria, describes the city/county's proactive and reactive inspection program and establishes levels of priority for scheduling of repairs. One unique component of the sidewalk maintenance program is the use of volunteers for repair work and third-party verification of short-term repairs. Appendices include photographs depicting trip hazard examples and volunteer agreement.

- 5) City of Missoula, Montana, *Public Works Department Master Sidewalk Plan*.
<http://www.ci.missoula.mt.us/DocumentCenter/Home/View/3041>

The *Master Sidewalk Plan* takes a systematic approach to developing and maintaining a sidewalk network. It defines a system for identifying sidewalk projects, which includes establishing priority areas, discusses engineering and construction considerations and outlines the steps for implementation. Appendix A provides excerpts from the city's municipal code pertaining to sidewalk installation and maintenance, which includes snow and ice removal. Appendix C includes policies and design criteria, including criteria for hazardous sidewalks, replacement/repair of sidewalks and determining the scope of sidewalk repair work. Appendix D relates the city's standards for sidewalk construction and maintenance to ADA requirements.

- 6) City of Plattsburg, New York, Article V, Removal of Snow and Ice on Public Sidewalks.

This municipal code clearly establishes the duty of the abutting property owner to clear ice and snow from sidewalks and exceptions to this duty. Despite these exceptions to liability for snow removal costs, the owner or occupant is not relieved from liability for injuries to pedestrians using such a sidewalk. Perhaps the strongest component of the city's ordinance are sections 233 – 35 and 233 – 36, which specify the noticing

procedure and how the city may collect snow removal costs if the owner or occupant does not remove snow and ice within the established timeframe.

- 7) City of Seattle, Washington, *Client Assistance Memo 2208 - Sidewalk Repair and Maintenance*.

<http://www.seattle.gov/transportation/cams/CAM2208.pdf>

This memo is intended to assist applicants in getting a permit for sidewalk maintenance and repair. It clearly outlines what a property owner's responsibility for streets and sidewalks (referencing the Seattle Municipal Code), when a sidewalk needs to be repaired (including specific criteria), the steps for obtaining a permit, how to hire a concrete contractor, and how to manage street trees during sidewalk repair, including contact information for the city arborist. Attachment 1 provides descriptions and photographs that illustrate sidewalk repair criteria.

- 8) *Snow Removal Policy Toolkit*, Metropolitan Area Planning Council (Boston Metro Area).

<http://mapc.org/sites/default/files/Snow%20Removal%20ToolkitFINAL1.10.12.pdf>

The Toolkit is an excellent resource intended to better inform communities about snow removal policies and procedures and to provide them with tools to increase compliance and safety. A major impetus for development of the toolkit was a Massachusetts Supreme Court decision, *Papadopoulos v. Target*, which exposed the liability of property owners that do not clear their sidewalks of snow and ice and established that property owners must use reasonable care to maintain property in reasonably safe condition. MAPC's *Snow Removal Policy Toolkit* provides cities and towns with tools to increase snow removal compliance and safety. The toolkit includes sidewalk snow clearance policies and maps, policies and ordinances addressing timeframes and fees for snow removal, and sample snow removal policy brochures from municipalities.

- 9) Village of Grand Rapids, Ohio, *Sidewalk Repair Policy Page*.

<http://www.grandrapidsohio.com/SidewalkRepairPolicy.htm>

This resource defines the types of typical sidewalk deficiencies with illustrations and provides a clear list of criteria for when sidewalk blocks (the area between contraction joints) should be repaired or replaced. The document also provides guidance on vegetation trimming and addressing slip hazards.

1.2.4 | Other Related Research and Resources

The following resources have been developed by various non-governmental organizations, including non-profit institutes and academic researchers. Resources are listed alphabetically.

- 1) Costello, L.R. and K.S. Jones, 2003. Reducing Infrastructure Damage by Tree Roots: A Compendium of Strategies.

This book offers information regarding strategies to reduce potential infrastructure damage from trees, including choosing the appropriate tree species, channeling root growth and using structural soils.

- 2) *Developing an Effective Sidewalk Program (course L155)*, University of Wisconsin - Madison Department of Engineering Professional Development, 2000 to 2011.
http://epdfiles.engr.wisc.edu/pdf_web_files/epd/L155.pdf

Of the 10 chapters of this two-day course, three directly address sidewalk maintenance while others address new sidewalk construction. One chapter is devoted entirely to improving the survivability of trees next to sidewalks and curbs and includes dozens of instructions and photographs.

- 3) *Doing the Best with What You Have*, League of Minnesota Cities Insurance Trust, 2010.
<http://www.lmc.org/page/1/streets.jsp>

This succinct report calls on communities to adopt a policy for street and sidewalk maintenance, inspection, and repair. It establishes the legal underpinnings for maintaining municipal facilities and gives practical guidance on how communities can limit their liability and create better-maintained facilities by following simple and consistent steps. The report places sidewalks and curb ramps in the same category as streets in terms of importance of maintenance and calls for action on part of communities to put in place a reporting protocol and to be responsive to complaints.

- 4) Evans-Cowley, Jennifer. *Sidewalk Planning and Policies in Small Cities*, Journal of Urban Planning, 2006.
http://ascelibrary.org/upo/resource/1/jupddm/v132/i2/p71_s1?isAuthorized=no

This journal article discusses the overall problems associated with pedestrian mobility, and specifically, sidewalk accessibility. Lack of sidewalk maintenance is cited and

discussed as one of the major factors affecting accessibility. The article focuses on the need for conducting more pedestrian planning.

- 5) *Extending Beyond the Curb: Winter Maintenance Liability*, Public Works Journal Corporation, August, 2001.

<http://trid.trb.org/view.aspx?id=692728>

Pedestrians cannot be left out of the winter maintenance program. Even in cities that have delegated sidewalk maintenance to homeowners, liability can fall on the city in the event of accidents. The article describes some approaches to oversight and enforcement of clearing ordinances in Canadian communities.

- 6) Hayward, Gordon. *Performance-based Sidewalk Contracts for Snow and Ice Control*, Journal of Public Works & Infrastructure, November, 2011.

<http://trid.trb.org/view.aspx?id=913248>

This paper allows the reader to draw conclusions regarding the potential advantages of providing winter snow and ice maintenance to municipal sidewalks using a performance-based contract. Performance-based contracts essentially have the contractor supply a set price for a route based on certain performance standards, regardless of how often it snows. The paper outlines the basis of the contracts and draws comparisons with other contracting methods. It also identifies some of the pitfalls experienced by Halifax Regional Municipality in developing the contracts including managing poor performance, setting expectations for residents and counselors, supervisor training, unclear contract language, record keeping, seasonal evaluations and post-winter follow-up on damages.

- 7) *Keep it Clear: Recommendations for Sidewalk Snow and Ice Removal in Massachusetts*, WalkBoston.

<http://www.walkboston.org/documents/snowReport.pdf>

WalkBoston is non-profit membership organization dedicated to improving walking conditions and encouraging walking in Massachusetts cities and towns. *Keep it Clear: Recommendations for Sidewalk Snow and Ice Removal in Massachusetts* presents seven basic recommendations to improve snow and ice clearance. The recommendations are: 1) Create a norm of snow and ice clearance through social awareness campaigns that make unclear sidewalks and curb ramps as unacceptable as litter; 2) Identify a municipal point person for snow removal so that reporting an unclear sidewalk or getting

assistance is provided through one well-advertised and well-staffed phone number; 3) Set priorities for sidewalk snow clearance that identify the most critical sidewalks to ensure that enforcement and public snow clearance are focused on the most important locations; 4) Improve monitoring and enforcement by giving ticketing authority to municipal workers who are already outdoors and can therefore see the problems in person (and remember that the goal is to clear sidewalks, not to raise money); 5) Design sidewalks for easier snow removal with simple design interventions, especially at common trouble spots such as curb ramps, 6) Train municipal and private snow plowing personnel so that plow drivers are sensitive to the needs of pedestrians and are proficient in techniques that aid clearance of sidewalks, curb ramps, crosswalks and pedestrian crossing islands; 7) Create sensible state policies through appropriate legislation to eliminate the liability property owners face for clearing sidewalks and allow municipalities to levy more reasonable fines against those who fail to clear.

- 8) O'Donnell, Edward, Andrew Knab, Lorene Athey. *Sidewalks and Shared-use Paths: Safety, Security and Maintenance, Summary Report*, Institute of Public Administration, University of Delaware, September 2007.

<http://dspace.udel.edu:8080/dspace/bitstream/handle/19716/3255/SidewalksSharedUsePaths.pdf?sequence=1>

Part 3 of this report addresses maintenance issues for sidewalks and shared-use paths, including management and responsibility, specific maintenance tasks and snow removal. The report provides background information on why maintenance is important and necessary. Part 4 of the report provides brief case studies of plans and policies, problem reporting and inspections from around the country.

- 9) PEDS - PEDS is a nonprofit, member-based advocacy organization dedicated to making metro Atlanta safe and accessible for all pedestrians.

<http://peds.org>

The Pedestrian Hazard Reporting form is an online tool that allows users to report broken sidewalks, dead walk signals, faded crosswalks and other pedestrian hazards in the greater Atlanta area. The tool allows registered users to report problems, view past reports and view neighborhood reports. The organization's website provides excerpts from (and links to) the City of Atlanta's ordinances pertaining to sidewalk repair and replacement, as well as advocacy tools such as an online petition and city council contact information.

- 10) *Sidewalk Inspection and Maintenance Policies –They Are All They’re Cracked Up to Be*, League of Minnesota Cities Insurance Trust, 2010.
<http://www.lmc.org/page/1/streets.jsp>

This report calls on communities to adopt a set of sidewalk inspection and maintenance policies. It adroitly expels the five major myths often associated with the maintenance and inspection of sidewalks. The report conveys the purpose of policies such as providing guidelines to city employees, conveying information to city residents and preventing and/or minimizing lawsuits and exposure. It clearly communicates the five critical components of a sidewalk inspection and maintenance program and includes a model policy.

- 11) Sirota, Luanne Dawn. *A Risk-Based Decision Policy to Aid the Prioritization of Unsafe Sidewalk Locations for Maintenance and Rehabilitation*, Department of Civil Engineering, University of Saskatchewan, March 2008.
<http://library.usask.ca/theses/available/etd-03242008-165457/unrestricted/sirota.pdf>

This research proposes a decision model that prioritizes a given list of existing unsafe sidewalk locations needing maintenance or rehabilitation using a direct measure of pedestrian safety, namely, quality-adjusted life years lost per year. A decision model was developed for prioritizing a given list of unsafe sidewalk locations, aiding maintenance and rehabilitation decisions by providing the associated risk to pedestrian safety. The model used data mostly from high quality sources that had already been collected and validated. Probabilities and estimations were used to produce value-added decision policy.

- 12) Williams, Joel et al. *Development and Use of a Tool for Assessing Sidewalk Maintenance as an Environmental Support of Physical Activity*, Health Promotion and Practice, Jan. 2005, pp. 81-88.
<http://hpp.sagepub.com/content/6/1/81.abstract>

The importance of regular physical activity is well documented, yet according to epidemiological surveillance data, physical inactivity among all age groups persists. Past attempts to promote physical activity focused on individual-level changes; current approaches focus on environmental changes that will provide opportunities for whole communities to be active. The current ecological focus has led to an increase in funding and research regarding environmental supports of physical activity. As this is a new area of research, much work needs to be done to improve the ability to assess environmental

features that support physical activity. This article describes a partnership between researchers and community members to develop and test an objective tool to measure sidewalk maintenance. Community members used data collected with the tool to increase awareness about sidewalk maintenance issues among local policy makers. Collaboration between researchers and community partners was critical for the success of this study.

- 13) *Winter Maintenance of Pedestrian Facilities in Delaware: Guide for Local Governments*, Institute for Public Administration, University of Delaware, February 2012.

<http://www.ipa.udel.edu/publications/SnowRemoval.pdf>

Funded by the Delaware Department of Transportation, this guide provides a comprehensive overview of the legal framework that requires proactive winter maintenance of pedestrian facilities, including ADA. It also provides a thorough summary of the policies, programs and plans of local governments in the state of Delaware, as well as best practices from around North America. The guide concludes with a list of recommendations for Delaware local governments addressing emergency operation plans, winter maintenance management plans, municipal procedures, responsibilities, ordinances and regulations, communications, and innovative practices.

1.3 | BEST AVAILABLE RESOURCES

Included below is a discussion of the best available resources identified by the Research Team, organized by topic area for which there are at least two useful resources worth noting. At the end of this section is a discussion about gaps in existing guidance. A gap indicates that there is either very little information about the topic, or the information that is available provides little guidance or is not widely transferrable.

1.3.1 | Maintenance Responsibility and Liability

While numerous existing resources discuss common approaches to establishing responsibility (most commonly delegated to the adjacent property owner) for sidewalk maintenance, few provide guidance on the specific policy and programmatic steps agencies should take to minimize their liability. Several notable exceptions are discussed below.

The Institute of Public Administration at the University of Delaware's *Sidewalks and Shared-use Paths: Safety, Security, and Maintenance, Summary Report* provides good background information on why agencies should be concerned about having clear and proactive maintenance policies and practices from an ADA and liability perspective. The Report includes an extensive discussion on best approaches to shared-use path management and responsibility, as well as specific management tasks for minimizing risk and liability.

The League of Minnesota Cities Insurance Trust has published two guidance documents that address maintenance responsibility and liability. *Sidewalk Inspection and Maintenance Policies – They Are All They're Cracked Up to Be*, addresses five common misconceptions and myths about sidewalk inspection and maintenance policies and cites relevant case law. The paper provides specific guidance on developing a maintenance policy that includes identification of defective conditions, development of an inspection procedure and schedule, prioritization of replacement and repair, development of cost recovery mechanisms, and response to resident complaints and concerns. Just as important as having a policy, is documenting that policy to demonstrate the city is exercising reasonable care in inspecting and maintaining sidewalks. The paper also discusses the importance of fixing defects even if they may be associated with ongoing litigation, and presents a solid argument for municipalities being more proactive. Lastly, this paper presents a model sidewalk inspection and maintenance policy.

Another paper issued by the League of Minnesota Cities Insurance Trust entitled *Streets and Sidewalks – Doing the Best with What You Have*, offers ten simple suggestions for safer street and sidewalks. Among the ten suggestions include establishing a reporting mechanism for street and sidewalk defects, making sound decisions about where to locate street fixtures (i.e. storm sewer grates, water shut-off valves, utility poles, etc.) to minimize future problems.

Generally sidewalks are expected to be more defect free than streets, so if given a choice, work should occur in the street and not the sidewalk. Other recommendations include documenting inspections and repair decisions, knowing what the city owns, paying special attention to transition zones (e.g., between sidewalk and wheelchair ramps and between gutter and sidewalk), taking special care of special surfaces, being aware of potential obstructions in sidewalk zones and responding to complaints.

Winter Maintenance of Pedestrian Facilities in Delaware: A Guide for Local Governments, developed by the Institute for Public Administration at the University of Delaware is a comprehensive guide to winter maintenance that provides a well-researched argument for communities to adopt formal winter maintenance policies and practices as a means to minimize risk and liability. The Guide contains a section on the legal aspects of shared winter maintenance, which includes federal law and municipal maintenance requirements, responsibilities of various agencies, special assessment districts and maintenance agreements.

The Guide provides a thorough discussion of the steps a municipality should take to mitigate risk, including having an ordinance that clearly establishes responsibility and ensuring that this ordinance is consistently enforced. It also recommends that when property owners are required under a local ordinance to maintain, repair, and clear snow from sidewalks, a municipality should go beyond enforcement and also advise property owners to take additional steps beyond shoveling. Other important steps to clearing sidewalks include diverting melt water away from sidewalks and avoid piling snow onto curb ramps and bikeways, in order to reduce risk of liability.

1.3.2 | Winter Maintenance

Winter maintenance is a topic well covered by existing literature. While most federal and state manuals touch upon the importance of removing snow from sidewalks (primarily from an ADA perspective) and identify some of the challenges, they do not generally offer detailed guidance. However, there are a number of other good resources available that provide detailed information about why winter maintenance policies and programs are important. The resources include good examples of tools and practices that are in place throughout North America. Many existing resources focus on snow management plans that encompass both street and sidewalk maintenance. Of particular note, are the resources discussed below.

Winter Maintenance of Pedestrian Facilities in Delaware: A Guide for Local Governments, developed by the Institute for Public Administration at the University of Delaware is a comprehensive guide to winter maintenance that provides a well-researched argument for cities to adopt formal winter maintenance policies and programs and provides detailed

information about the key elements of winter maintenance management plans. Perhaps the most informative part of the Guide are examples of policies, programs and practices that cities throughout North America have put in place. Examples touch on everything from communications between agencies and departments, to prioritizing maintenance efforts, to regulations on sidewalk snow removal, to examples of citizen-assistance programs. The Guide also provides a pro/con review of the different types of equipment that can be used for sidewalk snow removal.

The *Snow Removal Policy Toolkit* developed by the Metropolitan Area Planning Council (Boston Metro Area) is an excellent resource intended to better inform communities about snow removal policies and procedures and to provide them with tools to increase compliance and safety. The toolkit provides examples and guidance on how local governments should approach snow removal, including effective ordinances and regulations and use of technologies. The *Toolkit* includes verbatim excerpts from snow clearance ordinances in the Boston region and comparison charts of time allotted for residents to clear their sidewalk and fines for not doing so.

WalkBoston's *Keep it Clear: Recommendations for Sidewalk Snow and Ice Removal in Massachusetts* offers seven recommendations what municipalities should do to improve snow removal, which are easily transferrable to other regions and states. Of note are the report's suggestions for social awareness campaigns that create a norm of snow clearance, a framework for prioritizing snow removal and recommendations for how to design sidewalks for easier snow removal and storage. The report also offers a model sidewalk snow and ice removal ordinance.

Unlike the resources above that advise or guide on how to do removal or the importance of it, communities rarely provide guidance to property owners abutting sidewalks on how best to remove snow and ice from sidewalks. As part of an extensive snow removal program, the City of Chicago has developed *the Snow Removal: Guidance for Chicago Residents and Businesses* pamphlet that is available in print or on the city's website. The pamphlet provides clear diagrams and images as to how to clear snow so that ADA guidelines are met along sidewalks, landings and curb ramps. The city also provides information on how to report violations. For positive reinforcement, the city has a "Winter Wonder Nomination" where the public can nominate businesses and organizations that demonstrate outstanding sidewalk snow clearing practices. The City of Cambridge, Massachusetts, also has an informative website for snow removal with an emphasis on pedestrian needs. The site links to resources and videos geared toward educating citizens about sidewalk snow removal. The City of Worcester, Massachusetts, provides a handout that has detailed written information about how, from

where and when to remove snow and the associated fines for not doing so. It also clearly identifies who is responsible for sidewalk snow removal.

1.3.3 | Sidewalk Repair and Replacement

While sidewalk repair and replacement is a topic that is discussed in many of the identified resources, the majority of these resources offer little specific guidance on repair and replacement policies, procedures or techniques. One exception is *Sidewalk Design, Construction, and Maintenance* from the Federation of Canadian Municipalities, which provides a fairly comprehensive overview of sidewalk failure mechanisms and discussion of specific remedial measures. The League of Minnesota Cities' *Sidewalk inspection and Maintenance Policies: They Are All They're Cracked Up to Be* white paper addresses prioritization of sidewalk repairs and replacement including establishing criteria and a repair and replacement schedule. The paper also offers a model sidewalk inspection and maintenance policy that includes a sidewalk replacement and repair policy.

Among the local policy and guidance that has been analyzed, the communities that seem to have unique or innovative elements include Honolulu (involving volunteers in sidewalk repair and verification), Corvallis, Oregon (clearly outlines city's procedures for recouping repair costs from property owner), Seattle, Washington, and Clive, Iowa, which provide "how-to" guides that walk a property owner through the steps of sidewalk repair, including illustrations of sidewalk deficiencies, securing a permit, hiring a contractor, and protecting trees. Fond du Lac, Wisconsin, has a Sidewalk Management Program that involves annual inspection of one of ten target areas, identification of pedestrian hazards, a bid process for sidewalk repairs and mailing of inspection reports to property owners that includes estimated costs and information about options for sidewalk repair, including financing.

1.3.4 | Inspection, Assessment and Reporting

There are numerous approaches to assessing sidewalk condition and identifying maintenance needs ranging from routine inspection by city staff or contractors to citizen reporting and utilizing volunteers. The *Sidewalks and Shared-use Paths: Safety, Security, and Maintenance, Summary Report* provides a good overview with examples of the different approaches to inspection and problem reporting that agencies are using. Chapter 11 of FHWA's *Designing Sidewalks and Trails for Access – Part 2, Best Practices Guide* (2001) provides a thorough discussion of sidewalk assessment considerations and techniques. Chapter 10 of this guide discusses various non-internet based citizen-reporting techniques used by agencies. Since the publication of this report, many communities have initiated on-line reporting procedures. The League of Minnesota Cities' *Sidewalk inspection and Maintenance Policies: They Are All They're Cracked Up to Be* white paper makes several recommendations related to inspection and

includes a model sidewalk inspection and maintenance policy that establishes inspection procedures. *Doing the Best with What You Have* also from the League of Minnesota Cities suggests having a central repository for all requests that may come from citizens or from city employees such as police, street maintenance crews or parking enforcement.

Among the local policy and guidance that has been reviewed, the communities that clearly outline sidewalk assessment procedures include Clive, Iowa (establishes a schedule), Missoula, Montana (establishes priority areas), and Honolulu, Hawaii (establishes a schedule and explains method). Fond du Lac, Wisconsin, is one of the first communities in Wisconsin to computerize their inspection process and sidewalk database and GIS for field inspection and mapping.

Florida DOT's Office of Maintenance has a very detailed inspection process operationalized through its *Maintenance Rating Handbook*. A high standard is established for sidewalk maintenance: "99.5% of sidewalk area is free of vertical misalignments greater than 1/4 inch, horizontal cracks greater than 3/4 inch, or spalled areas greater than 1/2 inch in depth, and no visible hazards". A series of photos and descriptions help inspectors properly measure conditions. The overall standard is measured in square feet, but any foot of linear misalignment or cracking is computed as one square foot of sidewalk area not meeting desired conditions.

1.3.5 | Compliance and Enforcement

Compliance and enforcement efforts are not discussed in much detail in any of the federal or state resources. On the local level, the majority of compliance and enforcement issues discussed are in relation to sidewalk conditions during the winter. Regarding repairs, it is common for communities to have the responsibility to respond to structural deficiencies in sidewalks such as displacements (heaved panels) and cracking. Many jurisdictions have ordinances or policies that require adjacent property owners to fund sidewalk replacement when undertaken by the community. In other cases, the community will repair and replace sidewalks on their own without any property owner involvement. Despite these two approaches to attending to sidewalk repairs, lack of enforcement is still one of the key factors contributing to sidewalk deterioration and non-compliance.

A series of discussions were conducted with communities as part of this research and are detailed later in this chapter. Although there was not a specific question regarding sidewalk repair enforcement, several communities did speak of this in relation to other questions. Of those jurisdictions who spoke of the enforcement protocol, or lack thereof, many of them conveyed that enforcement of sidewalk repair would result in untenable costs to residents and community backlash, others mentioned the issue of shared or unclear responsibility for

sidewalk repair, for example in the case of city maintained street trees causing damage to sidewalks. In communities that do enforce delinquent sidewalk repairs, common enforcement mechanisms include tickets from the police department or public works department and bills for work completed by the city. For unpaid fines, it was common for a lien to be placed on the property. Several successful local agency enforcement programs were identified in regard to sidewalk repair. In most cases, this was in communities that have a sidewalk repair program that requires the adjacent property owner to make and fund repairs.

The sidewalk program in the city of Ithaca, New York, “exists to help property owners repair their sidewalks.” If the abutting property owner does not address a sidewalk repair, the city sidewalk program issues a Sidewalk Notice of Defect to them when the city has identified a location for sidewalk repair (triggered either by a complaint or by the sidewalk inspection program). The property owner has 60 days to repair the sidewalk. If the sidewalk repair is not made the city will do the repair and charge the property owner for the work plus 25 percent for the cost of labor. If the charge is not paid within a grace period, the charge becomes a lien against the property. On its website the city sidewalk program provides property owners with all of the resources necessary to complete a sidewalk repair including a list of contractors, concrete patching instructions, sidewalk detour plans, etc.

In Hoboken, New Jersey, where sidewalk repair is also the responsibility of the adjacent property owner, the city gives the property owner 14 days to make necessary repairs to damaged sidewalks. If the repair is outstanding after 14 days the city will issue a summons to the property owner.

1.3.6 | Vegetation Management

Vegetation management includes keeping vegetation clear from sidewalks and shared use paths as well as choosing appropriate vegetation and protecting vegetation, particularly trees, during maintenance and construction.

The *Sidewalks and Shared-use Paths: Safety, Security, and Maintenance, Summary Report* provides a good overview of the considerations of vegetation management, but the focus is primarily on shared-use paths. *Constructing, Maintaining and Financing Sidewalks in New Jersey* provides a good discussion on street trees including selecting the appropriate type of street tree, avoiding damage to trees during sidewalk construction and repair, and establishing an urban forestry review process for street and sidewalk construction projects. Sidewalk Design, Construction and Maintenance offers brief, yet informative, guidelines for how to avoid tree root damage to sidewalks using appropriate planting techniques.

Among the local policy and guidance that has been analyzed for communities, the Village of Grand Rapids, Ohio, provides guidance on what is required of property owners and what the city will do in terms of vegetation management. Seattle, Washington, and Corvallis, Oregon, address protection of trees during sidewalk repair/replacement, and the latter provides alternative approaches to sidewalk construction as a means to accommodate/protect existing trees.

1.3.7 | Public Awareness and Social Marketing

Raising awareness among the public about sidewalk maintenance is an important component of maintenance programs. In terms of winter maintenance (snow and ice removal) *Winter Maintenance of Pedestrian Facilities in Delaware: A Guide for Local Governments* is an excellent resource that provides a number of examples of what agencies around North American are doing to communicate with and raise awareness among the public. The *Snow Removal Policy Toolkit* (Metropolitan Area Planning Council) includes several examples of brochures that agencies have developed to communicate with the public and raise awareness about snow and ice removal. WalkBoston's *Keep It Clear* report provides a good framework for what they call social awareness campaigns that create a norm of snow clearance.

Several municipalities have developed exceptional public awareness campaigns particularly in regard to winter conditions. The city of Boston and Chicago produce brochures and door hangers and have extensive information about their annual snow plans and the snow removal requirements for sidewalks on the city websites. Many cities also include sidewalk maintenance information in utility bills and on public access TV.

Technology is revolutionizing the maintenance process by speeding and organizing the communication between the public and municipalities. Mobile applications, real-time tracking, and interactive maps, blogs and on-line comment submissions are a few of the common tools used to identify maintenance needs. See Click Fix is a mobile application that allows the public to report and track maintenance concerns via their mobile phone. These types of online reporting methods could be utilized for pedestrian facility maintenance reporting. For information dissemination, blogs, Facebook pages and websites are commonly used.

For communities with frequent winter maintenance, a common use for interactive mapping is real-time snow removal with the use of GPS in snow plows. This is not yet being applied to sidewalk snow removal. Some cities, such as Chicago make text message alerting possible in snow events. This technology has not been applied to sidewalk snow removal but has potential uses such as alerting property owners when it is time to shovel the sidewalks.

1.3.8 | Gaps in Existing Guidance

The following topics are either not generally discussed or existing guidance does not provide much detail or transferability. These topic areas will likely be important to address in the Guide that will be developed as part of the second phase of this project.

- New types of sidewalk surface materials
- Comparative review of sidewalk repair techniques
- Alternative pedestrian facility design (to traditional curb and gutter)
- Preventive maintenance and design
- Advanced tools and technologies for pedestrian facility assessment and inventory
- Comparative costs and expected longevity of crosswalk marking types
- Pedestrian signal maintenance
- Comprehensive review and comparison of state laws and practices

1.4 | NCHRP 07-17 MAINTENANCE-RELATED SURVEY QUESTIONS

As part of a survey conducted by a Research Team led by Toole Design Group for NCHRP 07-17 Pedestrian and Bicycle Data Collection and Prioritization Along Existing Roads, six pedestrian maintenance-focused questions were included. The responses to these questions provided basic information about which of the 439 responding agencies have pedestrian facility maintenance programs and procedures in place and the criteria, if any, used to prioritize projects. In addition, the responses provided a pool of potential agencies to contact to obtain further detail on their pedestrian facility maintenance practices. Many of these agencies were contacted and provided valuable information some of which is included in Section 1.5 Agency Discussion.

The following pedestrian maintenance-related questions were asked in the 07-17 survey:

- What are the criteria used to prioritize maintenance of pedestrian facilities on existing roads?
- Which of the following best describes the process for weighting criteria for prioritization of maintenance of pedestrian facilities (i.e., safety, projected demand, sidewalk condition, accessibility, grants funding opportunity etc.)?
- Is the process for prioritizing maintenance of pedestrian facilities formalized (i.e. written down) in a departmental memorandum or other document?
- Do you feel that the process for prioritizing maintenance of pedestrian facilities is sufficient for your community's needs?

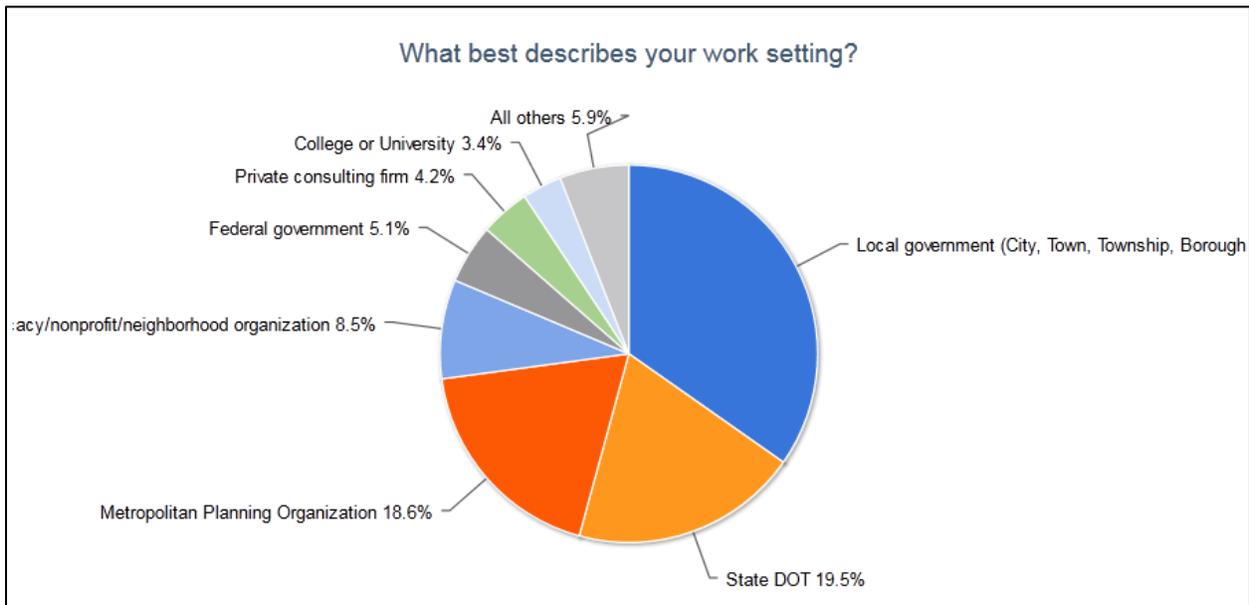
- Was the process for prioritizing maintenance of pedestrian facilities used to...? (multiple choice question)
- How often is the process for prioritizing maintenance of pedestrian facilities used?

In addition to the above pedestrian facility maintenance-focused questions, general questions were asked about the respondent's work setting, including the type of agency or organization they work for, and the population of that entity's service area. Of the 439 NCHRP 07-17 survey responses received, 177 answered at least one of the maintenance-related questions listed above. This section provides a summary of responses to the pedestrian facility maintenance-related questions asked in the survey.

What best describes your work setting?

The majority of the respondents who answered questions about pedestrian facility maintenance work in a local government (city, town, township or borough) setting, followed by State DOTs and Metropolitan Planning Organizations (MPO). A smaller number of respondents represent advocacy, nonprofit or neighborhood organizations, the federal government, private consulting firms, colleges or universities, counties, transit agencies, or school districts. Figure 1 provides a percentage breakdown of responses based on the 118 respondents who answered this question.

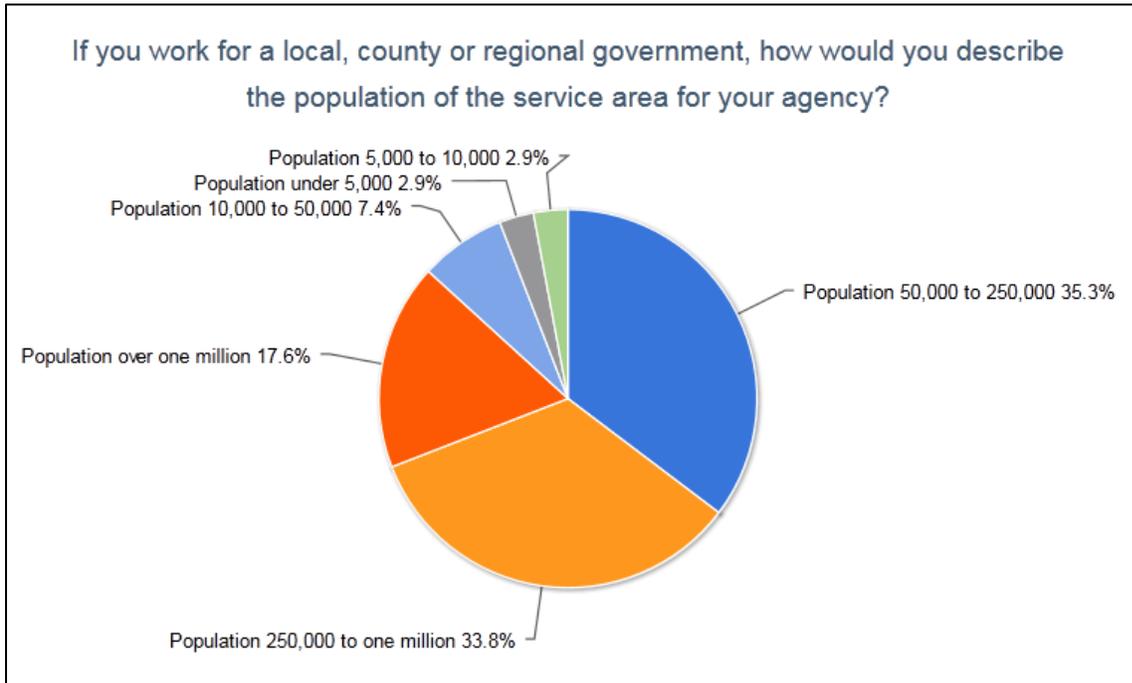
Figure 1: Work setting



If you work for a local, county or regional government, how would you describe the population of the service area for your agency?

Sixty-eight respondents indicated the population of the areas served by their agency. The largest number of respondents (24) work for transportation agencies serving communities with populations in the range of 50,000 to 250,000, closely followed by communities with populations in the range of 250,000 to one million (23). Twelve respondents work for agencies serving communities with a population over one million. Figure 2 provides a full summary of responses to this question by percentage (based on 68 responses).

Figure 2: Population of the service area



What are the criteria used to prioritize maintenance of pedestrian facilities on existing roads?

Thirty-five survey respondents chose one or more of 21 listed criteria used to prioritize maintenance of pedestrian facilities. Table 1 shows the total number and percentage of agencies that use the listed criteria.

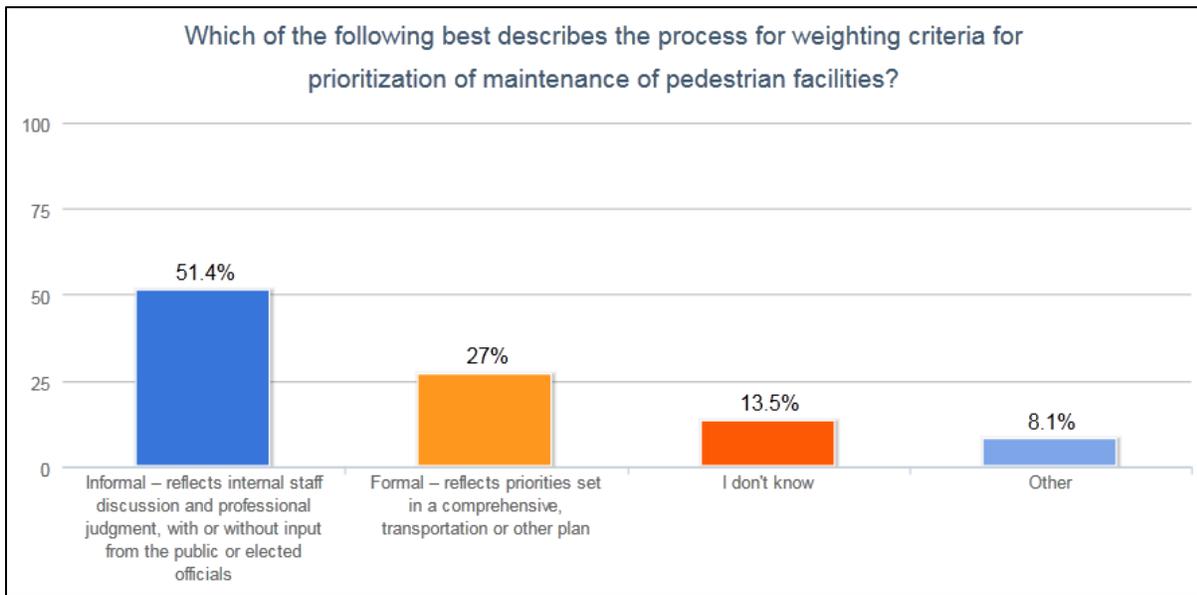
Table 1: Criteria used to prioritize maintenance of pedestrian facilities

CRITERIA	COUNT	%
Community priority (including complaints/requests)	29	83%
Sidewalk condition	25	71%
Accessibility (ADA complaint)	24	69%
Safety (pedestrian crash reduction)	23	57%
Guidance from elected leaders	20	57%
Access to school	19	54%
Access to transit	16	46%
Previous plans or studies	16	46%
Project feasibility or cost	15	43%
Projected demand	14	40%
Grant/funding opportunity	14	40%
Connectivity/filling gaps	14	40%
Pedestrian quality of service (quality of the walking environment)	13	37%
Other implementation opportunities (including “piggybacking” on other	12	34%
Motor vehicle traffic volumes	12	34%
Pedestrian level of service (capacity/delay)	10	29%
Pedestrian counts	9	26%
Economic development opportunities	7	20%
Motor vehicle level of service	7	20%
Health impact	6	17%
Other	1	3%

Which of the following best describes the process for weighting criteria for prioritization of maintenance of pedestrian facilities?

The majority (19) of the 37 respondents who answered this question indicated their agency uses an informal prioritization process that entails internal staff discussions and professional judgment, with or without input from the public or elected officials. Ten respondents indicated their agency uses a formal process based on priorities set in a comprehensive, transportation or other plan. Five respondents did not know what type of process they have while three used another type of process, which included either a mix of formal and informal or no process. Figure 3 shows the percentage breakdown of responses to this question based on 37 responses.

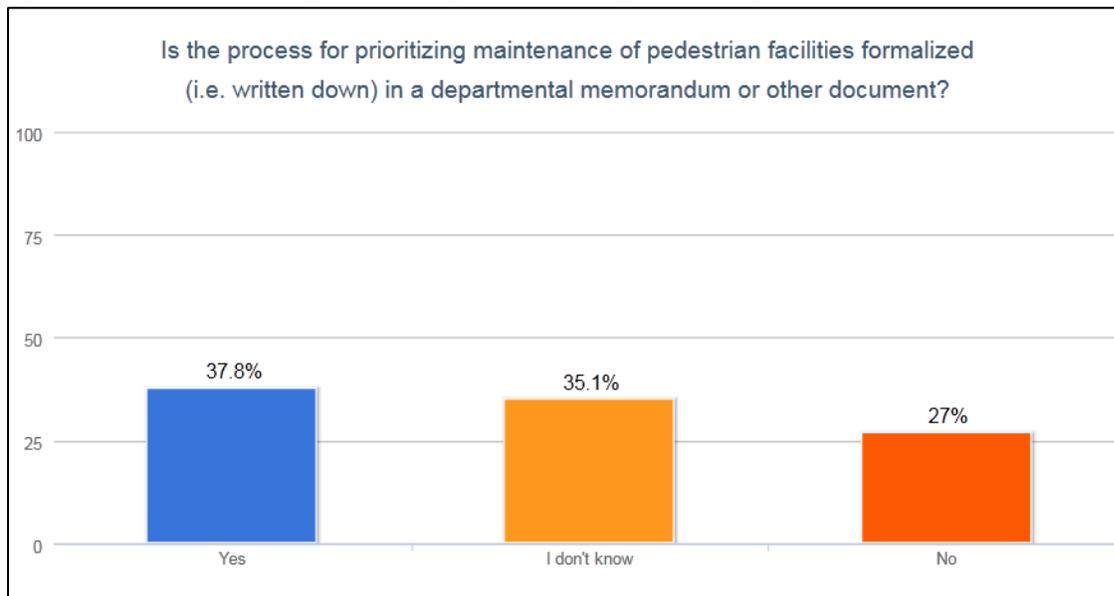
Figure 3: *Weighting criteria for prioritization of maintenance of pedestrian facilities*



Is the process for prioritizing maintenance of pedestrian facilities formalized (i.e. written down) in a departmental memorandum or other document?

Approximately 38% of the 37 respondents who answered this question indicated that their agency's process for prioritizing maintenance of pedestrian facilities is formalized in a departmental memorandum or other document. Ten respondents indicated their agency's process is not formally recorded, while 13 did not know. Figure 4 shows the percentage breakdown of the 37 responses to this question.

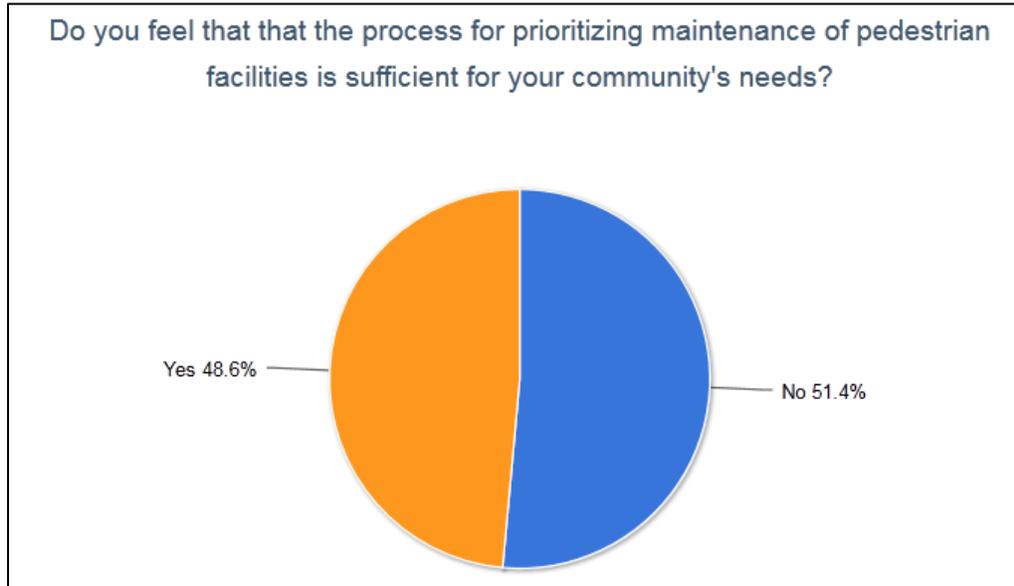
Figure 4: Formalized process for prioritizing maintenance of pedestrian facilities



Do you feel that the process for prioritizing maintenance of pedestrian facilities is sufficient for your community's needs?

A slight majority (18 of the 35 responses) of respondents indicated that their agency's prioritization process is not sufficient for their community's needs (Figure 5).

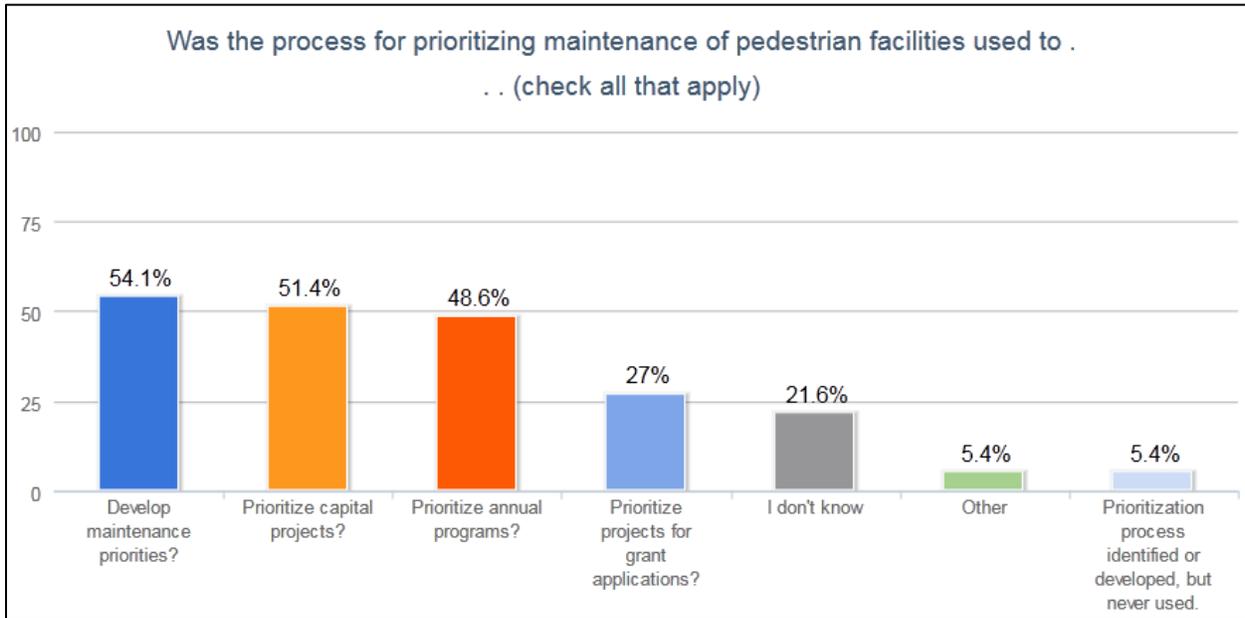
Figure 5: Sufficient process for prioritizing maintenance of pedestrian facilities



Was the process for prioritizing maintenance of pedestrian facilities used to...?

Respondents could choose one or more of six possible answers, or indicate that a process has been identified, but never used. Open text responses for those that indicated “other” included ADA compliance and receiving grant funding. The percentages in Figure 6 are based on 37 responses.

Figure 6: Use of process for prioritizing maintenance of pedestrian facilities



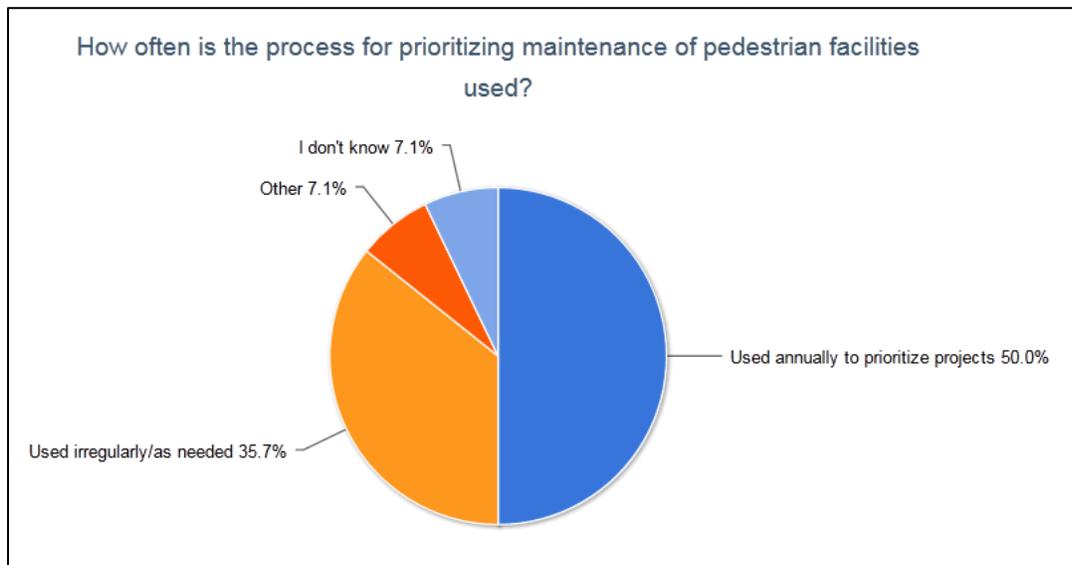
How often is the process for prioritizing maintenance of pedestrian facilities used?

Fourteen of the 28 responses to this question indicate that the prioritization process is used annually to prioritize maintenance projects. Ten respondents indicated their agency uses their prioritization process irregularly or as needed, while two did not know. Open text responses for the two respondents that indicated “other” included:

- Annual prioritization, but also as needed/requested
- Used for Plan, and will be also used for grant funding cycles

Figure 7 provides a percentage breakdown of the 28 responses to this question.

Figure 7: Frequency of use of the process for prioritizing maintenance of pedestrian facilities



1.4.1 | NCHRP 07-17 Survey: Analysis of Findings

Responses to the NCHRP 07-17 survey questions pertaining to maintenance of pedestrian facilities may point to a need or demand for more systematic methodologies for prioritizing maintenance. A slight majority of respondents indicated that their agencies’ process for prioritizing maintenance of pedestrian facilities is insufficient. About the same percentage of respondents indicated that their process for prioritizing maintenance of pedestrian facilities as “informal,” meaning that it reflects internal staff discussions and professional judgment with or without input from the public. There may be a correlation between the insufficiency of an agency’s prioritization process and the degree to which it is formalized and systematic, however, the survey did not ask why the prioritization process was sufficient or not.

1.5 | AGENCY DISCUSSIONS

Table 2 lists the forty-six agencies that were contacted for this report. The agency contact list was compiled using the Pedestrian and Bicycle Information Center's Walk Friendly Communities program list, responses to the *NCHRP 07-17: Pedestrian and Bicycle Data Collection and Prioritization Along Existing Roads* online survey conducted by a Research Team led by Toole Design Group and through a random selection process utilizing a 2010 U.S. Census Bureau place names. In addition, several communities contacted the Research Team requesting to participate in the study.

The purpose of agency discussions was to further develop an understanding of facility maintenance programs and practices throughout the United States. Each agency was asked the questions that are listed in this section. Questions are grouped under general topic headings and accompanied by a discussion of findings. It was expected that agency discussions would reveal exemplary programs and practices, e.g. programs and practices that are innovative and/or achieving success in terms of responding to maintenance needs. Discussion of exemplary programs and practices is included in Chapter 2 of this report.

Table 2: Communities Participating in Discussions

	Jurisdiction	2010 Population	Region		Jurisdiction	2010 Population	Region
1	Akron, OH	207,216	Midwest	26	Lee's Summit, MO	86,556	Midwest
2	Ann Arbor, MI	112,852	Midwest	27	Louisville, KY	256,231	South
3	Alexandria, VA	140,912	South	28	Madison, WI	233,209	Midwest
4	Atlanta, GA	420,003	South	29	Minneapolis, MN	385,542	Midwest
5	Austin, TX	795,378	West	30	Missoula, MT	68,876	West
6	Boulder, CO	295,166	West	31	Norwalk, IA	8,945	Midwest
7	Burlington, VT	38,647	Northeast	32	Omaha, NE	408,958	Midwest
8	Camp Verde, AZ	10,610	West	33	Perry, GA	13,579	South
9	Carmel, IN	85,267	Midwest	34	Phoenix, AZ	1,601,587	West
10	Cedarburg, WI	11,158	Midwest	35	Plattsburg, NY	11,190	Northeast
11	Charlotte, NC	709,441	South	36	Rancho Cordova, CA	64,960	West
12	Coeur d'Alene, ID	43,805	West	37	Rochester, MN	106,769	Midwest
13	Concord, NH	42,463	Northeast	38	Roseville, CA	53,572	West
14	Corvallis, OR	51,560	West	39	Salisbury, NC	33,662	South
15	Crossville, TN	11,810	South	40	Seattle, WA	617,334	West
16	Davidson, NC	9,645	South	41	Sparks, NV	89,346	West
17	Durham, NC	229,174	South	42	State of Alaska	710,231	West
18	Fayetteville, AR	77,142	South	43	State of Florida	18,900,773	South
19	Fort Worth, TX	727,575	West	44	State of West Virginia	1,859,815	South
20	Greenwich, CT	61,171	Northeast	45	Traverse City, MI	14,674	Midwest
21	Hill City, KS	1,308	Midwest	46	Trotwood, OH	25,894	Midwest
22	Hoboken, NJ	41,015	Northeast	47	Tucson, AZ	520,116	West
23	Ironwood, MI	5,387	Midwest	48	Virginia Beach, VA	439,122	East
24	Ithaca, NY	30,014	Northeast	49	Wilsonville, OR	19,342	West
25	Lansing, MI	113,810	Midwest				

1.5.1 | Maintenance program staffing, and structure

- 1) Does your agency maintain pedestrian facilities (sidewalk, crosswalks, trails, and pedestrian signals) and if so (if not see Question 2):
 - 5) Are there general or formal policies regarding pedestrian facility maintenance that can be shared?
 - 6) What department or bureau is responsible for each?
 - 7) How many full time employees, staff each program? (See Funding)
 - 8) (See for additional questions or hold off on this and next question until then)

- 2) If pedestrian facility maintenance duties are not performed by your agency, who within your community is responsible? For example state agencies, private homeowners associations, neighborhood groups, volunteers etc. Explain.

Discussion

All agencies that were contacted maintain pedestrian facilities and all but a few agencies have formal policies that guide how maintenance is performed. It is typical for public works departments, or specific divisions within public works, e.g. streets division, to be responsible for maintaining pedestrian facilities. Numerous agencies indicated that property owners abutting sidewalks are responsible for maintaining those sidewalks, especially with respect to winter maintenance. Business Improvement Districts (and other similar organizations) and homeowners associations were also commonly mentioned by agencies as other entities that are responsible for sidewalk maintenance. Maintenance of shared use paths is typically performed by parks and recreation departments or is a shared responsibility with public works or street maintenance departments, particularly for shared use paths within street right-of-ways. Non-profit organizations, regional recreational districts and homeowners associations were also mentioned, although less commonly, as entities responsible for shared use path maintenance.

The majority of agencies that were contacted do not have dedicated staff for the maintenance of pedestrian facilities. Those agencies that do have dedicated staff are deploying such staff for sidewalk repair/replacement, curb ramp repair/replacement, crosswalk maintenance, pedestrian signal maintenance, vegetation management, shared use path maintenance and inspection activities. Much more common among agencies is deployment of general street maintenance staff for a wide range of maintenance activities within the street right of way, including pedestrian facilities. Maintenance staffing levels vary widely and correlate with the size of the community.

1.5.2 | Funding

- 3) What is the annual budget of each program and what is the funding source?
- 4) What is this amount in relation to the overall budget for all facility maintenance?
- 5) You have indicated above that the city/county/state you work for does pay for sidewalk repairs, curb ramps repairs, and/or sidewalk replacement. What is the source of funding? Bonds, general revenue, Community Development Block Grants?
- 6) You have indicated above that property owners pay for expenses associated with sidewalk repairs, curb ramps repairs, and/or sidewalk replacement. Is this assessed? What percentage do they contribute to repairs or sidewalk replacement (if answer not recorded above)?

- 7) Do you have any innovative financing options or programs for sidewalk maintenance?

Discussion

Most agencies that were contacted have an annual budget for pedestrian facility maintenance, but were not able to provide a precise breakdown of how these budgets are programmatically allocated. In many cases, it was difficult for communities to report dollar amounts because roadway crews or park crews were performing maintenance as an incidental part of other maintenance duties. For those reporting annual budgets dedicated to pedestrian facility maintenance, they vary widely from \$28,000 to \$8 million. Pedestrian facility maintenance funding levels are proportional to the size of the community, with some exceptions. Annual budgets for pedestrian facility maintenance as a percentage of overall transportation facility maintenance also vary widely from less than 1% to 25% among agencies that were able to provide this information.

Sources of funding for pedestrian facility maintenance include state gas tax and other state aid funds, sales tax, special assessments, bonds, voter-approved levies, general fund (supported by property tax), utility fees, grants (SRTS, CDBG, CMAQ, ARRA) and funds established from special sources such as red light cameras and vehicle license fees. Funds most often come out of a city's general fund. Often sidewalk replacement programs are made part of Capital Improvement Programs. In the case of sidewalk repair/replacement at least half of the agencies contacted have a mechanism to assess property owners, however only about half these agencies actively employ it. Among those agencies that do actively assess property owners for sidewalk repair and/or replacement, property owners are typically required to pay 100% or 50% of the costs. Several agencies indicated that jurisdictions will pay for 100% of repair costs if sidewalk damage is due to trees planted within public right-of-way or other infrastructure-related damage. Often adjustments are made for property owners located on corners. The few innovative financing mechanisms mentioned by agencies include targeted levy, tax incremental financing districts and public-private partnerships.

1.5.3 | Sidewalk Repair and Inspection

- 8) Are there state laws or local ordinances that govern the maintenance of sidewalks?
- 9) Who is responsible for minor repairs with short-term fixes – patching, wedging, crack filling, grinding etc.? Do adjacent property owners do any of these repairs or does your agency make these repairs?
- 10) What techniques are typically used?
- 11) Does your agency have an ongoing inspection program or do you just respond to complaints?
- 12) Describe the inspection program – how many inspectors, do they inspect all sidewalks in a year or just a subset?

- 13) What is the unit cost for sidewalk repair?
- 14) What threshold is used as a tripping hazard for vaulted sidewalks (i.e. 1/2 inch, 5/8 inch, 3/4 inch, etc.). For cross-slope and running grade?

1.5.4 | Sidewalk Replacement

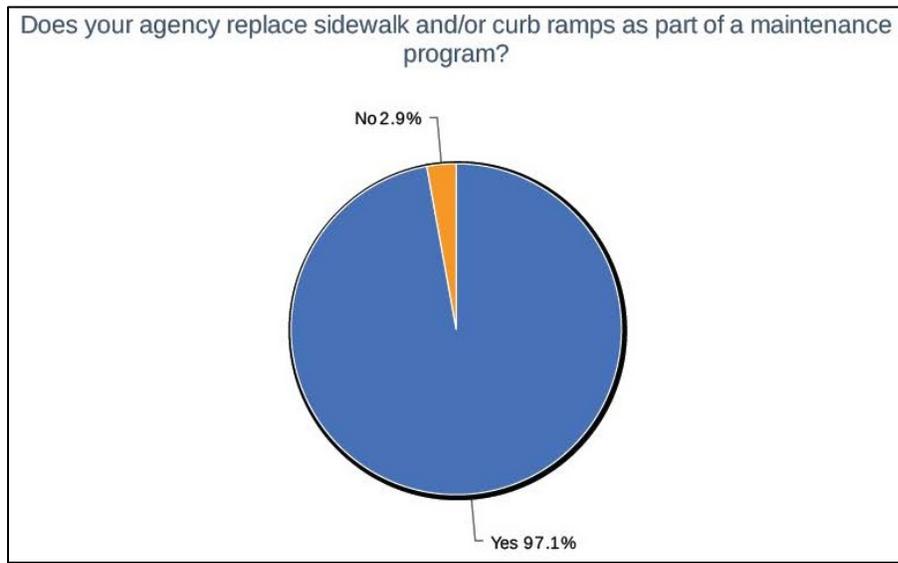
- 15) Does your agency replace sidewalks and/or curb ramps as part of a maintenance program? (Figure 8) Is this program separate from the sidewalk repair program?
- 16) How is sidewalk replacement funded? For example, does the agency pay for the entire amount of the curb ramp cost or do you require a property owner match? What percentage?
- 17) To what extent does ADA compliance factor into your pedestrian facility maintenance program?

Discussion

The majority of communities surveyed comply with ADA guidelines on new projects and have state law or local ordinances that govern the maintenance and clearing of sidewalks. Adjacent property owners, city public works and parks departments and business associations most often share responsibility for these activities.

It is more common for public works departments rather than adjacent property owners to fund and perform repairs of sidewalks. The completion of these repairs is most often in response to complaints as opposed to coordinated programs. Even though more communities have ordinances that place the responsibility for sidewalk maintenance on the adjacent property owner, shared and unclear responsibility, weak enforcement mechanisms, high costs and liability concerns lead to many jurisdictions to perform sidewalk repairs and replacement. Many of the agencies reported that they will allow adjacent property owners to replace sidewalks that have been identified for replacement. If the sidewalks are not replaced by a certain date, the agencies will include the work as part of a contract and charge the adjacent property owners the cost of the replacement.

Figure 8: Replacement of curb ramps



Jurisdictions are slightly more likely to perform full sidewalk replacement rather than invest in short term fixes. If short-term fixes are done before a segment can be replaced, the common techniques are grinding, patching and wedging. It is not uncommon for agencies to have both repair and replacement programs working together; one to respond to immediate reported problems, and the other to operate as a longer term replacement program rotating through a community zone by zone.

In many jurisdictions where sidewalk repair budgets are limited, public works departments are targeting parts of the sidewalk network that are the most damaged, thus full replacement is often the only option available given the condition of the sidewalks. Most jurisdictions working under this model do not have dedicated staff, but deploy work crews seasonally to complete sidewalk repairs. These communities are also much less likely to have a property assessment policy, allowing them to move quickly to replace sidewalks.

In other jurisdictions, clear responsibility rests on the adjacent property owners who are responsible for funding and /or performing all maintenance of the sidewalk adjacent to their property. Under this model, sidewalk repair may be triggered by notice from the jurisdiction of non-compliant conditions or construction activities on the property. Public works departments are only responsible for curb ramps and sidewalk repairs adjacent to public lands and facilities. In some cases, the jurisdiction will perform short-term repairs with the understanding that the adjacent property owner will then be responsible for more long-term solutions.

Other entities may be responsible for sidewalk repairs. It is common for downtown commercial districts to form Local Improvement Districts or Special Improvement Districts to fund and

complete sidewalk repairs using contractors. Business Improvement Districts, which commonly perform day-to-day maintenance such as sweeping and snow removal, will, in some cases, conduct repairs of sidewalks.

Inspection and inventory enables communities to identify priorities for sidewalk repair and replacement. Communities identify sidewalk repair needs by the intake of complaints from citizens, through follow-up and routine inspections, and by conducting inventories. There are two common strategies for inspection: inspection by zone and case-by-case inspection. With zone inspection, a portion of a jurisdiction is inspected annually. Case-by-case inspection occurs in response to a complaint or claim or preceding a capital or scheduled project. Comprehensive community-wide sidewalk inventories are expensive and not common. Some larger communities and communities with universities are making use of this tool especially as a way to complete or update ADA transition plans.

In response to a rather specific question about tripping hazards, many communities indicated that they are following ADA standards (1/4 inch to 1/2 inch) and have reduced their threshold accordingly. Nevertheless, a wide range of thresholds were still reported by communities.

1.5.5 | Shared-use Paths

18) Is your agency also responsible for maintaining shared use paths?

19) If not, what agency is responsible for this in your community?

If so, do you treat trail repairs in the same way as you treat sidewalk repairs (inspection process, same maintenance criteria, same response time, etc.)? Differences?

Discussion

For shared use pathways, the responsibility of path repairs most often falls under the jurisdiction of the parks department. In some instances, public works departments will assist with pavement maintenance of paths. It is uncommon that paths be maintained within the same program as sidewalks. Several communities acknowledged that they pay closer attention to maintenance standards used for paths than sidewalks because of higher usage on paths and the tendency for more problems to be reported. It is common for volunteer groups to assist with path maintenance needs.

1.5.6 | Snow and Ice Removal

20) Does your jurisdiction have an ordinance or specify a timeframe for removal of snow and ice from sidewalks? From shared use paths?

21) If done by adjacent property owners, how successful is this? Does the agency have a process in place to follow-up and remove snow and ice when adjacent property owners do

not? Is this process driven by complaints or routine inspection? Do you fine and/or charge for this service? How is it enforced?

- 22) If done completely or partially by your agency, do you have special equipment and how significant of an effort is this? What are the costs associated with this service? How is this paid for? Do you have a rating system or policies for determining priorities for snow removal? What is the frequency of these activities?

Discussion

It is common practice that private property owners are responsible for removing snow and ice from the sidewalk that abuts their property and that public agencies such as state and local jurisdictions, public works and parks departments are responsible for sidewalks adjacent to public lands. Of the 47 communities contacted 32 had formal policies or laws for snow and ice removal. Many of the communities in California and the Southeast U.S. indicated it was a senseless question for them since they have no snow or ice. The majority of the communities that had formal laws or policies have shared snow removal policies performed by the local government, public institutions and private property owners. This is comparable to a study conducted by the Salt Institute, which found that 83 percent of highway agencies had policies requiring property owners to remove snow from adjacent sidewalks.¹

Although shared responsibility for snow removal is common practice, the success of snow removal to the extent of compliance with the ADA is varied. Of the communities surveyed with formal shared snow removal policies the majority (83%) stated that the current practice of adjacent property owners removing snow and ice was a successful strategy. However, the measure of success was not defined. Challenges in winter maintenance arise with vacant properties or rental properties. In addition, elderly or disabled residents may have mobility limitations that make it difficult for them to remove snow. The presence of clear policy that is conveyed through education, inspection and enforcement is important to a successful snow and ice removal program.

Other snow removal strategies include the use of contractors, the formation of Local Improvement Districts (LIDs) or Special Improvement Districts (SIDs) most common in commercial districts and developments to fund and perform maintenance duties including snow removal. In some instances, local jurisdictions are responsible for all snow and ice removal. The state of New Hampshire, by state law, requires all local jurisdictions – not adjacent property owners - to maintain all roadways and sidewalks including snow and ice

¹ "Extending Beyond the Curb: Winter Maintenance Liability." Public Works. 2001. HighBeam Research. Accessed January 23, 2013. <http://www.highbeam.com/doc/1G1-78178335.html>.

removal. In southern states where snow events are light and/or infrequent, it is common that a “melt strategy” is used in place of a formal snow removal policy. Communities with melt strategies generally do not expect adjacent property owners to clear sidewalks except in business districts.

Municipal ordinances most often determine the conditions and responsibilities associated with snow and ice removal from sidewalks. It is common that the ordinance specify the timeframe, responsible party, desirable conditions, enforcement mechanism and penalties associated with non-compliance.

Timeframe

The timeframe required for snow removal range from 2 to 72 hours after a snowfall. Some municipalities require snow and ice to be removed or treated by a specific time such as by 6am of the morning following a snow event. In some instances, cities will specify different requirements for different days such as Sunday when the timeframe is relaxed or have different requirements for high pedestrian traffic areas. The majority of municipalities with snow removal timeframes require snow to be removed from sidewalks within 24 hours after a snow event.

Responsibility

In the majority of jurisdictions, snow removal is a shared responsibility that may involve the adjacent property owner, renter, ground floor occupant, municipality or a specified contractor. Few jurisdictions have municipal crews that manage all of the snow removal from streets and sidewalks.

Enforcement

Enforcing snow removal from sidewalks is critical to a successful snow removal program in minimizing risk and legal exposure. Of the communities contacted with laws governing sidewalk winter maintenance by adjacent property owners, 46 percent did enforce snow removal laws. Of those communities, 83 percent felt that snow removal was done successfully in their community. Of communities that have ordinances in place but do not enforce snow removal, 40 percent felt that the program was successful.

Penalties

Many communities with snow removal ordinances and active enforcement of the ordinance issue penalties to property owners who do not meet the requirements of the ordinance. Of the communities surveyed that do enforce their snow removal policy, about 75 percent issued fines to property owners who did not clear snow within the requirements of the ordinance. Fines

range from \$1 to several hundred dollars depending on the length of time the violation remains. A few communities clear snow and charge the property owner for the work in addition to imposing a fine. A few other jurisdictions issue warnings, but do not fine. In some cases municipalities cleared snow from sidewalks where adjacent property owners had failed to do so. Of those communities, some charged the adjacent property owner or fined them for negligence.

Memoranda of Understanding

In some cases it was found that maintenance agreements are used to clarify roles and responsibilities in the removal of snow and ice. This may include a Memorandum of Understanding (MOU) that specifically defines the roles and responsibilities of different parties such as between a Business or Neighborhood Association and a municipality. In some instances where multiple agencies or departments must coordinate snow removal efforts, such as at state and local roadway interchanges, shared use paths through parklands or at transit stops, a cooperative or interagency agreement is in place. Agencies that have such agreements in place indicated having success with snow removal operations.

Snow Removal Equipment

Mechanical snow removal from sidewalks is performed using a variety of equipment such as shovels, blowers, small tractors, bobcats, ATVs, etc. depending on the equipment budget, the severity of the snow event, the depth of snow and space constraints. Due to the constraints of the pedestrian zone a variety of tools may be necessary in order to properly clear sidewalks, curb ramps, medians and intersections.

Funding

In the majority of communities funding for snow removal from sidewalks and other pedestrian facilities (where the jurisdiction has established responsibility) comes from the general fund. Some communities have established snow and ice removal budgets for roadways, which includes pedestrian facilities, and is also typically drawn from their general fund.

Liability

In general, there is confusion about shared winter-maintenance practices and who has liability. The development of a snow removal policy that clearly defines roles and responsibilities helps to mitigate legal risk.

1.5.7 | Vegetation Trimming

23) Are there routine inspections or is this complaint based? (Figure 9)

24) If done by adjacent property owners, how successful is this? (Figure 10)

25) If done by your agency, how significant of an effort is this?

Discussion

Trimming vegetation along sidewalks is not a high priority or high-effort activity for most jurisdictions. Agencies typically engage in vegetation management when vegetation is blocking sightlines to signals, signs or crosswalks. Adjacent property owners are most often responsible for the management of vegetation on their property that may impact the pedestrian zone. As shown in Figure 9, the majority of communities contacted does not perform routine inspection along sidewalks for vegetation overgrowth issues, but rather respond to complaints. In general, this is viewed as a successful practice that requires little effort on the part of the jurisdiction. However, for management of vegetation in the right of way there is more active inspection and/or management by the jurisdiction.

Figure 9: Vegetation trimming

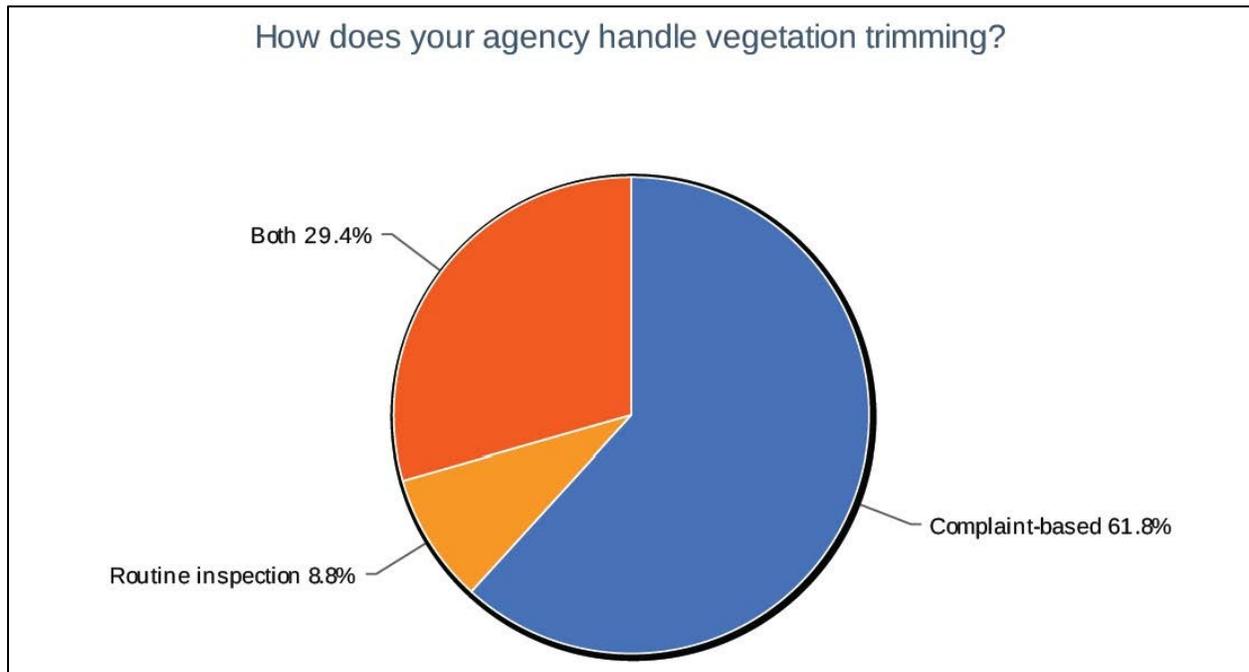
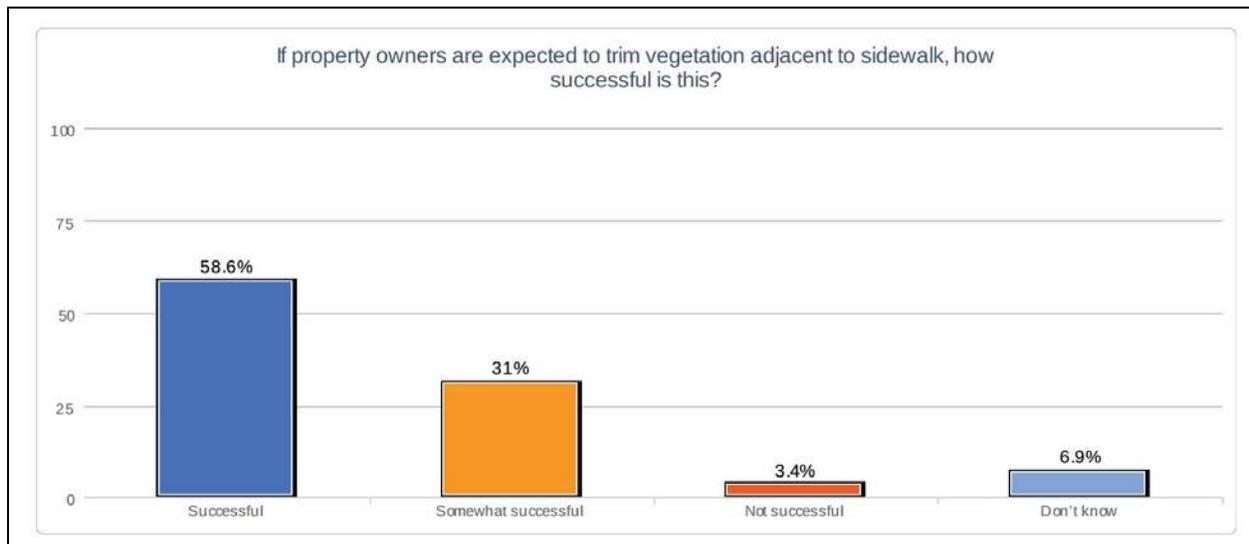


Figure 10: *Vegetation trimming by property owners*



1.5.8 | Sweeping, Debris and Leaf Removal

- 26) If done by adjacent property owners, how successful is this?
- 27) If done by your agency, how significant of an effort is this?
- 28) What is the frequency of these activities?

Discussion

Most communities are proactive about debris and leaf removal. Street sweeping, seasonal leaf collection and garbage pick-up are common activities for jurisdictions. Sidewalk sweeping is not as common although one jurisdiction sweeps all city sidewalks in the spring. The amount of effort in leaf collection varies depending on the region and program. This ranges from communities with no debris removal program (including garbage) to weekly yard waste pick-up. Of the communities contacted most felt that property owners were successful in keeping sidewalk clear of debris.

1.5.9 | Crosswalks

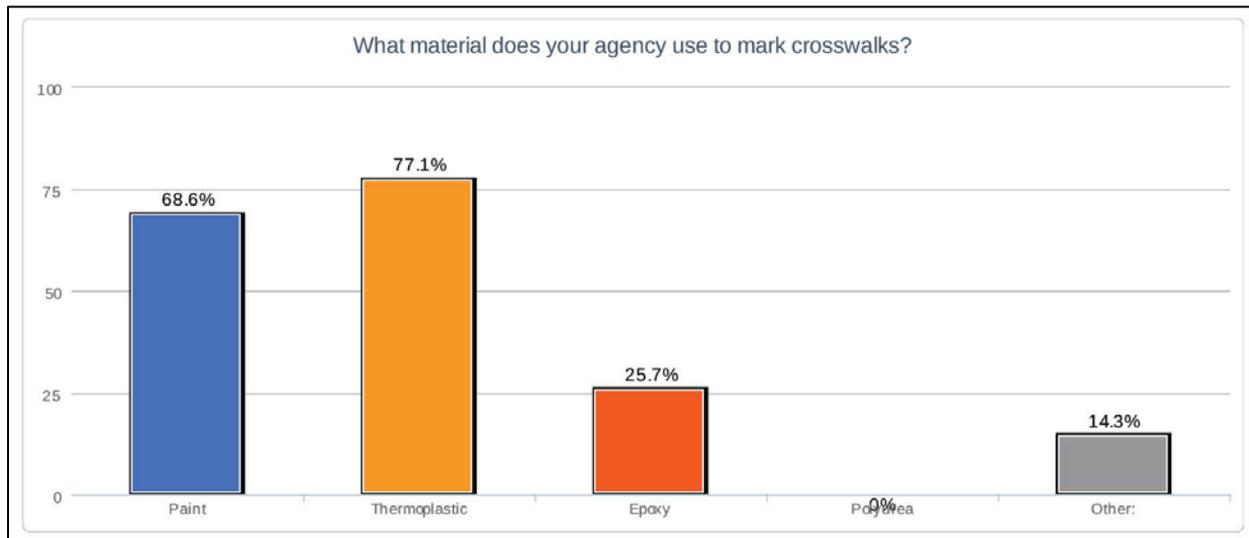
- 29) Are your crosswalks marked with paint, epoxy, or thermoplastics/preformed? Combination?
- 30) Do you employ any special marking treatments or scheduling to elongate the life of the markings?
- 31) Are there any special strategies for maintaining markings?
- 32) Are there any strategies/materials that have worked to reduce slip hazards?
- 33) Have you reduced your efforts at marking crosswalks in the past 4 years?
- 34) What is the unit cost to remark a crosswalk?

Discussion

Thermoplastic is the crosswalk marking material most favored by those communities that were contacted. Paint is also frequently used, particularly on existing roads or where there is an immediate need. Epoxy was also mentioned by a number of communities. Thermoplastic and epoxy markings are used most often on repaving projects (Figure 11). The communities that use paint markings typically use city crews and equipment to do the work, while installation of thermoplastic and epoxy markings is typically contracted out. At least one community mentioned the use of cold plastic in-lays for federal projects. Several communities mentioned using recessed thermoplastic to avoid plow damage and another community mentioned using this marking technique where there are a high number of turning movements, particularly by large vehicles.

Only a few communities mentioned that they have had slip hazard issues related to crosswalk markings. Several strategies were mentioned for reducing slip hazards associated with thermoplastic. One community mentioned using the British Pendulum method to determine appropriate friction coefficient to avoid slip hazards. The same community mentioned that having the right conditions for the thermoplastic curing process was an important factor for avoiding slippery markings. It was noted by several communities that newer thermoplastic mixtures contain sand or other coarse materials for reducing slip hazards. Bricks and stamped concrete were noted by at least two communities as creating hazards for bicyclists.

Figure 11: Crosswalk marking materials



When asked what special treatments or strategies are used for maintaining crosswalks, the majority of communities indicated that they did not have any special techniques for reducing maintenance. Some notable exceptions include spraying streets with primer to reduce salt

damage, spacing crosswalk bars so they are generally out of tire path, using pre-form thermoplastic in high-traffic areas, and using different types of markings for different types of roadway surfaces, e.g. thermoplastic on concrete and polyurethane on asphalt.

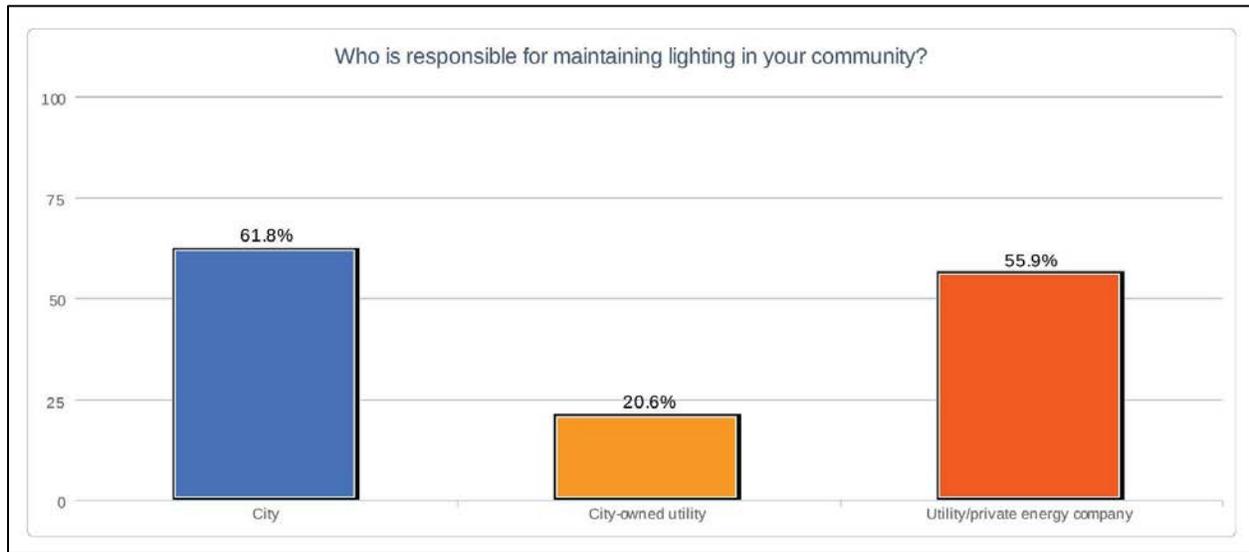
1.5.10 | Lighting

35) Who is responsible for maintaining lighting in your community?

Discussion

Street lighting is generally managed by local jurisdictions (Figure 12). It is also common for municipalities to share lighting maintenance responsibilities in their jurisdiction with private utilities.

Figure 12: Maintenance of lighting



1.5.11 | Pedestrian Signals

36) If you are responsible for pedestrian signals. How would you characterize their durability and frequency of repair?

37) How long does it typically take to respond to an identified problem with a pedestrian signal?

38) Have you been able to employ any methods or use of equipment that improved on the maintenance of pedestrian signals?

Discussion

Most communities that were contacted indicated that they have either switched out all their signals for LED countdown signals or are in the process of doing so. Newer LED lights are highly rated by communities in terms of durability. No special techniques were mentioned for

maintaining pedestrian signals. Pushbuttons were the most problematic features of pedestrian signals. Several communities mentioned that they have issues with pedestrian pushbuttons being stuck. Some mentioned that tampering with pushbuttons was more frequent near schools.

1.5.12 | Prioritization

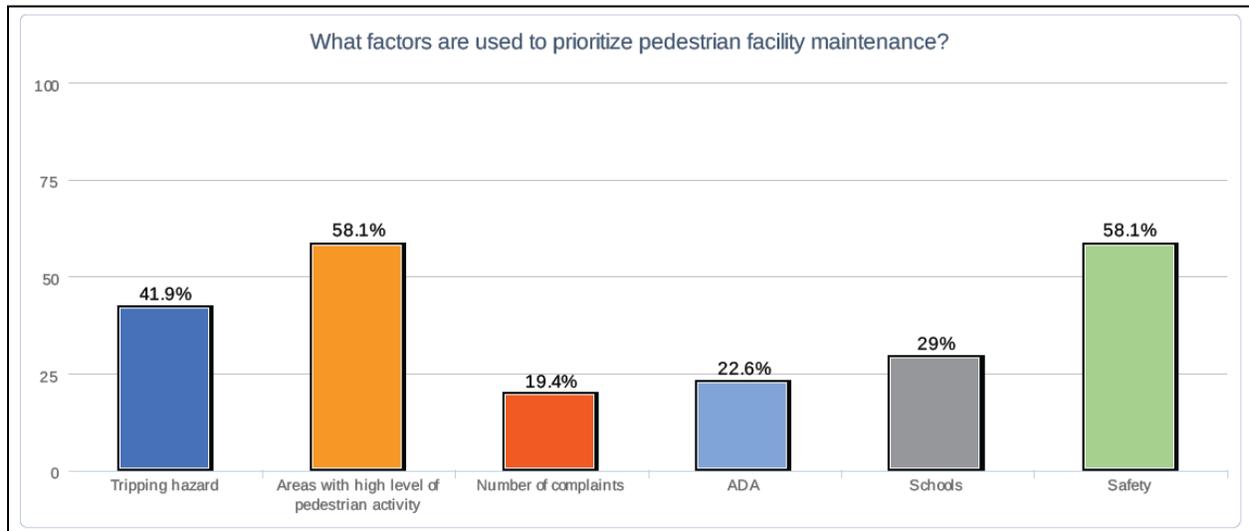
39) Does the agency employ a methodology to prioritize pedestrian facility maintenance needs and is that related to a sidewalk replacement program and/or other pedestrian maintenance programs? What is the nature of the methodology (what are the factors used, such as safety, current usage, etc.).

40) How is the program balanced to meet needs throughout the jurisdiction?

Discussion

The majority of contacted agencies employ some kind of methodology to prioritize pedestrian facility maintenance. The most common factors used in prioritization are tripping hazard, areas with high levels of pedestrian activity (community centers, business districts and transit stops were commonly mentioned), school access, number of complaints, ADA compliance and safety (Figure 13). It is common for agencies to inventory sidewalk maintenance needs and update these inventories through periodic inspection and on a rotating basis. As a means to balance maintenance programs, particularly sidewalk maintenance, agencies may split the city into geographic zones or neighborhoods and inspect each zone, and do required maintenance, every five years.

Figure 13: Factors to prioritize pedestrian facility maintenance



1.5.13 | Reporting and Performance Measures

- 41) Are measures used to judge performance of pedestrian facility maintenance? For example - how many lineal feet of sidewalk are inspected, repaired, replaced; number of curb ramps repaired or replaced; number of crosswalks remarked, etc.?
- 42) Does your agency have other pedestrian maintenance benchmarks especially related to safety? For example, how many pedestrian hazards are reported, how many claims have been filed for pedestrian falls, any hospital admissions data for pedestrian mishaps collected and used as a measure, etc.?

Discussion

Over half of the agencies contacted use performance measures or benchmarks to judge how well they are addressing pedestrian facility maintenance needs. Typical measures are units of facilities (e.g. linear feet of sidewalk, number of curb ramps) replaced/repared, number of complaints resolved and number of claims per year (Figure 14). Only a quarter of agencies indicated that they have specific pedestrian safety benchmarks in place (Figure 15). Several agencies mentioned specific software applications that are used to track complaints, inspections and work performed.

Figure 14: Performance measures

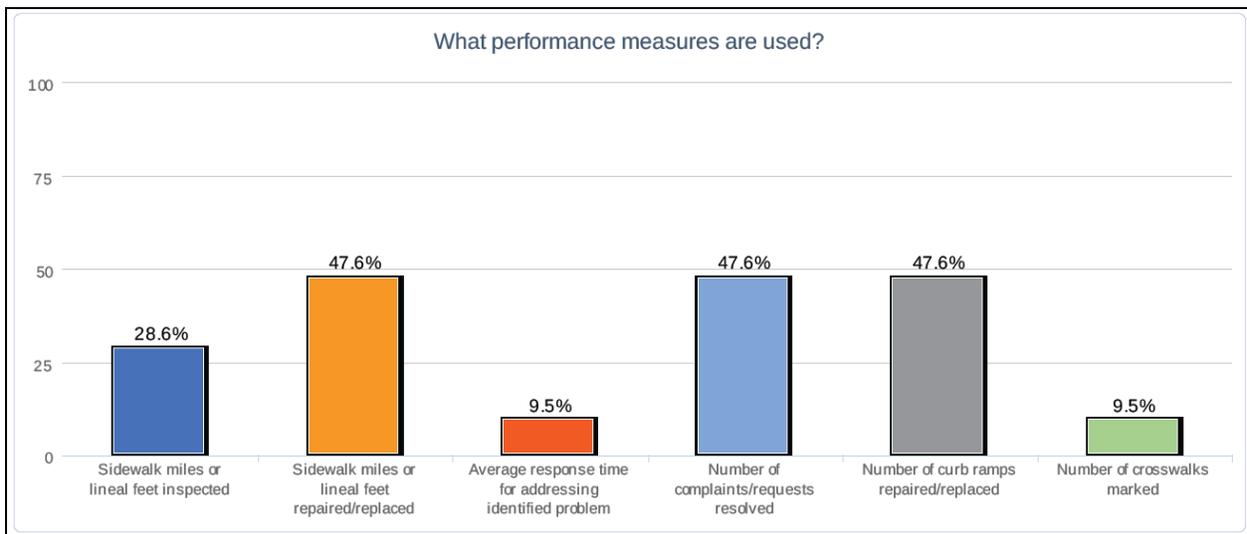
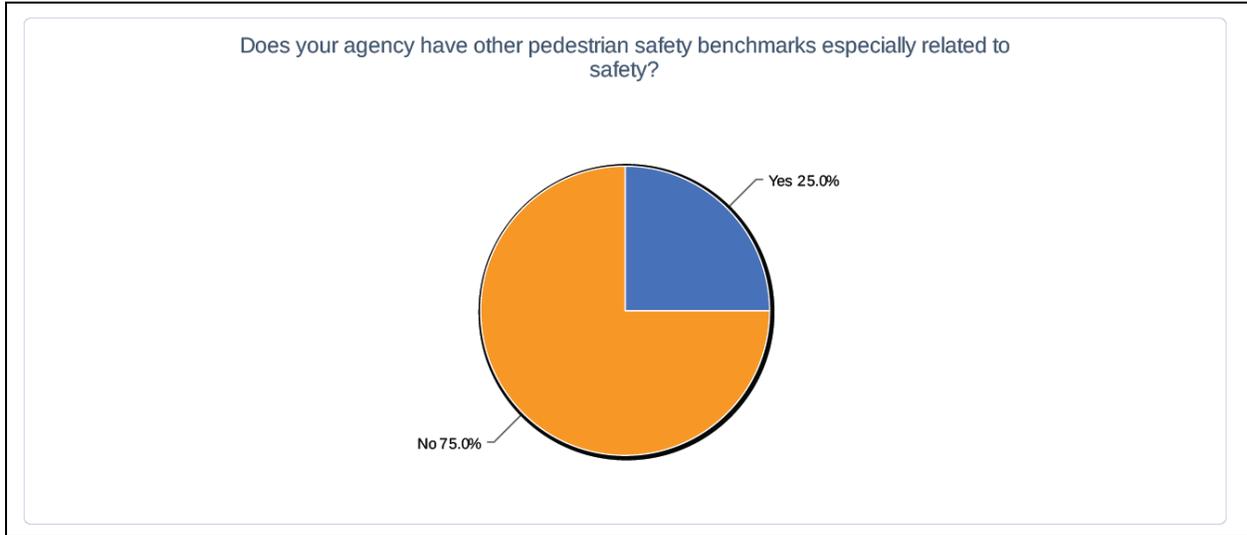


Figure 15: Pedestrian safety benchmarks



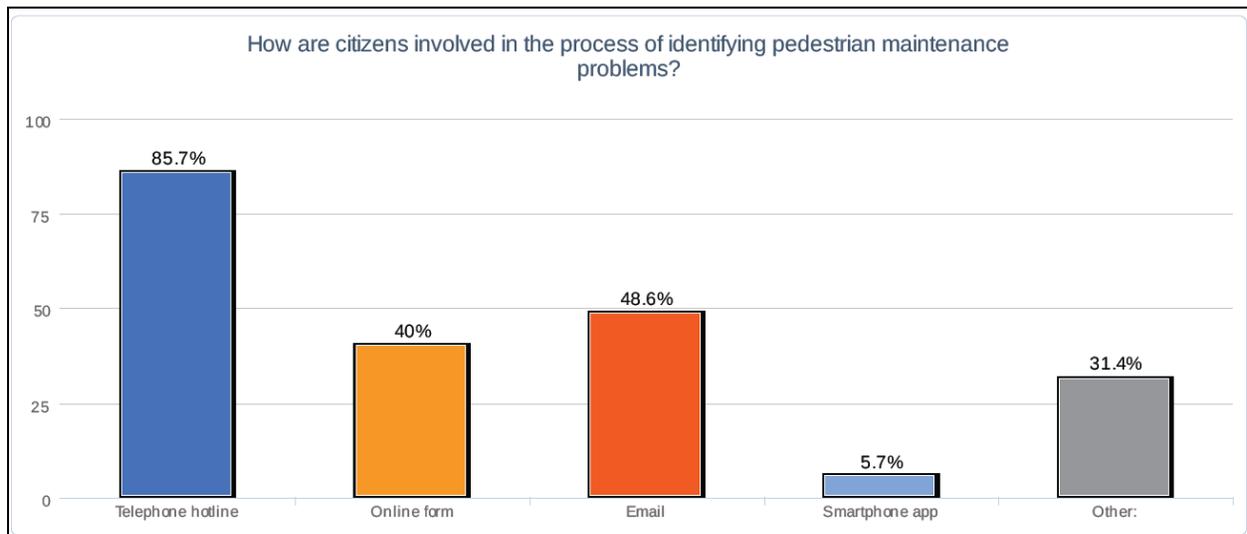
1.5.14 | Communication

- 43) How are citizens involved in the process of identifying problems? Is there a mechanism that enables citizens to report maintenance problems, and how are these requests handled? Are they using new technologies to facilitate this communication (See Clickfix.com)?
- 44) Is there an organization e.g. Landlord Association, Business Association that you work with to provide services or disseminate information to members about pedestrian maintenance issues?

Discussion

Almost all contacted agencies have some kind of mechanism for citizens to report maintenance issues whether it is a telephone hotline, email address or online form that is accessed on the city's website (Figure 16). A smaller number of agencies indicated having sophisticated applications that log and track citizen requests/complaints. Other reporting mechanisms mentioned include neighborhood councils, alders and agency-specific Facebook pages.

Figure 16: Citizen involvement in identifying pedestrian maintenance problems



Only a few agencies indicated that they work directly with outside organizations such as Homeowners Associations, Business Improvement Districts, merchant organization, neighborhood associations or large institutions (e.g. hospitals or universities) to disseminate information about pedestrian facility maintenance. Several agencies indicated using local publications to notify the public and provide information, particularly regarding snow and ice removal.

1.5.15 | Liability

45) Who has liability for mishaps on sidewalks due to maintenance problems?

46) Has the jurisdiction ever been involved in litigation involving a pedestrian maintenance issue and did it have an impact on practices?

47) On average, how many claims per year does the jurisdiction receive involving mishaps due to alleged conditions of sidewalks?

Discussion

These three questions were perhaps the most difficult ones for discussion participants to answer. Most of the agency representatives participating in the discussions were from public works or streets departments and often were unaware of claims against their jurisdictions or lawsuits that were initiated or settled. Most communities were able to answer the question about liability, but the results were mixed. About half of the respondents placed liability for mishaps on property owners and half felt it was their responsibility. Several people were able to give examples or cite supporting laws, but many people were uncertain about their responses and often said it was a shared liability. Some of the responses seemed inconsistent

with earlier responses in which they stated they had complete or overall responsibility for the maintenance of pedestrian facilities.

Most jurisdictions were either unaware of lawsuits related to mishaps and maintenance practices or stated that their community was not involved in any lawsuits. Likewise, there was a lack of knowledge of claims being filed against their community. However, many of the departments represented in the discussions that were notified from their attorneys that a claim was filed resulted in quick action for repairs or even sidewalk replacement. A handful of communities knew how many claims per year were made and it ranged from a few to 80.

2 | Identification and Assessment of Common and Successful Practices

2.1 | INTRODUCTION

This chapter identifies and assesses practices and programs for the maintenance of pedestrian facilities. It begins with the basics of how pedestrian facilities fall into disrepair and how jurisdictions inspect those facilities. It includes a discussion of differences in practices from community to community and from state to state (including effect of climates). The chapter also includes a discussion on the American with Disabilities Act (ADA), as well as state laws and their impact on the provision of maintenance. The chapter draws on the literature review, community discussions and other resources contained in Chapter 1 and forms the basis for the recommendations included in the Guide.

For the purposes of this research report and for the Guide, pedestrian facilities that will be addressed include sidewalks and walkways, shared use paths, crosswalks, curb ramps, and pedestrian signals. Other types of pedestrian facilities exist, such as street lighting and paved shoulders, but are maintained as part of a larger street or highway projects with the maintenance for pedestrians considered incidental to the maintenance needs required by other users of the facilities.

2.2 | REPAIR AND REPLACEMENT OF SIDEWALKS AND SHARED USE PATHS

2.2.1 | Materials Used for Sidewalks and Shared Use Paths

Sidewalks and shared use paths are the main types of pedestrian facilities that serve pedestrians between intersections. Occasionally walkways or footpaths exist in separate corridors that are not part of the street right-of-way. Surfacing is typically concrete for sidewalks and asphalt pavement for shared use paths. However, there are communities that rely entirely on concrete surfacing for shared use paths and others that rely on asphalt for sidewalks. Furthermore, asphalt pavement is often used as a temporary pavement for patching concrete sidewalks.

Bricks and pavers are also used for pedestrian facilities. In some communities these materials are used to preserve a traditional material and appearance in a downtown or historic district. In some settings pavers are used to border concrete sidewalks. Although these materials tend to be very durable, they have some unique maintenance issues which will be discussed briefly in this research, but more thoroughly covered in the Guide itself. Briefly here are the main types of sidewalk materials.

Concrete

Concrete is by far the most common form of pavement material used for sidewalks in the United States. It is a mixture of cement, water, aggregate, and sand. It is very durable and has a life of between 40 and 80 years. It is poured material and within 15 to 30 minutes a smooth finish is applied to the surface followed by a broom finish to help with traction. Because of its semi-fluid state when it is poured it is an especially attractive material to use when there



Image 1: A concrete sidewalk and curb ramp

are multiple grades and cross slopes such at corners and curb ramps. New paving equipment in the past thirty years is now permitting the paving of long stretches of sidewalk without the use of form works. Repair and replacement of sidewalks in concrete is still performed the same way it has 50 years ago with forms and skilled finishers.

Asphalt

Asphalt is less common than concrete and typically has a significantly shorter life than concrete. However, the initial cost for application is significantly less. It consists of a petroleum base (tar) and aggregate. Asphalt must be compacted soon after it is applied to the surface preferably by heavy equipment. This makes it an attractive material for long stretches of sidewalk or path where a roller can be used.



Image 2: Asphalt is commonly used for shared use paths, but sometimes also for sidewalks

Asphalt can be used in other tighter settings, such as corners and curb ramps, where a hand mechanical tamper is used, but results typically do not match that of concrete. Often when asphalt is used for a sidewalk, concrete is used for the curb ramps. Asphalt is commonly used as a temporary patching and wedging material for concrete sidewalks. Asphalt is the common material used for shared use paths in the United States.

Brick

Brick is a traditional type sidewalk material used for centuries in the United States. Bricks offer a high level of durability and can be reused and easily replaced. Bricks differ from concrete pavers in that they are made from formed clay which is then fired in a kiln. Bricks and concrete pavers are considered a "segmental material" since each paver is separate and is often not tied

or bonded together the way a concrete slab is formed and functions. Proper installation is important for bricks and concrete pavers to reduce future maintenance. Bricks have unique maintenance requirements and many communities consider bricks to be more costly and problematic to maintain than concrete. Some communities are using bricks and concrete pavers to highlight sidewalks in commercial areas or plazas. The main shape of bricks is rectangular and they are manufactured in a wide range of colors. More recently, bricks and pavers have been manufactured and placed to create a more permeable surface, but it requires more spacing between the individual blocks.



Image 3: Brick is often used for sidewalks in historic areas

Concrete Pavers

Concrete pavers are also used for sidewalk applications and for sidewalk border applications. They consist of a mixture of cement, sand and water and function much like bricks when they are set in place as sidewalks or walkways. Like bricks, concrete pavers can be produced in many shapes, sizes and colors. They are durable, versatile and can be reused; however, they do have unique maintenance requirements. Like all other sidewalk materials, attention to proper construction can reduce maintenance problems and costs in the future.

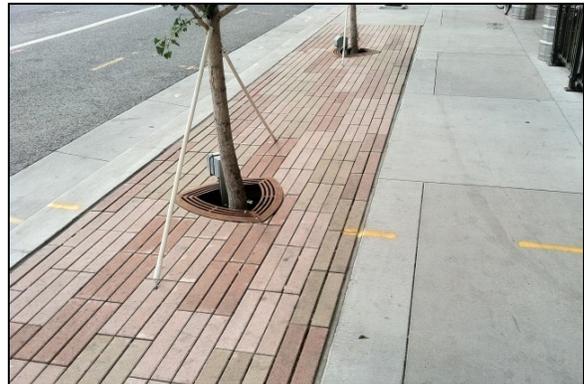


Image 4: Concrete pavers are often used in terrace areas

Rubberized Pavers

Pavers made from recycled rubber and plastic have recently been introduced as a substitute for traditional sidewalk pavements. These pavers are modular systems similar to large concrete pavers. They are linked together with tabs. Communities have been attracted to these pavers for applications around trees where tree roots have caused concrete sidewalks to heave,



Image 5: Rubberized pavers have seen increased used in the past few years

although they can be used in most environments calling for sidewalks in a straight alignment. They are half the depth of concrete sidewalks and are typically more expensive than concrete in most applications.

Other Sidewalk and Trail Materials

Research conducted for this report did not identify use of permeable pavements for sidewalks and paths. Discussions with communities did not lead to any discovery of permeable materials; however, since this is an emerging pavement type, it will be covered in the Guide, but not discussed in detail in this research report.

Sidewalk Material Comparison

Table 3 compares some of the materials described in this section based on cost, lifespan, maintenance requirements and repair or replacement costs. Because these figures vary widely based on region, climate and specific application, only relative values are used to compare one material to another.

Table 3: *Relative comparison of various sidewalk materials*

Material	Cost	Lifespan	Maintenance	Repair or Replacement Cost
Concrete	\$\$	***	Low	High
Asphalt	\$	**	Moderate	Moderate
Brick	\$\$\$\$	***	High	Low
Rubberized Pavers	\$\$\$\$		Low	High

2.2.2 | Causes of Sidewalk and Path Failures

There are a series of structural failures that lead to the vast majority of sidewalk problems and hazards. Many of the forces that cause damage to sidewalks are related to frost action. Note paths that are paved in concrete share the same deformation problems as concrete sidewalks. The Institute for Research in Construction of the Canadian National Research Council has undertaken an extensive study of concrete sidewalk issues and has defined four major deformation types leading to structural damage to sidewalks. An additional type was added and involves surfacing problems that are not structural in character. These five conditions are identified in Table 4. These same conditions cause failures in asphalt, as well as bricks and pavers (sometimes referred to as segmental pavements). These resulting failures will also be highlighted as follows although they were not part of the Canadian research study report.

Table 4: Types of sidewalk deformations as identified by the Canadian National Research Council

Rigid Body Uplift or Settlement

The tendency for a concrete sidewalk slab to rise, subside or tilt as a result of expansive native soil, frost action or thermal expansion of the concrete slab. This could also be due to non-uniform compaction of the subgrade. Since asphalt has a high tensile strength compared to concrete, deformation around the uplift will occur often causing a crack or a mounding of the material, but typically not a break characterized by a rift or fault of the material as seen with concrete.

Image courtesy of PVC Pump



Tensile Shrinkage

Deformation resulting from tensile stresses caused by the shrinkage of underlying soils from decreasing moisture content. As a clay or silty subgrade dries, the strong bond of the subgrade to the underside of the concrete induces tensile stresses in the concrete slab as the subgrade shrinks. The concrete slab will crack when the tensile stress exceeds the tensile strength of the concrete.

Illustration courtesy of Canadian National Research Council

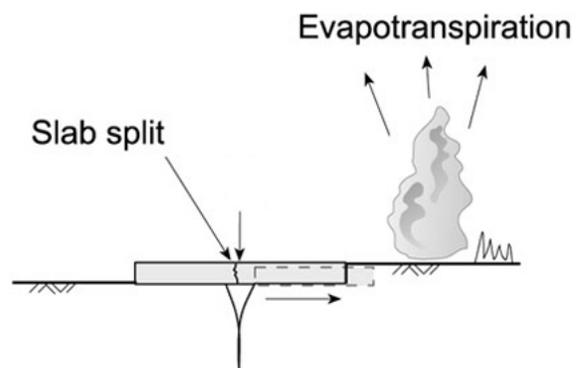
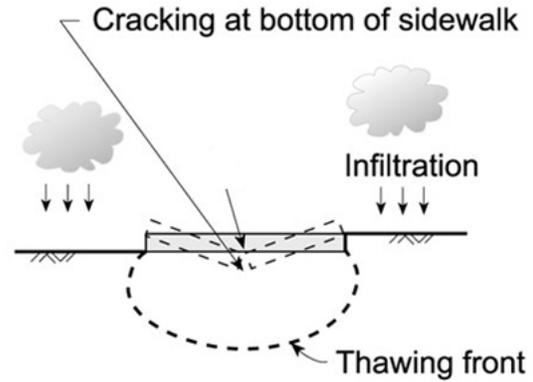


Table 4 continued

Sagging

The unequal movement of the slab as a result of the center of the sidewalk or path having a larger thaw settlement than at the edges, or native soil conditions where clays swell significantly at the edges. This leads to longitudinal cracking.

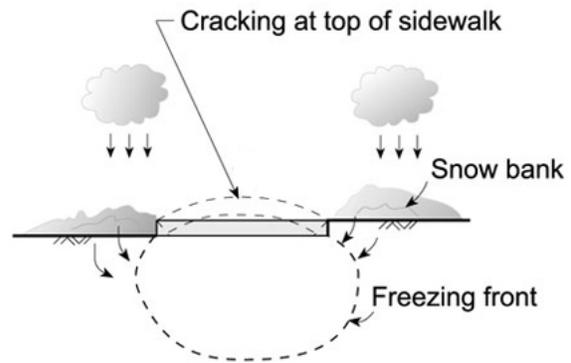
Illustration courtesy of Canadian National Research Council



Raised or Heaved (Hogging, fault)

Unequal movement of the slab caused by frost heave or upward vertical movement due to swelling of clay native soils being greater at the center than at the edges. Raised pavements are also commonly caused by tree roots. Hogging also leads to longitudinal cracking.

Illustration courtesy of Canadian National Research Council



Surfacing Defects

The finish of the concrete is compromised. Unlike the previous conditions which are structural in nature, surfacing defects are due to poor concrete quality and finishing. Improper asphalt compaction or improper mixing of the material can lead to premature surface deformation as well. Rarely do bricks or concrete pavers themselves exhibit surface problems since the quality of material is controlled by a more stable manufacturing process.

Image courtesy of City of Middleton, WI



The structural and surfacing conditions in Table 4 lead to a multitude of problems impacting maintenance, which include longitudinal cracks, transverse cracks, faulting, corner breaks, gaps and changes in grade due to settling and heaving.

Longitudinal cracks occur along the length of the sidewalk, usually in the middle third of the sidewalk, and can extend through several expansion or control joints. Transverse cracks occur across the width of the sidewalk due to non-uniform subgrade compaction, especially where sidewalks are subjected to high vehicle loads such as where driveways cross sidewalks.

Although there can be other surfacing problems associated with asphalt surfaces, the common defects from poor surfacing for sidewalks and paths are associated with raveling and cracking. Raveling is caused by high air voids in the material due to poor compaction or late season paving. Cracking can also lead to series of problems for asphalt surfaces overtime. The ones mostly closely impacting sidewalks and paths are edge, alligator, and longitudinal cracking.

The series of defects associated with concrete include spalling, scaling and popouts. Poor curing practices, concrete quality or finishing techniques can all contribute to these defects. Often these surface defects will appear in the first several years after application. Minor defects may only affect appearance, but moderate to severe conditions will ultimately become a safety concern and significantly affect the usable life of the sidewalk.

2.2.3 | Inspection and Inventory

Inspection practices are most often associated with sidewalk surface irregularities such as cracks, spalling and faults (also known as step separation or changes in level). Many communities provide varying forms of inspection to proactively identify sidewalk problems which are then addressed on a zone-by-zone basis. However, basic inspection practices need to be in place for all communities to assess problems which are reported by citizens or as identified as a result of a pedestrian slip or fall. Although most of these immediate problems can result in tripping hazards, inspection also occurs on a smaller scale for sidewalks and paths that need to be swept or have vegetation trimmed. Additionally, many communities in snowier environments will use inspectors to ensure that snow and ice has been removed from sidewalks when complaints or slips are reported. This section of the research report focuses on the inspection of pedestrian facilities due to surface or structural problems. It builds on the research conducted for the report and the discussions conducted with communities as presented as part of Chapter One.

An inspection process is most often used to plan and stage efforts to address problems that are identified through a proactive effort or are reported by citizens or staff. It is done in several

ways and varies from community to community. Inspection and repair are inextricably linked. When an inspection system works at one of the following levels, repairs are often delivered in the same manner. For example, if a community uses inspectors to do assessments on a zone-by-zone basis, the repairs then follow on a zone-by-zone basis too.

Community-Wide

A city, village or town may establish a community-wide effort to inspect every sidewalk within a defined period, such as a six month window. This requires significant resources, and is often comprehensive and most often involves more than simple maintenance issues. Many times this approach is associated with conducting an ADA Transition Plan or is in response to outstanding facility needs that have not been addressed over a long period of time. When a sidewalk system deteriorates to this level, only through a community-wide approach can a reasonable prioritization of sidewalk needs occur. Some smaller communities or communities with relatively few sidewalks can annually inspect all of their sidewalks, but this is difficult for larger communities with extensive sidewalk systems.

The City of Durham, North Carolina, used its comprehensive inventory of sidewalks to create a prioritization plan. This followed a set of bond referendums in 2005 and 2007, which financed the replacement of sidewalks and the construction and replacement of over 1,000 curb ramps. Often a community-wide effort to assess sidewalks will result in an operational plan aimed at making repairs by zones. This was the approach used by Boulder, Colorado. In order to identify and prioritize sidewalk needs an overall community-wide assessment was made, which better enabled the city to identify zones to focus efforts.

Zone-by-Zone

A city, village or town will segment their community into zones or groups of neighborhoods. The inspection process will focus on these zones, often with a sidewalk repair and replacement program put in action to respond to the identified problems. By having the community split into three to ten zones, efforts and funds can be targeted in more manageable areas. Costs can also be further controlled by keeping crews within in a tighter geographic area, reducing mobilization and traffic control costs. Although inspections are made in a proactive fashion on a zone-by-zone basis, often the same inspectors are used to respond to immediate inspection issues throughout the community if a hazard has been reported.

About half of the communities in which discussions were conducted are using this zone-by-zone approach or a variant of it. For instance, the City of Minneapolis has split their city into ten zones and targets most of its \$3.1 million sidewalk and curb ramp replacement budget to one zone at a time. Similarly, almost all of the communities had either informal or formal

arrangements to focus inspection and repairs in their downtown areas. The one community that took that effort to the greatest length was Rochester, Minnesota. The central downtown area around the Mayo Clinic is examined on a monthly basis and the greater downtown area is inspected on a yearly basis. The rest of the city, which is primarily single-family use (but some areas of multi-family use as well), is then inspected at 5% per year; the city will also respond to any complaints or safety hazards. The targeted hospital area is roughly one quarter of a mile in radius while the greater downtown area is roughly one half to three quarters of a mile in diameter. The city is cognizant of the need to create a safe pedestrian experience, that is not only highly ADA accessible, but also takes into account the number of new visitors, the sick, the elderly and even the family members of the sick.

Spot Inspection

Nearly every community researched has a variation of a spot inspection program. Spot inspection occurs when a hazard is identified and reported by citizens or staff. Additionally, this type of inspection occurs when a fall or slip is reported due to a hazard. Before any repair is made, an employee of the community needs to verify that a problem exists. Several communities researched relied only on spot inspection and the subsequent repair of sidewalks and paths. Communities involved in zone-by-zone inspection also conducted spot inspections, and were better equipped to do so because they already have trained inspectors and/or inspection teams.

Statewide Inspection

On a statewide basis, Florida DOT's Office of Maintenance has the most or one of the most detailed inspection processes and criteria of any DOT. It is incorporated into its *Maintenance Rating Handbook*. A high standard is established for sidewalk maintenance requiring over 99% of the sidewalk area to be free of vertical misalignments greater than 1/4 inch, horizontal cracks greater than 3/4 inch, or spalled areas greater than 1/2 inch in depth, and no visible hazards. The handbook contains a series of photos and descriptions to help inspectors properly measure conditions. Florida DOT is among just a handful of states who maintain all sidewalks on its highways.

Choosing an Inspection Program

Of cities surveyed for this report, the majority either does not have a formal sidewalk inspection program or employ a zone inspection program. The type of program selected depends largely on the resources available: community-wide inspection requires the most resources, while a spot inspection program requires the least; a zone inspection program falls between community-wide and spot programs, but the amount of resources required can vary widely based on the number of zones used. The resources required to carry out an inspection

program vary not just with the type of program selected, but also with the age of the sidewalks being inspected. In newer communities, it may be possible to inspect large areas very quickly, as sidewalk systems have been built to current guidance, and have not had extensive damage from tree roots or other items. Inspection of older sidewalk systems can take considerable time, especially in areas where curb ramps have not been brought up to ADA standards, or mature trees have damaged sidewalks.

At a bare minimum, a basic inspection system should consist of spot inspections as described above. This is certainly the least formal and robust approach to inspection, but is necessary to respond to immediate maintenance problems caused by a variety of factors. This approach is taken by communities to ensure they are responding to hazards in a way that lessens incidences and reduces their exposure to claims and liability. Upon completion of inspection and determining the extent of a problem, some form of work order will likely be issued leading to one of the following repairs: wedging, grinding, patching or sidewalk replacement. It could also lead to sweeping, vegetation removal or trimming. For a path, an asphalt patch or overlay may also be considered.

When sidewalk and trail conditions deteriorate, one of the following factors will exceed an acceptable threshold. Routine inspections should consider, at a minimum, changes in level or grade, excessive cross-slopes and vertical clearances. Additional factors are considered in more comprehensive inspections such as those conducted zone-by-zone or community-wide.

Chapter 11 of *Designing Sidewalks and Trails for Access, Part II* has an excellent discussion laying out a complete sidewalk assessment system. This is used for more extensive inspection processes for community-wide assessments and often for ADA transition plans and sidewalk replacement programs being conducted on a zone-by-zone basis within a community. Features of such an assessment go beyond routine inspection procedures with the following measurements being involved: sidewalk cross slopes (including cross slopes at driveways), maximum running grades when exceeding 5%, changes in level, changes in grade, maximum cross slope, minimum clear width, surface defects, minimum vertical and horizontal clearances and the distance protruding objects intrude into the pedestrian path. The actual criteria or threshold values used to evaluate and inspect facilities are included under the *Sidewalk and Path Maintenance and Inspection* sub-section provided later in this section.

Unlike sidewalks, shared use paths were uniformly owned and maintained by the communities contacted for this study. There appeared to be little ambiguity about who's responsible for maintaining paths. Despite this, only a few of the communities contacted had any formal and proactive inspection process for shared use paths, even though they may have had a robust

inspection and repair program for sidewalks. Most communities relied on reports of hazards from users; almost all of whom were bicyclists. However, when path inspection and repair was discussed with communities, nearly every community indicated that their attention to repairs on paths was as good or even better as the efforts they were making for sidewalks. Several indicated that they paid more attention to deficiencies in paths than sidewalks, because of the sheer volume of users (often citing heavy bicycle traffic) on paths compared to sidewalks. Several communities indicated that they do visual inspections when their staff is on the paths, but it did not constitute a formal inspection process.

Of the communities contacted, Madison, Wisconsin, had the most extensive path inspection system. All paths are visually inspected on a regular basis, and individually rated for pavement condition on an annual basis. Condition reports are reviewed every year and a number of paths are selected for resurfacing or repaving based on condition rating, path usage and other factors. Between major resurfacing projects, surface problems are addressed based on reports of hazards, with pothole patching or other repairs being completed as necessary and priority given to problems with safety implications.



Image 6: Section of a shared use path being repaired in Madison, Wisconsin

A unique approach to sidewalk inspection involves the use of volunteers. Hoboken, New Jersey has an annual inspection program where the city enlists trained volunteers to walk the sidewalks and record any problems. The volunteers tend to be younger students and elderly residents, and are given some training in how to recognize and document pedestrian facility issues. Currently, the volunteers note the location of damage to a specific slab and rate the severity of the disrepair. The City of Hoboken has enlisted college student volunteers to develop a smartphone application (separate from Hoboken311 described below) that their volunteer inspectors can use so that the whole sidewalk inventory would be digitized instantly.

Nearly every community contacted offered at least one means of reporting hazards. The most common form of reporting was by phone to the public works, transportation department, or parks department for paths. The next most common form was electronically through an agency's website. PEDS, a metropolitan Atlanta advocacy group, has established an online hazard reporting system used by the City of Atlanta and many Atlanta suburbs. People are

encouraged to report broken sidewalks, dead walk signals, faded crosswalks and other pedestrian hazards. Hoboken has a program called Hoboken311, which brings together all manners of reporting issues into one system. Along with phone and website reports, the program includes a smartphone application (also called Hoboken311) that can be used to report any number of public nuisance problems including snow removal issues, needed sidewalk repair, burnt out pedestrian lighting, damaged pedestrian signals, etc. The application allows the user to take a picture of the problem to send in with the complaint and the system will automatically send the user status updates until there is a resolution to the problem. Several communities also have developed similar smartphone application, including Cambridge, Massachusetts, Boston, Massachusetts, Louisville, Kentucky, and Charlotte, North Carolina.

An important aspect of sidewalk and trail inspection is the management of collected data. Inspection of all types – from spot inspection to comprehensive assessments – should be documented. During an inspection a form is typically completed for each property. If a spot inspection is conducted due to a reported problem, only one or two properties may be assessed. For more comprehensive inspections, notes and forms are completed assessing the defective panels, the types of defects found, and the length and width of the anticipated repair. These field notes are then used to generate inspection reports, which are often sent to the adjacent property owners who are required to pay for all or part of the sidewalk repair or replacement.

After a complaint is received and the inspection reveals the condition does not meet the city's criteria for correction or repair, the city's records should indicate an inspection occurred; document the nature and extent of the conditions observed; and that the condition does not meet the city's established criteria for replacement or repair.

According to resources provided by the League of Minnesota Cities and many other resources, it is helpful if a community documents its sidewalk inspection and sidewalk problems. Not only does it help the community plan and program for the correction, which in turn will reduce trips and falls, but it is a hedge against liability. In the event of a lawsuit, the city's attorneys can use these documents to prove the existence of the community's inspection policies and the community's adherence to the policies. They can also show that the city exercised reasonable care in inspecting and maintaining its sidewalks. The League cautions that sometimes communities will have the mistaken notion that if they do not document policies or problems, there will be no paper trail to hurt them later on; however, judges and juries can draw negative inferences from a lack of documentation. Documentation shows that a community took deliberate action to inspect and maintain facilities.

The City of Fond du Lac, Wisconsin, was one of the first communities in the country to use a more sophisticated data management system for sidewalk inspections. Fond du Lac created a custom database application using computer software to help manage the vast amount of data associated with the city's sidewalk program. This database application stores all of the sidewalk data in one central location and automatically generates several reports. The electronic database allows the city to not only manage the data in one place, but to automatically calculate quantities for estimating sidewalk replacement costs and bid quantities.

A mobile GIS application consisting of a handheld computer with GIS software and a global positioning system (GPS) is used in the field and synchronized with the sidewalk database as inspections occur. A GIS parcel map is used to note defects in the sidewalk and creates points in the database using the inspector's GPS location. Digital photographs are also taken of the defects during the inspection and are added to the parcel information in the database.

Specific sidewalk and trail inspection tools that can be used include check sheets, smart levels and GPS programs. There are specific criteria related to prevent tripping hazards. A profile gauge is used to measure small changes in level and a smart level or digital inclinometer is used to measure cross slopes and running grades. It is ideal to maintain a $\frac{1}{2}$ inch maximum change in level. However, among the communities contacted, a common practice was $\frac{3}{4}$ inch. When this was discussed with several communities in severe winter states, they felt this was a reasonable since sidewalk displacements are typical due to frost heaves. Grinding or horizontal cutting is recommended for changes in level between $\frac{1}{4}$ inch and $\frac{1}{2}$ inch (see section below). Prevention of tripping hazards is especially crucial for seniors and people with disabilities. This is because seniors can sometimes have visibility issues and wheelchair tires are likely to get stopped by level changes.

Sidewalk and Trail Management Inspection Criteria

The above defects need to be assessed and measured against accepted guidelines and standards. The actual practice of performing this function is commonly known among communities as inspection (see the previous section on *Inspection and Inventory*). Sidewalk inspection criteria serve many useful purposes, especially to reduce or eliminate slips and falls based on avoidable sidewalk and trail hazards. Other reasons include providing guidelines to agency employees, conveying information to residents, and preventing and/or minimizing lawsuits and exposure. The following section summarizes the actual thresholds or measurements used in the United States.

Every community that has a maintenance program in place uses criteria to evaluate existing conditions. Based on discussions with community officials, the criteria are not always published, many times discretionary and are often not applied equally across the community. Additionally, many communities contacted only used sidewalk faults (changes in level) for responding to immediate problems and their inspection protocol did not extend beyond that level of assessment even on a long term basis.

Communities should develop and adopt sidewalk inspection and maintenance policies if guidelines, standards and policies do not already exist. At a minimum, inspections should consider changes in level, changes in grade, excessive cross-slopes (including cross slopes at driveways), vertical clearances, maximum running grades, minimum clear width and the distance protruding objects extend into the pedestrian path. In the communities researched, not all of these criteria are being used – or should be used – for spot inspection purposes. Spot inspection occurs when communities respond to immediate hazards. Many of these spot repairs will focus on tripping hazards, which are caused primarily by faults in the sidewalk.

The ADA Draft Guidelines for the Public Right of Way provide the following guidance for walkways. The guidance states that surfaces of public sidewalks be stable, firm, and slip-resistant, and shall lie generally in a continuous plane with a minimum of surface warping. More specifically, the guidelines address the conditions:

- *Faults/Changes in Level:* Surface discontinuities shall not exceed 13 millimeters (0.50 inches) maximum. Vertical discontinuities between 6.4 millimeters (0.25 inches) and 13 millimeters (0.5 inches) maximum shall be beveled at 1:2 minimum. The bevel shall be applied across the entire level change.
- *Maximum Running Grade:* Where pedestrian access routes are contained within a street or highway right-of-way, the grade of the pedestrian access route is permitted to equal the general grade established for the adjacent street or highway, except where pedestrian access routes are contained within pedestrian street crossings a maximum grade of 5 % is required. This is consistent with the AASHTO "Policy on Geometric Design of Highways and Streets" which recommends that the sidewalk grade follow the grade of adjacent roadways, and also recommends maximum cross slopes for roadways. Where pedestrian access routes are not contained within a street or highway right-of-way, a maximum grade of 5 % is required.
- *Cross-Slope Grade:* A maximum cross slope of 2 % is specified for pedestrian access routes, except for pedestrian access routes contained within certain pedestrian street

crossings in order to allow for typical roadway geometry. A 5 % maximum cross slope is specified for pedestrian access routes contained within pedestrian street crossings without yield or stop control to avoid any unintended negative impacts on the control and safety of vehicles, their occupants, and pedestrians in the vicinity of the intersection.

- *Minimum Clear Width:* The continuous clear width of pedestrian access routes (exclusive of the width of the curb) must be 1.2 meters (4 feet) minimum, except for medians and pedestrian refuge islands where the clear width must be 1.5 meters (5 feet) minimum in order to allow for passing space.
- *Protruding Objects:* Objects with leading edges between 685 millimeters (2.25 feet) and 2 meters (6.7 feet) above the finish surface must not protrude into pedestrian circulation paths more than 100 millimeters (4 inches). Post-mounted objects such as signs that are between 685 millimeters (2.25 feet) and 2 meters (6.7 feet) above the finish surface must not overhang into pedestrian circulation paths more than 100 millimeters (4 inches) measured horizontally from the base of the post. The post base must be 64 millimeters (2.5 inches) thick at a minimum. Where objects are mounted between posts, and the clear distance between the posts is more than 305 millimeters (1 foot), the lowest edge of the object must be 685 millimeters (2.25 feet) minimum or 2 meters (6.7 feet) maximum above the finish surface. The requirement for post-mounted objects differs from the 2004 ADA and ABA Accessibility Guidelines but is consistent with the MUTCD which requires the bottom of signs installed on the sidewalk to be 7 feet minimum above the sidewalk, and the bottom of secondary signs (i.e., signs mounted below another sign) that are lower than 7 feet above the sidewalk to project not more than 4 inches into the sidewalk (see MUTCD section 2A.18).

Several smaller communities contacted had good descriptions of defects, along with thresholds they use for triggering repair and replacement of sidewalks.

The City of Corralville, Iowa's website provided a narrative and photos with a simple categorization of problems and thresholds (Table 5).

Table 5: Descriptions and photos of common sidewalk problems in Corralville, Iowa



Code A: Sidewalk panel is raised $\frac{3}{4}$ " or more from an adjacent panel, creating a vertical edge; panel is cracked or separated by $\frac{3}{4}$ " or more in width; or panel is separated horizontally or vertically by $\frac{3}{4}$ " or more with any adjacent paved surface.



Code B: Sidewalk panel is raised or depressed from normal grade by 2 inches or more within 10 feet or less of sidewalk.



Code C: Sidewalk panel is cracked into more than three pieces, with one or more loose pieces.



Code D: Sidewalk panel is sloped or tilted, ponding water covering half or more of the sidewalk width.



Code E: Sidewalk has 50% surface deterioration and $\frac{1}{2}$ inch surface depressions.

Similarly, the City of Oregon, Ohio, also had a useful set of guides (Table 6). The city used letter codes to denote the deficiency and also to identify if it was the property owner or city's responsibility to repair or replace the sidewalk.

Table 6: Descriptions and pictures of common sidewalk defects in Oregon, Ohio



Stub Toe (S): The vertical misalignment along any part of the seam between two slabs, or between sections of a cracked slab, of $\frac{1}{2}$ " or more, or deemed hazardous by engineering judgment



Cracked Slabs (C): Slabs fragmented by cracks into four or more sections, and/or where any one of the gaps is greater than 2 inches and prohibit the sidewalk from functioning as designed



Traverse Slope (T): Any individual slab or portion of a slab shall not slope either toward the street or the adjoining property at a ratio of more than $\frac{5}{8}$ " per foot (1:20)



Gaps (G): Opening in between sidewalk slabs greater than 2" in width, or those caused by the absence of a fragmented section of sidewalk exceeding 2" in width

Table 6 continued



Spalling (Pitted) Slabs (P): Slabs whose surface is granular or if a chunk of the sidewalk surface greater than 2" in width has broken out, and the result is a hole $\frac{1}{2}$ " or deeper

Longitudinal Slope (Sunken or Raised Sections) (L): Any sidewalk panels that have lifted to a peak or sunken such that the slab or portion of a slab deviates from the average line of the sidewalk surface level at a ratio of more than 1 inch per foot



Tree Root Damage(R): Any deficiencies in a slab or part of a slab that are deemed to be caused by tree roots from a tree in the city right-of-way will be the responsibility of the city.

Public Utility Damage (O): Any deficiencies in a slab or part of a slab that are deemed to be caused by public infrastructure (sewer and water mains, sewer manholes, catch basins, etc.). Damage deemed to be caused by public infrastructure will be the responsibility of the City of Oregon.

Brick and Paver Damage

Most communities who have sidewalks constructed of bricks or pavers use the same inspection criteria for these materials as they do for concrete sidewalks. These materials are considered a "segmental material" since each paver is separate and is often not tied or bonded together the way a concrete slab is formed and functions. When there is an underlying problem in the subgrade, it is not unusual to have just one or two bricks become displaced sometimes forming a tripping hazard for just those few bricks. In contrast, concrete sidewalks might be able to withstand smaller more localized pressures until a time the entire slab is displaced. Gaps between bricks and pavers might also cause problems in greater frequency than with concrete and asphalt sidewalks simply because of the greater number of potential gaps that exist.



Image 7: Bricks and pavers that have come loose or are not evenly placed can create a hazard.

Bricks and pavers should be set in place so they are easy to reset or replace. Bricks and/or pavers can cause vibrations that are painful for pedestrians who use mobility aids. Again, the design of the sidewalk can reduce this problem based on the pattern of the bricks and joint width that is used. Many communities are simply replacing the bricks and pavers they have in place and using bricks or pavers only for sidewalk borders in certain settings to reduce possible maintenance problems in the future.

2.2.4 | Accessibility

Before describing repairs and practices in more detail, a brief explanation of accessibility is necessary. There are generally two accessibility issues related to maintenance, and both require maintaining an “accessible path.” First, proper and routine maintenance of walkways allow access between intersections and points between intersections. Secondly, the maintenance of transition points – curb ramps, medians, crosswalks, etc. – ensures access at intersections. These are inextricably linked to form an accessible path.

The maintenance of an accessible path can be put into the context of universal design. Routinely maintaining a pedestrian system will ensure that facilities accommodate people with disabilities, but in turn, will also give dependable access and an improved level of service to people of all ages and abilities.

ADA and Section 504

The Americans with Disabilities Act (ADA) of 1990 and Section 504 of the Rehabilitation Act of 1973 address how transportation facilities should accommodate people who are disabled. The essential ADA requirement is to create a pedestrian route within the public right-of-way to link access points and destinations. Within the public right-of-way, sidewalks are considered a pedestrian access route, as are crosswalks, paths, traffic signals and other pedestrian facilities. Just as minor changes in facilities can greatly improve accessibility, seemingly minor maintenance problems can form a significant barrier to people who are disabled or even able bodied.

The Architectural and Transportation Barriers Compliance Board (the U.S. Access Board) has recommended accessibility guidelines for the design, construction and alteration of pedestrian facilities in the public right-of-way. These ADA accessibility guidelines and standards address new and altered pedestrian facilities. The guidelines ensure that sidewalks, pedestrian street crossings, pedestrian signals and other facilities for pedestrian use that are constructed or altered in the public right-of-way by state and local governments are readily accessible to and usable by pedestrians with disabilities. When the guidelines are adopted as accessibility standards in regulations issued by other federal agencies implementing the Americans with

Disabilities Act, Section 504 of the Rehabilitation Act and the Architectural Barriers Act, compliance with the accessibility standards is mandatory.

The ADA and Section 504 do not require public agencies to provide pedestrian facilities. However, where pedestrian facilities exist they must be accessible. Furthermore, when public agencies construct improvements providing access for pedestrians, the completed project also must meet accessibility requirements for persons with disabilities to the maximum extent feasible.

As part of maintenance operations, public agencies' standards and practices must ensure that the day-to-day operations keep the pedestrian path of travel open and usable for persons with disabilities throughout the year. According to federal code Title 28 CFR35.133 "Maintenance of Accessible Features:"

- 1) A public entity shall maintain in operable working condition those features of facilities and equipment that are required to be readily accessible to and usable by persons with disabilities by the Act or this part.
- 2) This section does not prohibit isolated or temporary interruptions in service or access due to maintenance or repairs.

Both of these requirements will be examined in more detail.

Alterations

The distinction between maintenance of pedestrian facilities and the alteration or new construction of facilities is important. This report addresses the maintenance of pedestrian facilities. Alterations to pedestrian facilities are more significant and offer considerably more opportunities to incorporate ADA compliant features. ADA requires public entities that *alter* facilities to incorporate accessibility improvements. Typically, alterations to sidewalks occur as a result of alterations to the adjacent roadway. Projects altering the usability of the roadway must incorporate accessible pedestrian improvements at the same time as the alterations to the roadway occur. See *Kinney v. Yerusalim*, 9 F.3d 1067 (3d Cir. 1993), cert. denied, 511 U.S.C. 1033 (1994). Since alterations are changes to a facility in the public right-of-way that affect or could affect access, circulation or use by persons with disabilities, it is conceivable that replacing long segments of sidewalk could rise to the level of an alteration. The replacement of significant sections of sidewalks associated with a street reconstruction or intersection reconstruction would be considered altered facilities.

Maintenance and Repair

Maintenance activities that involve the actual repair of a pedestrian facility are not considered alterations. Therefore, maintenance projects do not require simultaneous improvements to pedestrian accessibility under the ADA and Section 504. The U.S. Department of Justice (DOJ) and the courts have not ruled on what defines an alteration when sidewalks are impacted by various types and scopes of projects. FHWA has considered common maintenance activities associated with roadways as those that are intended to preserve the system, retard future deterioration and maintain the functional condition of the roadway without increasing the structural capacity.

Maintenance activities include, but are not limited to, thin surface overlays (nonstructural), joint repair, pavement patching (filling potholes), shoulder repair, signing, striping, minor signal upgrades and repairs to drainage systems. Based on that, surfacing treatments for sidewalks such as filling holes and cracks, wedging, grinding and horizontal cutting are considered maintenance. The replacement of short segments of sidewalk to repair surface irregularities is also maintenance in nature; however, communities and states should use this opportunity to meet ADA standards on these types of projects to the extent possible – even with small sidewalk replacements – given the scope of the repair and the technical feasibility. Most of the communities in which discussions were held indicated that they are meeting ADA standards when doing routine maintenance work.

Day-to-Day Operations

As part of maintenance operations, public agency practices must ensure that day-to-day operations keep the path of travel open and usable for persons with disabilities throughout the year. This includes snow and debris removal, and maintenance of pedestrian traffic in work zones with only isolated or temporary interruptions in accessibility. According to FHWA, “A public agency must maintain its walkways in an accessible condition, with only isolated or temporary interruptions in accessibility. 28 CFR §35.133. Part of this maintenance obligation includes reasonable snow removal efforts. (9-12-06).”²

2.2.5 | Surface Maintenance Practices

The following sub-section summarizes the common repair practices associated with concrete sidewalks based on the research conducted for the report and the discussions conducted with communities as presented as part of Chapter One. The Guide will elaborate upon these identified repairs and expand the discussion to asphalt pavement and brick and concrete paver.

² “Question and Answers About ADA/Section 504.” U.S. Department of Transportation, Federal Highway Administration. Accessed January 23, 2013. http://www.fhwa.dot.gov/civilrights/programs/ada_sect504qa.cfm.

While this research report identified the current state of practice for sidewalks, the Guide itself will provide a series of exemplary approaches to maintenance repair practices accompanied with recommendations.

Maintenance practices can be categorized into two main groups: short term measures typically lasting from one to five years, and longer term measures lasting many years, perhaps in some situations even over ten years. Short term measures consist of repairs that are often temporary until sidewalk segments are replaced. Long term measures include sidewalks being replaced either through a sidewalk replacement program or when a street is reconstructed and sidewalks are replaced as well.

Temporary Maintenance Measures

When a sidewalk is reported as damaged, or damage is found during routine inspection, temporary repairs may be made. These temporary measures may include wedging or patching with asphalt or quick-mix cement that may not meet a municipality's desired level of maintenance. However, the temporary repair should alleviate most hazard concerns until a more comprehensive repair is later performed.

Short Term Maintenance Measures (Repairs)

There are several measures that can be considered short term maintenance techniques (lasting one to five years) for sidewalks and trails. The main measures include wedging, patching, horizontal cutting, grinding, mud-jacking, overlays, etc. and the inevitable solution in many cases – sidewalk replacement – which is most often considered a long term solution.

Long Term Maintenance Measures (Replacement)

The universally accepted long term maintenance technique is sidewalk replacement. However, many of the communities contacted have had some success with grinding and mud-jacking as longer term solutions. Horizontal cutting is a newer technique that is similar to grinding and should have the same success rate as grinding. The problem in considering grinding, mud-jacking and horizontal cutting as longer term solutions is the uncertainty that the underlying problems associated with these fixes will continue to be an issue. For example, if a sidewalk sags and mud-jacking is used to correct the problem, the sidewalk may continue to sag after the mud-jacking due to the underlying problem – an unstable base. Likewise, grinding and horizontal cutting will often be used to rid a sidewalk of a tripping hazard, but will leave one or two sidewalk panels with a cross slope of greater than two % or with warped transitions between panels.

Following are photographs and descriptions of the main set of sidewalk repairs and replacement.

Wedging

Entails the placement of an asphalt or concrete filler placed in the advance of a vaulted section of a sidewalk or shared use path to essentially provide a ramp and remove a tripping hazard. If done properly to a sidewalk that has not vaulted severely, it can be made ADA accessible. The wedge on the left is just a few days old, while the wedge on the right is likely to be several years old with significant deterioration illustrating the short term nature of this technique. Also note the gradual grade with the wedge on the left consistent with a grade of less than 8.3% and in keeping with the ADA draft guidelines for public right-of-ways.



Image 8: A wedge has been placed to mitigate the hazard caused by a raised sidewalk slab.



Image 9: A small wedge may still create a hazard or be difficult to navigate in a wheelchair.

Patching

This is a common and often effective repair when small sidewalk corners have broken off or minor gaps have formed between sidewalk panels. It is temporary and most often done in asphalt. When a concrete filler is used, it is best to undercut the hole to allow the patch to bond more permanently with the existing sidewalk. As seen below, patching (as well as wedging) leaves a lip that is at least as significant as the aggregate that is used in the material. Choosing asphalt as a patching and wedging material is seldom done in the southwest parts of the U.S. because of the incompatibility of the material with high sustained temperatures.



Image 10: Missing areas of concrete have been marked for repair.



Image 11: The areas have been temporarily repaired with asphalt patches.

Grinding and Horizontal Cutting

Grinding and horizontal cutting are similar treatments. New cutting technology is allowing tighter tolerances with horizontal cutting saws. The photo on the left is of a horizontal cut at a sidewalk panel fault. Note that the panel has uniformly lifted allowing a straight cut across the width of the panel removing the tripping hazard. The panel being cut has not settled from one side to the other, just lengthwise. Therefore, there is no change in the cross slope, making cutting or grinding an appropriate treatment for this sidewalk displacement. Grinding or cutting of the panels depicted on the right will leave the transition between the panels without a tripping hazard, but will likely leave a warped condition as users transition to and from the treated area since the panel fault has settled to one side. A sidewalk with a cross slope greater than two % is not in compliance with ADA draft guidelines for public rights-of-way. ADA draft guidelines accept grinding and cutting for displacements of between $\frac{1}{4}$ in and $\frac{1}{2}$ in. If over a $\frac{1}{2}$ in, the repair has to be at the grade of a ramp – maximum of 8.3%.



Image 12: A raised sidewalk block has been ground down to provide a smoother transition.

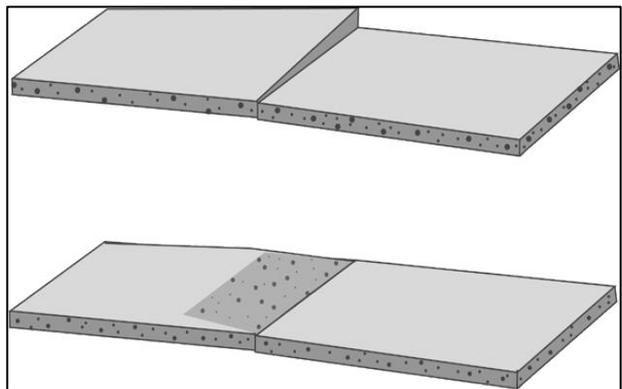


Image 13: The diagram shows how an unevenly raised slab can be ground to provide a smoother transition.

Mud-jacking, Concrete Raising, or Slab-jacking

This repair method lifts concrete sidewalk slabs back to their original position by pressure injecting cement or non-cement material under the sidewalk. Holes are drilled through the slab and grout is injected to raise the concrete slab or to fill the voids under them. Although it is less costly than replacement, it is only effective on sunken sidewalks. Of the communities contacted for this report, few were using this repair method. It can have long term success. The photo below of a mud-jacked sidewalk segment in Madison, Wisconsin, has been in good shape and in compliance to standards for more than 20 years.

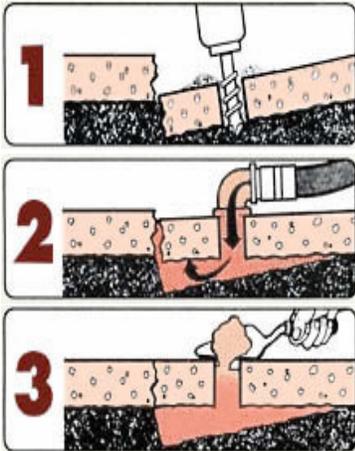


Image 14: Graphic detail of how the mud-jacking process works.

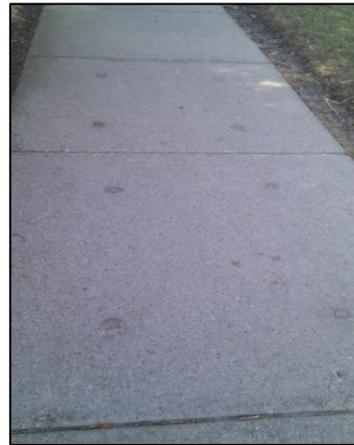


Image 15: These panels were mud-jacked more than 20 years ago and are still in good condition.

Sidewalk Replacement

Although many repairs can provide temporary solutions to sidewalk problems, especially tripping hazards, at some point it becomes necessary to replace concrete sidewalks. This involves the entire removal and replacement of sidewalk panels or slabs and if done properly usually results in extending the life of sidewalks well over 10 years.

Of the communities contacted for this part of the research, there were several approaches in how communities used sidewalk replacement practices. One of models used especially in many of the



Image 16: Replacement sidewalk being installed. Photo Courtesy of the City of Charlotte

Midwestern states was a zone-by-zone approach to sidewalk replacement. It is typically cost-effective for a moderately sized or larger community to manage an annual program for the replacement of sidewalks in a sub-area or zone of a community. Communities often put this in action on a four to 10 year cycle. It has the added benefit of being able to address all of the defects related to hazards and accessibility. Most communities combine this with short-term repairs as described above for addressing problems outside of the targeted zone(s) so that immediate hazards can still be addressed while a sidewalk replacement program is cycling through the city. Some of the smaller communities were able to manage such a program over the entire community on an annual basis. This model requires a significant commitment of inspection (see inspection and inventory).

Another model that was discovered when conducting discussions with communities was a sidewalk replacement program operated exclusively or nearly exclusively as the only means of sidewalk repair – none of the shorter term repairs cited above were used. Fifteen % of communities contacted for discussions used this approach including Norwalk, Iowa; Sparks, Nevada; Salisbury, North Carolina; Hoboken, New Jersey; Greenwich, Connecticut; Burlington, Vermont; Cedarburg, Wisconsin; and Crossville, Tennessee. Several in this group stated that they respond only to reported hazards on a community-wide basis and did not have a formal program in place where they had annual inspections and programmed replacements zone-by-zone. However, in these cases, their own city crews were replacing the sidewalks on the spot since these communities were funding 100% of the repairs. Not having to levy property assessments for these repairs significantly aided these communities ability to respond quickly to the hazards, and in some cases, they were replacing sidewalks in as few as three days to a week.

Nearly all of the communities reached for this study indicated that they take full advantage of street reconstruction projects to replace sidewalk pieces. At that time, cost for sidewalk replacement is generally at a lower unit cost.

2.3 | SEASONAL MAINTENANCE OF SIDEWALKS AND PATHS

The conditions of sidewalks for safe, comfortable and accessible travel are influenced by seasonal events such as snowfall, the accumulation of leaf debris and the overgrowth of vegetation. Maintenance activities to remove obstacles to safe walking are needed to keep sidewalks accessible and hazard-free year-round.

Meeting the obligations to keep sidewalks accessible is reinforced by the Americans with Disabilities Act (ADA).³ The act requires that to “the maximum extent feasible” pedestrian facilities in the public right-of-way be accessible to people with disabilities. The federal code acknowledges that there may be isolated or temporary interruptions in accessibility, but otherwise walking surfaces must be kept clear of snow, debris, and any obstructions to a minimum passage width of 36 inches.

The level of effort and cost associated with these activities varies widely between jurisdictions. Jurisdictions in different climatic zones have different seasonal activities. For example, jurisdictions in the “snow belt” must dedicate additional resources to snow removal while those with abundant street trees may require additional management of leaves and debris to ensure safe sidewalks. Throughout the United States, as conveyed by the communities researched, it is common that these activities are performed and balanced as part of an annual maintenance cycle. It is also common that local governments, by ordinance, pass on the responsibility of keeping sidewalks clear to the adjacent property owner abutting the sidewalk. This approach requires additional education, inspection, enforcement and administrative actions to be successful.

2.3.1 | Vegetation Management and Removal

Street trees and other plants adjacent to the sidewalk are a beneficial amenity for a variety of reasons including provision of shade, carbon dioxide reduction, increased property value, stormwater control and visual interest. However, vegetation must be properly installed and maintained in order to keep the sidewalk unobstructed. Sightlines must also be maintained for pedestrian safety. In addition, the surface of the sidewalk must be kept free of debris. Most communities reported that work related to vegetation maintenance is not a significant effort due to the informal nature of most programs. However, jurisdictions with large numbers of deciduous street trees require leaf collection, and may require a significant seasonal maintenance effort.

Vegetation in the public right-of-way is often managed differently than vegetation that is planted on private property. The majority of communities surveyed require adjacent property owners to maintain vegetation on their parcels so that it does not overhang onto the sidewalk. Most jurisdictions found that this was a successful practice with good compliance. If vegetation is not maintained and it overhangs onto the sidewalk, many communities will follow-up only when complaints are filed. For example, the City of Greenwich, Connecticut, has an informal

³ “2010 ADA Standards for Accessible Design – Alterations.” U.S. Department of Justice. September 15, 2010. Accessed January 23, 2013. <http://www.ada.gov/regs2010/2010ADASTandards/2010ADASTandards.htm#alterations>.

inspection program and complaints generally guide enforcement. Residents who have been notified of vegetation encroachment have 14 days to remove the vegetation. After 14 days the city will trim the vegetation for free. However, most residents comply because they do not want the city trimming their plants for aesthetic reasons. This process, although somewhat informal, has worked well to clear vegetation from adjacent sidewalks.

The City of Portland, Oregon, has developed a street tree program that equips residents with guidelines and information on how best to plant street trees. The pamphlet, which is available online, provides residents with spacing and planting information for the establishment of healthy trees. Other cities, such as Saint Paul and Minneapolis, Minnesota, encourage the planting of vegetation in the public right-of-way. A local organization has developed a “Twin Cities Boulevard Gardening” brochure that describes city guidelines such as vegetation height limits and location restrictions as well as the best materials to use for planter boxes.⁴ Providing the public with clear planting guidelines can encourage appropriate plantings in the public right-of-way, which can improve the stewardship of a community and help maintain a clear pedestrian zone free of obstructions.

Vegetation within the public right-of-way is managed in a variety of ways. Some communities require adjacent property owners to maintain vegetation planted between the sidewalk and the curb. Other jurisdictions may have city staff such as arborists, parks department personnel, public works personnel or urban foresters maintain city-owned street trees, which may include repairs to sidewalks when damaged by tree roots. Other jurisdictions require property owners to obtain a permit in order to plant between the sidewalk and the curb so that proper sightlines and the pedestrian clear zone are maintained. Successful programs employ arborists to do inspection, trimming and monitoring of construction activities that may influence street trees.

While some communities have ordinances regarding the maintenance of vegetation, it was unclear how many municipalities have ordinances that govern the maintenance of vegetation along the sidewalk on private property and in the public right-of-way. Wilsonville, Oregon, exemplifies the typical approach that small jurisdictions take toward vegetation maintenance. The city has one full-time arborist on staff in the public works department who is responsible for inspecting sidewalk vegetation overgrowth that impedes sightlines or sidewalk passage. If vegetation on private property has overgrown the sidewalk, the arborist will give the property owner notice to remove the vegetation. The city has the authority to remove the overgrowth

⁴ “Twin Cities Boulevard Gardening.” Sustainable Resources Center. Minneapolis. Accessed January 23, 2013. <http://www.mppeace.org/downloads/boulevard.pdf>.

and bill the property owner but that rarely occurs. Generally communities are less likely to enforce through fines than through the issuance of a warning.

The City of Seattle, a larger jurisdiction, has an Urban Forestry Department that is responsible for maintaining street trees. However, the street-use department manages enforcement of sidewalk overgrowth. Due to budgetary restrictions, the city has focused on educating property owners of their responsibilities rather than exercising enforcement mechanisms such as issuing tickets to property owners unless the conditions present a hazard.

In the presence of street trees, the success of sidewalk replacement and repair is determined by how well adjacent street trees are protected. Conversely, the health of street trees can be influenced by the maintenance and practices of sidewalk repairs. Factors that influence street tree health include: 1) adequate tree pit size for the tree type, 2) proper spacing along the roadway, and 3) making informed decisions when pruning and cutting roots.

Understanding the anatomy and special requirements of street trees and repairing sidewalks to best preserve existing trees can influence sidewalk conditions in the long-term. According to a presentation by James Kringer on urban forestry techniques presented as part of the UW-Madison's *Developing an Effective Sidewalk Program*, tree root systems extend horizontally one to two times the height of the tree and lie eight to 24 inches below the surface on average. Root systems are comprised of stabilizing roots and feeder roots. On average there are four to 11 stabilizing roots which are most likely to damage sidewalks. These roots extend horizontally from the trunk and provide stability and support for the tree. Cutting stabilizing roots can be detrimental to the health of the tree. Feeder roots are smaller and denser roots that absorb moisture and nutrients. These roots are less likely to be influenced by sidewalk repair.

There are several methods recommended to avoid damage to sidewalks and adjacent street trees. Each of these recommendations will be addressed in more detail in the final guide:

- *Sidewalk Width Reduction*: Creating additional space around a mature tree can be done by reducing the width of the sidewalk as long as the width is not reduced to below 48 inches-- the minimum recommended passageway width required by ADA.
- *Sidewalk Arching*: Moving the sidewalk alignment to provide more space for the tree root zone is a successful technique for preserving both tree and sidewalk. However, this may require an easement from adjacent property owners; property owners may be willing to cooperate in order to preserve mature street trees.

- *Rubber, Plastic and Permeable Sidewalk:* These alternatives to concrete are beginning to be used in areas adjacent to street trees with on-going root issues. These sidewalk material alternatives will be discussed further in the guide.
- *Manual Root Cutting:* Use of mechanical root cutting techniques such as root saws or Jack-hammers is not recommended. These techniques often fatally damage the tree by severing the major stabilizing roots. Roots cuts should be kept to minimum and hand cut with an ax.
- *Arborist Supervision:* During sidewalk repair and replacement when tree roots must be cut an arborist should be present to assist with the decision making process. Making the correct decisions can protect the tree and prolong the life of the sidewalk segment being repaired.

In communities with street trees and large amounts of street vegetation leaf collection can be a significant seasonal activity on the part of the jurisdiction. Surveyed communities reported spending between \$10,000 and \$200,000 annually on leaf and debris pick-up programs. Jurisdictions with leaf collection programs usually require residents to collect leaf and vegetation debris from adjacent properties, sidewalks, and gutters or sweep debris to the street for pick-up. Some communities dictate the collection techniques such as banning leaf blowers to reduce dust and noise pollution. Jurisdictions will then provide curbside pick-up on a weekly, monthly or seasonal basis. Some jurisdictions provide community composting opportunities in an effort to reduce costs of debris pick-up programs.

While most communities sweep streets of debris, only one community had an active city-wide, sidewalk-sweeping program. Many other jurisdictions have sidewalk debris removal programs within commercial business districts. For example, the City of Perry, GA, sweeps sidewalks in the core business district three times per year. Adjacent property owners or business improvement district contractors more commonly perform this work. The City of Concord, NH, sweeps sidewalks citywide every spring. The cost of the sidewalk sweeping program is approximately \$15,000 annually. This activity clears sidewalks of accumulated debris remaining from snow removal.

2.3.2 | Snow and Ice Removal

Following a snowfall, snow and ice must be cleared from sidewalks, curb ramps and crosswalks to provide safe and accessible passage for pedestrians. Common challenges to pedestrian travel after snowfall include street plowing that pushes snow onto sidewalks or blocks crosswalks, clogged or obstructed drains that creates puddles at curb ramps, patches of ice that create slip hazards, and failure to remove snow and ice from sidewalks. Jurisdictions should have policy and action plans that address these key issues.

While the ADA guidelines specify that sidewalks have 36 inches of clear passageway, different municipal ordinances have varying degrees of detail for how best to achieve a safe clear zone for pedestrians after a snowfall. For example, some ordinances require the use of gravel, ash or salt on ice to prevent slip hazards, while others require the breaking out of ice or do not specify treatments. Some ordinances specify the maximum allowable height of snow banks and where snow cannot be piled to insure proper visibility of pedestrians. Some jurisdictions require snow removal from specific features such as fire hydrants, benches, driveways and curb ramps. Of the communities contacted, the most successful programs specify clearance expectations in detail by ordinance and in education materials provided to the public about their responsibilities.

Common Snow and Ice Removal Strategies

In the event of a snowfall, there are common strategies that communities employ to make streets and sidewalks passable to pedestrians. In regions where snowfall is infrequent most communities rely on the quick melting of accumulation or a “melt strategy.” For example, the City of Atlanta, GA, has little snow removal equipment and sanding does not work well. Rather than remove snow and ice, the City recognizes that snow and ice will most likely melt before mobility becomes an issue. In parts of the country where snowfall is more frequent one of the most common strategies is to require by ordinance that residential and commercial property owners remove snow and ice from sidewalks that abut their property within a specific time frame. This allows city crews to focus on priority locations for snow removal such as in business districts, school zones, transit stops, bridges, intersections and other priority locations. Another common strategy for snow removal in business districts is the use of Business Improvement Districts (BIDs) or Special Improvement Districts (SIDs) where businesses encumber a tax that funds maintenance activities such as snow and ice removal from sidewalks by a hired contractor. The majority of communities surveyed reported that these strategies were successful. Even communities in low snowfall areas had measures in place to remove snow from sidewalks in downtown areas.

Several common strategies may be employed in the event that a sidewalk is not cleared of snow in a timely manner. Some communities issue a citation, like a parking ticket, that can increase in cost per day. Some communities will remove the snow and ice at the owner’s expense plus issue a citation and/or administrative fee. Some communities use a proactive approach and formally or informally organize volunteers to remove snow from properties where elderly or disabled residents cannot remove snow on their own or cannot afford the cost of hired services. In larger communities, the latter strategy is often part of a larger snow removal plan. In some smaller communities, especially those that are located in warmer

climates, volunteerism may be relied upon as an even more important strategy to remove way snow and ice from sidewalks.

The next section will highlight some of the outstanding practices discussed by the communities that were contacted.

Snow Removal Plans

A snow removal plan is a strategy for determining the priorities and actions a jurisdiction will take in response to a snow event. The development of an action plan is essential for a successful snow removal program. Often sidewalks are a secondary priority to snow removal on streets. However, plans that address sidewalks can provide important guidance on timeliness, techniques, priorities and coordination between jurisdictions and agencies to ensure that the needs of pedestrians are met. A successful plan acknowledges that pedestrian needs are important year round. Successful action plans have the following elements relating to sidewalk snow removal policies.^{5,6}

- Address the need to keep pedestrian facilities safe, accessible, and free from snow and ice
- Clarify responsibilities for winter maintenance activities, including pedestrian facilities
- Provide level of service guidelines and prioritization of facilities
- Stress the need for continuous improvements, trainings and performance measurements
- Mitigate risks and manage costs
- Utilize electronic communications and social media to enhance outreach
- Ensure compliance with federal and state laws
- Incorporate innovative and/or environmental sustainability practices that provide cost savings measures, foster efficiency of operations, and/or aid in efforts to preserve air and water quality

Jurisdictions should include the most comprehensive information available when developing or updating a plan to include pedestrian zones. Two comprehensive guides for developing snow removal plans were reviewed for this study and are recommended in the development of a plan that specifically addresses pedestrian needs:

⁵ Amsler, Duane E., Sr. P.E. "Snow and Ice Control." Ithaca: Cornell Local Roads Program. 2006. Accessed January 23, 2013. http://www.clrp.cornell.edu/workshops/pdf/snow_and_ice_control-web.pdf.

⁶ Scott, Marcia and Brandon Rudd. "Winter Maintenance of Pedestrian Facilities in Delaware: A Guide for Local Governments." Institute for Public Administration, University of Delaware. February 2012. Accessed January 23, 2013. <http://www.ipa.udel.edu/publications/SnowRemoval.pdf>.

- The *Winter Maintenance of Pedestrian Facilities in Delaware: A Guide for Local Governments* outlines sources of information for winter maintenance management plans as they relate to sidewalks, provides guidance on processes for developing a plan and highlights several communities with outstanding plans for sidewalk snow removal.⁷
- *Snow and Ice Control* is a workbook that provides a comprehensive overview of the elements of a snow removal plan.

The City of Seattle has developed a *Disaster Readiness and Response Plan* that serves as a model for fully integrating the needs of pedestrians into a city's response to snowfall.⁸ Depending on the severity of the storm, crews are deployed to provide three levels of service that include clearing snow from high priority sidewalks, bridges and transit zones. The city focuses on educating the public about snow removal requirements and uses local media, an interactive website with live snowplow locations, a blog and Twitter to update the public about snow removal progress. The city also distributes pamphlets to parents of school children containing information on winter preparedness.

Snow Removal by Adjacent Property Owners

The majority of jurisdictions contacted for this study require property owners to remove snow and ice on sidewalks that abut their property. Because the majority of sidewalks abut private property, and most communities rely on property owners to remove snow and ice, the success of sidewalk snow removal relies on a coordinated program for education and enforcement with the community. This is a common and economically efficient technique for snow removal as long as abutting owners are educated and held responsible for removal or the community is set to step in to remove snow and ice themselves when property owners fail to do so. Arguments have also been directed at this approach since it taps the resources of adjacent property owners for maintaining sidewalks when the street itself (in the same public right-of-way) is maintained by the community.

Model Programs

Depending on the region, snow removal can be a major seasonal effort for communities of all sizes. The following example programs engage the public in snow removal responsibilities through a variety of methods from encouragement to enforcement. Although the examples come from larger cities, these strategies can at least in part be employed in communities of all sizes.

⁷ *Ibid.*

⁸ Seattle Disaster Readiness and Response Plan, Volume II. April 2007. Accessed January 23, 2013. http://www.seattle.gov/emergency/library/SDRRP_VolumeTwo_linked.pdf.

The City of Chicago has developed Chicago Shovels, “a tool to help connect the public with City winter resources and empower neighbors to come together to help Chicago navigate winter.”⁹ The program employs positive messaging coupled with action opportunities that stress the shared snow removal responsibilities between residents, neighbors and the city during a snow event. The program has several services accessible online to inform and assist city residents. The Adopt-a-Sidewalk Program is an online mapping and encouragement tool that allows property owners to take the sidewalk in front of their property and link it to social media. The intention is to help neighbors and neighborhoods organize and coordinate snow removal. The Snow Corps program pairs volunteers with low income residents who are elderly or disabled. The program also provides weather alerts so that residents can receive text messages, phone calls or emails about emergency or non-emergency conditions in the city. In addition, the city has developed a brochure that provides clear diagrams and instructions on where and how to remove snow and ice. This program is exemplary in that it uses real-time mapping and social media to education and enable neighbors to work together to perform their responsibilities.

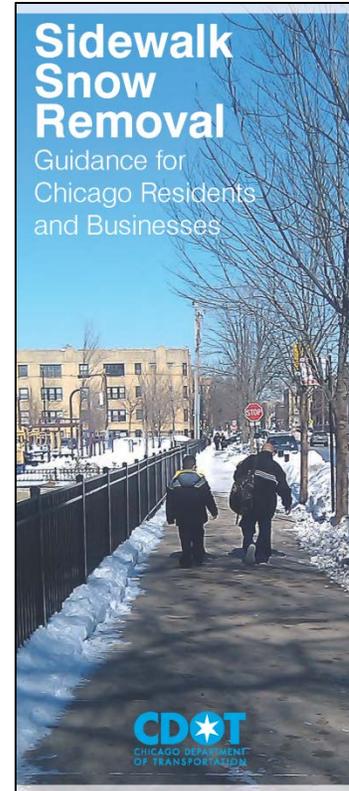


Image 17: Chicago DOT's snow guide for residents.

The City of Cambridge, Massachusetts' website has a specific section for sidewalk snow removal which includes detailed information on how to make Cambridge walkable throughout the year. There is a video about how to properly clear snow and ice from the perspective of residents with mobility impairments. The website also provides detailed instructions on how to remove snow and ice and outlines the property owner's responsibilities. Much of the information is also provided in pamphlet form for those who do not have internet access and for easy distribution.

The City of Seattle sidewalk snow removal program provides a winter weather fact sheet online and in print in six languages.

⁹ “Chicago Shovels.” The City of Chicago, Illinois. 2013. Accessed January 23, 2012. <http://www.cityofchicago.org/city/en/depts/mayor/snowportal/chicagoshovels.html>.

Time frame

There are several common approaches to the time frame for when snow should be cleared from sidewalks. A common strategy requires snow to be removed within a certain time after a snowfall. The time frames specified for snow removal ranges from 2 to 72 hours after a snowfall. The majority of municipalities contacted require snow to be removed from sidewalks within 24 hours after a snow event. It is common and appropriate to require a shorter time frame in high pedestrian zones such as in business districts where pedestrians need to access transit and amenities. Another strategy is to set a time for when all snow must be cleared. The City of Boston combines these strategies by requiring all property owners to remove snow and ice within three hours of the end of the snow fall or three hours after sunrise.³⁰ This is one of the shorter time frames of those contacted and is actively enforced with substantial fines for noncompliance. Ann Arbor, MI, requires that any snowfall accumulation before 6 AM must be removed by noon. Other communities such as Alexandria, VA, require different time frames depending on the category of storm. The larger the storm the more time allotted for snow removal. All time frames must balance the needs of pedestrians and provide a reasonable amount of time for property owners to remove snow.

Ordinances, Penalties and Enforcement

In most communities, property owners and residents are responsible for a large part of sidewalk snow removal. Communities can reduce risk of slip and fall claims and mobility issues when citizens are informed of their snow removal responsibilities, educated in good snow removal practices and encouraged to participate. Strong, efficient enforcement is a key to compliance with snow removal ordinances.

Requirements for snow removal from sidewalks are commonly outlined in the form of city ordinances. Within different ordinances, there are varying degrees of requirements, guidance, inspection and enforcement to ensure that sidewalks are cleared to the maximum extent feasible as required by federal ADA guidelines, or in the case of some communities beyond the minimum requirements. The best ordinances specify requirements such as removing snow and ice from drainage structures, curb ramps and crosswalks as well as sidewalks.

There are different strategies used for following through with snow removal requirements. Some communities have ordinances requiring snow removal, but there is little or no enforcement of the ordinance. Other communities enforce snow removal through warnings and citations. Some communities have the ability to place liens on adjacent property when

³⁰ "Snow Removal from Sidewalks." The City of Boston, Massachusetts. 2013. Accessed January 23, 2013. <http://www.cityofboston.gov/snow/removal/snowremoval.asp>.

finances are not paid. Other communities issue warnings and fines and then charge the property owner for the fine plus the cost of snow removal by city crews or hired contractors.

There are varying degrees of success among the communities contacted for this report where adjacent property owners are responsible for snow and ice removal by ordinance. Most communities reported that adjacent property owners were successful at removing snow from sidewalks abutting their properties. There were several common factors that tended to negatively impact the success of snow removal by adjacent property owners: the presence of rental properties, especially in areas near colleges or universities, and the presence of elderly or disabled households that require assistance to remove snow. Factors that tended to positively impact snow removal were enforcement mechanisms and the ability of communities to respond in a timely fashion to non-compliance to ordinances. In smaller communities, it is more common for neighbors to informally help their neighbors remove snow, where larger communities tend to develop snow removal assistance programs.

Proper and prompt enforcement is the key to a successful snow removal program. Some states have legislation that grants local jurisdictions the power to place fines accrued for snow removal non-compliance as a lien on property taxes. The state of Massachusetts has passed a bill that specifically defines snow removal from sidewalks as a finable offense.¹¹ Such a bill makes it more likely that municipalities will garner fees and residents will comply. Several jurisdictions within the state of Massachusetts have model snow removal enforcement fees structures and mechanisms.

Communities with strict enforcement of snow removal are more successful at having snow removed from sidewalks by adjoining property owners. Communities use police, public works staff, inspectors and, in one case, parking enforcement officers to issue citations to non-compliant properties. The City of Cambridge deploys inspection and enforcement of non-compliant snow removal much like a parking enforcement program. This is a successful program because it utilizes an existing enforcement mechanism and fine process. One strategy that is not as successful is the issue of warnings before citations. This process can elongate the time that the sidewalk remains impassable to pedestrians and creates additional work for the jurisdiction.

Most communities contacted respond to complaints regarding sidewalk snow removal. A few had formal snow and ice inspection programs as well.

¹¹*Municipal Fines*, Massachusetts Session Laws ch. 40U. 2010. Accessed January 23, 2013. <http://www.malegislature.gov/Laws/SessionLaws/Acts/2010/Chapter26>.

Communities with fines that increased over time saw greater success in compliance because residents would rather shovel snow than face hefty fines. Like many communities in Massachusetts, the City of Boston has an aggressive snow and ice removal program that by ordinance fines property owners, managers or tenants for non-compliance on a recurring basis as long as they are delinquent on clearing sidewalks to city specifications. Each day that the snow is not removed is considered a separate violation. The fee structure is displayed in Table 6 and includes different fines for residential and commercial properties. Charges can accrue daily for failure to remove snow and ice and/or for the cost of crews to remove snow and ice per cubic yard. Fees range from \$50 to \$200 per category. Fees collected from the fines remain in the snow removal program to fund city sponsored snow removal at non-compliant properties. Recurring charges resulting in a lien on property taxes can be an effective strategy for encouraging property owners, managers and tenants to comply with snow removal requirements.

Table 7: City of Boston fines for non-compliant snow removal

Type of Property	Failure to Remove Snow/Ice From Sidewalk	Removal of Snow/Ice from Private Property to Street or Sidewalk	
		More than one cubic yard	One cubic yard or less
Commercial Property	\$200	\$200	\$150
Residential Property with More than 16 Units	\$100	\$150	\$100
Residential Property with 16 or Fewer Units	\$50	\$100	\$50

Note: For all violations, each day that a violation exists is considered a separate and distinct violation

Another successful program is in the City of Rochester, MN. When snow is not removed by the adjoining property owner, the city will hire an outside contractor to clear the snow with the cost and an administrative fee billed to the property owner. If the fine is not paid, a lien will be placed on the property. This has been successful because citizens are sensitive to escalating fines.

Of the programs reviewed, successful enforcement programs treat snow removal enforcement much like parking enforcement: violators are promptly ticketed, and failure to pay the initial fee results in additional penalties. Mechanisms for enforcement are performed by parking officers, police or inspectors. Like parking fines, snow removal fines can be a predictable revenue stream.

Snow Removal in Business Districts

Business Improvement Districts (BIDs) or Special Improvement Districts (SIDs) are a common means for business districts to fund and perform snow removal from sidewalks in higher use pedestrian areas. Of the communities contacted, about a quarter have BIDs that perform maintenance activities including snow and ice removal from sidewalks. This is a good strategy for business districts that tend to have higher pedestrian volumes.

Prioritization (level of service)

Of the communities contacted most prioritized clearing snow from streets over sidewalks immediately after a snow event. This is likely because most jurisdictions rely on property owners to remove snow from sidewalks. Few communities have a prioritized system in order for sidewalks to be cleared by city crews. After streets are plowed, many communities report that sidewalk clearing is focused on areas near schools, transit stops and business districts. The City of Alexandria, VA, prioritizes sidewalks in the following order: 1) schools, 2) high transit use areas, 3) city faculties and 4) bus stops. Other communities such as Perry, GA, prioritize bridges for snow removal.

Sidewalk Snow Clearing by Municipality

Snow removal from sidewalks abutting public lands is often a shared responsibility between the jurisdiction, county, state, transit and private agencies and institutions. Responsibility can often be a point of confusion that may lead to uncleared sidewalks. Clearly defined responsibilities are important to a successful snow removal program. Many communities deploy crews or hire contractors to clear snow and ice from sidewalks adjacent to public lands or buildings. Often this is shared responsibility between Parks Departments and Public Works Departments. Some smaller communities require school, fire and police staff to clear snow from sidewalks around buildings. A snow removal plan that outlines clear responsibilities and assigns those responsibilities through written agreements are important when coordination is required between agencies, institutions and organizations.

Some jurisdictions take full responsibility for snow and ice removal from streets and sidewalks whether required by state law, local ordinance or city policy. However, this is not a common practice and there is a considerable level of effort and cost associated with such programs. In regions where snowfalls are frequent, this may require the use of seasonal staff or contractors, investment in equipment and strategies to make costs associated with snow removal more predictable due to fluctuations in snowfall year to year.

The City of Burlington Public Works Department is responsible for all snow and ice removal from all city streets and sidewalks. The city has a unique "Snowfighting Program" that tasks

city crews with snow removal from all city streets and sidewalks despite an ordinance that assigns removal of snow to property owners.¹² The plan was enacted to provide flexibility due to unpredictable weather, ensure geographic equity in snow clearing, and address the challenges of snow removal in dense areas of Burlington. The snow removal program includes temporary parking bans that are determined on a case-by-case basis per parking zone. Parking bans are posted on a city blog, and residents are alerted via email and by flashing lights that are turned on by 3pm. Due to narrow street widths the city has found that snow removal costs and hazards decrease significantly when parking is removed from the streets to allow for street plowing. Crews remove snow and ice from roadways and then clear sidewalks up to 24 hours after a snow event. The annual cost for these activities was \$734,000 in 2012. This appears to be an exceptional practice that ensures the compliance of city standards to snow removal; however, this practice is costly.

The State of New Hampshire requires state and local jurisdictions to perform all sidewalk related construction and maintenance activities including snow and ice removal at no cost to the adjacent property owner.¹³ This places the responsibility of clearing all snow and ice from sidewalks on municipalities. The state law grants municipalities the flexibility to determine a course of action such as a snow removal action plan for prioritizing snow removal activities within a reasonable amount of time. As a result, communities in New Hampshire are encouraged to have a snow removal plan that outlines the requirements of “reasonable removal of snow, ice and debris.” Due to the challenges and cost associated with snow removal efforts, jurisdictions in New Hampshire are often challenged by these requirements. When municipalities are not responsive to snow removal or do not have an action plan in place, they increase their exposure to litigation.

The Halifax Regional Municipality (HRM) in Nova Scotia, Canada, maintains 400 miles of sidewalk with an operating budget for sidewalk snow removal of \$4.2 million dollars and average snowfall of 81 inches per year.¹⁴ In an effort to make the cost of snow removal more predictable, a performance-based contract was developed that required contractors to provide costs for snow removal based on performance standards rather than the number and intensity

¹² “Burlington DPW FY12 Snowfighting Program.” City of Burlington, Vermont. December 2011. Accessed January 23, 2013. http://www.burlingtonvt.gov/uploadedFiles/BurlingtonVTgov/Departments/Public_Works/Streets_and_Sidewalks/FY12%20DPW%20Snowfighting%20Program.pdf.

¹³ *Sidewalk Repair and Maintenance*. New Hampshire State Title XX ch. 231 § 231:113. 1981. Accessed January 23, 2013. <http://www.gencourt.state.nh.us/rsa/html/XX/231/231-113.htm>.

¹⁴ Halifax Snow Information Site. Halifax Regional Municipality. 2012. Accessed January 23, 2013. <http://halifax.ca/snow/index.html>.

of snow events.¹⁵ Performance expectations such as final sidewalk condition and time frames for snow and ice removal are required in each contract. Contractors are also tasked with inspection, complaint tracking and conditions monitoring. Per the contract, the City assumes liability for slips and falls unless gross negligence is documented on the part of the contractor. The Halifax Regional Municipality has seen cost saving of CAN\$4,600 per kilometer of sidewalk. The benefit of this strategy is consistent, competitive costs for snow removal no matter how many snow events occur over the contract length.

Jurisdictions that are tasked with snow removal from sidewalks often assume higher levels of efforts or cost in exchange for more consistent and potentially convenient snow removal programs. Two strategies were found to streamline this process: parking restrictions to expedite simultaneous plowing of streets and sidewalks and the use of performance based contracts to balance the costs of annual sidewalk snow removal.

Snow Removal Assistance Programs

Many municipalities have programs to assist low-income elderly or disabled people with sidewalk, walkway and driveway snow removal. Snow Angels,¹⁶ Snow/Ice Busters,¹⁷ Snow Buddy,¹⁸ and Shovel our Snow¹⁹ are just a few names of programs throughout the nation. These programs are for residents who cannot physically or financially perform sidewalk snow removal. For those in need, an application is often required to demonstrate eligibility. Some jurisdictions provide an online questionnaire to match volunteers with those in need of help, such as the City of Chicago's Snow Corps program. Snow removal may be performed by city sponsored contracted services, city crews, neighbors, youth or volunteers. Assistance programs, whether highly organized or informal, not only help elderly or disabled citizens and ensure snow removal will be performed consistently, but are also good community building and service opportunities.

Snow Removal from Shared Use Paths

Shared use paths are generally treated differently than sidewalks after snow events. Some communities deliberately do not clear pathways to allow for cross-country skiing. Of the

¹⁵ Hayward, G. "Implementing Performance-Based Sidewalk Maintenance Contracts." *Journal of Public Works and Infrastructure*. Volume 2, Number 2. November 2009.

¹⁶ "Snow Angels." City of Pittsburgh, PA. 2013. Accessed January 23, 2013.
<http://www.pittsburghpa.gov/servepgh/snowangels>.

¹⁷ "Snow Busters." City of Aurora, CO. Accessed January 23, 2013.
<https://www.auroragov.org/LivingHere/GivingBack/SnowBusters>.

¹⁸ "Ice Busters." City of Boulder, CO. Accessed August 15, 2012.
http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=175&Itemid=1703#icebusters

¹⁹ "Winter Guide." City of Brookline, MA. 2012. Accessed January 23, 2013.
http://www.brooklinema.gov/index.php?option=com_content&view=article&id=193&Itemid=877.

communities surveyed with paths, about half required path clearing within a specified time frame in their snow removal plan. However, shared use path snow removal was not generally a high priority for jurisdictions unless complaints were received. Because shared use path maintenance responsibilities are often shared, snow removal may be performed by public works departments, parks departments, non-profits, volunteers or other agencies. For regional paths this can create a patchwork effect when adjacent jurisdictions have differing snow removal policies. Unless shared use paths are used for winter recreation, a plan should be put in place that clearly defines responsibilities for snow removal on shared use paths. Of the communities contacted, the cities of Minneapolis and Madison had responsive snow removal programs for paths operated by city crews.

2.4 | MAINTENANCE OF CROSSWALK MARKINGS AND PEDESTRIAN SIGNALS

2.4.1 | Marking Material

There are a number of different materials used for marking crosswalks, including paint (waterborne or oil-based), epoxy, poly urea, thermoplastic and preformed tape. Transportation agencies weigh several factors when determining which marking material is most appropriate including costs, durability, reflectivity, friction coefficient (avoiding slip hazards) and whether or not the material can be applied using city labor and equipment. Thermoplastic is the crosswalk marking material most favored by those communities that were contacted. Paint is also frequently used, particularly on existing roads or where there is an immediate need. Epoxy was also mentioned by a number of communities. Thermoplastic and epoxy markings are used most often on repaving projects. Those communities that use paint markings typically use city crews and equipment to do the work while thermoplastic marking is more typically contracted out. At least one community mentioned the use of cold plastic inlays for federal projects. Several communities mentioned using recessed thermoplastic to avoid plow damage and another community mentioned using this marking technique where there are a high number of turning movements, particularly by large vehicles.

Only a few communities mentioned that they have had slip hazard issues with crosswalk markings. Several strategies were mentioned for reducing slip hazards associated with thermoplastic. One community mentioned using the British Pendulum method to determine appropriate friction coefficient to avoid slip hazards. The same community mentioned that having the right conditions for the thermoplastic curing process was an important factor for avoiding slippery markings. It was also noted by several communities that newer thermoplastic mixtures contain sand or other coarse materials for reducing slip hazards. Bricks and stamped concrete were noted by at least two communities as creating hazards for bicyclists.

2.4.2 | Strategies for Maintaining Crosswalks

When asked what special treatments or strategies are used for maintaining crosswalks, the majority of communities indicated that they did not have any special techniques for reducing maintenance. Some notable exceptions include spraying streets with primer to reduce salt damage, spacing crosswalk bars so they are generally out of the tire path, using pre-form thermoplastic in high-traffic areas and using different types of markings for different types of roadway surfaces, e.g. thermoplastic on concrete and poly urea on asphalt.

Thermoplastic is preferred in many cases due to the longevity of the material, however the initial cost and time requirements for installation are greater than paint. Snowplow damage was sighted as a common maintenance issue with the use of thermoplastic markings. Several communities have found that recessing thermoplastic markings decreases the likelihood of snowplow damage however; the practice is expensive and may require additional resources, especially if grinding concrete is necessary.

One community noted that they are beginning to see a clear correlation between traffic volumes and when maintenance of pavement markings, including crosswalk markings, is needed. This has allowed them to reduce inspection efforts. It was also noted that turning vehicles cause significantly more wear of pavement markings, and locating markings out of turning areas, when possible, can reduce maintenance.

A common strategy to pay for the more expensive, but longer-lasting markings is to include the marking application within the initial construction, reconstruction or pavement replacement project. In most cases, the costs for these markings are covered by the project budget and not the maintenance budget. Maintenance budgets tend to be tight, whereas including even more expensive marking materials in a project, represent a small part of a larger construction budget.

It should also be noted that crosswalk maintenance should include the actual street surface, and not simply the pavement markings. Although crosswalks are a part of the roadway, they require a higher level of maintenance than surrounding roadway because pedestrians are less tolerant of defects than motorists. A minor pothole may not present an issue for most motorists, but can present a significant hazard for pedestrians. Surface defects in crosswalks should be noted when crosswalks are inspected or remarked, and repairs should be completed quickly.

2.4.3 | Costs

Unit costs for various crosswalk marking materials vary considerably across the country. A National Cooperative Highway Research Program (NCHRP) Synthesis 306: *Long-Term Pavement Marking Practices* provides cost comparisons and a life-cycle-cost table. In general, thermoplastics provide a life of two to three times that of paint for long lines, however, costs averaged almost five times that of paint (epoxy markings had a life of two to three times that of paint, but had a cost of four times that of paint). Thus, when life-cycle-cost was calculated, paint was half the cost of thermoplastic. It is important to note that costs and durability ranged significantly in this study. There is a clear trade-off between the durability of thermoplastic and the lower costs of paint. Communities that use paint to mark crosswalks indicated that they must repaint crosswalks two to four times per year, whereas thermoplastic markings typically last 2 to 3 years.

Table 8 displays characteristics of four common crosswalk marking materials. It should be noted that costs vary widely across the country (see §2.4.3), and the ranges provided are approximate. Similarly, material lifespans are strongly impacted by the volume of traffic passing over the marking, and the use of snowplows on streets. Thermoplastic and preformed tape may not be appropriate in areas using snowplows unless the marking are inlaid in the pavement, which makes it less likely that a plow blade will pull the material off the street.

Table 8: Relative comparison of crosswalk marking materials^{20,21}

Material	Cost	Lifespan (months)	Retroreflectivity (new application)
Paint	\$0.03 – \$0.05/LF	9 – 36	Low
Epoxy Paint	\$0.20 – \$0.30/LF	48	Medium
Thermoplastic	\$0.19 – \$0.26/LF	72*	Medium
Preformed Tape	\$1.50 – \$2.65/LF	48 – 96*	High

Note 1: Thermoplastic and tape have shortened lifespans in snowy areas where they are often damaged by snowplows

Note 2: Inlaid thermoplastic or preformed tape may last significantly longer than standard surface applications

When considering the cost of crosswalk marking materials, it is important to consider the expected lifespan of one product versus another. Additionally, it is critical to take into account the cost of altering traffic patterns when markings must be redone. Products that may be more expensive up front may actually be less expensive over time if they need to be replaced less frequently. It is recommended that agencies perform lifecycle cost analysis for different materials based on their local product costs, labor costs, the cost of diverting traffic, and real-world observations of product lifespans given local maintenance conditions.

2.5 | PEDESTRIAN SIGNALS

All communities that were contacted indicated that they have either switched out all their signals for LED countdown signals, or are in the process of doing so. Newer LED lights are highly rated by communities in terms of durability. Some cold-weather communities have noted that LED-based pedestrian and vehicle signals do not generate nearly as much heat as incandescent signals, and therefore do not melt off accumulated snow and/or ice as readily as incandescent systems.

2.5.1 | Maintenance Issues and Response Time

Almost all communities that were contacted indicated that they have had few issues with their pedestrian signals. The term “durable” was used frequently. Several communities indicated that repairs are mostly due to damage from crashes. Most communities indicated that pedestrian signal repair is a high priority. Response times for repairs range from several hours to two weeks with the majority of communities reporting that they have signals fixed within one to two days.

²⁰ Cuelho, Eli, Jerry Stephens and Charles McDonald. “A Review of the Performance and Costs of Contemporary Pavement Marking Systems.” Western Transportation Institute. Bozeman, MT. 2003.

²¹ Montebello, David and Jacqueline Schroeder. “Cost of Pavement Marking Materials.” Minnesota Department of Transportation. 2000.

At least two communities indicated having some issues with push buttons for pedestrian signals. In one community it was mentioned that the push buttons have been difficult to replace while another community mentioned that the buttons tend to stick once they receive some wear. If a community has a sidewalk inspection program, push button signal actuators should be inspected for functionality at the same time as adjacent sidewalks. Pedestrian signals should also be inspected at the same time as vehicular signal heads at the same intersection.

NCHRP Project 3-62 produced the document *Accessible Pedestrian Signals: A Guide to Best Practices* which includes the following statements about accessible pedestrian signal maintenance:

As with complex devices, APS have many features that may malfunction or fail in the course of its operation. If features such as WALK indication, locator tone, or signal interaction fail to work correctly, the resulting lack of information or misinformation for pedestrians who are blind can be dangerous. It is important that municipalities who have taken steps to install these devices also take steps to ensure correct functioning through the years.

The overseeing agency should conduct an audit or checkup of APS installations on a regular basis. Checkups should be conducted frequently if factors such as harsh weather may have affected the devices. At a minimum, APS should be inspected:

- Every 6 months
- After repairs to the intersection signals, poles or controller
- After changes to signal timing

The Guide also outlines repair issues after a crash damages signals and lessons learned from APS installations around the country.²²

²² Harkey, David et al. *Accessible Pedestrian Signals: A Guide to Best Practices*. NCHRP Web-Only Document 117A. June 2007. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w117a.pdf.

2.6 | FUNDING

Most communities surveyed have allocated budget for pedestrian facility maintenance. Sidewalk repair and replacement programs were often grouped into a single budget category.

2.6.1 | Common Funding Sources

General Fund

Of the communities surveyed, many fund sidewalk repair and replacement through the general fund, which is typically funded by property and sales tax revenues. Funding sidewalk maintenance from the general fund is typically done through a separate sidewalk repair and replacement program, or in some cases, several sidewalk maintenance projects (e.g. typically replacement) may be lumped together and included as a line item in the capital improvement program. Sidewalk repair and replacement projects often compete with other projects and funding obligations. Based on discussions with communities, sidewalk repair and replacement programs that are largely funded out of the general fund often fall victim to budget cuts or shifting priorities.

Most cities of the cities surveyed fund winter maintenance out of the general fund. Typically cities set aside a discrete amount of money for snow and ice removal. Due to the uncertainty of how much snow and ice removal may be required during winter, cities may end up with a surplus of money or have to acquire additional funds from the general fund. Most cities return surpluses back to the general fund or carry the funds over for the following year.

Gas Tax

Gas tax revenues are a common component of sidewalk maintenance funding. Though not common, some local governments have been given authority to levy local fuel taxes, typically in the range of one to three cents per gallon, to pay for roadway improvements including sidewalks. More commonly, in many states a portion of state-generated gas tax revenues are shared with local communities to fund street improvements. Sometimes gas tax revenues are a component of a larger state-side fund that pools revenues from a variety of sources and distributes them to local governments based on a distribution formula (see below). Communities in North Carolina, Arizona, Oregon and Washington that were contacted specifically mentioned gas tax monies being used to fund sidewalk maintenance.

State Aid Funds

State-aid funds are funding programs aimed at distributing state-generated revenues to local governments for funding transportation projects. In some cases such funding is only made available for transportation projects within state-aid eligible rights-of-way. Such funds are typically comprised of revenues from fuel tax and vehicle license fees and taxes. In some cases,

such funds are set-aside for communities to draw on for specific transportation purposes, e.g. safety projects. In other cases, like Wisconsin and Virginia, such funds are set up as reimbursement programs. A portion of costs associated with local sidewalk construction is reimbursable in the State of Wisconsin.

The Arizona Highway User Revenue Fund (HURF) distributes transportation funding to cities, towns and counties and to the State Highway Fund. The HURF itself is funded by taxes on motor fuels and a variety of fees and charges relating to the registration and operation of motor vehicles on the public highways of the state. These taxes represent a primary source of revenues available to the state for highway construction, improvements and other related expenses. Twenty-seven and a half % of revenues are distributed among cities and towns, 19% among counties, and 3% among the three largest cities (Tucson, Phoenix and Mesa).

In Minnesota bicycle paths and sidewalks may be eligible for state-aid funding if the facility is located within the permanent right-of-way of a state-aid-eligible route or within an easement generally parallel with a state-aid route. County state-aid funds may be spent on bicycle paths or sidewalks as a match to federal-aid funds or on bicycle paths or sidewalks that are both a part of an adopted plan and are located within the permanent right-of-way of a state-aid route or within an easement generally parallel with a state-aid route. County municipal state-aid funds may be spent on bicycle paths or sidewalks located within the permanent right-of-way of a state-aid route or within an easement generally parallel with a state-aid route.

Massachusetts and Maine are two other examples of states that have active state-aid funds that may be used for pedestrian facilities.

Special Communitywide Assessments

Some communities are able to target the funding of pedestrian facilities by voter approved levies or special property tax assessments. Several communities surveyed had received funding by this means. The City of Seattle funds sidewalk repair through the "Bridging the Gap" Levy, a voter approved levy that addresses the city's maintenance backlog of transportation projects. The city's ADA program is also partially funded by the levy. The \$365 million levy requires that "no less than 18%" of the overall levy be spent on pedestrian and bicycle safety projects including pedestrian signals, new and repaired sidewalks, walking routes to schools, curb ramps and remarked crosswalks. The city plans to repair 144 blocks of sidewalks over the course of the levy.

The City of Ann Arbor, MI, has a voter-approved sidewalk millage tax, which generates \$560,000 or more per year for sidewalk repair and replacement. It was proposed by city

officials as a means to address significant sidewalk maintenance that was not being adequately addressed through the city's code requirements, which assigns the responsibility of sidewalk maintenance to the adjacent property owner. The special millage was seen as a more equitable and effective means to address the city's sidewalk maintenance needs and was approved by over 60% of voters. As a result of the 0.125-mill the average household pays an additional \$13 per year.

Sales Tax

While many communities indirectly use sales tax to fund pedestrian facility maintenance by way of the general fund, no communities that were contacted mentioned having sales tax revenue specifically earmarked for pedestrian facility maintenance. However, sales tax revenue is a common source of funding for street maintenance and there are communities that use these revenues to also fund sidewalk repair and replacement programs. The City of Fort Collins uses 33% of its sales tax revenues for street maintenance and repair and 17% for other street and transportation needs.

Property Owner Assessments

Many of the municipalities contacted require property owners to partially or completely cover the costs of repairing or replacing abutting sidewalks; however, in practice, few municipalities follow through on assessing property owners for these purposes. The two common reasons cited by agencies for not addressing sidewalk maintenance through special assessments are the amount of time it takes to do so and political considerations. Several communities that were contacted have shifted responsibility of sidewalk maintenance away from property owners in order to address a backlog of sidewalk maintenance in a more expedient and equitable fashion. These communities have revised their municipal codes by removing provisions referring to property owner responsibility and assessments for sidewalk repair. In some cases these communities established dedicated funding sources for sidewalk maintenance, however, at least one community had not, which has resulted in little sidewalk maintenance being completed.

Madison, Wisconsin, is among the few communities contacted that actively assesses property owners for costs associated with sidewalk replacement. However, only about a quarter of the city's million dollar plus sidewalk program is funded through property owner assessments. Property owners are responsible for 50% of the cost of sidewalk repairs and 100% for sidewalk replacements. The remainder of the city's sidewalk program is funded with general obligation bond funds. Minneapolis, Minnesota, and Seattle, Washington, pay for minor sidewalk repairs, but require adjacent property owners to pay the city 100% of costs associated with sidewalk replacement. Hoboken, New Jersey, and Ithaca, New York, are two other communities that

have successful sidewalk repair/replacement programs based largely on property owner assessments. Ithaca does cover the cost of repairing/replacing sidewalks damaged by trees in the public right-of-way and the cost of curb ramp replacement. It also has a program to assist low-income residents with sidewalk maintenance. Boulder, Colorado, assesses residential property owners up to \$420 and commercial property owners 50% of total cost for sidewalk repair and replacement.

Bonds

Bonds are often used by governments to address significant funding gaps by leveraging existing revenues to pay for large capital expenditures. Several communities that were contacted use bond-generated funds to pay for sidewalk and other pedestrian facility maintenance. In 2011, residents in Boulder, CO, approved a capital improvement bond measure by a three-to-one margin, which gave the City the authority to leverage existing revenues to bond up to \$49 million to pay for necessary capital investments. The bond is focused on funding significant deficiencies to address maintenance and renovations needed for existing facilities as well as high priority system enhancements. Sidewalk reconstruction is among the types of projects that are being funded by the bond. Lee's Summit, Missouri, is using a voter-approved general obligation bond to fund public safety improvements, sidewalks, curbs and new roadway construction. The bond issue earmarks just under \$12 million for the purpose of constructing new sidewalks, rehabilitating existing sidewalks and replacing curbs and curb ramps. Voter approved bonds in Durham, North Carolina, provide approximately 86% of the city's sidewalk funding, which includes significant amounts of funding dedicated to ADA-related repairs. Two bond measures (one in 2005 and another in 2007) have provided about \$8.45 million for sidewalk repair, replacement and ADA repairs.

Utility Fees

Utility fees are used by some municipalities to fund street and sidewalk maintenance, although they are less common among those agencies contacted. Often such fees are voter-approved. Examples of utility fees, which are provided below, seem to indicate that the amount an individual household pays is relatively small, but the steady funding source enables municipalities to plan and execute maintenance activities in a systematic way.

Corvallis, Oregon, includes a sidewalk maintenance fee as part of residents' monthly City Services bill, which also includes water and sewer charges. The \$0.80 monthly fee was determined by taking the average yearly cost to repair defective sidewalks (\$150,000) divided by the number of utility customers divided by 12. In the past, the property owner paid for repairs to sidewalks in the public right-of-way along their property. Now, the City will use the money raised by the new fee to pay for repairs to defects on public sidewalks.

Cheney, Washington, uses a voter-approved tax on electrical and natural gas services to fund maintenance of residential streets and sidewalks. The 4% electric and natural gas tax generates roughly \$380,000 annually. This dedicated funding paid for the repair of nearly 18 miles of existing residential streets and nearly 6 miles of existing residential sidewalks throughout the city over 14 years.

Vehicle License Fees

Funding pedestrian facility maintenance using revenues from vehicle license fees is not common based on information gathered from agency discussions. Seattle is the one community that explicitly mentioned using vehicle license fees to partially fund its ADA program, which includes replacing curb ramps. The state of Arizona's Highway User Revenue Fund, a portion of which is distributed among the state's cities and counties, receives funding from vehicle license fees.

Red Light Camera Revenues

Funding pedestrian facility maintenance using revenues from red light cameras is not common based on information gathered from agency discussions. Fort Worth, Texas was the only community that explicitly mentioned red light cameras as a funding source for its pedestrian maintenance activities. Seventy-five % of this revenue goes towards new sidewalk construction and 25% goes towards repairing existing sidewalks.

Grants

It is common for cities to seek grant funding for pedestrian facility construction and maintenance; such funding may be used to supplement other available financial resources, and typically is used for targeted projects such as replacing large segments of sidewalks, installing ADA-compliant curb ramps, and installing and upgrading pedestrian signals. Grant funding sources used for pedestrian facilities by communities that were contacted include Safe Routes to School (Traverse City, Mississippi, Plattsburg, New York, and Carmel, Indiana), Community Development Block Grants (Carmel, Indiana, and Louisville, Kentucky), and American Recovery and Reinvestment Act grants (Durham, North Carolina, for greenway repaving; Lee's Summit, Missouri, for pedestrian signals; and Omaha, Nebraska, for pedestrian signals). Perry, Georgia, and the State of Alaska were the only agencies that mentioned using Transportation Enhancement grants as a means to replace/install pedestrian facilities.

Innovative Funding Strategies

Piggy-backing sidewalk repair/replacement with other improvements within the public right-of-way can be an effective and efficient means to address maintenance needs. An example of a community taking such an approach is Ironwood, Missouri. That city had to replace a

significant number of water and sewer lines and was able to wrap in the cost of replacing sidewalks into the total project costs.

Davidson, North Carolina, has had some success in partnering with developers to address sidewalk and other pedestrian facility maintenance needs through an informal process. Where a developer may have equipment and crews dispatched for street-related work and there is an identified maintenance need nearby, the City has asked the developer to address the maintenance need.

Improvement Districts

The majority of communities that were contacted have downtown or other business district areas established (i.e. Business Improvement Districts, Community Improvement Districts, Business Improvement Area, etc.) that have assumed responsibility of sidewalk maintenance, including winter maintenance.

Tax Incremental Financing (TIF)

Fort Worth, Texas was the only community that was contacted that mentioned using tax incremental financing (TIF) districts as a means to address pedestrian facility maintenance needs in commercial areas. TIF is a method to use future gains in taxes to subsidize current improvements. TIF districts operate in most states and are typically targeted toward making improvements in distressed, underdeveloped or underutilized parts of a jurisdiction where development might not otherwise occur. These could be areas where there are existing pedestrian facilities in disrepair.

2.7 | LOW-MAINTENANCE DESIGN

Damaged sidewalks present a significant obstacle to pedestrian mobility: they present trip hazards for users, can block access for people with disabilities and pose liability risks to municipalities and property owners. Some common types of sidewalk damage can be prevented or slowed through the use of exceptional practices in initial sidewalk construction. In particular, close attention to specific design details can result in sidewalks that require low or lower levels of maintenance over their lifespan, thereby improving access in a community and reducing municipal and property owner costs. A good example is that of bricks and concrete pavers for sidewalks and walkways. Recently, there has been a great deal of discussion on the use of bricks and pavers related to accessibility issues. Many communities are replacing existing bricks with concrete sidewalks. Some of these issues are tied to the reputed increased maintenance need of these material types to keep the surfaces stable, firm and in a continuous plane (free from vertical faults of more than ¼ inch). Aside from the accessibility issues, the design details chosen for brick and concrete sidewalks can have a significant impact on

lessening future maintenance. This includes the material chosen for the base layers and its depth and how well the sidewalks will ultimately be constructed.

2.7.1 | Material Lifespans

Initial design and construction methods greatly influence the long-term maintenance and lifespan of sidewalks. The thickness of the sidewalk material, depth of subbase below the sidewalk, distance from trees, and other design details impact how well a sidewalk will age over time. If best practices are followed, the expected sidewalk materials service life can be as long as:

- Concrete: 80 years
- Bricks and Interlocking pavers: 80 years
- Asphalt: 40 years²³

Although the lifespans noted above are achievable, many cities consider 25 years to be an expected lifespan for concrete sidewalk.²⁴

Research into sidewalk construction best practices for reduced maintenance has been limited. While some data exists on construction methods that can mitigate the potential for future damage, there is an opportunity for increased research in this area.

2.7.2 | Sidewalk Failure

As noted earlier in this chapter, sidewalk failure can be described as damage that results in cracked, broken or uneven sidewalk surfaces. Sidewalks fail for a variety of reasons including damage due to:

- Poor base soils
- Nearby trees
- Heavy vehicle loads

Much of this damage can be avoided by using proper construction techniques that take into account the type of soils underlying the sidewalk, seasonal extremes that impact soils underlying sidewalks, tree placement and sidewalk thickness.

²³ *Sidewalk Design, Construction, and Maintenance: A Best Practice by the National Guide to Sustainable Municipal Infrastructure.* Federation of Canadian Municipalities and National Research Council. July 2004.

²⁴ T. Davis Sydnor, David Gamstetter, Joan Nichols, Bert Bishop, Jammie Favorite, Chelle Blazer, and Leslie Turpin "Trees are not the Root of Sidewalk Problems." *Journal of Arboriculture* 26(1): January 2000. 20 – 26.

2.7.3 | Subgrade

The type of soil underlying a sidewalk may be the greatest determinant if the sidewalk will fail before the end of its projected lifespan. A comprehensive study in Cincinnati showed a greater correlation between soil types under failed sidewalks than the presence of nearby trees.²⁵ Providing an adequate subgrade below sidewalks may deter many of these failures by providing a stable material below the sidewalk that drains well and is less susceptible to climatic changes. Canadian best practices outline the following guidance for construction:

- Subgrade should be uniform material compacted to a minimum 98% standard Proctor density.
- Provide 100 – 150 millimeters (4 – 6 inches) of free-draining granular material under sidewalks for base material²⁶
 - For pavers, 200 millimeters (8 inches) recommended over slow draining soils or frost zones
 - Minimum compaction of 95 % standard Proctor density for concrete and asphalt
 - Minimum compaction of 98 % standard Proctor density for pavers

Providing an adequate subgrade of free-draining material may also reduce problems from nearby tree roots, and is detailed below.

2.7.4 | Pavement Thickness

In the United States, standard concrete sidewalk thicknesses range from 3.5 inches in warm climates with no vehicle loading to 6 inches or more in areas that experience a winter freeze and vehicle loading. In theory, the thicker the sidewalk, the less likely it should be to fail prematurely; however, adequate research does not exist to support this claim with regards to failure due to frost heave or tree roots. It is important to ensure that sidewalks are constructed with enough thickness to support expected vehicle loading which may include maintenance vehicles or more substantial loads at driveway crossings.

- Concrete slab thickness²⁷
 - 110 millimeters (4.33 inches) for light axle loading over sand/gravel
 - 130 millimeters (5.11 inches) for light axle loading over silt/clay
 - 140 millimeters (5.51 inches) for heavy axle loading over sand/gravel

²⁵ Snyder et al.

²⁶ *Sidewalk Design, Construction, and Maintenance: A Best Practice by the National Guide to Sustainable Municipal Infrastructure.* Federation of Canadian Municipalities and National Research Council. July 2004.

²⁷ *Ibid.*

- 160 millimeters (6.30 inches) for heavy axle loading over silt/clay
- Many communities require the following sidewalk thicknesses: 5 inches standard depth, 6 inches at driveways, 7 inches at commercial driveways
- State DOTs require thicknesses of either 4 or 5 inches for sidewalks and 6 to 8 inches for sidewalk section of driveways consistent with the depth of the driveway aprons.

Asphalt thicknesses for shared use paths range from two inches with an adequate aggregate depth (4 inches) suitable for only very light duty equipment to 8 inches for full depth asphalt without a base and suitable for medium duty trucks. According to a recent report by the Illinois Center for Transportation - *Best Practices for Bicycle Trail Pavement Construction and Maintenance in Illinois, June, 2012* – a minimum hot mix asphalt thickness for paths that can support regular-duty and heavy-duty trucks is 3 inches for a 4 inch aggregate. Depths for asphalt sidewalks are not very well documented, but at a minimum should be 2 inches with an adequate aggregate depth similar to the minimum depth of an asphalt path.

2.7.5 | Drainage

Proper sidewalk drainage is important for maintenance purposes and to provide a safe and comfortable experience for users. It is important to provide a slight cross slope on sidewalks to ensure proper drainage and prevent pooling of water, especially in climates where ice can form. ADA requirements prescribe a maximum cross slope of 2%, which provides adequate drainage, but also does not adversely impact sidewalk usability for people with disabilities.

Sidewalk immediately behind the curb should be considered for installation of a subdrain system parallel to the curb to facilitate drainage away from the base and reduce frost heave. Additionally, providing a subgrade of quick draining material as noted above will help reduce frost heave in areas with poor draining soils.

2.7.6 | Control Joints and Scoring Patterns

Control and expansion joints should be provided in all sidewalks to minimize cracking and guide where cracking should occur. Decorative jointing/scoring should be minimized to aid accessibility. Saw cutting control/construction joints is recommended rather than troweling joints into the surface. Joints should be level and as narrow as possible. For interlocking pavers, the maximum variation in height should be 2 millimeters.²⁸

²⁸ *Sidewalk Design, Construction, and Maintenance: A Best Practice by the National Guide to Sustainable Municipal Infrastructure.* Federation of Canadian Municipalities and National Research Council. July 2004.

Full depth isolation joints should be placed adjacent to existing rigid structures such as “s” poles, walls, hydrants and buildings. Isolation joints should also be located at the beginning and end of curved sections of sidewalk and at all intersections.

Control joints, also known as contraction joints, provide a location where drying shrinkage cracks can occur without affecting the appearance of the sidewalk. Control joints are to be located at a maximum distance of 24 to 30 times the thickness of the concrete. The transverse contraction joint should extend to a depth of one quarter to one third of the depth of the concrete sidewalk and be a maximum width of 5 millimeters. If the sidewalk width is 2.5 meters or greater, a control joint should also be formed along the center line of the walk. It is recommended that the control joints be saw cut instead of trowelled.

2.7.7 | Curb Ramps & Detectable Warning Fields

Curb ramps and ADA mandated detectable warning fields present unique maintenance challenges. The primary issues with detectable warning fields are debris collection, detachment from the sidewalk, or domes becoming damaged. Detectable warning fields tend to collect dirt and debris between raised domes. This is particularly true at curb ramps where pooling occurs during rain events. The primary solution to this issue is frequent sweeping of curb ramps and detectable warning fields. Seasonal pressure washing of detectable warning fields may also be of value, and may help retain the color contrast between the detectable warning field and the surrounding sidewalk.

Physical damage to detectable warning fields and their domes is common in areas that require snow removal. Detectable fields are easily damaged by snowplows that clear some paths and sidewalks, and can even be damaged by snowblowers. A number of manufacturers are now providing cast iron detectable warning fields that are significantly heavier and stronger than those manufactured from stainless steel, alloy, thermoplastic or pressed directly into the concrete. The cast iron detectable warning fields may be excessive for areas that do not experience significant snowfall, but may provide reduced maintenance and replacement costs in areas with snowfall.

Detectable warning fields pressed directly into fresh concrete suffer from two primary issues. First, it is common for some of the concrete domes to not be fully formed during the initial installation on the curb ramp. When this occurs, it is likely that the incomplete domes will break off. Second, snow removal equipment, even household snowblowers, can cause damage to concrete domes. If concrete detectable warning fields are used, a regular maintenance schedule should be developed to monitor the integrity of the fields and perform necessary maintenance.

2.7.8 | Street Trees

Street trees are a common feature along most streets and roadways. Trees can provide a canopy over the street, enhance aesthetics of a corridor, provide shade and green space in urban environments and help define the character of a corridor. However, street trees can also cause damage to sidewalks and walkways when either the trees or sidewalks are poorly sited. Proper selection and location of street trees is essential to ensure that the trees thrive in their location and do not interfere with nearby utilities, sidewalks or streets.

Tree Selection

Street trees should be carefully selected to ensure that they will be compatible with their surroundings. While appropriate trees will vary from location to location, desirable features should be selected:

- Tree species should be adapted to a site's climate. This includes tolerance of the local precipitation cycle, extreme winter and summer temperatures, radiant and reflected heat from nearby structures and surfaces, local soil conditions and types, and natural winds as well as those created by passing traffic.
- Trees should typically be "limb up" trees that develop branches that grow away from the ground rather than spreading horizontally or drooping. Trees with horizontal or drooping branches can create hazards for nearby pedestrians or vehicles.
- Trees with large amounts of shallow or surface roots should be avoided. While all trees have a large network of fine roots near the soil surface, trees that have larger surface roots may cause maintenance issues with nearby sidewalks, streets or parking areas.
- Trees with large trunk flares should be avoided next to pavement and in narrow planting areas.
- Local municipalities should consult an arborist to develop a list of recommended tree species for use in the public right-of-way. The list of recommended trees should include specifications for each species including minimum planting site sizes, appropriateness for planting below utility lines and appropriateness for use in stormwater catchment areas.
- Although use of a single tree species can provide a strong identity to a corridor or neighborhood, street tree species should typically be varied to provide resistance to disease and insects.

Tree Planting Sites and Placement

Planting street trees in appropriate sites will help ensure their successful growth and development while minimizing sidewalk and street maintenance issues commonly caused by

poorly sited trees. Following are broad guidelines drawn primarily from Chapter 11 of the Los Angeles County Model Design Manual for Living Streets:

- Establish and maintain 6 – 8 foot wide sidewalk furniture zones where possible. Many large trees need up to 12 feet in width, and are not suitable for placement in narrower furniture zones. In residential areas, sidewalk furniture zones within the root zone of trees should be unpaved and planted/surfaced with low groundcover, mulch or stabilized decomposed granite where these can be maintained. Where maintenance of such extensive sidewalk furniture zones is not feasible, provide 12 foot long tree wells with true permeable pavers (standard interlocking pavers are not permeable).
- Establishing wide furniture zones or terraces benefits trees, but also provides additional space for snow storage in snowy climates.
- If the above conditions are not feasible, provide for the tree's root system an adequate volume of uncompacted soil or structural or gap-graded soil (angular rock with soil-filled gaps) to a depth of 3 feet under the entire sidewalk (in the furniture, frontage, and pedestrian sidewalk zones).
- Spacing between trees will vary with species and site conditions. The spacing should be 10 % less than the mature canopy spread. Closer spacing of large canopy trees is encouraged to create a lacing of canopy, as trees in groups or groves can create a more favorable microclimate for tree growth than is experienced by isolated trees exposed to heat and desiccation from all sides. Where constraints prevent an even spacing of trees, it is preferable to place a tree slightly off the desired rhythm than to leave a gap in the pattern.
- Planting sites should be graded, but not overly compact so that the soil surface slopes downward toward the center, forming a shallow swale to collect water. The crown of the tree should remain 2 inches above finished grade and not be in the center of a swale, but off to the side. The finished soil elevation after planting is held below that of the surrounding paving so 2 – 3 inches of mulch can be added. The mulch layer must be replenished as needed to maintain a nearly continuous level.
- Generally tree grates and guards are best used along streets with heavy pedestrian traffic. Along streets without heavy foot traffic and in less urban environments, use mulch in lieu of tree grates.
- Providing a gravel sub-base below sidewalks near street trees has been shown to reduce pavement damage and root growth immediately below pavement on well drained sites.²⁹

²⁹ Smiley, E. Thomas. *Comparison of Methods to Reduce Sidewalk Damage from Tree Roots*. *Arboriculture & Urban Forestry* 34(3): May 2008. 179 – 183.

- Vertical barriers next to sidewalks (DeepRoot or poly sheets) have been shown to be effective at reducing root growth under pavement which may reduce long-term sidewalk damage from roots.³⁰
- Some communities are now willing to pay for street trees on private property adjacent to a sidewalk. Doing so can increase the tree setback from the sidewalk, and reduce the likelihood of root damage.

Damage to sidewalks from nearby tree roots can largely be eliminated by selecting appropriate tree species for the region and providing ample room for tree root systems to develop.

2.8 | LAWS AND LIABILITY

Laws and municipal ordinances play an important role establishing who is responsible for pedestrian facility maintenance. In determining which entity is responsible by law for the maintenance, it is necessary to review state statutes and often state case law to determine legal precedent in cases of civil liability. In most circumstances, liability in regards to pedestrian facility maintenance revolves around trip-and-fall and slip-and-fall cases on sidewalks. If a pedestrian trips on a cracked or uneven sidewalk or slips on an icy sidewalk in winter, sustains injuries and/or damages and seeks monetary compensation, who is found at fault and why?

Laws that directly and indirectly affect the maintenance of pedestrian facilities vary from state to state. Additionally, local ordinances will also vary from community to community, but should be consistent with state statutes. For this research project rather than simply review state statutes, case law was reviewed in four states to determine how laws relating to pedestrian facility maintenance are being interpreted, supported and enforced. The four states selected for this review included North Carolina, New Hampshire, California, and Wisconsin. Sidewalk case law was reviewed with an emphasis on liability. These four states of various sizes and regional differences were not meant to be necessarily representative of certain parts of United States, but chosen to analyze both the similarities and differences of sidewalk liability across the country.

Chapter 1 of this report summarized discussions with municipal and states officials related to pedestrian facility maintenance. Over 45 communities of varying size were contacted to have discussions about maintaining pedestrian facilities. Of all the questions asked, none were responded to with more uncertainty than those about laws and liability. This lack of clarity reinforced the need to review laws and case law. By reexamining responses from communities and states in light of the case law review, observations on how accurately legal precedent was

³⁰ *Ibid.*

being incorporated into a community's sidewalk maintenance policies and practices was enabled.

Issues of sidewalk liability were a significant factor in driving pedestrian facility maintenance practices in the states reviewed. It is more important to maintain a walkway system to increase safety for pedestrians than to do so just to avoid lawsuits; however, the legal ramifications of being sued as the responsible entity are compelling for communities. A claim for injuries related to a deficient sidewalk is often far more expensive than general upkeep of sidewalks.

One of the main tenants of liability is who has the duty of care to the public. While most states hold municipalities ultimately responsible in cases of sidewalk liability, there are growing instances of municipalities deferring responsibilities to abutting property owners through ordinances. Still, in both situations, there are stipulations put in place to create some protection for the responsible party. Many factors are weighed when determining fault and with the many potential outcomes, having a better understanding of civil liability and the legal precedents for pedestrian facility maintenance is important for pedestrians, abutting land owners and municipalities alike. Unfortunately, this review only enables a narrow look at this issue. As indicated in reference materials, it is important for every community to be in contact with their attorney and risk manager to provide a more complete assessment.

2.8.1 | North Carolina

The North Carolina State Department of Transportation states in their Policy and Procedure Manual that local governments are responsible for maintaining all pedestrian facilities. However, legally some responsibility in pedestrian maintenance does shift away from municipalities in North Carolina due to ordinances passed that protect municipalities from complaints. This is especially true in claims made about maintenance issues of sidewalks. While municipalities are still charged with the provision of safe and accessible sidewalks, adjacent property owners are often held liable for sidewalk maintenance issues if an ordinance placed them in control of such property. The landowner is generally and understandably presumed to be liable for conditions on his/her property that is *adjacent* to sidewalks, but *Petty v. Charlotte* (1987) states: "it is the control and not the ownership which determines the liability." This ruling highlights how communities can pass the responsibility of public sidewalk maintenance to the adjacent property owner by way of showing that the property owner is in "control" of the sidewalk even if he or she does not own it.

In reviewing case law in North Carolina, there are important distinctions made in regards to who is legally held accountable for sidewalk maintenance and what conditions must exist to be held accountable. This often comes down to the issue of negligence, of which a key aspect is

who knew what about the present conditions and when they knew of them. The two most common sidewalk claims regarding negligence are trips and falls and slips and falls (including ice and snow). There are two central cases in North Carolina speaking to sidewalk liability and negligence. In *Evans v. Batten* (1964), it was found that "...slight depressions, unevenness and irregularities in outdoor walkways, sidewalks and streets are so common that their presence is to be anticipated by prudent persons." Additionally, in North Carolina and five other states, an injured party will be denied judgment (payment) if found to have been guilty of even slight "contributory negligence" in the incident.

This sets the stage for much of sidewalk liability in North Carolina and is the reason why it is difficult for a claimant to win cases in the state. Essentially this ruling says that since no length of sidewalk can be physically perfect at all times, it is considered common knowledge that there will be "minor imperfections" in the sidewalk and a pedestrian must anticipate them. It is often argued then that a fall occurring due to sidewalk damage is the result of pedestrian negligence. What constitutes "minor imperfections" is left unclear in this ruling but it does still give municipalities and property owners in North Carolina the upper hand in cases of liability.

There are several cases which discuss what constitutes "minor imperfections." *Joyce v. City of High Point* (1976) determined that an elevation difference between two sidewalk pieces between 1-2 inches was not negligence on the part of the city. A more recent case, *Desmond v. City of Charlotte* (2001), found that 1.6 inches of elevation difference also did not constitute negligence on the part of the city.

In cases where it is shown that anticipation of imperfections was not possible, for a city or property owner to be held responsible it must be shown that the entity charged with maintaining the sidewalk had notice of the condition (*Sowers v. Forsyth Warehouse Co.*, 1962). *Oglesby v. S.E. Nichols, Inc.* (1991) found that "A building's owner may not be found negligent for a code violation unless: (1) the owner knew or should have known of the Code violation; (2) the owner failed to take reasonable steps to remedy the violation; and (3) the violation proximately caused injury or damage." Proximate cause" means that the injury or damage was a direct consequence of the violation.

In North Carolina, given the temperate climate and scarcity of snow fall and ice, most slip and fall cases take place inside private businesses and do not concern municipalities. However, liability surrounding ice and snow can still be an occasional issue. It is state policy that municipalities are not responsible for the removal of snow and ice from sidewalk except when the sidewalks are adjacent to municipal property. Therefore slip and fall cases are tried similar to trip and fall cases: negligence and prior knowledge need to be proved.

Based on this, where the pedestrian has equal knowledge of the ice, the landowner does not have a duty to remove it (*Grayson v. High Point Dev. L.P.*, 2006). However, if the defendant has actual knowledge of the hazard, he or she has a duty to correct or warn of the condition. Additionally, where there is a “reasonable inference that a [dangerous] condition had existed for such a period of time as to impute constructive knowledge to the defendant,” it can be ruled either way and is a question for a jury to decide (*Carter v. Food Lion, Inc.*, 1997).

During our discussions with communities across the county, four municipalities in North Carolina were interviewed: Charlotte, Durham, Salisbury and Davidson. In each community sidewalk maintenance was the responsibility of the adjacent property owner in terms of cost, but the municipalities would do all of the construction and repair work. However, perhaps due to the vagaries of the laws, each community did not know who was liable for claims stemming from maintenance issues. Salisbury mentioned that they have a risk manager who is in charge of investigating all claims, but no other city stated that they have any similar type of practice in place. This may also be due to the fact that the legal precedent set in North Carolina liability cases is that pedestrians are liable except in fairly rare and specific circumstances.

Though it is difficult to directly relate each of their practices to existing case law in the state, there was general consistency between the case law and the sidewalk repair practices reported in the four community discussions. In Charlotte, for example, it was noted that the City’s Department of Transportation does temporary repairs to sidewalks as soon as it is notified of issues in order to protect the city and adjacent property owner from liability. This practice is in keeping with the liability protection procedures outlined in North Carolina’s case law. Salisbury also has a program that gives immediate attention to reported sidewalk problems and puts into place an action plan for repair. In addition to liability protection, the City also has a risk manager who investigates all claims made against the City. Overall, pedestrian facility programs reviewed for this research tended to be more reactive in nature and not proactive.

Case Law

- Petty v. Charlotte, 85 N.C. App. 391, 394-396 (1987)
- Evans v. Batten, 262 N.C. 601,602, 138 S.E.2d 213, 214 (1964)
- Joyce v. City of High Point, 30 N.C. App. 346, 226 S.E.2d 856 (1976)
- Desmond v. City of Charlotte, 142 N.C. App. 590 (2001)
- Sowers v. Forsyth Warehouse Co., 256 N.C. 190, 194 (1962)
- Oglesby v. S.E. Nichols, Inc., 101 N.C. App. 676, 679 (1991)
- Grayson v. High Point Dev. L.P., 175 N.C. App. 786 (2006)
- Carter v. Food Lion, Inc., 127 N.C. App. 271, 275, 488 S.E.2d 617, 620, disc. review denied, 347 N.C. 396, 494 S.E.2d 408 (1997)

2.8.2 | New Hampshire

In New Hampshire it is the duty of municipalities to maintain pedestrian facilities. According to Chapter 231 of the New Hampshire's state laws "sidewalks shall be maintained, repaired and reconstructed by the city or town in which they are located without further assessment to the abutting owner". This can also be traced through case law to the New Hampshire constitution beginning with *State v. Jackman* (1898) continuing with two more recent cases, *Rutkauskas v. Hodgins* (1980) and *Ritzman v. Kashulines* (1985). These three cases combine to provide the framework for sidewalk maintenance law in New Hampshire. The *Jackman* decision found that calling upon only those property owners whose property abuts sidewalks to perform maintenance creates a burden leading to an "unequal division of public expenses among taxpayers in direct violation of the principle of equality which pervades the entire (state) constitution."

In *Rutkauskas v. Hodgins* (1980) it was found that: "...Absent (of) such negligent construction, design or maintenance causing an artificial accumulation of ice or snow...a landlord has no obligation with respect to the condition of the public sidewalk."

Ritzman v. Kashulines (1985) used this language as well in determining that parking lots adjacent to property are also considered the responsibility of the municipality to maintain.

While the responsibility to maintain facilities falls entirely on the municipality, liability stemming from maintenance is based on precedents set by these three cases as well as to state statutes. Under the New Hampshire Revised Statutes Annotated in Title XX Transportation Chapter 231 (RSA 231:92) which is in regards to roadways and liability of municipalities, it states:

A municipality shall not be held liable for damages in an action to recover for personal injury or property damage arising out of its construction, maintenance, or repair of public highways and sidewalks constructed thereupon unless such injury or damage was caused by an insufficiency, as defined by RSA 231:90.

In RSA 231:90, an insufficiency exists when the road or sidewalk is either not safely passable or there is a safety hazard that is not reasonably discoverable by people using the road or sidewalk in a reasonable, prudent and lawful manner. This "insufficiency law" does seek to protect the municipality, however RSA 231:92 does go on to further state that municipalities are held liable when actual notice or knowledge of an insufficiency is present. Based on RSA 231:92, municipalities have a duty to correct "insufficiencies" on public roads and sidewalks and will be held liable in cases where they are not doing so.

Along with the insufficiency law, municipalities in New Hampshire do have some additional protection in regards to liability. There is a time frame of liability that municipalities can use to their advantage. The law states that even when an insufficiency exists and it causes damage or injury, municipalities may not be liable if they follow certain time frame instructions. Within 72 hours after receiving written notice of the condition (or discovering it), the municipality is required to post warning signs and develop a plan to address the condition. That plan must be carried out in a "reasonable" amount of time. As long as the municipality does not respond to an insufficiency in a way that is "grossly negligent or recklessly disregards the hazard," the statute provides protection from liability. The municipality will also not be held liable for any prioritization practices in regards to pedestrian facility maintenance. Prioritization refers to the fact that municipalities cannot repair/maintain all infrastructures at once so a plan is often put into place that prioritizes the maintenance and places all work into a queue. So long as there has been formal written policy beforehand, a jurisdiction may not be held liable for any maintenance that was not done due to being lower on the prioritization list.

On a final note, property owners abutting sidewalks may be held liable in some cases if it is found that they themselves (or their property) caused an insufficiency in the pedestrian environment that resulted in injury. Examples of this could be improper snowblowing that places snow on the sidewalk or perhaps water runoff from roofs or yards that freezes to ice on the sidewalk.

In our discussions with Concord, New Hampshire, regarding pedestrian facility maintenance, the municipality's practices directly reflected those that are in this case law review. The City had an extensive snow removal program that was in keeping with the state mandated municipal responsibility and liability for the clearance of snow and ice. The citizens of Concord were used to having their snow cleared by the city and knew that if a person did their own plowing he/she ran a greater risk of being liable in the case of claim being filed. While the city is held liable for most issues, Concord closely followed the 72 hour window of liability in order to protect itself from claims.

Case Law

- State v. Jackman, 69 N.H. 318 (1898)
- Rutkauskas v. Hodgins, 120 N.H. 788, 423 A.2d 291 (1980)
- Ritzman v. Kashulines, 126 N.H. 286 (1985)
- New Hampshire Revised Statutes Annotated in Title XX Transportation Chapter 231 (RSA 231:92) , <http://www.gencourt.state.nh.us/rsa/html/XX/231/231-113.htm>

2.8.3 | California

Existing state law (Streets and Highway Code Section 5610-5618) requires the adjacent property owners fronting on any “portion of a public street or place maintain any sidewalk in such condition that the sidewalk will not endanger persons or property and maintain it in a condition that will not interfere with the public convenience” in the use of the sidewalk. The municipalities have the responsibility to provide “notice to the owner or person in possession of the property fronting on that portion of the sidewalk so out of repair or pending reconstruction, to repair the sidewalk.” The property owner has two weeks to begin the repair or the superintendent of streets shall make the repair and the cost of the repair shall be billed to the property owner.

In California, under present law, governmental liability for dangerous conditions of public property is imposed by government codes, in particular Government Code Section 835. Although this lays out liability in general it could and has been applied to sidewalks. Public entity liability occurs when property resulting from a “dangerous or defective condition of public property...” exists. Within this code however, there are several protections made for municipalities that prevent them from being held liable in every case. For a municipality to be held liable there must be prior knowledge or notice of the dangerous or defective condition and a failure to act in a reasonable time.

Specific case law germane to sidewalks themselves comes from a ruling in *Whiting v. City of National City* (1936), which stated that it is a matter of common knowledge that it is impossible to maintain a sidewalk in perfect condition: minor defects will exist and a municipality cannot be expected to maintain the surface of its sidewalks free from all inequalities and from every possible obstruction to travel. This ruling was further upheld in *Barrett v. City of Claremont* (1953):

“Growing out of the difficulty of maintaining heavily traveled surfaces in perfect condition is the practical recognition that minor defects inevitably occur, both in construction and maintenance, and that their continued existence is not unreasonable. In such case ... no liability may result.”

Even with these protections, Californian municipalities take on liability for sidewalks since the state’s Streets and Highways Code conferred a duty to maintain sidewalks on the adjoining property owner without changing common law. Property owners could be found liable due to other acts of negligence like improper use, but generally liability falls on the municipality. The code (law) clearly asserts that since property owners have the duty to maintain adjacent sidewalk, they can be held accountable for repair and maintenance costs. This means that

property owners are often responsible for the costs associated with maintaining sidewalks adjacent to their property but cannot be held liable in such cases of public injury or damage resulting from the maintenance of their adjacent sidewalk. This type of liability generally falls on municipalities so it is necessary for the jurisdiction to ensure the maintenance of sidewalks.

While this system of law states that adjacent property owners cannot be held liable for sidewalk maintenance issues, California's Streets and Highways Code §5610 (1941) asserts that property owners have the duty to maintain adjacent sidewalk and can be held accountable for repair and maintenance costs. This means that property owners are often responsible for the costs associated with maintaining sidewalks adjacent to their property but cannot be held liable in such cases of public injury or damage resulting from the maintenance of their adjacent sidewalk. This type of liability generally falls on municipalities so it is necessary for the jurisdiction to ensure the maintenance of sidewalks.

This notion was upheld in *Williams v. Foster* (1989). This case focused on an ordinance passed by the City of San Jose that was modeled on S&H Code §5610 and intended to better protect the city against liability cases by imposing liability on property owners if damages resulted from a failure to maintain adjacent sidewalks. The court found this ordinance to be in conflict with California law and ceased the ordinance.

However, the City of San Jose slowly began to change its ordinance and in 2004 passed another ordinance that allowed for liability in sidewalk cases to be shared or fall solely on the adjacent property owner. This ordinance was upheld in the landmark case of *Gonzales v. City of San Jose* (2004). Since this ruling, the State of California has seen more cities pass ordinances that place liability on the adjacent property owner but it remains a city-by-city ordinance.

Two communities in California were contacted during the course of researching pedestrian facility maintenance practices: Rancho Cordova and Roseville. Rancho Cordova is aware of its sidewalk maintenance liability and follows the California Streets and Highways Codes. The municipality's procedures are consistent with legal precedence in California: if the city knows of a dangerous condition or defect, it is liable so it seeks to fix issues as soon as possible. Often the city will do temporary fixes to remove itself from liability until a more permanent solution is put in place. In the event of the city not knowing of a problem and in cases of negligence, it is possible for the property owner to be held liable. The city is trusted with the maintenance of all residential sidewalks but not commercial ones so liability is often on a case-by-case basis. An official from Rancho Cordova also mentioned that because the municipality is so young, they find themselves more vulnerable to liability cases because the jurisdiction does not have enough formal policy in place regarding sidewalk maintenance. It seems that the city will

eventually move in the direction of San Jose and seek to deflect some liability onto adjacent property owners.

In Roseville, the city has a program to maintain all public sidewalks with a special emphasis on eliminating tripping hazards. Roseville residents are responsible for the repair or replacement of their sidewalk but the city does have a designated zone where the city has planted street trees. If it is found that city-owned trees have caused a dangerous condition, the city will cover the cost of replacement. In terms of liability, Roseville closely follows California legal precedence in that liability is determined on a case-by-case basis. Depending on what the dangerous condition or defect was and whether it was caused by a city-owned tree or a privately-owned tree or was caused by something else entirely is necessary in determining who was at fault and liable for any damages. At this time, the city was not pursuing an ordinance to place greater liability on the adjacent property owner.

Case Law

- California Government Code section 835
- *Ness v. City of San Diego*, 144 Cal. App. 2d 668, 670 (1956)
- *Whiting v. City of National City*, supra, p. 166 (1936)
- *Barrett v. City of Claremont*, 41 Cal.2d 70, 73 (1953)
- *Williams v. Foster* 216 Cal. App. 3d 510 (1989)
- *Gonzales v. City of San Jose* 125 Cal. App. 4th 1127 (2004)

2.8.4 | Wisconsin

Chapter 66 of the Wisconsin state statutes covers general municipal law and issues of sidewalk maintenance. Sidewalk maintenance cases generally follow the standard negligence rules of highway maintenance cases. These statutes assert that municipalities must exercise reasonable care under all circumstances. Reasonable care stipulates municipal liability in sidewalk cases no matter the circumstances including whether or not the municipality was aware or should have been aware of a defect, whether or not it had the time or opportunity to repair the defect, and whether it was reasonably foreseeable that the defect, if left unrepaired, would cause injury to a user. It is also noted that in cases of natural causes of defective sidewalks (i.e. snowfall or ice buildup due to topography and not substandard drainage systems), the municipality can be held liable if it does not remedy the situation within three weeks of notice.

This three-week rule provides the municipality with significant immunity in cases involving snow and ice removal. This immunity is thoroughly discussed in many sidewalk cases in Wisconsin, most notably in *Kowalski v. City of Wausau* (2000). While the municipality is ultimately held liable for cases involving sidewalk maintenance, they can fine owners for negligence such as failure to remove snow in order to keep sidewalks safer and thus prevent some claims against them. Another power municipalities have is the ability to create a special tax on adjacent properties for sidewalk repair without having to show how the properties will benefit. This allows for repair of sidewalks deemed defective by the community.

There are several important cases that give precedence to these statutes in the court of law. *Kobelinski v. Milwaukee & Suburban Transport Corp.* (1972) stated that "a city cannot delegate its primary responsibility to maintain its sidewalks, nor delegate or limit its primary liability by ordinance." *Hagerty v. Village of Bruce* (1978) found that a "property owners' failure to remove snow and ice from sidewalks in violation of a municipal ordinance did not constitute negligence per se." The case giving municipalities greater ease in repairing of sidewalks at adjacent property owner expense is found in *Stehling v. City of Beaver Dam* (1983).). Municipalities in Wisconsin will often require adjacent property owners to pay for repairs to sidewalks and will step in to conduct day-to-day maintenance if property owners fail to do so. The municipality may fine and/or receive reimbursement for that maintenance. However, the ultimate responsibility for the maintenance of the sidewalks is still the municipality's.

More recent case law also furthers this precedent. *Dorantes v. Heritage Mutual Insurance Company and Jacquez Automotive Service* (2002) was a case involving a person who slipped on a sidewalk that crossed the driveway of an auto repair shop. There was additional snow that had fallen off of cars moving in and out of the driveway and also packed snow on the sidewalk from tires. Dorantes slipped on this portion of the sidewalk and sued the auto shop. It was

ruled that adjacent property owners had no responsibility to remove snow and ice from sidewalk and could only be found liable if the snow or ice unnaturally accumulated (snow falling off of or getting compacted by cars was considered natural). The ruling was in favor of Jacquez and proved the city to be ultimately responsible for this slip and fall accident rather than the adjacent property owner. *Gruber v. Village of North Fond du Lac* (2003) affirmed this position, but ruled in favor of the Village of North Fond du Lac because the ice accumulation that directly caused Gruber's slip and fall was a "natural accumulation" and was believed to be an accumulation that occurred within a three week window that communities in Wisconsin can use to clear snow and ice.

Wisconsin cities interviewed for this study were found to follow these statutes and case law precedent closely. Cedarburg, Wisconsin mentioned that if the city built the sidewalk, it was responsible to see that it got repaired. Depending on what caused the damage, it could be the city's or the adjacent property owner's expense. In the case of a city tree causing the defect, the city would be liable. The City also reported instituting programs to increase consistent maintenance to demonstrate that it was doing all that it could to avoid claims. In terms of snow removal, the City specifically mentioned its state-granted three week leeway in terms of snow removal and that the city passes removal responsibilities to property owners (though the City is still ultimately responsible for snow removal and liability claims stemming from such). Madison, Wisconsin also stated that it was specifically liable for all cases involving sidewalks. While the City does have the three-week immunity to provide clear and safe sidewalk conditions, the City has ordinances that fine adjacent property owners for snow removal negligence to encourage the fast removal of snow from its sidewalks. The City also has a maintenance program that requires a share of the construction costs of repair on the adjacent property owner if repairs are needed and not caused by city trees.

Case Law

- Kowalski v. City of Wausau (2000)
- Kobelinski v. Milwaukee & Suburban Transport Corp. 56 Wis. 2d 504, 202 N.W.2d 415 (1972)
- Hagerty v. Village of Bruce, 82 Wis. 2d 208, 262 N.W.2d 102 (1978)
- Stehling v. City of Beaver Dam, 114 Wis. 2d 197, 336 N.W.2d 401 (Ct. App. 1983)
- Dorantes v. Heritage Mutual Insurance Company and Jacquez Automotive Service (Ct. App. 2002)
- Gruber v. Village of North Fond du Lac (2003)