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A Guide for Maintaining Pedestrian Facilities for Enhanced Safety



Guide for Maintaining Pedestrian Facilities for Enhanced Safety

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1 | Purpose and Background

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 Federal Highway Administration (FHWA) developed the Guide as one of several means of reducing the approximately 4,000 pedestrian fatalities and tens of thousands of pedestrian injuries occurring in the United States annually. This Guide is based on a research report completed as a part of developing the guide. The report is available online and includes a literature review, review of local maintenance programs including discussions with 50 municipalities and state agencies, and an overall assessment of the current practice of pedestrian facility maintenance.

http://safety.fhwa.dot.gov/ped_bike/tools_solve/

1.1 | PURPOSE

FHWA works toward reducing pedestrian fatalities and injuries by providing tools and technology to assist practitioners in improving pedestrian safety. One way pedestrian safety can be improved is by encouraging state, local and municipal governments to provide and maintain accessible sidewalks along streets and highways where there is pedestrian activity such as near school zones, transit locations and other locations with frequent pedestrian activity. Although there are guidelines and standards to aid in the design of pedestrian facilities, it can be difficult to adequately maintain facilities once they are in place so they remain safe and accessible. Federal funding is not available for maintenance activities, and many state and local government agencies have severely constrained resources for monitoring, inspecting, and maintaining sidewalks and other pedestrian facilities. Not only does this problem relate to walkability and accessibility, there are also liability consequences related to poor, inadequate, or infrequent inspection and maintenance of pedestrian facilities.

The purpose of the guide is to identify effective and exceptional practices, along with barriers for pedestrian facility maintenance: what works and

Who is responsible for facility maintenance?

Many jurisdictions have laws or ordinances addressing pedestrian facility maintenance, which often require the adjacent property owner to repair deteriorated sidewalks adjacent to their property. More often ordinances require property owners to remove snow and ice and vegetation encroaching onto sidewalks. However, property owner requirements and enforcement of these regulations may vary widely from jurisdiction to jurisdiction. Maintenance of shared use paths is more complicated still, because the agencies that are responsible for them do not always make a practice of monitoring them and making sure they are in safe and passable condition.

what does not work based on experience from state and local agencies. The guide will provide exemplary and effective practices for maintaining pedestrian facilities and infrastructure.

1.2 | AUDIENCE FOR GUIDE

This guide is intended for any agency or organization that builds and maintains pedestrian facilities. Most commonly this includes government bodies at the state, county or local level, but it may also include homeowners associations, private land management organizations and other groups. Any government entity, group or organization that builds or maintains sidewalks or shared use paths will benefit from the material contained in this guide.

For the purpose of brevity, these groups will often be referred to as “agencies,” “municipalities” or “communities” in this document, even though the group may include non-governmental entities such as homeowners associations.

1.3 | TYPES OF PEDESTRIAN FACILITIES

In this guide maintenance is defined as inspecting, preserving, repairing, and restoring a pedestrian facility and keeping it in condition for safe, convenient, and accessible use. Maintenance includes repairing surface defects and changes in level (e.g., heaving) as well as snow/ice, debris, and vegetation removal.

This Guide will focus on the following categories of facilities used by pedestrians:

- Sidewalks, walkways and curb ramps
- Shared use paths
- Crosswalks, signals and other treatments of facilities for crossing streets
- Signs

Sidewalks or walkways (a slightly broader term that also includes walks that do not parallel a street) will receive the greatest attention in this Guide as they comprise the vast majority of the pedestrian system in the United States. Shared use paths will often have the same maintenance needs as sidewalks, and where a discussion can cover sidewalks and paths, the guide does so. The guide includes discussions on Americans with Disabilities Act (ADA) including curb ramps, detectable warning fields and sidewalk surface materials. Pedestrian facilities used to cross streets, such as crosswalks and signals, and their associated maintenance issues are also discussed. Other sections of the report include funding and techniques to elongate the maintenance life of pedestrian facilities. All of the sections include a discussion of exemplary maintenance practices from around the United States and

recommendations for maintenance. In some cases, a discussion of a practice or set of practices to avoid is provided.

1.4 | OVERVIEW OF PEDESTRIAN MAINTENANCE PROGRAMS IN THE UNITED STATES

Although there are strong similarities among some areas of the country, the maintenance of pedestrian facilities varies widely across the United States. This is due to a variety of factors including different management structures for maintaining agencies, different legislative requirements, and different climates that require varied approaches to maintenance. Although pedestrian facilities are not subject to the wide variation in traffic volumes and vehicle loads as roadways, in some ways maintenance of them is more challenging than roadway maintenance. For instance, the repair of sidewalks is fairly labor intensive, regularly requires specialized treatments, and is difficult to maintain with heavy equipment. The situation is complicated by the wide variety of parties responsible for pedestrian facility maintenance (e.g. different local agencies, individual property owners, state departments of transportation, and community and homeowners associations).

As part of the research conducted for this guide, dozens of local agency programs were identified and profiled. Follow-up discussions were arranged with 50 communities and state departments of transportation. A review of an equal number of community maintenance programs were also conducted, but without discussions with agencies. Based on this work, several patterns emerged:

- In the vast majority of states, local and municipal governments can and do require that adjacent property owners perform day-to-day maintenance of sidewalks including snow/ice removal, vegetation removal and trimming, and sweeping. Jurisdictions may be ultimately responsible for this type of maintenance, but at least initially, that responsibility is shifted to the property owners. In the absence of the adjacent property owners providing the maintenance, local jurisdictions may have to step in to do the maintenance, although they will most often charge or fine the adjacent property owner for that service.
- Based on the research conducted for this guide, it appears that the majority of state and local governments are either initially or ultimately responsible for the repair and replacement of sidewalks and shared use paths. In many cases the community will either carry out the repair work or notify the property owner that the work will be done by city or village crews at partial or full cost charged and/or assessed to the property owner. It is less common for communities to initially enlist or obligate an adjacent property to perform this work themselves only to later intervene if the work is not

undertaken in a short timeframe (often 30 to 60 days). In a small percentage of cases, communities require that the adjacent property owners conduct the work themselves or hire a contractor to complete the work. A list of approved contractors is often supplied to the property owner, but the city, village, or county will not arrange for any of the repair work. The property owner will likely be fined for non-compliance.

- Curb ramps, crosswalk markings, and pedestrian signal maintenance are all part of a jurisdiction's maintenance program. The maintenance of crosswalk markings presents significant problems for continued upkeep because of the excessive wear caused by motor vehicles driving over them.
- The maintenance of shared use paths is typically performed by local governments, although state governments, homeowner associations and other groups are also involved in maintenance. Based on the research performed for this guide, in many communities shared use paths are not cleared of snow and ice by the local government or maintaining authority. This often contrasts with winter sidewalk maintenance where the local government or maintaining authority either performs snow and ice removal or requires abutting property owners to do so. There are exceptions to this, and some communities do clear snow and ice from shared use paths, but research indicates that this is rare. However, communities are beginning to make changes to this approach, and winter maintenance is increasingly more commonplace.

1.5 | CONCLUSION

There is no simple way to explain how and to what extent pedestrian facilities are maintained in the U.S. The quality and timing of maintenance, inspection standards, funding, and even ownership of facilities varies considerably across the country. This is one of the first national guides of this type that focuses entirely on maintenance with an emphasis on safety. There were many examples that were identified in the research that placed a municipality or a state agency as the maintaining authority for all pedestrian facilities. When the maintenance becomes the responsibility of adjacent property owners the dynamic changes and enforcement processes now have to be put in place to ensure consistent and timely maintenance because another constituency is accountable.

There is considerable overlap between maintaining pedestrian facilities and accessibility. Later in this guide this relationship is explained in more detail, but it is important to establish this connection in the first chapter. The Americans with Disabilities Act (ADA) of 1990 and Section 504 of the Rehabilitation Act of 1973 prohibit discrimination against people with disabilities. Within the public right-of-way, sidewalks are considered an important part of the pedestrian

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access route, as are crosswalks, paths, curb ramps, traffic signals, and signs. Maintenance projects do not automatically require simultaneous improvements to pedestrian accessibility under the ADA and Section 504. For example, the spot repair of a heaved sidewalk does not require re-engineering a steep cross-slope. Nevertheless, because pedestrian facilities are required to be accessible, maintenance activities may also provide an opportunity to improve conditions and move agencies closer to meeting their accessibility obligations.

2 | The Case for Pedestrian Facility Maintenance

2.1 | PEDESTRIAN FACILITIES – A PART OF THE TRANSPORTATION SYSTEM

Sidewalks, shared use paths and other pedestrian facilities are important components of the transportation network. Regardless of the primary means of transportation chosen (auto, bus, rail), nearly everyone is a pedestrian at some point in nearly every trip and pedestrian facilities serve nearly everyone. Because of this, it is important to provide dependable pedestrian facilities that are usable year round by people of all abilities.

Sidewalks are an integral part of the transportation system and should be regarded as such. In the same way that the maintenance for a street or roadway is considered, it is also important to consider maintenance for any adjoining sidewalk or path. In many states the definition of a street or highway is inclusive of everything within the public right-of-way including all of the pedestrian facilities contained within that right-of-way. Maintenance of the street or highway should automatically cover the maintenance of the pedestrian facilities – sidewalks, curb ramps, pedestrian signals, and crosswalk markings.

Pedestrian facilities provide a relatively low cost mobility option that is available to nearly everyone if properly designed and maintained. Pedestrian facilities are also relied upon disproportionately by a significant segment of the public who cannot drive. Once constructed, it is important to maintain pedestrian facilities for varieties of reasons that are detailed below.

2.2 | MAINTENANCE IS CRITICAL FOR SAFETY

There are many safety issues that are directly attributable to poorly maintained pedestrian facilities. Improved safety through proper maintenance can be considered in two ways – reduction of crashes with motorists and the reduction in trips, slips, and falls.

In 2008, the FHWA Office of Safety produced a list of nine proven safety countermeasures that was revised in 2012.¹ These countermeasures have the potential to significantly reduce traffic fatalities and injuries. The 2008 list included walkways as a proven countermeasure to improve pedestrian safety. The 2012 list includes three measures that are related to pedestrian safety: pedestrian hybrid beacons, road diets and medians/pedestrian crossing islands. According to the findings of the studies, the presence of a sidewalk or pathway on both sides of the street corresponds to approximately an 88 % reduction in “walking along road” pedestrian crashes. Providing raised medians or pedestrian refuge areas at pedestrian crossings at marked

¹ Furst, Tony. Memo to Division Administrators. “Promoting the Implementation of Proven Safety Countermeasures.” Federal Highway Administration. Jan 12, 2012. http://safety.fhwa.dot.gov/provencountermeasures/pc_memo.pdf.

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crosswalks has demonstrated a 46% reduction in pedestrian crashes. To fully realize the potential for crash reductions for these facilities, routine maintenance is critical. Pedestrians will walk in roadways to avoid improperly or unmaintained sidewalks or will stand in the middle of intersections waiting for traffic to break when crossing islands are not accessible.

Another countermeasure is marked crosswalks. Although this is not specifically promoted as part of the nine countermeasures by FHWA, crosswalks are a known and effective countermeasure in most urban and suburban environments. Poorly maintained crosswalk markings may not provide the visibility necessary to warn motorists of the street crossing.

Safety issues also relate to the prevention of trips and slips that cause falls. Unfortunately, these incidents are not recorded in the same way that crashes between pedestrians and motorists are recorded. However, based on hospital records and claims made to state and local governments for injuries, these incidents can be very harmful and on occasion fatal. The seriousness of falls tends to disproportionately impact older adults.

The Center of Disease Control (CDC) profiles the seriousness of falls for older adults, although they are not profiled specifically for sidewalk or walkway incidents. According to the CDC² one out of three adults age 65 and older falls each year. Twenty to thirty percent of older people who fall suffer moderate to severe injuries such as lacerations, hip fractures, or head traumas. Most fractures among older adults are caused by falls. Falls are also the most common cause of traumatic brain injuries for older adults. The likelihood for serious injury increases exponentially as people age past 65. One of the most common and serious fractures for an older adult to recover from is a hip fracture. About half of people who could walk before a broken hip cannot walk as well afterward, even after treatment and rehabilitation. There are many examples where months after the fall people have died from complications brought on by the injury.

There are other longer term effects of a fall that directly impact a person's willingness to continue to walk within their community. People who have fallen may develop a fear of falling that reduces their confidence and causes them to give up walking. Because of the inactivity, joints can become stiff and muscles can become weak. These worsening physical conditions are the very ones that can further increase the risk of falling. Independent living becomes more difficult because older adults are often those most dependent on walking options because a significant percentage of this population does not drive. Given these obstacles, the simple maintenance of pedestrian facilities can have a very positive effect of encouraging walking

² "Falls Among Older Results: An Overview." Centers for Disease Control and Prevention. September 20, 2012. <http://www.cdc.gov/homeandrecreationalafety/falls/adultfalls.html>

among older adults. Icy or uneven surfaces are very dangerous for pedestrians using walking aids such as canes, crutches, and walkers. Furthermore, where sidewalks have virtually no separation from the street, crowds, rain, snow, or ice, all increase the chance of falls or slips. Grades become more dangerous with inclement weather and debris.

At the other end of the age spectrum are youth. Crash involvement rates (crashes per 100,000 people) are the highest for 5- to 9-year-old males, who tend to dart out into the street. This problem may be compounded by the fact that speeds are frequently a problem in areas where children are walking and playing. It also underscores the need to have sidewalks in place that are in walkable condition. Using *Safe Routes to School* programs provide an excellent means of developing walking audits that identify hazards or otherwise poorly maintained pedestrian facilities.

2.3 | MAINTENANCE IMPROVES MOBILITY

Access and mobility are inextricably linked. It is difficult if not impossible to have mobility for a significant segment of the population without providing overall access to pedestrian facilities. Just as the last section on safety revealed the link between safety and mobility, poor pedestrian facility maintenance can have an equally profound impact on overall pedestrian mobility. Any break in the pedestrian network or disrepair can potentially eliminate walking or transit option for people or force a choice to drive instead of walking. At its worst, it may prevent a trip altogether for a segment of the population that has few or no travel options other than walking. Oddly, in some cases, pedestrian safety might actually appear to improve as access is reduced. With fewer trips being made because of poorly maintained pedestrian facilities, overall pedestrian exposure will be reduced and the injury numbers themselves may indicate a safer environment for pedestrians. However, what is really occurring is an overall diminution in pedestrian mobility caused by a reduction in access.

The most obvious examples of compromised pedestrian facilities are of sidewalks and curb ramps where snow and ice are blocking facilities for days or even weeks at a time. However, sidewalk facility defects or malfunctioning pedestrian signals can also have a more subtle, but just as negative, year-round impact on pedestrian travel, especially for people who might be more susceptible to being tripped by surface problems or are at greater risk to injury if they were to fall.

2.4 | MAINTENANCE IS CRITICAL FOR PEOPLE WITH MOBILITY RESTRICTIONS

At its core, accessible designs are significantly undermined if maintenance is neglected and pedestrian facilities are allowed to degrade to a state where they cannot be used or are avoided. 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. Secondly, the maintenance of transition points – curb ramps, medians, crosswalks, etc. – ensures access at intersections. These are linked to form an accessible path.

The Americans with Disabilities Act of 1990 and Section 504 of the Rehabilitation Act of 1973 address how transportation facilities should accommodate people who have mobility restrictions. When pedestrian facilities are built, the essential accessibility requirement is to create an accessible 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, shared use paths, traffic signals and other pedestrian facilities. Seemingly minor maintenance issues can form a significant barrier to people with disabilities.

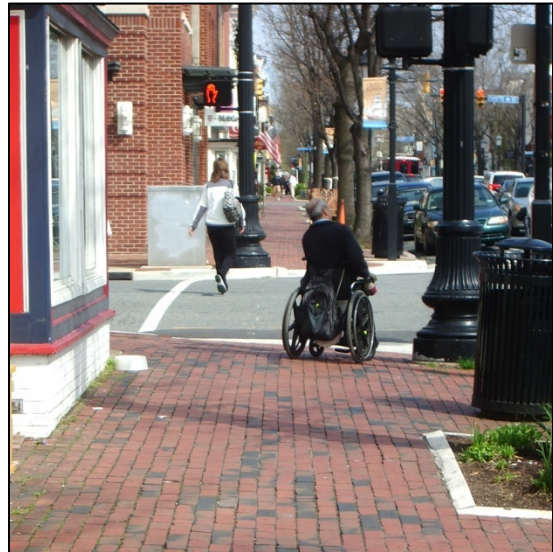


Figure 1: Sidewalks and pedestrian areas should be accessible to all users.

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, “In accordance with 28 CFR §35.133, a public agency must maintain its walkways in an accessible condition, with only isolated or temporary interruptions in accessibility. Part of this maintenance obligation includes reasonable snow removal efforts.”³

The need for relatively expensive paratransit increases when facilities become inaccessible because of poor pedestrian facility maintenance. The U.S. Department of Transportation's ADA regulations provide three categories of paratransit eligibility and one of these three relates directly to inaccessible sites. People who have a specific disability-related condition

³ Wlaschin, Butch. Memo to Directors of Field Services Division Administrators. “Snow Removal on Sidewalks Constructed with Federal Funding.” Federal Highway Administration. August 27, 2008. <http://www.fhwa.dot.gov/preservation/082708.cfm>.

that prevents them from traveling to a boarding location or from a disembarking location are considered eligible for paratransit. Environmental barriers, such as snow and ice that prevent an individual from traveling to or from the boarding or disembarking locations may form the basis for their eligibility.

2.5 | ASSET MANAGEMENT

Asset management has been defined by the American Association of Highway and Transportation Officials (AASHTO) as a strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their lifecycle. Through asset management better decision-making occurs based on the quality of information and the defined objectives. The maintenance of pedestrian facilities falls squarely within this definition and is no different than other components of the transportation system.

Sidewalks are known to last well over 50 years in most environments. The recent drive for asset management for transportation facilities has called attention to how the maintenance of sidewalks fits into an asset management approach. For sidewalks and other pedestrian facilities to last for that length of time maintenance is critical as a means of protecting and extending the initial investment. Although a new name and a more sophisticated process has been applied to managing transportation assets, communities that have been carefully maintaining pedestrian facilities have already learned the benefits of asset management. Here are few examples of how asset management and pedestrian facility maintenance are linked:

- **Protect initial investment.** The initial construction of sidewalks requires a significant outlay of capital. A maintenance program continues to protect that investment. Relatively small outlays of maintenance funds can elongate the life of pedestrian facilities and in some cases avert significant future outlays.
- **Level of service.** The maintenance of pedestrian facilities is inextricably tied to the level of service they offer. Asset management practices focus not only on the simple function of a facility, but on the level of service or performance they provide.
- **Information management and analysis.** An important aspect of the maintenance of pedestrian facilities – and asset management – is the on-going inspection of the facilities. Careful monitoring of the condition of pedestrian facilities can lead to the timely repair and the day-to-day maintenance of the facilities. This not only protects the investment, but keeps the facilities in a safer condition for users.

2.6 | LIABILITY MANAGEMENT

The objective of maintenance programs is to keep facilities accessible and safe for users and to efficiently extend the lives of these facilities through routine and preventative efforts. When there is a breakdown in maintenance of pedestrian facilities the outcome can result in an injury. A related objective of pedestrian maintenance programs is to manage liability. Based on research conducted for this guide, liability varies from state to state and community to community. There is a complex web of interactions within some states that make it difficult to point entirely to public agencies for tort liability. According to the limited research on liability conducted for this guide, some agencies have liability for mishaps stemming from maintenance problems. This is especially common when agencies are aware of a defect or actually have caused the defect themselves. Even if a community has ordinances that require adjacent property owners to maintain facilities on a day-to-day basis (snow removal, sweeping, vegetation trimming) it may still have ultimate responsibility for maintaining the facilities. It is strongly recommended that agencies comprehend their own exposure to liability by fully understanding their state's statutes, local ordinances, and related case law.

Having a sound maintenance program can significantly reduce an agency's exposure to liability. Having a written policy is better than having an informal, unwritten policy. If a community establishes and follows a policy and a mishap occurs, it can help prove that the municipality or community provided reasonable care in the maintenance of its facilities. If a jurisdiction has limited resources, it cannot simply ignore sidewalk maintenance. The jurisdiction still needs to formulate a policy that effectively utilizes the resources it does have. To limit exposure to liability even during times of budget reductions, a community may need to alter its inspection schedule or re-prioritize sidewalk repair projects, but should not eliminate its maintenance practices. Communities that document maintenance decisions and continue to consider complaints and concerns from the public will be in a more defensible position from a liability standpoint.

It is important to emphasize that reducing mishaps through proper pedestrian maintenance has two important outcomes – first and foremost it will improve pedestrian safety. Secondly, when this occurs, there is a commensurate reduction in the occurrence of legal actions taken against a maintaining authority for injuries.

3 | Common Maintenance Issues

3.1 | SURFACE TYPES

Sidewalks and shared use paths are the main types of pedestrian facilities that accommodate pedestrians. The surface material used for these facilities can have a significant effect on how and how often maintenance is performed. Of the hard surfaces, concrete is the most common surfacing type for sidewalks while asphalt is commonly used 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 do have some unique maintenance issues which will be discussed in more detail later in this guide.

Surfaces can also be “soft” and composed of loose stone, compacted stone dust, or wood chips. Since wood chips are not considered a firm and stable material type under ADA and are very rarely found in the public right-of-way, they will not be discussed in this guide. Stone surfacing, especially crushed stone, is sometimes used for paths and sidewalks. It is more likely that stone or gravel will be used for sidewalks as a temporary fix before a more permanent surface material ultimately replaces it.

Here are the main types of sidewalk materials with a brief discussion of their maintenance characteristics.

3.1.1 | 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 lifespan between 40 and 80 years. It is poured material and within 30 minutes or less 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 suitable material to use when there are multiple grades and cross slopes such as at



Figure 2: Concrete is the most widely used material for sidewalks in the United States.

corners and curb ramps. New paving equipment in the past thirty years now enables the paving of long stretches of sidewalk without the use of form works. Finishing of the material requires a rapid pace when formless paving equipment is used because the concrete excreted by the machines is very stiff. Repair and replacement of sidewalks in concrete is still performed the same way it was 50 years ago, with forms and skilled finishers.

3.1.2 | Asphalt

Asphalt is the most common material used for shared use paths in the United States. Asphalt is a less common material for sidewalks than concrete and typically has a significantly shorter life than concrete. However, the initial cost to install asphalt is typically significantly less than concrete. Asphalt 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. 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 path or sidewalk, concrete is used for the curb ramps. Asphalt is commonly used as a temporary patching and wedging material for concrete sidewalks.



Figure 3: Asphalt is commonly used for shared use paths, but is less commonly used for sidewalks in the United States. Above is a section of shared use path after a repair in Madison, Wisconsin.

3.1.3 | Brick and Pavers

Brick is a traditional sidewalk material type that has been 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” because each paver is separate and is often not tied or bonded together the way a concrete slab is formed. Bricks have unique maintenance requirements and most communities consider bricks to be more costly and problematic to maintain than concrete. However, bricks and pavers can be

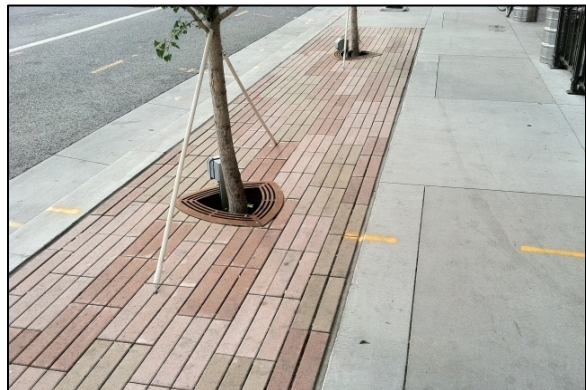


Figure 4: Porous pavers in downtown Denver allow storm water infiltration into tree planting areas.

individually replaced by experienced personnel with a smaller amount of effort than replacing entire sections of concrete sidewalks. Some communities use bricks and concrete pavers to highlight sidewalks in commercial areas or plazas. This approach often reduces maintenance costs and potential tripping hazards within the accessible path because the bricks are often laid over a solid concrete surface. Bricks are primarily rectangular and are manufactured in a wide range of colors. More recently, bricks and pavers have been manufactured and placed to create a more permeable surface and reduce surface runoff, but this requires more spacing between the materials.

Concrete pavers are also used for sidewalks 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. Like all other sidewalk materials, attention to proper construction can reduce maintenance problems and costs in the future.

One of the shortcomings of bricks and pavers is that they can pop out of place and present a tripping hazard more easily than concrete or asphalt slab sidewalks. Both concrete and asphalt can also be horizontally cut or ground to mitigate tripping hazards, whereas bricks and pavers can be reused, but often have to be removed and repositioned so the base material can be modified to effectuate the leveling of the sidewalk.

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, although they can be used in most environments where sidewalks need to be placed in a relatively straight alignment. They are typically half the depth of concrete sidewalks and are more expensive than concrete.

3.2 | COMMON MAINTENANCE ISSUES

There are a number of specific maintenance issues that commonly occur for pedestrian facilities. These issues can be sorted into two broad groups – those that are directly related to the pedestrian facility infrastructure itself,



Figure 5: Rubberized pavers allow for modular installation.

such as sidewalk surfacing deficiencies, and those that relate to seasonal or day-to-day maintenance which require keeping the facility clean and free of nuisance materials. This involves removal of vegetation, snow, ice, sand, and other materials. An effective pedestrian facility maintenance program needs to address both sets of issues. The responsibility of day-to-day maintenance is often addressed by communities that then relegate the duties to adjacent property owners. This section will lay out the common types of issues associated with these two broad categories while later sections discuss inspection of these conditions, and a range of solutions to address them.

3.2.1 | Infrastructure Issues Leading to Increased Maintenance

Infrastructure problems can be broadly categorized into two groups for sidewalks and paths – surfacing problems and structural problems. Both sets of problems cause maintenance issues. Most structural deficits will ultimately affect surface conditions, but there are certain surface conditions that are not caused by structural conditions.

Infrastructure deficiencies also exist for curb ramps, traffic signals, and crosswalks and are covered below.

Surfacing defects

Surfacing defects lead to a multitude of problems impacting maintenance. Certain defects cause concrete surfaces to crumble, including spalling, scaling and popouts. Poor curing and concrete quality or finishing techniques can all contribute to surface defects. Often these defects appear in the first several years after application. Minor defects may only affect appearance, but moderate to severe conditions will ultimately become a safety hazard and may significantly affect the usable life of the sidewalk. Often even minor defects will become moderate to major defects as more deterioration occurs over time because of the compromised surface.

Other surfacing deficits include raveling and cracking. Raveling is caused by high air voids in the material due to poor compaction or late season paving. Cracking can lead to series of problems for asphalt and concrete surfaces overtime. Cracking is caused by underlying structural defects below the surface.

The surface of bricks and concrete pavers occasionally exhibit surface problems. The



Figure 6: A crumbling surface on this walkway can lead to accessibility issues and tripping hazards.

quality of material is generally and consistently good because it is produced through a controlled and stable manufacturing process. The major maintenance problems with pavers and bricks usually are associated with displacement of the material itself and not the surface deterioration of the material.



Figure 7: Spalling on a sidewalk

Deformation forces causing structural problems for sidewalks and paths

The most common maintenance problems with hard surface materials result from structural conditions such as those caused by cracking, heaving, tilting, gaps (often at concrete joints), and sidewalk and path sections that either are depressed or raised. The Institute for Research in Construction of the Canadian National Research Council has undertaken an extensive study of concrete sidewalk issues and has defined the following four major deformation actions leading to structural damage to sidewalks. These same conditions cause failures in asphalt, as well as bricks and pavers. With the exception of cracking and gaps (which can be just a surface condition), all of the problems listed below are structural in nature and result from a series of structural failures from deformation forces described below. Many of the forces that cause damage to sidewalks are related to freeze and thaw action of the subbase. Photographs are provided which illustrate the potential aftermath of the forces at work.

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 (freeze and thaw) 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. Also commonly known as "vertical uplift" or "projecting edge."



Tensile Shrinkage

Deformation resulting from tensile stresses during the shrinkage of underlying soil from decreasing moisture content.



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.

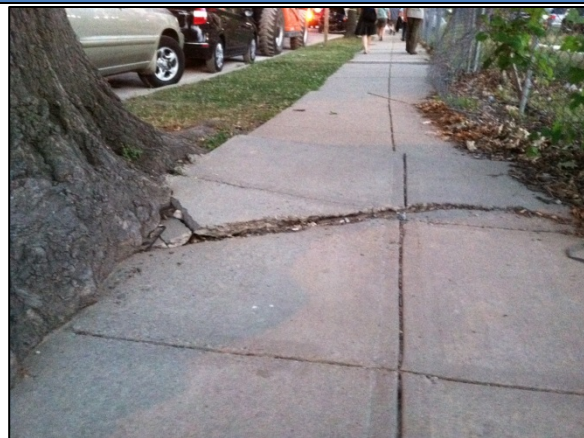
Note: The term sagging is commonly used to describe sidewalks that subside and entire slab or set of slabs drop below the initial grade. The forces that contribute to that are more accurately explained as tensile shrinkage described above.



Raised or Heaved (Also referred to as hogging)

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. This will often lead to longitudinal cracking.

Raised pavements are also commonly caused by tree roots.



All of the above conditions will cause sidewalks and paths to deform, shift, heave, or buckle. When this occurs the surface of the material is affected and maintenance is necessary often involving spot repair of small or large sections of sidewalk or path.

Cracking and heaving are the two main results of the deformation forces at work. Cracking can occur in every direction of a surface when concrete is used. Since any given length of concrete will eventually crack, methods are used to control it. The main method of avoiding surface problems is to direct the cracking at joints which are placed in the concrete by either manually finishing them into the surface or making cuts with concrete saws as the surface is curing. Most of the maintenance problems stem from uncontrolled cracking, although sidewalk panels do heave at the joints. The ones mostly closely impacting sidewalks and paths are edge, alligator, and longitudinal cracking.



Figure 8: Cracking of sidewalk sections can lead to accessibility issues.

Alligator cracking is characterized as typically fine, longitudinal hairline cracks running parallel to each other with none or few interconnecting cracks. Longitudinal cracking occurs along the length of the sidewalk, usually in the middle third of the sidewalk, usually in the middle third of the sidewalk, and can extend through several expansion or control joints. Unlike alligator cracking, they are often larger. 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.

Heaving of concrete sidewalk panels is a common problem that causes a significant number of tripping hazards. Heaving is also called vertical uplift, vertical displacement, faulting, and changes in level. Several of the deformation forces described above can lead to heaving. Because sidewalks are built with joints to control cracking, heaving most often occurs at these locations.



Figure 9: Heaved sidewalk

Other Pedestrian Facility Infrastructure Problems

Maintenance of pedestrian facilities is often associated with just sidewalks and sometimes paths, but other pedestrian facilities also incur problems which increase the need for maintenance. These facility types include curb ramps, crosswalk markings, pedestrian signals, and signage.

Curb Ramps

Curb ramps provide the transition between sidewalks and street crossings and allow pedestrians to reach street level at corners without stepping up and down at a curb. They are required by accessibility laws. Most of the same maintenance issues impacting sidewalks also impact curb ramps. All of the forces outlined above also deform curb ramps. All new curb ramps are required to have detectable warning fields which provide indications to



Figure 10: Damaged detectable warning fields.

people who are sight-impaired or blind to that they are about to enter a street. Although many different forms of detectable warnings have been used over the past 40 years, only truncated domes are now acceptable for use. They can be inserted into concrete as cast iron or stainless steel plates, applied as a glued-on material, or formed in place as the concrete ramp is finished. Each of these processes may lead to special maintenance problems. For example, the plate could become displaced causing a tripping hazard, adhesive may weaken for glued-on domes, or the concrete domes are likely to chip off when plowed. Additionally, the truncated domes must provide a color contrast to the ramp. Especially for formed-in-place domes, this requires an agency to periodically repaint the warning field. Chapter 7 of *Designing Sidewalks and Trails for Access – Part II* provides guidance for the current recommended design of curb ramps:

http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/sidewalks2_07.cfm

Crosswalk Markings

The most frequent maintenance problem with crosswalk markings is durability. Painted crosswalks have to be repainted several times a year based on the volume of traffic and the severity of the weather. Two other marking materials – epoxy and thermoplastics – are far more durable, but are significantly more expensive. In cold weather climates where salt and sand is used, the abrasiveness of the materials causes more rapid deterioration of the markings.

Another durability-related maintenance problem is the conspicuity or retroreflectivity of pavement markings. Glass beads or other reflective materials are added to marking materials to enhance nighttime conspicuity. When the markings wear, the reflective quality of the material is compromised.

Another area of concern with crosswalk markings is slipperiness of the markings. Manufacturers of these materials have taken steps to significantly improve the friction factor of their materials, but as the material wears, sometimes it becomes slicker causing a need for reapplication. Slippery markings make it necessary for municipalities to replace the markings sooner.



Figure 11: A street is prepared for the installation of new crosswalk in-laid markings.

Signals

Based on the research conducted for this guide, communities consider their signals to be durable with the most serious maintenance problems being signal “take-downs” related to vehicle crashes. Other significant problems requiring maintenance include push buttons and signal heads that are malfunctioning. The replacement of signal heads with light emitting diodes (LEDs) has significantly reduced the need for replacement of light fixtures. LED lights last for approximately 100,000 hours, many times the life of incandescent bulbs. Filaments in incandescent bulbs burn out in approximately 10,000 hours. However, LEDs do not produce as much heat as incandescent bulbs and can become snowed over in blowing snow conditions.

Another set of hardware problems relates to the controller for the signal system. The controller is the device that manages the entire signal system for the intersection. Occasionally problems with the controller cause a pedestrian signal to malfunction.

Pedestrian signal systems have become more complex with the advent of Accessible Pedestrian Signals (APS). APS devices work with existing traffic signal controllers. Some APS devices require no additions to equipment in the signal controller cabinet for installation and operation depending on the type of equipment that is already installed.

APS devices will require additional wiring most often between the pedestrian signal head and pushbutton which on occasion have cause maintenance problems. However, most of the servicing needs are related to initial set-up including attention to pushbutton placement and alignment, and careful adjustment of sound volumes. APS devices offer considerable benefits to people who are disabled and most of the servicing needs can be resolved within the first several weeks or months of the initial installation.

Signage

Signs that act as wayfinding devices for pedestrians are no exception to this on-going maintenance problem. Unlike markings, signs have a much longer life – quite often more than 10 years. Several factors tend to lessen the life of signs - ultraviolet radiation and airborne pollutants can dramatically reduce the sign's useful life. Vandalism to signs is also a significant maintenance problem for signs in general. Signage replacement for pedestrian-related signage tends to take a lower priority to the maintenance of regulatory signs purposes (i.e. stop and yield signs).

3.2.2 | Seasonal Maintenance

The conditions of sidewalks for safe, comfortable and accessible travel are influenced not only by infrastructure problems, but also 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. Often these seasonal conditions are the cause of problems people most associate with maintenance or lack thereof.

Meeting the obligations to keep sidewalks accessible is reinforced by the Americans with Disabilities Act. The act requires that pedestrian facilities in the public right-of-way be accessible to people with disabilities. The federal act 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 48 inches according to the proposed draft of the ADA Public Rights of Way Accessibility Guidelines (PROWAG).

Snow and Ice

The removal of snow and ice for many U.S. communities presents the most significant maintenance challenge they confront. Following a snowfall, snow and ice must be cleared from sidewalks, paths, curb ramps and crosswalks to provide safe and accessible passage for pedestrians. Common challenges exist to resumption of pedestrian travel after snowfalls. These include street plowing that pushes snow onto sidewalks or blocks crosswalks, clogged or obstructed drains that create puddles at curb ramps, patches of ice that create slip hazards, and failure to remove snow and ice completely from sidewalks. The need for winter maintenance is impacted by the amount of snowfall, the mean winter temperature, the amount and intensity of sunlight and a host of other issues in urban and suburban areas.

Expectations and preparedness for snow and ice removal range significantly based on the factors listed. The snowfall maps displayed in Figure 9 indicate where snow is most plentiful and for how many days on average snow remains on the ground, but these are just two factors in establishing the need for winter maintenance. It is possible for communities with relatively

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smaller amounts or drier (fluffier) snow, such as Fairbanks, Alaska, to have more significant maintenance problems because their average temperatures and sun penetration do not allow for the melting of snow and ice the same way it would occur in a place like Ohio. On the other hand, there are many southern U.S. communities that receive snow and ice so infrequently that they rely primarily on temperatures and sun to melt the maintenance problem away.

The likelihood of snow accumulations in the U.S. are better explained by climate type than how far north a community is located. Based on climate types, even cities in the most northern latitudes of the U.S. (not including Alaska) are prepared differently for snow and ice removal. For example, Seattle receives mostly rain during the winter months while Minneapolis (located further south) experiences snow. Minneapolis is better prepared for snow and ice removal than Seattle and the expectations among residents for prompt snow and ice removal are set higher than cities in more temperate regions. Where snowfalls and ice storms are infrequent and temperatures rebound quickly, snow and ice removal maintenance needs are low due to the temporary presence of the snow. Jurisdictions should still have policies and an action plan in place that addresses these key maintenance issues even though snow and ice are infrequent. Even within these more temperate areas, snow and ice accumulations during the months of December and January have a far greater chance of lingering than when inclement conditions occur in other months.

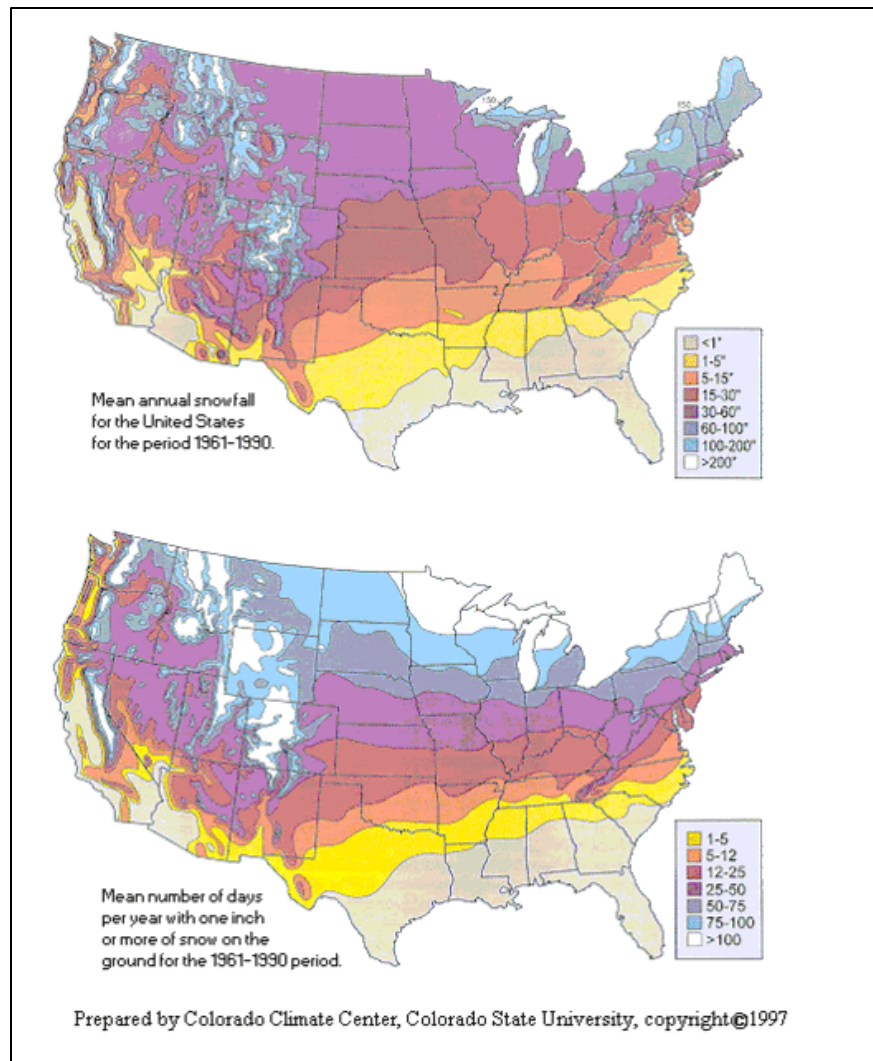


Figure 12: Maps display the mean annual snowfall and mean number of days that snow remains on the ground before melting from 1961 – 1990. Permission to use maps granted by Colorado Climate Center.

A Guide for Maintaining Pedestrian Facilities for Enhanced Safety

The maintenance issues with snow and ice are fairly straightforward. The accumulation of snow causes difficulty for people to move through it. More importantly, snow is obviously slippery and becomes even slipperier as the water content of the snow increases. As snow melts, it can refreeze as ice causing increased difficulties in removing it and greatly worsening conditions for pedestrian travel. It can also pool and then refreeze on sidewalks and in curb ramps causing unexpected and adverse conditions for pedestrians especially during nighttime hours when visibility is compromised. On their own, ice storms or ice accumulations are very serious for safe pedestrian movement. Rain that freezes on contact presents the most serious of all maintenance problems depending on the amount and duration of the accumulation. Adding complexity to how communities respond to these ice and conditions is the fact that often each one of the identified snow and ice accumulation problems calls for a different maintenance approach or technique and level of resources.

Curb ramps and median crossing islands present particular problems for accumulations and removal. They are often depressed and near gutters where water (and ice) can accumulate. Because of the presence of truncated domes in newly constructed ramps and crossing islands, removal of snow and ice is more of a problem than other detectable warning devices. Shoveling out curb ramps of snow is often the best way of controlling the snow and ice problem. However, very few communities have personnel that use shovels. If the curb ramps and median cut-throughs are not easily accessible by a skid steerer, pick-up truck, or snow plow, snow removal and ice control is often delayed if provided at all.

While the ADA PROWAG specify that sidewalks have 48 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, most ordinances specify that snow be removed from the edge of sidewalk to the edge of sidewalk, while others do not require this but specify the use of gravel, ash or salt on ice to prevent slip hazards. Some ordinances specify



Figure 13: Snow and ice should be promptly removed from sidewalks and shared use paths to maintain usability and reduce hazards during the winter.

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.

Extreme Heat

Just as snow and ice can create outstanding problems for maintenance, so can extreme heat which is especially common in the southwest U.S. Most of the problems caused by extreme heat manifest themselves as serious structural problems and are presented in the first part of this chapter in 3.2.1. One of the most serious problems is when concrete expands and causes the sidewalks to buckle or heave. Asphalt is rarely used as walkways in these areas because of its problems with high air temperatures. However, asphalt used elsewhere leads to problems. For instance, the expansion of asphalt on streets at concrete curb ramps at higher trafficked intersections causes maintenance problems. When the asphalt gets heated up, heavier vehicles rounding the corner push it out and up which creates a 1" to 2" high asphalt lip next to the ramp. This causes problems for wheelchair users who cannot travel across the street and requires that maintenance crews to shave off the lips to make the transition smooth again.



Figure 14: Asphalt pushed up against curb ramp. Photo by Tom Fisher



Figure 15: New markings tracked over already. Photo by Paula Reeves

Another problem in hot climates is associated with markings. Markings on newly paved streets can be degraded with vehicles tracking over them. Manufacturers recommend not putting the markings in place until a number of days to a week after new asphalt has been laid, but often this is not a viable option for busier streets. This is a more serious problem in hotter climates where a higher percentage of paving projects are completed and marked during a relatively long construction season much of it with high temperatures.

Vegetation overgrowth and debris accumulation

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, vegetative growth encroaching upon sidewalks or paths is a serious condition that requires maintenance. Sightlines to driveways and intersections must also be maintained for pedestrian safety. In addition, the surface of the sidewalk must be kept free of debris. Many communities require adjacent property owners to keep a sidewalk free of vegetation or property owners are doing so on their own without any prodding. Here are the main problems with vegetation:

- Vegetation overhanging into the pedestrian path
- Vegetation growing at sidewalk level narrowing the effective width of the sidewalk and causing a tripping hazard
- Discarded vegetation building up on sidewalks, including leafs and branches
- Tree roots upheaving sidewalk sections

Vegetation that overhangs sidewalks and paths often presents serious and unexpected hazards to pedestrians. At its worse, this problem can completely close down a pedestrian facility. When that occurs, pedestrians will need to use adjacent streets presenting a safety issue. Vegetation growth at the sidewalk level can effectively narrow the width of a sidewalk or path. With asphalt, vegetation intrusion at the edges can break up the pavement. Narrowing of sidewalks and paths are an acute problem when the widths of the facilities are already at their minimum width.

In communities with street trees and large amounts of street vegetation, management of leaves and branches can be a significant seasonal factor. When leaves are left unintended on pedestrian facilities several problems arise: pedestrians cannot make out the pedestrian path below the leaves or are unable to spot tripping hazards or surface irregularities below the vegetation and the vegetation itself can become wet creating a slip and fall hazard.

Other debris can also form on sidewalks often carried by water or wind. This includes sand and other fine material. By the same token, many communities will use these materials to improve traction during ice or snow conditions. When



Figure 16: Soil accumulation across a sidewalk has allowed for thick vegetation overgrowth which limits the use of the sidewalk by people with some disabilities.

these materials collect or reach a certain concentration they become a hazard when wet. Jurisdictions should have policy and action plans that address these key issues.

Other materials collecting on pedestrian facilities can also become problems. This includes rubbish that is simply discarded by people such as bottles and cans. Most communities sweep streets clean of debris, but do not extend that same level of care to pedestrian facilities. As with other maintenance practices, sweeping and dealing with the collection of debris is commonly made a responsibility of the adjacent property owners. The presence of debris on shared use paths presents the same issues with broken glass being an especially acute problem for bicyclists especially those with higher pressure tires.

4 | Inspection, Accessibility, Compliance, Plans and Policies

The work of maintaining pedestrian facilities should be guided by an inspection and by a repair regimen, supported by policies and ordinances. A community's desire to comprehensively address the pedestrian environment should be expressed in a plan and policies that help the maintenance staff do their jobs and helps adjacent landowners and other residents understand what is expected of them and what they can expect.

The use of inspection and criteria that spark action are hallmarks of a well-operated maintenance agency. One size does not fit all in how an agency conducts inspections. Capabilities in part relate to in-house resources and every community is a little different with varying amounts of on-hand resources. There are many ways to proceed with an inspection program from the personnel being used for inspection to how much new technologies will play in measuring and documenting conditions.

Plans provide both short range and long range direction for communities. They help manage the resources available for maintenance of pedestrian facilities and contain a range of recommendations covering good practices associated with policies, ADA compliance, inspection, prioritizing maintenance activities and funding. Plans should also include an inventory and assessment of sidewalks, curb ramps, and path conditions to help establish a basis for repair.

Policies addressing maintenance of pedestrian facilities are more commonly provided as standalone documents than as part of a plan. Policies act as the supporting materials for municipal ordinances and agency directives. All agencies responsible for the pedestrian facilities have maintenance policies; sometimes simply writing them down is an important first step. Formal adoption of policies by agencies or elected officials helps head off problems when controversy arises. Policies should cover the funding of sidewalks, inspection procedures and criteria, responsibilities of property owners and the community, and problem reporting methods.

4.1 | INSPECTION AND ACCESSIBILITY

4.1.1 | Importance of Inspection

In order to make pedestrian facilities safe and accessible, the maintenance problems identified in Section 3.2 must be addressed. But at what point does a sidewalk, path, or curb ramp

become a hazard, inaccessible, or impassable? Even facilities built to the tightest tolerances will have irregularities or suffer some displacement during freeze and thaw cycles. Criteria needs to be established and used to assess in quantifiable terms when facilities become a hazard or inaccessible for pedestrians. There are national guidelines and criteria (provided later in this section) which communities are advised to use for their own adopted inspection criteria.

Sidewalk and path inspection criteria serve many useful purposes, especially to reduce or eliminate slips and falls based on avoidable sidewalk and path hazards. Damaged surfaces and defects can make facilities impassable for everyone and also limit accessibility of people with disabilities or mobility impairments. Other reasons include providing guidelines to agency employees, conveying information to residents, and preventing and/or minimizing lawsuits and liability exposure. Section 4.1.5 below summarizes the actual thresholds or measurements that should trigger a response from a maintaining authority. Inspection results will help guide a program and are integral to a community's maintenance program.

4.1.2 | Inspection Criteria

Every community that has a maintenance program in place uses criteria to evaluate existing conditions and trigger repairs. Community and agency officials contacted for this guide indicated the criteria they use are not always published, are often discretionary and are not always applied equally across the community. Additionally, many communities contacted had established criteria only for sidewalk displacements (faults, heaves, changes in level, steps) and their inspection protocol did not extend beyond that level of assessment even on a long term basis. Many other agencies responded that they follow the ADA guidelines and their criteria is consistent with that.

Communities should develop and adopt sidewalk inspection and maintenance criteria. At a minimum, inspections should consider displacements (heaving, faults, changes in level), changes in grade, cross-slopes (including cross slopes at driveways), vertical clearances,

Other ADA Standards

The 2010 ADA Standards are the measure of accessibility for buildings and sites and can be enforced at the Federal level. Some agencies will use these standards for the public right of way to the extent they seem to fit because PROWAG is not yet a federal standard. While this may work in limited circumstances, the 2010 ADA standards do not address the situations commonly found in the public right of way such as steep terrain and the constraints of being located next to roadway. They also do not address additional features such as pedestrian signals, crosswalks, refuge islands, on street parking and the need for detectable warnings at street crossings. The Access Board also establishes the guidelines for buildings and sites, so there is consistency where it is reasonable to use the same criteria.

maximum running grades, minimum clear width and the distance protruding objects extend into the pedestrian path.

4.1.3 | Inspection and Accessibility

Pedestrian facilities are meant to be used by everyone, including people with disabilities. Therefore, accessibility obligations are generally considered when establishing the minimum criteria for maintenance inspections. Identifying those criteria can be difficult due to the lack of an established Federal standard for pedestrian facilities in the public right of way accessibility, as of the time of publication of this document. The current document establishing the criteria is the proposed Public Right of Way Accessibility Guidelines, 2011.

Generally, there are two broad accessibility categories related to maintenance and both require maintaining an “accessible path.” First, proper and routine maintenance of walkways allow access between intersections while the maintenance of intersections – including curb ramps, medians, crosswalks, etc. – ensures access at street crossings. In combination, they form an accessible path and both sets of pedestrian facilities have to be maintained equally.

ADA and Section 504 Relationship to Maintenance

The Americans with Disabilities Act of 1990 and Section 504 of the Rehabilitation Act of 1973 prohibit discrimination against people with disabilities. Section 504 applies to agencies receiving Federal funds and Title II of the ADA applies to State and Local agencies and requires all programs, services and facilities to be accessible to and usable by people with disabilities. Title III of the ADA may apply to homeowner associations whose facilities are available to the public and requires accessibility and readily achievable barrier removal. Pedestrian routes within the public right-of-way link access points and destinations. Within the public right-of-way, sidewalks are considered an important part of the pedestrian access route, as are crosswalks, paths, bridges, railroad crossings and curb ramps. Traffic signals, parking and bus stops and other pedestrian facilities are also important parts of an accessible pedestrian network. 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 - the proposed Public Right of Way Accessibility Guidelines - address new and altered pedestrian facilities. Minimum criteria are developed by the US Access Board with input from the public and other federal agencies. Although PROWAG is still a draft guideline, for the meantime, the Federal Highway

Administration has endorsed the use of PROWAG as a best practice where the building standards do not apply. Since PROWAG includes guidelines that can and are used as minimum accessibility criteria, they have considerable significance for this section of the guide. In addition, shared use paths are covered under a *Supplemental Notice of Proposed Rulemaking* (SNPRM) which covers shared use paths in the public right of way that are not associated with a street or highway. The guidance for shared use paths is intended to ultimately be contained in PROWAG.

The ADA and Section 504 do not require public agencies to provide pedestrian facilities, or to build new facilities in response to an ADA complaint. However, where pedestrian facilities exist they must be accessible. Furthermore, when public agencies alter facilities affecting 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 are examined in more detail below.

Alterations

The distinction between maintenance of pedestrian facilities and the alteration or new construction of facilities is central to the provision of accessible facilities. The determination of what falls into each category should be considered carefully. This guide addresses the maintenance of pedestrian facilities. Technically, maintenance activities do not trigger accessibility upgrades. Alterations which occur to pedestrian facilities or streets impacting pedestrian facilities are more significant and offer considerably more opportunities to incorporate ADA compliant features. When facilities are altered there is an expectation that the facility be "accessible to the extent practicable within the scope of the project." Typically, alterations to sidewalks occur as a result of alterations to the adjacent roadway.⁴ Since

⁴ See *Kinney v. Yerusalim*, 9 F.3d 1067 (3d Cir. 1993), cert. denied, 511 U.S.C. 1033 (1994).

alterations are defined as 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 a maintenance project that replaces long segments of sidewalk or path 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.

Day-to-Day Maintenance and ADA

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).”⁵

Maintenance and Repair under ADA

Maintenance projects do not require simultaneous improvements to pedestrian accessibility under the ADA and Section 504. For example, the spot repair of a tripping hazard does not require re-engineering a steep cross-slope. Nevertheless, as the scale of the repair or replacement grows, the adherence to acceptable standards become more feasible and expected. And because pedestrian facilities are required to be accessible, maintenance activities may also provide an opportunity to improve conditions and move agencies closer to meeting their accessibility obligations. The U.S. Department of Justice (DOJ) and the courts have not ruled on what defines an alteration vs. maintenance when sidewalks are affected by various types 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.

DOJ and FHWA have released guidance that states that the following types of pavement treatments are considered maintenance of streets or roads:

- Painting and Striping
- Chip Seals
- Crack Filling and Sealing
- Diamond Grinding

⁵ “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.

- Dowel Bar Retrofit
- Fog Seals
- Joint Crack Seals
- Joint Repairs
- Pavement Patching
- Scrub Sealing
- Slurry Seals
- Spot High-Friction Treatments
- Surface Sealing

All other pavement treatments and surfacing are considered an alteration that triggers simultaneous improvements to pedestrian accessibility, including the installation of compliant curb ramps.

Based on this guidance for streets, 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 must strive 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 technical feasibility. Most of the communities who were contacted for this guide indicated that they are meeting ADA standards when doing routine maintenance work.

Accessibility Criteria

The ADA Draft Guidelines for the Public Right of Way provide the following guidance to insure accessibility for walkways and shared use paths. The guidelines for accessible routes are summarized below.

Firm and Stable: The guides state that surfaces of public sidewalks and paths be stable, firm, and slip-resistant, and shall lie generally in a continuous plane.

Displacement/Changes in Level (includes faults and heaves): Surface discontinuities shall not exceed a half inch (13 millimeters). Vertical discontinuities between a quarter inch (6.4 millimeters) and half inch (13 millimeters) 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 percent is allowed. 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 or paths are not contained within a street or highway right-of-way, a maximum grade of 5 percent is established.

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 4 feet (1.2 meters) minimum, except for medians and pedestrian refuge islands where the clear width must be 5 feet (1.5 meters) minimum in order to allow for passing space.

Protruding Objects: Objects with leading edges between 27 inches (685 millimeters) and 80 inches (2 meters) above the finish surface must not protrude into pedestrian circulation paths more than 4 inches (100 millimeters). Post-mounted objects such as signs that are between 27 inches (685 millimeters) and 80 inches (2 meters) above the finish surface must not overhang into pedestrian circulation paths more than 4 inches (100 millimeters) measured horizontally from the base of the post. The post base must be 2.5 inches (64 millimeters) at a minimum. Where objects are mounted between posts, and the clear distance between the posts is more than one foot (305 millimeters), the lowest edge of the object must be 27 inches (685 millimeters) minimum or 80 inches (2 meters) maximum above the finish surface. The requirement 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 to project not more than 4 inches into the sidewalk (see MUTCD section 2A.18). See Appendix B for more discussion and illustrations.

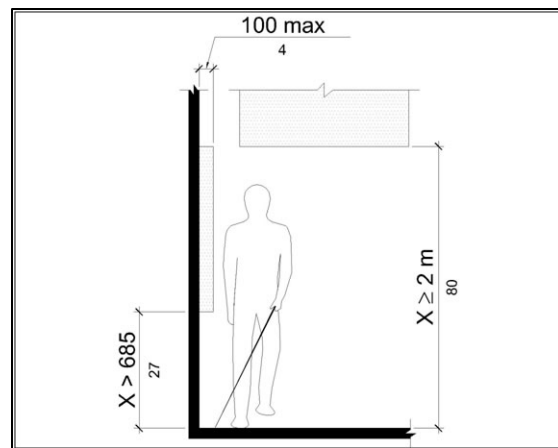


Figure 17: The maximum extension of this object is limited to 4 inches.

4.1.4 | Using Maintenance to Improve Accessibility

Section 3.2 of this guide characterized maintenance problems with pedestrian facilities that often caused the facilities to exceed the acceptable standards. Not every sidewalk, path and curb ramp within a community is going to simultaneously meet all of the guidelines listed above. However, communities need to have a multiple prong approach to meeting the criteria.

First, communities should respond to and eliminate immediate hazards to pedestrians such as tripping hazards as soon as possible. Most of these hazards are related to displacements in sidewalks and paths, especially around trees and utilities, but serious hazards could also result from cracks, holes, and damaged surfaces or from objects protruding into walkways. Inspections using the adopted criteria should uncover these problems which must be addressed immediately.

Second, communities should address other deficiencies in an ADA transition plan. This plan, required for communities that have more than 50 employees, should lay out a timeframe for replacing pedestrian facilities that fail to meet any of the ADA criteria listed above, but may not present an immediate hazard. For instance, a community may have sidewalks that cross driveways at a 4% grade. This fails to meet the criteria above, but replacing long segments of sidewalks at driveways is beyond the scope of maintenance, needs to be funded through a longer range capital budgeting plan, and does not present a defect in the same way a tripping hazard or obstacle does.

Finally, another recommended means of addressing all of the maintenance needs is with a zone-by-zone sidewalk repair and replacement program. This approach may take a longer view on correcting and preventing maintenance problems. Communities can respond quickly to sidewalk hazards community-wide while a more robust sidewalk repair and replacement program – applying all criteria – is working zone by zone in a community addressing problems that are not necessarily related to urgent defects which might require immediate treatment.

Many communities contacted or researched for this guide had good inspection programs including descriptions of defects and the thresholds they use for triggering repair and replacement of sidewalks. However, many communities were using criteria that failed to meet the above criteria established for accessibility, such as a displacement threshold that exceeded the quarter to half inch displacement limit.

Several communities had photos on their website clearly depicting sidewalks that failed to meet inspection criteria. This is a recommended practice, because as an information tool, it provides illustrative examples of maintenance problems and establishes clear expectations for

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repairing and replacing sidewalks. Figure 18 from a Midwestern community's website provides excellent photos and descriptions of problems that would fail inspection. Even in this otherwise good example, the community has some criteria that fail to meet the ADA guidelines.

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Figure 18: Sidewalk inspection examples and criteria from a Midwestern city (some criteria fail to meet ADA).

 <p>Stub Toe (S): The vertical misalignment along any part of the seam between two slabs, or between section of a cracked slab, of $\frac{1}{2}$" or more, or deemed hazardous by engineering judgment</p>	 <p>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</p>
 <p>Traverse Slope (T): Any individual slab or portion of a slab shall not slope toward the street or the adjoining property at a ratio of more than $\frac{5}{8}$" per foot (1:20)</p>	 <p>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</p>
 <p>Spalling (Pitted) Slabs (P): Slabs whose surface is granular or 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</p>	 <p>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.</p>
<p>Longitudinal Slope (Sunken/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</p>	<p>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.</p>

Temporary Closures

If an inspection reveals areas where a sidewalk or path is not up to the established inspection standards, the pedestrian facility must be brought up to the standard and a planned course of action should be laid out for ultimate repair. If the facility presents a hazard a temporary repair should be made as soon as practicable. In some cases where alternate pedestrian facilities can clearly serve the same adjacent land uses and destinations, a temporary closure can be considered. Temporary closings can give staff more time to return the pedestrian facility to sufficient conditions often associated with weather-related events, but they are rarely effective at keeping pedestrians from key destinations.

4.1.5 | Inspection Types

Inspections can be conducted on a community-wide basis, by zones, or simply on the spot after a complaint. There are reporting mechanisms that are important components of these three main approaches.

Community-wide Inspection

A community or agency may conduct an initial inspection of every sidewalk, path, and curb ramp within a defined period, such as a six-month window. This can also be done “system-wide”. For instance, a state transportation agency may decide to inspect its entire sidewalk system in an area thus extending beyond a community. Community-wide or system-wide inspection often requires significant resources, and commonly involves more than simple maintenance issues. This approach is often associated with conducting an ADA Transition Plan (described later in this chapter) or is in response to outstanding needs that have not been addressed over a long period of time. Some smaller communities or communities with relatively few sidewalks can inspect all of their sidewalks annually, but this is difficult for larger communities with extensive sidewalk systems.

Several communities contacted for this guide used an initial inventory of sidewalk conditions as basis for a prioritization plan. Sometimes this was done when pedestrian facilities had fallen into such a state of disrepair that funding and staff had been marshaled to begin to correct the problem by first doing a comprehensive inspection.

In other cases, a community-wide effort to assess sidewalks often acts as the planning phase to develop an operational plan aimed at making repairs by zones. This was the approach used by Boulder, Colorado. The inventory was conducted using a van to video the sidewalk condition and identify defects. The city established zones and a list of criteria that enabled them to prioritize the most critical needs by zone and guide an annual schedule for repairs. This

particular example demonstrated how a community can move from a community-wide inspection to a zone inspection (zone inspection addressed below).

Zone Inspection

Another approach is for a city, village or town to segment their community into zones to implement a repair program. By having the community split into three to ten zones, efforts and funds can be targeted in more manageable areas – zone by zone. Costs can also be further controlled by keeping crews within in a tighter geographic area, reducing mobilization and coordination 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 in other areas of a community if a hazard has been reported.

Many communities are using this process of inspection and repair and it is a recommended practice. About half of the communities who were contacted for this guide use this zone-by-zone approach or a variant of it. For instance, the City of Minneapolis has organized their sidewalk inspections and repair program into ten geographic zones, and targets their annual sidewalk repair budget into one of these zones each year, thereby inspecting and maintaining their public sidewalks on a ten year cycle. Similarly, almost all of these communities had either informal or formal arrangements to focus inspection and repairs in their downtown areas where pedestrian traffic is most common. The 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 residential (but some areas of multi-family use as well), is inspected at 5 percent per year; the city will also respond to any complaints or safety hazards on a community-wide basis. 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 and ADA-compliant pedestrian experience, particularly for the many new visitors to the hospital area and downtown.

Statewide Inspection

The Florida DOT is one of just a few State DOTs that maintains nearly all sidewalks on its highway system. Their Office of Maintenance has one of the most detailed inspection standards for a state DOT. Its *Maintenance Rating Handbook* 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 $\frac{1}{4}$ inch, horizontal cracks greater than $\frac{3}{4}$ inch, or spalled areas greater than $\frac{1}{2}$ inch in depth, and no visible hazards. The manual has detailed instructions and photos of how measurements should be made and computed.

Spot Inspection

Nearly every agency that has pedestrian facilities has a variation of a spot inspection program. Spot inspection occurs when a hazard is identified and reported by the public or staff. This type of inspection also occurs when a fall or slip is reported due to a hazard. Before any repair is made, an employee of the agency needs to verify that a problem exists. In many smaller communities the repair crews are authorized to inspect the reported problem and follow-up with an immediate repair based on their inspection. Several communities researched relied entirely on spot inspection and the subsequent repair of sidewalks and paths. Upon completion of inspection and determining the extent of a problem, some form of work order is usually 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, crack filling, or overlay may also be considered.

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.

Actions Following a Complaint or Injury

Depending on state and local laws and ordinances as well as general exposure to liability, it may be prudent for a community to establish standard operating procedures when handling inspection of a pedestrian facility in the event of an injury. The following steps are recommended, but certainly a community should keep its attorney aware and involved in these instances.

- An incident report should be completed by the injured person or agency employee. The report should include the incident location, what occurred, and the presence of any identified defects.
- Ownership and maintenance of the pedestrian facility should be verified. Often there are several different agencies having control over pedestrian facilities within a single community.
- Inspect the pedestrian facility immediately after the incident becomes known and details are made known (through the incident report). An inspector should describe the condition of the pedestrian facility including any defects, take photographs, take measurements, and compare the post-accident sidewalk condition with the condition at the last inspection.
- At the same time, the inspector should determine if the defect causing the mishap met the criteria for a spot improvement using the adopted inspection criteria. A spot improvement includes a temporary repair or even minor sidewalk replacement.

- Documentation is important and should include strong and clear support for a decision when no repairs are made.

There should be communication with the injured party. According to the League of Minnesota Cities Insurance Trust the community can acknowledge the mishap, but should not admit fault or liability. The community should inform the injured party what action has been taken in the past (inspection and maintenance policy) and will be done in the future in response to a complaint or injury. A community should keep its staff (including its attorney) involved in the process especially if there was a defect that was associated with the injury.

Documentation, discussed below, is a guard against liability. In the event of a claim or lawsuit, the community can use these documents to prove the existence of its inspection practices and adherence to adopted practices and policies. Documentation can also show that the city exercised reasonable care in inspecting and maintaining its sidewalks. Although there are some agencies that are not liable for injuries if there was no prior written notification of a maintenance problem, documentation of problems and when they were addressed is always a recommended practice. The League of Minnesota Cities, who maintains excellent information sheets on this topic, 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 (see appendix B for information sheet). 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.

Reporting by the Public

Every community should have more than one means of learning about problems. In addition to staff inspections, the public should be enlisted to help identify hazards and offered multiple reporting methods. Research conducted for this guide found that the most common form of

Using Volunteers for Inspections Hoboken, New Jersey

A unique approach to sidewalk inspection involves the use of volunteers. Hoboken, New Jersey has an annual inspection program in which 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 sidewalk 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 separately) that their volunteer inspectors can use so that the whole sidewalk inventory would be digitized instantly.

reporting was by phone to the public works, transportation department, or parks department (particularly 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 now checked 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.

The City of Hoboken, New Jersey 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 applications, including Cambridge, Massachusetts, Boston, Massachusetts, Louisville, Kentucky, and Charlotte, North Carolina.

Preferably, all types of inspections and hazard reports will go to one person or unit. In the absence of that, it is important to have a unit responsible for overall coordination of reporting. Complexity grows when various reporting methods are used and cover all types of pedestrian facilities because reports may be received by the Parks Department for path problems, the Public Works Department for sidewalk hazards, and the Streets Department for crosswalk and signal problems. As noted above, a "311" program can bring together all manners of reporting issues into one system. Many communities have a "report a problem" section to their website. This will allow a community to easily sort through the pedestrian problem reports.

Choosing an 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. 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. Inspection and recording of problems 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.

Chapter 11 of *Designing Sidewalks and Trails for Access -Part II*⁶ 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 and maximum cross slopes), running grades, changes in level, changes in grade, minimum clear width, surface defects, minimum vertical and horizontal clearances and the distance protruding objects intrude into the pedestrian path.

Of communities contacted and profiled for this report, the majority lacks a coordinated sidewalk and path inspection program and typically responds to problems that could be caught earlier with inspections. Creating such a program can be an early priority for a sidewalk maintenance plan. 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.

When sidewalk and path 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.

Unlike sidewalks, nearly all shared use paths are 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 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

Inspecting Shared Use Paths Madison, Wisconsin

Of the communities contacted for this guide, 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.

⁶ *Designing Sidewalks and Trails for Access - Part II of II*. U.S. Department of Transportation, Federal Highway Administration. 2001. http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/index.cfm

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. When there is an opportunity to coordinate the inspection of paths with street inspections it is worth considering since the inspection for asphalt paths is often very similar to that conducted for street surface ratings and inspections.

4.1.6 | Documentation of Inspection Results and New Technologies

An important aspect of sidewalk and path 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 inspected. For more comprehensive inspections, notes and forms are completed assessing the defective sidewalk sections, 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 sent to the adjacent property owners in communities where they are required to pay for all or part of the sidewalk repair or replacement.

Communities can streamline and benefit by use of sophisticated data collection and management systems for sidewalk inspections. Specific sidewalk and path inspection tools that can be used include check sheets, smart levels and GPS and GIS programs. Since there are specific criteria related to prevent tripping hazards, a profile gauge is often used to measure small changes in level and a smart level or digital inclinometer is used to measure cross slopes and running grades. A new and innovative approach to inspection makes use of sensor and data acquisition components mounted on a Segway HT scooter. The inspection device, supported through the Federal Highway Administration, allows a single person to inventory sidewalks and convert the data into a city's GIS system at a rate of nearly six miles per hour. It is based on an inertial profiler system that had been in use since the 1970s to measure defects on highway and airport pavement surfaces. The device's laser measurement system, three accelerometers, and gyroscope measure the sidewalk profile at a rate of 10,000 records of data per second. Together, these devices enable the capture of highly accurate location-specific information about sidewalk slope and even small surface variations.

Higher tech but much less expensive measurement devices are also being tested. In Atlanta an Android App operates on a tablet that records video, GPS, accelerometer, and gyroscope data. The tablet is attached to a wheelchair and automatically records the video and collects the data necessary to identify sidewalks that may need of repair or reconstruction. This data collection system is low-cost due to the use of a standard, manual wheelchair and computer tablet device. It is being tested and supported through Georgia Tech College of Engineering, Georgia DOT, and the City of Atlanta.

Many agencies are using electronic management systems to record sidewalk, curb ramp, and path data. Departments should keep in mind that data collection and documentation efforts require the use of limited resources so choosing the right technology is an important step. One form of technology that has caught on is the use of handheld computers (or even smart phones) to increase data collection efficiency and accuracy. One of the major benefits is that these tools are GPS-enabled and can record spot problems to within three feet of the problem. Sidewalks can be identified and cross-referenced by parcel number and/or street address. This level of sophistication is often used to conduct a comprehensive sidewalk and curb ramp inventory. Once in place, the inventory and the same tools can be used by inspectors as they respond to problems and update the inventory.

Without an electronic inventory of facilities, it is still possible for inspectors to make use of new technologies. For example, an inspector can issue work orders by address or parcel number electronically from the field. Although that would be using only a small part of the available

Using Technology to Aid Inspections Fond du Lac, Wisconsin

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 create 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.

technology, it may be just right level of technology for communities that have not gone through an extensive inventory process.

Having trained inspectors is crucial to the delivery of a sound inspection program. This training should be extended to all personnel making decisions in the field and applying engineering judgment when a spot repair is going to be made or a sidewalk section replaced. For smaller agencies first line public works employees may be summoned to inspect and repair reported sidewalk and path defects. In many communities there will not be a dedicated inspector, so street or public works employees can be trained on standards and requirements. This produces the benefit of having the same employees inspecting, documenting, and making or supervising the repair. Empowering inspectors and other field personnel to make decisions on the spot is often the most efficient and reliable means of dealing with reported defects.

4.2 | COMPLIANCE

In most places, maintenance and often repair of sidewalks is a cooperative effort between the community and its residents. According to research conducted for this guide, the majority of agencies require adjacent property owners to attend to year-round day-to-day maintenance of sidewalks and even curb ramps. This includes sweeping, vegetation control, and snow and ice removal. And in many communities, property owners are also held responsible for making or paying for repairs on sidewalk segments in front of their homes and businesses. Jurisdictions committed to maintaining an accessible sidewalk network must create systems to ensure that responsibilities are spelled out with property owners and they themselves hold up their set of commitments. This usually involves inspection regiments and administrative and compliance actions.

In communities where the governmental agency conducts and pays for all sidewalk repairs and replacements, the main compliance issue is day to day maintenance. Compliance with regulations on removal of snow, ice, debris still requires an inspection and reporting system

4.2.1 | Principles for Compliance

There are a number of principles that should be considered for the effective use of administrative, compliance and enforcement measures. Laws, ordinances, and directives need to be understandable, clear, and reasonable. Any enforcement actions arising from the ordinances or laws must also be fair, prompt, consistent, and predictable. It does not help a program to have enforcement practices vacillate from season to season or from year to year.

4.2.2 | Compliance with Sidewalk Repair and Replacement Ordinances

The most outstanding maintenance and public coordination effort occurs when agencies require adjacent property owners to make sidewalk repairs or fund agency-lead repairs. A clear and consistent administrative effort is essential to the year-round safety and accessibility of sidewalks and curb ramps.

In the series of discussions which were conducted with agencies as part of the research for this guide, several indicated they had difficulty in applying sidewalk repair ordinances. Many communities expressed concern that enforcement of sidewalk repair ordinances could result in untenable costs to residents and community backlash. This can be compounded when there is a perception that the burden of sidewalk replacement fall more heavily on lower-income neighborhoods, or that higher-income residents are able to pressure city officials to avoid citations. Others respondents mentioned that often the responsibility for sidewalk repair is unclear (such as when city-maintained street trees crack sidewalks).

In some communities, this gap between the intent of an ordinance and effective enforcement means sidewalks are falling into disrepair. A community that recognizes this problem has several options. The leadership of the public works department can request that the ordinance be revisited and reaffirmed or revised; this is particularly helpful when simple changes would help address the problems. Some communities are taking more responsibility for sidewalk repair and replacement by lowering assessments and finding other funding sources for repairs. In some cases, residents' groups are helping raise the visibility of the issue so that sidewalk repair gets a higher priority. Most importantly, the public works staff should systematically document the condition of the sidewalk network, and provide this information to the community's leadership, so those leaders will have the tools to effectively address the problem.

In communities that do enforce delinquent sidewalk repairs, common compliance mechanisms include fines and assessment for work completed by an agency. For unpaid fines, communities commonly assess the cost to a property.

According to the research for this report, the most common approach used by agencies was the practice of making simple repairs (patching and wedging) themselves. But if sidewalks had to be replaced, a set of procedures were set in motion requiring adjacent property owners to pay for all or part of the cost of an agency to use its own crews or a hired contractor to replace the sidewalks.

It is important to note, that if a pedestrian facility is impacted by an alteration project (see 4.1.3), cost is not a reason for a public agency to refuse to bring a pedestrian facility in the scope of the project within ADA standards. "Each facility or part of a facility altered by, on behalf of, or for the use of a public entity in a manner that affects or could affect the usability of the facility or part of the facility shall, to the maximum extent feasible, be altered in such manner that the altered portion of the facility is readily accessible to and usable by individuals with disabilities, if the alteration was commenced after January 26, 1992." [28 CFR 35.151] "Maximum extent feasible" relates to technical infeasibility only, not cost, when considering how to meet ADA standards and determinations about what constitutes the "maximum extent feasible" need to be documented.

Several successful local agency compliance programs were identified for sidewalk repair and replacement as part of the research for this Guide. Most repairs are triggered by complaints, requests, incidents, or by a sidewalk inspection program. An agency's sidewalk program will then issue a *sidewalk notice of repair or defect*. In some cases an abutting property owner has an option to repair or replace a sidewalk panel and will give the property owner 2 weeks to 60 days to repair the sidewalk. If the sidewalk repair is not made the agency will often do the repair and charge the property owner for the work. Often if the charge is not paid within a grace period, the charge becomes a lien against the property. Adjacent property owners are provided opportunities to contest repairs and the costs associated with the repairs.

A much longer time period is established when a sidewalk has to be repaired or replaced to provide time for the repair to be made. Very clear procedures should be in place if the repair work is done by the agency, but assessed in full or in part to the abutting property owner.

Sidewalk repair supported by laws and ordinances

Federal or state laws or policies may govern local sidewalk maintenance compliance plans. For example, current maintenance provisions of the U.S. DOT require that pedestrian facilities built with federal funds be maintained just like other roadway facilities in the area.⁷ State agencies often have some of the same conditions when they construct sidewalks along state highways. In some situations, state agencies will provide maintenance for sidewalks along the roadways they control, and will not expect this to be done by the local agency.

Some jurisdictions that have adopted a complete streets policy or have otherwise reexamined their commitment to improving their sidewalk infrastructure have concluded that they need to take more direct responsibility for sidewalk repair and replacement. They see the sidewalk as an important part of the right-of-way, rather than an extension of an individual property, and

⁷ FHWA Office of Asset Management Memorandum, 2008. <http://www.fhwa.dot.gov/preservation/o82708.cfm>

may have also found that putting the burden on property owners results in an uneven sidewalk quality. While taking over such responsibility can be a major expense, some jurisdictions, such as Missoula, Montana, have created shared fee structures that ease the burden on individual homeowners and move the community in the direction of a better sidewalk network.

4.2.3 | Compliance with the Manual on Uniform Traffic Control Devices (MUTCD)

When pedestrian facilities are impacted due to maintenance activities, pedestrian accommodations should still be provided while avoiding detours. This issue will be especially commonplace when sidewalk or path sections are removed and replaced. The Manual on Uniform Traffic Controls (MUTCD) provides standards and guidance on “temporary traffic control (TTC) zones.” It is the national standard for designing, applying, and planning traffic control devices which applies to all streets and roads within the U.S. Temporary signs and devices will need to be provided to direct pedestrians safely through work zones. The standards from the MUTCD include several key provisions:

- The needs and control of all road users (motorists, bicyclists, and *pedestrians* within the highway, or on private roads open to public travel, including persons with disabilities) through a TTC zone shall be an essential part of maintenance operations.⁸
- Where pedestrian routes are closed, alternate pedestrian routes shall be provided for maintenance.⁹
- When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility.¹⁰



Figure 19: An accessible detour

Additional guidance provided in the MUTCD includes:

- Whenever possible, work should be done in a manner that does not create a need to detour pedestrians from existing routes or crossings.¹¹

⁸ Paragraph 2 of Section 6A.01 in the MUTCD.

⁹ Paragraph 8 of Section 6G.05 in the MUTCD.

¹⁰ Paragraph 9 of Section 6G.05 in the MUTCD.

- Pedestrian detours should be avoided because pedestrians rarely observe them and the cost of providing accessibility and detectability might outweigh the cost of maintaining a continuous route.¹²
- Bicyclists and pedestrians, including those with disabilities, should be provided with access and reasonably safe passage through the TTC zone.¹³
- A smooth, continuous hard surface should be provided throughout the entire length of the temporary pedestrian facility.¹⁴

Considerable guidance is provided in the MUTCD on the importance and support for providing temporary pedestrian facilities and traffic controls within TTC zones.

4.2.4 | Routine Maintenance Supported by Laws and Ordinances

Any enforcement effort should be backed by an ordinance or law that is easy to understand and provides clear direction to the people who are responsible for enforcement. Any lack of clarity or need for alteration should be called to the attention of the elected officials who are responsible for passing such ordinances. The ordinances and laws can establish a fine or fee schedule for issuance to people for failing to comply. Often they will establish a short grace or notification period in which the property owner can respond to reported problems especially for vegetation removal.

Compliance for clearing snow and debris

A goal for any agency is to have compliance with little enforcement, particularly when it comes to clearing sidewalks of snow and other debris. If an agency can keep sidewalks clear with little enforcement, they will likely be saving money while avoiding potentially negative interactions with residents. The jurisdiction can work to establish a community norm that supports the importance of sidewalk maintenance among residents as part of good citizenship and encourages people to help neighbors if they are struggling. A recommended approach is to formally or informally organize volunteers to help keep sidewalks clear where older or disabled residents cannot remove snow, ice, vegetation overgrowth, or sweep on their own. In larger communities, this strategy is often part of a larger snow removal plan or program. Fort Collins, Colorado, has an “Adopt-a-Neighbor” program which coordinates volunteers to shovel for someone who cannot do so on their own. The Cambridge Department of Public Works will clear the sidewalks at no cost if residents in need of assistance add their name to the annual exemption list. In some smaller communities, especially those located in warmer climates that have less severe snow events, informal volunteerism may be relied upon.

¹¹ Paragraph 7 of Section 6G.05 in the MUTCD.

¹² Paragraph 7 of Section 6G.05 in the MUTCD.

¹³ Item 2E in Paragraph 7 of Section 6B.01 in the MUTCD.

¹⁴ Item C in Paragraph 11 of Section 6D.01 in the MUTCD.

Getting Organized

Working with property owners on sidewalk maintenance requires a clear and organized approach. The jurisdiction should establish multiple means of reporting problems, such as through websites, over the phone, and by employees, but just one person or unit should be responsible for responding to all of these reports. Just as importantly, this same person or unit needs to manage and monitor enforcement actions that are taking place.

4.2.5 | Types of Enforcement Efforts

When property owners are required by law to maintain pedestrian facilities, enforcement through fines or other punitive measures should be used as a last resort. Fines will be one of the tools for enforcement, but should not be viewed or portrayed as a means of raising funds. The costs associated with a robust enforcement program are likely to be higher than the funds raised through fines. There are a number of strategies that can help establish and retain an effective enforcement effort. As with any enforcement effort, it is essential that enforcement information and protocols be clearly communicated to the public and within the agency including: which department (and contact person) within an agency is responsible for accepting reported problems and monitoring enforcement, the fines and notification periods for different types of maintenance, the standards expected for maintenance, and the options available for people who cannot perform maintenance.

In many communities a tiered enforcement approach is put into effect that makes use of warnings, but also cracks-down on chronic problems. For example, in Boulder a property owner is given a warning for the first incidence of non-compliance (per year/season) and then a ticket for the second non-compliance event. If the location is identified as a chronic issue the city may take more severe measures including conducting the maintenance themselves (or by contract) and billing the property owner for the work. Although this can work for many forms of property owner maintenance, providing a notification period for snow and ice removal is not recommended because of the immediate hazard confronted by pedestrians.

Enforcement for pedestrian maintenance can be aided by other employees of the agency. This involves the identification of problems by a range of public employees and is considered to be more proactive. Communities can train parking meter readers, parks employees or police, public works staff, and inspectors to be alert to and to report sidewalk accessibility issues and dangers. It is usually best if a public works employee – usually an inspector – then visits the property. The inspector can make a decision in the field, talk to the property owner, and process the paper work for a citation or fine if necessary. There can also be more proactive inspections after a major snowfall or on a schedule to identify problems that need an

immediate response. By using the range of employees and reporting mechanisms, hazards can be reported and attended to sooner.

Reactive enforcement of problems is probably more common and involves just specified employees being called upon to issue a citation or fine for a recently reported problem. This often involves a two-step process when an inspector assesses the problem, and depending on the problem, some time may be given for an adjacent property owner to address it. This is especially true if a sidewalk needs to be repaired or replaced. Conversely, if a sidewalk is impassable because of snow and ice, an inspector or a public works employee might issue a fine on the spot.

Communication is a key element of an enforcement strategy. The strategy should contain methods that enhance on-going communication on how citizens and employees will resolve problems. Lines of communication can be formalized with neighborhood groups and business associations. The annual timing of messages is also important. For instance, communication should begin in the fall of the year regarding snow and ice removal while repair of sidewalks and vegetation control are subjects for the spring and summer seasons. This line and type of communication will help to remind longer-term residents, but will also inform new residents for the first time. The goal is compliance without instituting more time-consuming enforcement practices or relying on fines to affect maintenance efforts. There is more on communication in section 4.4.3.

Fines

A common enforcement tool for getting compliance from property owners is through the use of fines and is used primarily with day-to-day maintenance efforts. Charges can accrue daily for failure to comply with the order or it may be effective enough for the fine to simply cover the cost of crews to clear the sidewalk or make a repair. In other cases, because the goal is to move toward compliance; increasing fines over time can prompt residents to reason that they would rather shovel snow or trim bushes than face higher fines. A fee structure can include different fines for residential and commercial properties or for single family and multi-family housing. Recurring charges resulting in a lien on the property can be an effective strategy for encouraging property owners and managers to comply with requirements.

Snow removal compliance efforts are covered in more detail under 5.3.3, but in general successful enforcement programs should treat snow removal enforcement much like parking enforcement: violators are promptly fined and failure to pay the initial fee results in additional penalties; warning tickets are not recommended since it can elongate the time the sidewalk remains impassable to pedestrians and creates additional work for the agency.

Although enforcement is a key element for compliance, agencies must make reasonable exceptions and always tie education with enforcement. For instance, exceptions and longer compliance windows are especially necessary for significant snowfalls or ice storms. Communities that combine education efforts with enforcement efforts are more successful at having sidewalks attended to. See 5.3.3 of this guide on examples of education programs related to snow removal by adjoining property owners.

4.3 | POLICIES AND ORDINANCES

It should be clear by now that the process of inspecting pedestrian facilities, deciding on actions to take, and working with (or issuing fines to) the public, requires strong policies and ordinances that clarify how facilities will be maintained and if adjacent property owners will be required to conduct maintenance on their own.

Most communities with pedestrian facilities will have at least some written maintenance policies, often through ordinances. The best way to develop policies is as part of writing a maintenance plan, but policies can also be established independently. They should cover the funding of sidewalks, inspection procedures and criteria, and responsibilities of property owners and the community. The policies will establish the overarching principles with direction to agency staff to carry out the specifics. It is likely that a complete set of adopted policies can have the same affect at directing pedestrian facility maintenance actions as does a plan. The City of St. Michael's sidewalk and trail maintenance policy is included in Appendix C.

One of the most important topics to cover in a policy is the general criteria used to determine when to repair and replace pedestrian facilities or address non-compliance of a standard level of service. These criteria will dictate when a repair should be made, a sidewalk replaced, vegetation trimmed, or snow and ice removed. The policy should address who is responsible for making repairs, and for regular chores such as clearing snow, ice, vegetation overgrowth, and debris.

Innovative Enforcement Boston, Massachusetts

According to *Keeping it Clear - Recommendations for Sidewalk Snow and Ice Removal in Massachusetts* by Walk Boston, even when there are adequate laws and ordinances, overall compliance might be negated by low manpower. In the City of Boston, the Inspectional Services Department (ISD) is responsible for issuing tickets for uncleared sidewalks. However, there are fewer than 15 code enforcement officers on staff and they cannot cover the entire city. As an example of a clever way to use other personnel who spend much of the day outside, the City of Cambridge recently gave parking enforcement officers the ability to ticket for uncleared sidewalks and that has resulted in a marked improvement in adjacent property owners clearing sidewalks.

The strongest policy will be written into an ordinance for passage by the jurisdiction's governing body; if the community is assessing property owners for installing or maintaining sidewalks or ramps this will almost always require an ordinance. In fact, some state statutes require the passage of an ordinance when special assessments are used. Ordinances carry more weight than plans and policies. The policies as suggested above will cover more facets of pedestrian facility maintenance than do ordinances. A plan will provide an even broader range of topics, measures and analysis, such as an inventory of facilities and a suggested prioritized scheme.

Sidewalk ordinances from the Cities of Des Moines, Iowa and Eau Claire, WI are included in appendices E and F. These ordinances cover the placement of sidewalks, inspection, construction standards, and obligations that these municipalities place on adjacent property owners for maintenance. Ordinances will vary from state to state and in those communities that have the responsibility of maintaining the sidewalks themselves, there will be no language requiring day-to-day maintenance.

4.4 | PLANS

Plans are the best way to cover all facets of pedestrian maintenance. They should be incorporated as an essential element of general maintenance plans. However, plans that are specific to just pedestrian facilities can provide important direction on timeliness, techniques and priorities, are encouraged. ADA transition plans are another excellent opportunity to incorporate the need for pedestrian facility maintenance. A community may also incorporate a section on pedestrian facility maintenance as part of community-wide pedestrian plan. For example, the City of Minneapolis' *Pedestrian Master Plan*²⁵ included a chapter of maintenance of pedestrian facilities. All such plans need to be officially adopted by the jurisdiction that completes them. Developing these plans will provide an excellent opportunity to involve the public in the planning process including residents, homeowner associations, neighborhood groups, and business development associations and interests.

Pedestrian plans which address facility maintenance at the municipal level will communicate the agency's responsibilities as well as lay out what is expected of property owners. Additionally, they will cover the coordination necessary between jurisdictions and agencies for effective and timely maintenance. The following categories are recommended as the main sections of a pedestrian facility maintenance plan. Each is described in more detail below.

- Prioritization and funding for maintenance

²⁵ City of Minneapolis Pedestrian Master Plan – 2009
http://www.minneapolismn.gov/www/groups/public/@publicworks/documents/webcontent/convert_286149.pdf

- Goals, objectives, performance measures
- Schedule for improvements
- Communication and mechanisms for reporting problems
- Inspection procedures (included in more detail under 4.1)
- Documentation (addressed in more detail under 4.1.3)
- Procedures for repair and replacement, including seasonal considerations
- Identification and recommendations of major pieces equipment necessary for pedestrian facility maintenance

4.4.1 | Inspection Criteria and Procedures

It is critical for a plan to establish how inspections will be done. This includes criteria that will be used to determine when to repair and replace pedestrian facilities, such as degree of displacements, cracking, holes surfacing problems, etc. A plan should also address who will inspect problems associated with snow, ice, vegetation overgrowth, and walkway and path debris. It is appropriate and helpful to identify the personnel (by job classification) expected to conduct the inspections and when and how it will take place – on a scheduled basis, in response to problems, or when street work or tree trimming is being conducted, or some combination.

4.4.2 | Prioritization and Funding

Each community will need to balance its needs and funding for maintaining pedestrian facilities. It should have a clear policy for how it expects to schedule and fund walkways, especially if special assessments will be used to repair or replace sidewalks. One option is to identify specific sidewalk sections and curb ramps that need to be repaired or replaced, while another approach is to create a system for prioritizing repair and maintenance of pedestrian facilities.

If a plan is new, the first step is to conduct an inventory of facilities. The inventory should collect and organize critical information on the condition of pedestrian facilities including sidewalks, curb ramps, paths, median crossings, and pedestrian signals. Such an inventory can also be used to update or prepare ADA transition plans. Conversely, the development of an ADA transition plan can be an excellent opportunity to conduct a comprehensive inventory and establish priorities for maintenance.

Communities use two main options for funding pedestrian facility repairs. The preferred method is to fund such repairs through general road repair funds or the general fund. If the road in question is a state highway, the existence of a state complete streets policy can be used to negotiate a cost-share or full-funding arrangement – with the potential use of federal transportation funds - that brings pedestrian facilities into alignment with state maintenance

of the roadway. However, in most states, it is common for local governments to assess the repair costs to adjacent property owners. This practice is grounded in English common law, but has become a barrier for installation and maintenance of adequate pedestrian facilities. Given the financial burden of changing this system, many communities use a combination of the two. For instance, a local government may pay for and conduct all of the temporary repairs to a deficient sidewalk and pay 50 percent of the costs for sidewalk replacement. It is also likely to pay for the entire cost of curb ramp replacement. If the option requires assessing the cost of the repair or replacement to adjacent property owners, a community's procedures should clearly cover the assessment procedures and provide a process for owners to dispute repairs and costs. Additional options should be spelled out which could allow residents to do the work themselves or hire a contractor. Funding priorities should be addressed in policies or ordinances; plans can focus on details or can include details on plans to look for additional funding. For more information on funding, see Chapter 7.

Transportation funds apportioned to a State to carry out the Transportation Alternatives Program (TAP) under MAP-21, may be used by a State to correct ADA and Section 504 (of the Rehabilitation Act of 1973) deficiencies in its public-rights-of-way (e.g., sidewalks and curb ramps) identified in the State's ADA/Section 504 transition plan if the correction of ADA and Section 504 deficiencies identified is part of the construction of any Federal-aid highway project. The Transportation Alternatives Program (TAP), authorized under Section 1122 of MAP-21 (23 U.S.C. § 213), provides funding for projects or activities, including: transportation alternatives, as defined at 23 U.S.C. § 101(a)(29); the recreational trails program under 23 U.S.C. § 206; the safe routes to school program under section 1404 of SAFETEA-LU; and the planning, design or construction of boulevards and other roadways largely in the right-of-way of former Interstate System routes or other divided highways. 23 U.S.C. § 213(b).

4.4.3 | Communication

A plan can be an important way to communicate to the public and internally to its own employees about the importance of maintaining pedestrian facilities, and who will do what when. The plan will begin and should also enhance on-going communication on how residents and employees will resolve problems. On-going communication should run in sync with the seasons - begin in the fall of the year regarding snow and ice removal while repair of sidewalks and vegetation control are subjects for the spring and summer seasons.

A plan should establish procedures that follow in logical order for the public to understand and follow. This should cover how a community repairs facilities, pays for them (especially if assessing them to property owners), informs affected residents, does inspections, establishes projects annually, and schedules repairs. This is also an excellent document to address and

communicate to the public what is expected of them for clearing snow and removing overgrown vegetation.

Finally, a good plan will establish a mechanism in how the jurisdiction deals with unforeseen circumstances and changes in conditions. A common change may be brought on by a budget shortfall. For example, resources might be stretched because of a severe winter that requires a greater use of maintenance funds for snow clearance than anticipated. Rather than eliminate all repairs, a discussion and process should be followed to address these changes. The plan could include a planned response, such as a reduction of sidewalk replacements coupled with greater attention to temporary repairs (hole and crack filling, wedging, grinding, horizontal cutting) to ensure the network remains safe until replacements can resume. The plan can also include provisions for responding to more unusual circumstances by specifying when a public works board or the city council itself should be called upon to make adjustments to the plan.

4.4.4 | Documentation

The plan should outline documentation procedures. It is always helpful and legally defensible to document the reasons why actions were taken the way they were. If a community establishes reasonable procedures through a plan (or policies) and follows them only to have a mishap occur, community employees or its attorney can argue that all the appropriate procedures were in place based on the plan or set of policies established in the plan. Even when cuts in funding or staff has led to a diminution of services, if appropriate documentation shows a thoughtful and deliberate consideration of the re-prioritization of resources, this will serve the community in a better way than if no documentation was made.

4.4.5 | Equipment

A plan is an excellent place to identify equipment needs for walkways and paths for the following purposes: repair and replacement of pavements, and the removal of snow, ice, vegetation and brush. This is especially important for communities that are taking on responsibilities for removing snow and ice on paths and sidewalks, where specialized equipment may be needed. Since equipment has an established expected life, and new equipment can add significantly to a budget, a plan can establish the timing for replacement or purchase of equipment that is not already in place. For example, often smaller-sized equipment or pick-up trucks mounted with plows can be used for paths, but those purchases (and the equipment to be attached to them) must also be identified and budgeted especially to respond to a change in policy or an expansion of snow removal responsibilities.

4.5 | CONCLUSION

Communities must continue to make their pedestrian systems safer, more accessible and well-maintained. These three goals are inextricably linked as discussed and presented as recommendations in this chapter on inspection, compliance efforts, plans and policies. Simultaneously, many of these recommendations will lead to improved efficiencies and often cost savings for cities and other sidewalk maintaining authorities. Efforts to deal with funding issues and any changes in maintenance operations should be documented and shared with the community. The most effective way agencies can deal with a flat or declining budget for maintenance is to prioritize sidewalk, curb ramp and path repairs. A sufficient amount must always be kept available to respond to reported hazards that need immediate repair. Longer term sidewalk, curb ramp, and path replacement projects can be prioritized. This is often done by dividing communities into zones and working within a specific zone on an annual basis.

Compliance efforts are necessary when agencies require adjacent property owners to take on the responsibility of maintaining facilities in the public right-of-way, for example, the removal of snow and ice or the repair of sidewalks. In several sections of this chapter and guide, practices within communities were highlighted where just the opposite was in place – property owners not called upon to provide maintenance. Sidewalks are being viewed more and more by society as public facilities that serve people just like streets serve motorists and bicyclists. In the same way streets are being maintained, so should sidewalks. The time, cost, and effort associated with compliance and enforcement efforts can be reduced or eliminated as agencies assume more or all maintenance responsibilities for pedestrian facilities.

Clearly, agencies are obligated to make their pedestrian facilities accessible. Inspection criteria should be based on the ADA guidelines. ADA compliance is triggered when alterations are made, however, maintenance repairs may also present an opportunity to improve accessibility. A pedestrian facility maintenance program can work hand-in-hand with a program aimed at accessibility problems. Conversely, an ADA transition plan should also consider which pedestrian facilities are priorities for repair or replacement based on maintenance issues. For example, a transition plan should target and prioritize deficient curb ramps and sidewalks that are in need of maintenance anyway.

5 | Maintenance Measures

This chapter summarizes the common repair and seasonal maintenance practices for pedestrian facilities based on research conducted for the guide. The first section provides a summary of the repair methods, and how they are used for the range of pedestrian facilities. Part two includes common day-to-day seasonal maintenance methods along with recommended practices. The treatments are presented in order from the easiest to implement to the more complex and difficult.

5.1 | WHEN IS MAINTENANCE NECESSARY FOR SIDEWALKS, PATHS, AND CURB RAMPS?

Chapter 3 of this guide outlined the problems that drive the need to maintain pedestrian facilities. The range of potential needs requiring servicing is expansive. Infrastructure maintenance needs involve the repair of sidewalk slabs or path segments by grinding, crack filling, and patching. In many cases the only solution is to replace sidewalks or resurface paths. Generally when surface conditions degrade to a point where tripping hazards exist or worsening running or cross slope conditions are making routes inaccessible, maintenance needs to occur. Maintenance is also necessary to respond to seasonal conditions such as fallen snow or overgrown vegetation. Every community should establish thresholds that trigger a response to these problems. Those thresholds should be informed by accessibility guidance using the criteria developed by the Access Board. Section 4 of this Guide outlines the thresholds, standards, and inspection techniques that should be in place. In summary, maintenance is necessary for sidewalks, curb ramps, and paths when an acceptable threshold is exceeded in the following categories. Additionally, seasonal maintenance is also required and is covered in detail in 5.6.

- Displacements
- Surfacing issues such as cracks, holes, surface deterioration
- Grades and cross slopes
- Other issues (detectable warning fields, ramp problems, etc.)

A large percentage of communities in many states employ a sidewalk replacement program that cycle through a community, focusing on different neighborhoods over a number of years. Over a period of years the entire community will be covered and the cycle begins again. This type of program often uses higher standards and tighter thresholds than spot repair programs. For example, a cracked sidewalk that currently exhibits no tripping hazard or other form of deterioration would not trigger a spot treatment, but would be addressed as part of a rotating sidewalk replacement program.

5.2 | MAINTENANCE REPAIR METHODS FOR SIDEWALKS AND PATHS

Maintenance practices involving infrastructure can be categorized into three main groups: temporary; short term measures; and longer term measures lasting many years (in some situations even over ten years). Temporary measures are made just to reduce tripping hazards and last less than a year. Short term measures typically last one to five years and are intended to extend the life of the sidewalk segment until it is replaced. Long term measures include sidewalks replacement. When sidewalks are replaced as part of a street project, the work may be considered higher order than simple maintenance, thus falling under the definition of alterations under the ADA.

Temporary Maintenance Measures

Temporary repair measures may include wedging or patching a sidewalk with asphalt or a quick-mix cement. The temporary repair should alleviate the most hazardous concerns until a more permanent repair is performed later

Short Term Maintenance Measures (Repairs)

Several maintenance techniques will last one to five years for sidewalks and paths. These include patching (5.2.1), wedging (5.2.3), grinding and horizontal cutting (5.2.4), mud-jacking (5.2.5), and overlays.

Long Term Maintenance Measures (Replacement)

The universally accepted long term maintenance technique is sidewalk replacement. However, many communities have success with grinding (5.2.4) and mud-jacking (5.2.5) as longer term solutions. Horizontal cutting (5.2.4) 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 that the underlying problems associated with these fixes may continue to be an issue. For example, if a sidewalk sags and mud-jacking is used to correct the problem, the original unstable base may cause continued sagging. Also, some repairs will degrade the overall quality of the sidewalk. For example, grinding and horizontal cutting may be a lasting solution to a tripping hazard, but may leave one or two sidewalk panels with a cross slope of greater than two percent or with warped transitions between panels.

Types of Maintenance

Defining maintenance is important and helps establish the point in which maintenance ends and higher forms of project development take form. The distinction is essential for funding and accessibility purposes. The ADA addresses maintenance activities and reconstruction projects far differently and certain types of funds can only be used for non-maintenance activities. The following are some broad definitions for maintenance. Practices which move beyond these definitions are likely to be considered alterations. Using FHWA's standardized definitions for project types do not fully clarify the issue, because the standard classifications used for roadway projects produces significant overlap for sidewalk and path repairs. At the lower end of the FHWA classification scheme is **Routine Maintenance** "which consists of day-to-day activities that are scheduled by maintenance personnel to maintain and preserve the condition" of facilities at a satisfactory level of service. This definition encompasses short term and some long term maintenance as described above.

Another definition is **Corrective Maintenance** which is described as "activities that are performed in response to the development of a deficiency or deficiencies that negatively impact the safe, efficient operations of the facility and future integrity of the pavement section. Corrective maintenance activities are generally reactive, not proactive, and performed to restore a pavement to an acceptable level of service due to unforeseen conditions." The application to sidewalk repair and replacement is evident in this definition where a tripping hazard exists. Temporary and minor repairs fit into this FHWA category, as do smaller scale sidewalk and path replacements identified as long term measures. FHWA's definition includes as examples rigid pavements where the full width and depth of a slab is replaced at isolated locations, clearly encompassing sidewalk replacement.

And still another category is **Preventive Maintenance** which consists of treatments to extend the functional condition of a facility. "Preventive maintenance is typically applied to pavements in good condition having significant remaining service life" and is commonly done by applying treatments to the surface or near-surface of structurally sound pavements. Preventive measures fall into the short and long term maintenance categories above with the best examples including mud-jacking, joint sealing, grinding, and horizontal cutting for sidewalks; and chip sealing and slurry for asphalt sidewalks and paths. <http://www.fhwa.dot.gov/pavement>

Based on these definitions, 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, but as the number of consecutive sidewalk panels (separated by joints) increases beyond a few, the definition of maintenance no longer applies.

Provided below are the common maintenance responses to on-going infrastructure problems along with recommendations for their use. Not every community will have the same toolbox or use maintenance measures in the same way. Much depends on the current stock of facilities in a community – brick sidewalks will require different repair methods than concrete. Secondly, maintenance problems vary by community, state, and region and could be affected by underlying soils and to climate. For example, southern Arizona does not use any asphalt patching for sidewalks because of the extreme heat. This is especially true for seasonal maintenance; while Miami may face problems with encroaching vines, Duluth, Minnesota is more likely to be concerned with heavy snowfall. Additionally, many communities are focused on sidewalk and path preservation. Different treatments and standards are used to try to preserve pavements than are used to take corrective measures.

Recommended Maintenance Repair Practices – A Model for Communities

Not every agency will need to use every repair practice identified in this chapter to be effective. In addition to using the above repairs methods appropriately, certain activities form the nucleus for an exemplary approach to pedestrian facility maintenance. Below are the main features of a model maintenance program for pedestrian facilities. Communities with outstanding maintenance programs will use most of these techniques.

Quick response. When a tripping hazard or obstacle – or any hazard impacting pedestrians – is reported, an agency makes note of the hazard and responds quickly. Multiple falls or complaints about the same area require a city to place a particular sidewalk or street higher on the schedule for repair or replacement. The first step is to inspect the problem location to determine if there is a hazard (as determined by the community’s inspection criteria). A follow-up repair is either made on the spot (if a repair crew has been sent to the location to verify it as a hazard and a repair can be made considering the weather and season) or a repair should be scheduled if an inspector is sent and a legitimate hazard exists. A program associated with a quick response is a spot improvement program intended to respond to problems such as tripping hazards. These problems will be addressed through patching, wedging, crack filling, or even sidewalk replacement. With this program in place, tripping hazards can be responded to in the quickest possible fashion.

Circulating sidewalk replacement program. To address sidewalk issues in a manageable and predictable fashion, communities should sponsor sidewalk replacement programs that rotate or cycle through a community on a zone by zone basis. By concentrating sidewalk replacement into zones, less expensive construction bids for replacement work can typically be negotiated. Alternatively, smaller communities may be able to manage community-wide inspection and replacement programs on an annual basis without a need to split the community into zones.

Funding. Communities that fully fund repairs (no special assessing of impacted properties) have the advantage of being able to move quickly with those repairs. This is also a more equitable way to fund repairs that does not rely simply on the residents that live adjacent to older sidewalks in need of repair.

Coordination. All requests for sidewalk work or reported hazards should go to the same department and preferably the same person. Every community employee who observes a potential sidewalk or path problem condition should be directed to report it.

Documentation. It is always good policy to document reported problems and how they were resolved. If, after a complaint is received, inspection reveals that a condition does not meet the community's criteria for repair or correction, appropriate documentation should note that.

Inventory and Inspection. Some communities are not aware of what pedestrian facilities it owns. Without knowing that, it is difficult to accept ownership for repairs. Every community should have an updated inventory of pedestrian facilities noting the general condition of each facility.

Policies and Plans. Cities should adopt and follow their own plans and policies, and ordinances for sidewalk inspection and repair. In any form, communities should define what conditions are defective (with criteria) and establish an approach for repair including how the repairs are going to be made and on what type of schedule. There may be times and reasons that a community cannot follow its own policy. At that point, a community should explain and support why it is not following its own established plan or policy along with how they are going to mitigate the impacts.

5.2.1 | Patching

Patching 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, asphalt patching (as well as wedging) leaves a lip that is at least as significant as the size of 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.



Figure 20: Missing areas of concrete have been marked for repair.



Figure 21: The areas have been temporarily repaired with asphalt patches. Note the patching material overlaid on the concrete extending beyond the hole.

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Material:	Asphalt, but sometimes a concrete-type filler (mortar or composite material consisting of vinyl or epoxy mix)
Most suitable:	Small holes of less than one foot
Least suitable:	Large holes or large surface areas
Durability:	Varies significantly based on repair method, material, depth of hole or crack, and underlying stress placed on the sidewalk. Generally less than several years.
Characteristics:	Hot mix asphalt is easy to use as a filler, but has a very short life. Cold asphalt mix is an even more temporary repair material most often only suitable for a winter to spring seasonal repair. Mortar or concrete-type filler has a longer life, but is time-consuming to apply and is rarely used by municipalities.
Recommendations:	Suitable as a temporary repair. Highly recommended as a quick-response corrective measure when tripping hazards are reported until a more permanent repair can be made.
Technique:	Clean hole extremely well to provide the best bond. When using asphalt or a concrete-type filler it is best to square off the sides of the hole. For concrete-type filler, undercutting the sides of the hole is recommended and will elongate the life of the patch. A bonding material or concrete adhesive such as a acrylic resin—a milky fluid—can be used to help with bonding a concrete filler or a mortar mix to the existing concrete. The material should be leveled- off and tamped down for asphalt and finished smooth using a trowel for concrete. If a large hole is filled for a sidewalk connected to a driveway apron and a concrete patch is used, the mix should contain aggregate to give the patch more compact strength because of vehicle loads crossing on top of the sidewalk .

5.2.2 | Cracking Repairs

Cracking of concrete sidewalks can take many forms. Because of the deformation forces constantly at work below the grade of sidewalks and paths (discussed in Section 3), expansion joints are used to control cracking. But this is only partially effective. Common types of cracks are edge, alligator, and longitudinal cracking. Alligator cracking is characterized as typically fine, longitudinal hairline cracks running parallel to each other with none or few interconnecting cracks. These are very difficult to treat with a filler unless a laborious routing procedure is used. Longitudinal cracking occurs 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. Longitudinal and transverse cracks are wider thus somewhat easier to rout and fill than alligator cracking.

Evaluating the type of cracking and the cause will determine the success rate for crack repairs. If a sidewalk has alligator cracking because of poor sub-base drainage or serious structural damage, crack sealing is not a good option. Sealants used for other forms of cracking should be thought of as only preventive in nature. Although new sealants have tremendous bonding power, they will not hold two sidewalk segments together; they are only effective in keeping water and moisture from descending into the void. If cracks are currently creating a tripping hazard or will very soon, sidewalk replacement is a better and necessary option. Under the best of scenarios, sealing cracks buys you time and helps defer more costly repairs.

Sidewalk cracks are rarely filled by agencies. This is in contrast to crack sealing being quite common place for concrete streets. There are several reasons for this, but this is most attributable to the time consuming nature of this repair, especially given that the cost and time it would take to replace sidewalk sections altogether is fairly comparable.



Figure 22: Cracking can cause trip hazards as well as hazards for bicyclists and wheelchair users. This crack is on a shared use path.

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Material:	Polymer-modified and asphalt rubber sealants for concrete and asphalt sidewalks and paths. Also, mortar mix for larger cracks in concrete sidewalks
Most suitable:	Cracks that are a quarter inch or greater but less than a half inch
Least suitable:	Large cracks of more than a half inch. Cracks with widths greater than this are not in compliance with the ADA so if the crack material settles or pops out, an accessibility problem is created.
Durability:	Varies significantly based on repair method, depth of crack, and underlying stress placed on the sidewalk. Generally lasts less than several years and will only prevent water infiltration.
Characteristics:	Cracking sealants themselves can last years, however, their efficacy is based not only on the material life, but how well they hold their bond to the concrete or asphalt. Sealants that are manufactured today for roadway applications are highly engineered products formulated to perform in a range of climatic conditions – they need to remain solid in the summer and still be flexible in freezing temperatures. The Strategic Highway Research Program tests materials and application devices.
Recommendations:	Crack sealing and repair is rarely used by agencies for sidewalks. However, crack sealing is more commonly used for asphalt paths. Costs associated with routing out cracks to prepare them for mortar or a sealant is expensive and temporary especially compared to the cost of sidewalk replacement efforts.
Technique:	Cracks are commonly routed to accept a sealant or a masonry material, but the cracks must be completely clean and dry when a sealant or masonry material is used. Two techniques are used. For deep cracks a backer rod may be necessary. For sealants, the material is simply applied to the clean, dry, and routed crack. The other way, for use with concrete only, is to undercut the crack and use a concrete or masonry material. This will help make a structural bond that <i>could</i> aid in the shifting and uplifting of the concrete pieces. Despite the laborious nature of these repairs, most often these repairs are only temporary and are recommended only as such.

5.2.3 | Wedging

Wedging entails the placement of an asphalt or concrete filler placed in advance of a heaved or displaced section of a sidewalk or shared use path to essentially provide a ramp and remove a tripping hazard. This is most often applied where there is a formed or saw joint in a concrete sidewalk and the concrete has uniformly lifted at the joint. If done properly to a sidewalk that is not severely displaced, it can be made ADA accessible. The wedge on the left in the photo (Figure 24) 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 5% or less and in keeping with the ADA draft guidelines for public rights-of-way.



Figure 23: Wedge has been placed to mitigate the hazard caused by a raised sidewalk slab. Note the extensive and appropriate ramping of the wedge.



Figure 24: A small wedge may still create a hazard or be difficult to navigate in a wheelchair. This wedge had deteriorated over time.

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Material:	Asphalt, but sometimes a concrete-type filler (mortar or composite material consisting of vinyl or epoxy mix). Cold mix asphalt mix is applied as a very temporary seasonal repair because the material often lacks adequate bonding capabilities.
Most suitable:	For temporary repairs when sidewalks lifts by more than a half inch to less than 2 inches.
Least suitable:	As a long term repair or when sidewalks displace by less than half inch. Or when the sidewalk displacement is more than a couple of inches. This will require a very long ramp (2 feet or greater) leading to the displacement.
Durability:	Varies somewhat on repair method, material, how well the asphalt material is compressed (hot mix), any continued shifting of the sidewalk pieces, and winter maintenance (especially plows mounted on pick-up trucks running over the wedge).
Characteristics:	Asphalt is easily to use as a wedge filler, but has a very short life and it will be noticeable in appearance because the material has a texture and color that will not match concrete. Cold asphalt mix is an even more temporary repair most often only suitable for a winter to spring repair. Mortar or concrete-type filler has a longer life, but is time-consuming to apply and has a comparatively long set-up time. It is rarely used by municipalities.
Recommendations:	Suitable as a temporary repair. Highly recommended as a quick corrective measure when tripping hazards are reported until a more permanent repair can be made later in the season or within a year depending on the slope and integrity of the wedge.
Technique:	The sidewalk area to be filled with the wedge material needs to be cleaned of any loose material. Often a stiff broom or blower is used to clean debris from the sidewalk. Level off and tamp down for asphalt hot mix. A mechanical tamper should be used, but if the wedge is very small in length (less than a foot), a hand tamping tool can be used.

5.2.4 | Grinding and Horizontal Cutting

Another set of treatments that can be used for heaved concrete sidewalk and path segments is grinding and cutting. Displacement of concrete sidewalk and paths will often occur at the joints. More and more communities are using grinding and cutting methods to make more permanent repairs to these types of displacements.

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 displacement at a joint. Note that the panel has uniformly lifted allowing a straight cut across the width of the panel. 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. The panels depicted on the right show uneven settling, so grinding or cutting will eliminate the tripping hazard, but will likely leave a warped condition. 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%. For instance, if the heaved sidewalk segment leaves a displacement of $\frac{3}{4}$ inch at the joint, the grind or cut would have to taper back approximately nine inches for the repair to be ADA compliant and considered permanent.

Grinding is also done to asphalt. On paths and sidewalks root pop-ups and minor heaves are often ground down.



Figure 25: A raised sidewalk block has been ground down to provide a smoother transition.

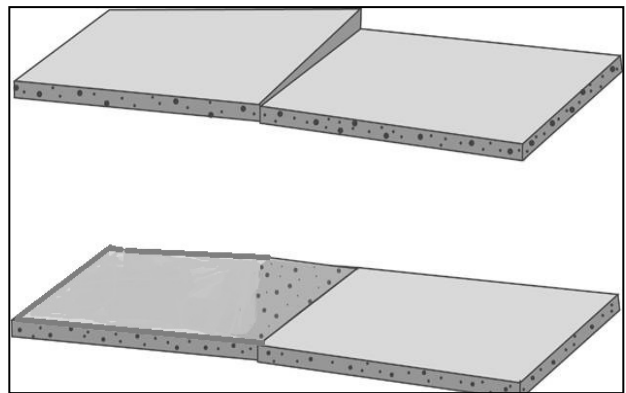


Figure 26: The diagram shows how an unevenly raised slab can be ground to provide a smoother transition.

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Material:	Grinding can occur with either asphalt or concrete, but is much more common with concrete. Horizontal cutting occurs almost exclusively with concrete
Most suitable:	For permanent repairs when sidewalks displace by a quarter inch to a half inch or for a temporary repair when sidewalks displace between a half inch and 1 inch. Repairs of a half inch or less can be provided at a one to one taper.
Least suitable:	As a long term repair when sidewalks displace by more than 1/2 inch. Any displacement of more than a half inch will require a longer ramp at 8.3% (at least 6 inches).
Durability:	The aggregate in the sidewalk is exposed and the thickness of the slab reduced, but the sidewalk and cut will still maintain its integrity. Repairs done appropriately and expertly can be considered permanent fixes.
Characteristics:	A horizontal cut will leave the appearance of a very smooth cut surface with exposed aggregate (the saw will cut right through the stones in concrete). Grinding will leave a much rougher texture and will show the grinding pattern of the apparatus used.
Recommendations:	Suitable as a temporary repair and even permanent repair based on the size and angle of displacement. Highly recommended as a permanent corrective measure when the displacement is between a quarter inch and a half inch. The sidewalk being ground down should be maintained at 2% or less cross-slope. Care should also be taken not to grind concrete slabs past minimum recommended thickness so as not to compromise the slab's integrity.
Technique:	This is a machine based operation. There are numerous pieces of equipment on the market that will grind and cut, but the technique is straightforward – grind the lip of a heaved section down or use a specially designed concrete saw to cut horizontal to the grade of the sidewalk to lop off the offending sidewalk lip.

5.2.5 | 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. It is important to identify the reason for the voids so that mud is not inadvertently pushed into storm sewers or other utilities. 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, even though it can have long term success. The photo in Figure 27 of a mud-jacked sidewalk segment in Madison, Wisconsin, has been in good shape and in compliance to standards for more than 20 years.

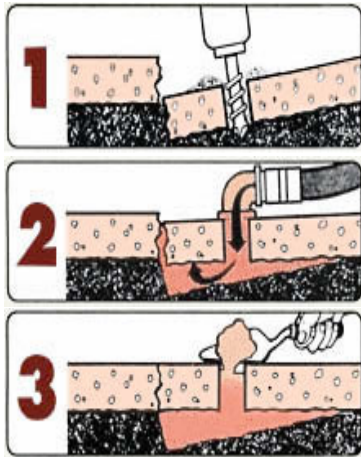


Figure 27: Graphic detail of how the mud-jacking process works



Figure 28: These panels were mud-jacked more than 20 years ago and are still in good condition so if done properly this can be a permanent fix.

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Material:	Mudjacking is done only to concrete sidewalks and paths. A concrete type "mud" or mixture is used as the material injected under the concrete slabs.
Most suitable:	For sunken sidewalk segments where confidence is high that the slabs will not simply sink again.
Least suitable:	When the sunken sidewalk segments have a short life and will need to be replaced soon anyway or the underlying structural problem cannot be counter acted.
Durability:	Repairs done appropriately and expertly can be considered permanent fixes.
Characteristics:	Small holes are detectable after mudjacking, otherwise the repair leaves the sidewalk appearing at a constant running grade and cross slope matching adjacent and untouched sections.
Recommendations:	Suitable as a long term repair, but typically mudjacking is relatively expensive often approaching the cost of sidewalk replacement so older sidewalk segments should be avoided unless communities can use this technique at a very modest cost. Recommended as a permanent corrective measure when the sidewalk is sunken by more than ½ inch and the panel can be lifted back into place with the correct sideslope. Care should be taken to identify the cause of settlement and ensure that issue has been addressed prior to mudjacking.
Technique:	The concrete sidewalk slab is lifted back to its original position by pressure injecting a concrete-like material under the sidewalk. Holes are drilled through the slab and the liquid material is injected to raise the concrete slab or to fill the voids under them. It is also possible to hydraulically lift sidewalk segments with a series of jacks.

5.2.6 | Sidewalk and Path Replacement

Although many repairs can provide temporary solutions to sidewalk and path problems, especially tripping hazards, at some point it becomes necessary to completely replace sidewalks or path sections (panels). This involves the entire removal and replacement of sidewalk sections or small path segments. When individual sidewalk sections or perhaps even a couple panels are being replaced at a time, this activity is considered as a maintenance effort.

It is imperative that agencies understand the underlying causes of sidewalk failure. Section 3.2.1 of this guide identified the deformation forces at work that cause sidewalk failures. Many of the failures for sidewalks are caused by poor subgrade or tree roots. Without addressing the underlying problems, the sidewalk being replaced will have a shortened life.

There are two basic approaches to replacement: zone-by-zone replacement and spot replacement. Often communities will combine both into a replacement program. Based on the research conducted for this report, the zone-by-zone approach to sidewalk replacement is common in Midwestern states. It is typically cost-effective for moderately sized or larger communities to manage an annual program for the replacement of sidewalk sections in sub-areas or zones of their community. Communities often put this in action on a four- to ten- year cycle. It has the added benefit of not only addressing all of the defects, but most of the accessibility issues as well.

Another common way sidewalk replacement is used is to make spot repairs when hazards are reported. In some communities the replacement of sidewalk sections (panels) is the only repair that is considered. Fifteen percent of the communities contacted for this Guide's research report were using this approach. 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. 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 their ability to respond quickly to the hazards, and in some cases, they were replacing sidewalks in as few as three days to a week after they were reported.

Although a significant number of communities use sidewalk replacement on a spot basis, many communities (and a slightly higher percentage in our research) combine this with the longer-term zone-by-zone repairs. This way, problems outside the targeted zone(s) can be addressed more immediately while a sidewalk replacement program is cycling through the community. Some of the smaller communities studied in the research were able to manage such a program

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over the entire community on an annual basis. This model requires a significant commitment to inspection (see Chapter 4 on inspection and inventory).

Nearly all of the communities reached for this study indicated that they take full advantage of street reconstruction projects to replace sidewalk segments. When combined with street reconstruction, sidewalk replacement can generally be completed at a lower unit cost. Because of the nature of these repairs – often involving the replacement of very long segments of sidewalk using tighter inspection standards – sidewalk replacement falls into rehabilitation or reconstruction definitions, the same as the street.

Material:	The replacement material used will almost always match the material used for the connecting sidewalk or path segments. Replacement material for most sidewalks is concrete and asphalt for paths.
Most suitable:	Replacement is the best and longest term repair solution for displaced sidewalks and paths. Although temporary repairs can be used to delay sidewalk and path repairs, only replacement ensures the best method for addressing displaced sidewalks and more easily permits the use of appropriate grades for the cross-slope and running slope of the sidewalk or path.
Least suitable:	When simple repairs, such as grinding and horizontal cutting, can result in significantly elongating the life of the sidewalk or path and are considered effective.
Durability:	Replacement of sidewalks and paths are considered permanent fixes.
Characteristics:	Smaller segments of sidewalk, path, or curb ramps removed and replaced with new concrete or asphalt (only concrete for curb ramps).
Recommendations:	The complete replacement of material for sidewalks and paths allows the best possible result for meeting standards and for providing the longest lasting repair. It is recommended where sidewalks and paths cannot be repaired through less expensive means or the displacement of the sidewalk or path is so significant that replacement is the only feasible measure. Replacement is also recommended where smaller defects may appear (that may not present a tripping hazard such as surface cracking), but a circulating sidewalk replacement program is targeting that area of the community for that year.
Technique:	The damaged sections are removed either by hand or a small skid-steer loader after they are broken up by a jack hammer. For projects where many concrete sidewalk pieces are being removed, a heavy piece of equipment is used which makes use of a strong, telescoping boom with an attached digging bucket that can lift individual sidewalk panels from the sidewalk grade. After removal, steel or wooden forms are pinned in place. The existing grade is adjusted and in some cases additional fill is used to level off the grade. Tree roots are very carefully cut if at all

	<p>necessary. The base surface is mechanically tamped if fill is added (with sidewalk replacement programs, the sections of sidewalk removed are too small to make use of a roller). Concrete is then poured into the grade between the two forms and the existing functional sidewalks. A strike-off board is used to level off the concrete from one existing sidewalk to the other where the old sidewalk exists. Finishers will trowel the surface of the concrete to push the aggregate from the surface and to move more of the mortar or "slurry" to the top. This provides for a smooth finish and aids in the final step of finishing which entails the use of a broom to finish the concrete with light brush marks made perpendicular to the direction of pedestrian travel.</p> <p>When asphalt is used, the removal is similar, but if the size of the removed section is limited, the replaced pavement can be completed by hand using shovels and an asphalt lute to level the asphalt. A hand tamping machine or roller is used to compact the asphalt. If the segments are longer, as is often the case with paths, paving equipment is used. This provides a far superior surface. Dump trucks are backed to the paving equipment which has a hopper for the asphalt. When paving equipment is being used, rollers will be used to compact the material.</p>
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5.2.7 | Bricks and Pavers

Bricks and pavers are materials which are considered a “segmental material” because 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 creating a localized tripping hazard. In contrast, concrete sidewalks might be able to withstand smaller more localized pressures until a time the entire slab faults or cracks. 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.



Figure 29: Damaged pavers have been repaired with asphalt to alleviate a hazard.

Bricks and pavers should be initially installed so they are easy to reset or replace. Of importance from an accessibility standpoint, bricks and/or pavers can cause vibrations that are painful for pedestrians who use mobility aids such as wheelchairs. Again, the design of the sidewalk can reduce this problem based on the pattern of the bricks/pavers, the edges used for the bricks/pavers, and the joint width that is used. Because of these issues, when the time has come for sidewalk replacement many communities are replacing bricks and pavers with concrete and then using bricks for sidewalk borders.

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Material:	Bricks are made from fired clay and most pavers are made from a concrete mix, but can also be made from clay. Bricks are commonly used as a replacement material for existing sidewalks initially constructed of bricks or pavers. Conversely, bricks or pavers are not used even as a temporary replacement material when concrete or asphalt sidewalks are being repaired. Often bricks and pavers can be salvaged and replaced and this is a common spot maintenance practice for brick and paver sidewalks. Occasionally asphalt is used to temporarily fill a gap, but this is not considered a permanent solution.
Most suitable:	Bricks and pavers are used in certain environments for their aesthetic appeal. The best repair for minor displacement of one to a few bricks or pavers is to replace or reset them. This is one of the major benefits cited for brick and paver maintenance. The grade will have to be adjusted before the material is replaced. This is often more challenging than it sounds for tightly placed bricks and pavers since they are difficult to completely extract and even more difficult to replace.
Least suitable:	Spot replacement and adjustment of bricks and pavers is not feasible when the underlying grade is impacted by tree roots. Deformation forces can also impact large segments of brick or paver sidewalks necessitating a larger scale repair.
Durability:	Repairs done appropriately and expertly can be considered permanent fixes, but are very dependent on the stability of the subgrade and avoidance of tree roots.
Characteristics:	Bricks and pavers are replaced or reset. Temporary measures can include asphalt ramps and wedges.
Recommendations:	The replacement of bricks and pavers is strongly recommended when they become a tripping hazard. When tripping hazards are reported, the community may respond with a temporary fix such as an asphalt wedge or a patch if the brick or paver is extracted or missing. When bricks and pavers have to be replaced, the subsurface should be regraded. In other situations, vegetation may need to be properly controlled. Tree roots will often lift bricks and pavers. The preparation of an adequate base course is one of the most important aspects of installing and replacing bricks and pavers and future maintenance needs can be reduced with keen attention to this construction detail. Repair of bricks and pavers – even the small maintenance tasks – require experienced workers. It is not recommended that untrained laborers begin making these types of repairs without proper training.
Technique:	Small spot repairs can be made by resetting the material in place. This is advantageous for repairing tripping hazards. Larger areas can also be replaced, but the effort becomes much more involved. However, the larger the effort becomes, the easier it is to address sub-base issues. Another temporary measure is the use of asphalt as a patch or wedge.

5.2.8 | Repairs to Curb Ramps

Curb ramps are required to be in place at every intersection where an accessible route crosses a curb to allow access to crosswalks for people with ambulatory disabilities. Once ramps are in place, their maintenance is critical to enabling accessibility. This section discusses ramp repairs while Section 5.3 provides guidance on seasonal maintenance of ramps.

Curb ramps should meet the same general thresholds for repair as sidewalks. Complicating the need for repairs for ramps are tight tolerances for running grade and cross-slope (see Section 4). Curb ramps built to the maximum slopes can easily fall out of compliance with just a slight displacement. The repair methods for sidewalks are all applicable to curb ramps – patching, crack-filling, wedging, mud-jacking, grinding/cutting, and replacement.

The other unique feature of curb ramps that separate them from sidewalks is the detectable warning surface, which is used to alert people with visual disabilities that they are about to enter a vehicular way as they descend into an intersection. Truncated domes are currently the only acceptable form of detectable warning that should be used for curb ramps. Detectable warning devices of the past and present often entail special repair solutions. Depending on the initial type of detectable warning device put in place, further annual maintenance may be necessary. In many parts of the U.S. where the truncated dome panel will not be subjected to plow blades or inclement winter weather, a viable short term repair for the panel is to fasten or re-fasten them with glue or screws. This can be done with little effort and may hold up until the ramp is reconstructed.

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Material:	Replacement material for ramps is concrete with truncated domes as the detectable warning field. Occasionally the ramp may have a brick or paver border
Most suitable:	Ramp replacement is the best and longest term repair solution for curb ramps. Although temporary repairs are often necessary, only ramp replacement ensures the best method of installing appropriate grades for the ramp. It also allows for the inclusion of the latest forms of detectable warning fields.
Least suitable:	When simple repairs, such as grinding and horizontal cutting, can result in significantly elongating the life of the ramp and the current detectable warning is in place and considered effective.
Durability:	Replacement of curb ramps can be considered permanent fixes.
Characteristics:	Ramp is removed and replaced with a new concrete ramp.
Recommendations:	Given the need to create a very predictable and workable transition between a sidewalk and a street crossing, replacing problem curb ramps with new replacement ramps is often the best long-term solution. This may involve replacing the level landing and a few adjacent sidewalk panels to bring the ramp into ADA compliance.
Technique:	The damaged ramps are removed either by hand or a skid-steer loader after they are broken up. A heavy piece of equipment that makes use of a strong, telescoping boom attached to a digging bucket can also lift individual ramps from the grade. Steel or wooden forms are pinned in place. The existing grade is adjusted and in some cases additional fill is used to level the grade. The base surface is mechanically tamped if fill is added. Concrete is poured into the grade between the two forms and the remaining pieces of concrete (back of gutter and the level landing). A strike-off board is used to level the concrete as the void is filled where the old ramp existed. Finishers often insert pre-manufactured truncated domes into the fresh concrete and finish it in place or use specially made forms to press in the domes (this method has created widely questionable results). Finishers will trowel the surface of the concrete to push the aggregate from the surface and to move more of the mortar or "slurry" to the top. This provides for a smooth finish and aids in the final step of finishing which entails the use of a broom to finish the concrete with light brush marks made perpendicular to the direction of pedestrian travel down and up the ramp.

5.2.9 | New Materials

Pavers made from recycled rubber and plastic have been in use in the public right-of-way since the year 2000. They can be used as a substitute for traditional sidewalk pavements. These pavers are modular systems similar to large concrete pavers and have uniform and tight fitting joints which are more comfortable for pedestrians. Some are linked together with tabs and are pinned in place. They have no known unique maintenance requirements. They are swept and cleaned like conventional concrete sidewalks.



*Figure 30: Porous pavement in Washington D.C.
Photo by Melissa Anderson*

As a maintenance measure, some communities have been attracted to these pavers for applications around trees where tree roots have caused concrete sidewalks to heave. They are half the depth of concrete sidewalks and can be cut to fit around trees. They are typically more expensive than concrete in most applications. One of the additional maintenance benefits is that they can be reset just like other pavers. If they begin to pitch because of tree roots or sub-base problems, the base can re-graded or the tree roots trimmed and the pavers reset. Additionally, if a panel needs to be replaced a new one can be clipped and pinned into place. Manufacturers of these products have detailed specifications and directions on how the base course should be prepared for the pavers and how the pavers should be installed. Since these are relatively new, it is not known what their true life is, but the main manufacturer is providing a range of limited warranties from 5 to 25 years on these products.

Other recently introduced products include those that increase permeability of walkways. This includes both porous concrete and asphalt and assorted pavers products that are either porous themselves or divert water to gaps in the pavers. They have unique maintenance requirements such as annual vacuuming to clean out the voids in the material that can be filled with fine material such as silt or sand. Some these new surfacing types have special significance for sidewalks especially around trees because they will often maintain their flexibility around roots and allow excellent water infiltration to feed roots. These pavement types will be covered in more detail in Chapter 6 on new construction practices to reduce maintenance.

5.3 | MAINTENANCE OF CROSSWALKS

Marked crosswalks indicate locations for pedestrians to cross and signify to motorists where they need to yield to them. Crosswalk markings are often installed at signalized intersections and other selected locations. It is critical that crosswalks be visible to motorists, particularly at night. Ladder or continental crossings using wide strips of retro-reflective material are the most visible. This also places a greater maintenance responsibility on agencies in charge of maintaining crosswalks.

The focus of this section is on the maintenance of crosswalk markings; however, it is important to note that maintenance should include the actual street surface where crosswalks are located, and not just the pavement markings. Crosswalks represent the accessible path within the street and require a higher level of maintenance than the 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 issue for pedestrians. Surface defects in crosswalks should be noted when crosswalks are inspected or re-marked, and repairs should be completed quickly.

5.3.1 | Crosswalk Marking Material

Agencies use a number of different materials for marking crosswalks, including paint (water- or oil-based), epoxy, polyurea, thermoplastic and pre-formed marking tape. Often these marking materials are divided into two categories with paint being considered non-durable and all other markings considered durable. Transportation agencies weigh several factors when determining which marking material is most appropriate including costs, durability, retroreflectivity, friction coefficient (avoiding slip hazards) and whether or not the material can be applied using existing agency labor and equipment. Most communities contacted for this guide use thermoplastic, which is recommended for its longevity. Many also frequently use paint, particularly on existing roads or when 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 they commonly use contractors to install thermoplastic markings.

The primary maintenance problem with crosswalk markings is durability. Often painted crosswalks have to be re-stripped several times a year based on the volume of traffic and the severity of the weather. The other marking materials are far more durable, but are much more expensive. In cold weather climates where the roads are salted and sanded, the abrasiveness of these materials will cause more rapid deterioration of the markings. Agencies researched for this guide also said snowplows often damage thermoplastic markings. Several agencies have

recessed thermoplastic markings to decrease the likelihood of snowplow damage, but this is very expensive.

Another durability-related maintenance problem is the conspicuity or retroreflectivity of the markings. A large percentage of pedestrian fatalities occur in the evening when conspicuity is reduced. Crosswalk markings must retain their retroreflectivity, usually accomplished by adding beads or other retroreflective material to marking material. But when the markings wear, the retroreflective quality of the material is often lost first. This guide recommends that agencies use the methods as established in the MUTCD and described on this website to check for the proper retroreflectivity of crosswalks:

http://safety.fhwa.dot.gov/roadway_dept/night_visib/pavementreg.cfm.

A problem with thermoplastic markings and some pre-formed marking tapes is that they sometimes become more slippery with wear. Manufacturers of these materials have taken steps to significantly improve the friction factor of their materials, but slippery markings make it necessary to replace the markings sooner. Successful use of pre-formed thermoplastic also relies on applying the material to a dry, clean surface nearly completely devoid of existing crosswalk material. This can complicate applications on existing pavement.

Epoxy markings involve a two-part system using a simple mixture of two bonding components. The most significant downside is that its application requires specialized equipment with a complex process control system which is required to assure proper blending of the two components. In some states, only a handful of private vendors have the equipment necessary for this application. Sandblasting of the pavement is normally required to remove existing materials and some epoxies have a relatively long cure time (up to 45 minutes depending on ambient conditions).

Figure 31: Relative comparison of crosswalk marking materials

Material	Relative Cost \$=Low \$\$\$\$=High	Lifespan (months)	Retroreflectivity *=Low ***=High
Paint	\$	3 – 24	*
Epoxy Paint	\$\$	24-48	**
Thermoplastic (sprayed)	\$\$\$	48-72*	**
Pre-formed Tape	\$\$\$\$	36 – 96*	***

Note: Estimates based on minimum standard crosswalk treatment and updated to reflect 2013 comparative costs.^{16,17} Thermoplastic and tape have shortened lifespans in snowy areas where they are often damaged by snowplows. Inlaid thermoplastic or pre-formed tape may last significantly longer than standard surface applications.

¹⁶ 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.

Figure 31 displays characteristics of four common crosswalk marking materials. It should be noted that costs vary widely across the country 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. Depending on the crosswalk marking material used, snowplows can snag or cut into markings.

This guide includes a number of broad recommendations for marking crosswalks, however, there are considerations that will affect those recommendations which are summarized in the next section.

- To promote a longer lifespan when using paint, a “high build grade” is recommended with glass beads for retroreflectivity. High build uses an acrylic cross-linking emulsion that allows for applications of up to 20 mils.
- According to the national Bicycle and Pedestrian Information Center, the most durable, and recommended, crosswalk marking material for new pavements is inlay tape. It is highly retroreflective, long-lasting, slip-resistant and requires little to no maintenance. Although initially more costly than paint, both inlay tape (preformed tape) and thermoplastic are more cost-effective in the long run. Inlay tape is recommended for new and resurfaced pavement while thermoplastic may be a better option on rougher pavement surfaces. Both inlay tape and thermoplastic are more visible and less slippery than paint when wet.
- Use a long-lasting marking for crosswalks at the time of new construction, reconstruction, or repaving using funding from the construction budget for the project.

High Visibility Crosswalk Markings Brookline, Massachusetts

Many communities have general policies that support highly visible and durable markings. The Town of Brookline, Massachusetts has a policy which states “because it is highly reflective, durable, slip-resistant, and does not require a high level of maintenance, it shall be the policy of the Town to install marked crosswalks using inlay tape whenever possible. To the maximum extent practicable, inlay tape shall be used as the preferred marking material whenever crosswalks are installed on new or resurfaced pavements.”

¹⁷ Montebello, David and Jacqueline Schroeder. “Cost of Pavement Marking Materials.” Minnesota Department of Transportation. 2000.

5.3.2 | Crosswalk Marking Considerations

Life-Cycle Costs

Unit costs for crosswalk marking materials vary considerably across the country. But given the durability issues discussed above, life-cycle costs are an essential consideration. 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 cost of paint. Communities that use paint to mark crosswalks indicated that they must repaint crosswalks two to three times per year, whereas thermoplastic markings typically last 2 to 3 years.



Figure 32: Old crosswalk markings removed for new crosswalk marking tape.

Agencies should perform life-cycle 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. The following factors will also affect such a local analysis.

Traffic

Traffic has a significant impact on the longevity of crosswalk markings. Also, frequently repainting crosswalks in high-traffic areas incurs traffic control costs that agencies should take into account as an important cost factor. Products that may be more expensive up front may be less expensive over time if they need to be replaced less frequently.

Communities can minimize the impact of traffic by spacing the bars of a crosswalk ladder design or a continental design so that the wheel wear occurs between the bars. Since turning vehicles can significantly increase degradation of pavement markings, locating markings out of turning areas, when possible, can reduce maintenance. However, this should never be done when it will compromise the appropriate placement of a crosswalk, thus this recommendation may have limited applicability at most intersections.

Equipment and Labor

Costs will be dramatically affected by the availability of equipment and labor. For instance, if thermoplastic equipment has already been purchased by an agency and in-house labor is trained and available for crosswalk marking, costs will be minimized. For communities that want to avoid investment in such equipment, some applications of markings are relatively inexpensive, such as applying tapes (cold or heated). Another equipment issue is whether a community commonly uses snowplows. Thermoplastic and pre-formed tape may not be appropriate in areas using snowplows unless the markings are inlaid in the pavement, which makes it less likely that a plow blade will pull the material off the street.

Pavement Type and Previous Markings

When considering the type of crosswalk marking material, pavement type – asphalt or concrete – is a consideration along with the type of material that was previously used as the marking material if an agency is simply remarking the crosswalk.

One of the benefits of restriping with paint is that the new paint can be sprayed on top of the old paint after the surface is cleaned and any paint flaking is removed. Liquid thermoplastics can generally be placed over worn paint or liquid-applied thermoplastic markings. However, liquid thermoplastics cannot be easily applied over tapes unless at least 70 to 90% of the former marking material has been removed through grinding or sand blasting. Similarly, tapes cannot be reapplied over existing tapes unless a minimum of 80 to 95% of the former tape has been removed through grinding or sand blasting. The performance of marking material is significantly affected by application over existing materials; it is important that agencies talk to vendors about this issue.

In new applications on asphalt surfaces, agencies typically use inlay tapes, hot-applied thermoplastics or high build grade applications of paint-based markings in order for the

Crosswalk Marking Material Selection

Santa Monica, California

In early 2012, the City of Santa Monica staff conducted an inspection of crosswalk materials along the major streets in the city. Conventional thermoplastic striping appeared to deteriorate much faster when applied on concrete streets compared to asphalt applications. Although pre-formed thermoplastic tape cost on average 30% more for the city than the conventional thermoplastics, the city decided to use the newer materials for concrete intersections. City staff developed a plan to restripe crosswalks on concrete using pre-formed thermoplastic while restriping asphalt crosswalks with the conventional thermoplastic. By using this approach, the less expensive thermoplastics can be used on asphalt while the more expensive pre-formed thermoplastic tapes will be used on concrete where increased longevity is expected to outweigh the additional costs.

markings to be visible. Markings generally last longer on asphalt than concrete, especially for a relatively new surface. Tapes can also be rolled in when new asphalt is being rolled; this is generally a very good way of improving the durability of the tapes during the winter and plowing applications. For new concrete surfaces marking applications are somewhat more limited and preparation of the surface is even more important than asphalt. Grooving concrete for inlay tapes is very expensive, but provides superior durability during the winter months where snowplows are in use.

Many agencies use more expensive inlay markings on new street, reconstruction, and repaving projects when these materials are covered by construction budgets. But the cost of remarking crosswalks usually comes out of the maintenance budget, which may not allow for easy reapplication using the same materials.

Maintenance budgets tend to be tight, whereas including more expensive marking materials in a construction project, represents just a small part of a larger project budget. Importantly, some applications of more expensive tapes can only be applied initially at the time of resurfacing or reconstruction.

Although there is a certain economy of scale and simplicity for agencies to use one marking type for initial marking and another for remarking, it is more important to make decisions about remarking independently of the original application. Traffic volumes, pavement surfacing type, initial marking material that will be marked over, cost, and availability of application equipment will be factors in the how agencies will need to consider a mix of treatments for remarking crosswalks. Agencies will need to be flexible in their approaches to remarking crosswalks. For example, it may be cost effective to use paint for remarking of a crosswalk on a lower volume street, while expensive pre-formed thermoplastic material will be used for other crosswalks in a higher volume downtown location even when the old material has to be ground off for re-application.

5.4 | MAINTENANCE OF PEDESTRIAN SIGNALS

5.4.1 | Background

Based on the research conducted for this guide, agencies considered their pedestrian signals to be durable with the most serious maintenance problems related to signal “take-downs” due to vehicle crashes. This is in contrast to the perception of many pedestrians who often say they find pedestrian signals more temperamental. Other significant problems reported by communities requiring maintenance include malfunctioning push buttons and signal heads.

Another set of hardware problems relates to the controller for the signal system. The controller itself is the device that manages the entire signal system for the intersection, but occasionally problems with the controller will cause pedestrian signal malfunctioning requiring a maintenance call.

5.4.2 | Maintenance Recommendations for Pedestrian Signals

Timely Response

Agencies should have multiple means for members of the public to report malfunctioning signals and have a system in place for a quick response. A malfunctioning signal can be a serious hazard for pedestrians, and people should be strongly encouraged to report malfunctions. In the research conducted for this guide, response times for agencies for repairs ranged from several hours to two weeks with the majority of communities reporting that they have signals fixed within one to two days. Agencies should establish a protocol that results in a response between 24 to 48 hours after the report is received (in high pedestrian and traffic volume areas perhaps even sooner). This will result in the reduction of hazards and an improvement in signal maintenance.

Inspection

If a community has a sidewalk inspection program, push button signal actuators should be inspected for functionality at the same time that adjacent sidewalks are inspected. Pedestrian signals should also be inspected at the same time as vehicular signal heads at the same intersection. Almost all communities that were contacted for this guide indicated that they have had few issues with their pedestrian signals, although some indicated they have some issues with pushbuttons for the signals. In discussions with pedestrians and pedestrian groups, their perspective was different as they often reported pushbuttons that seem to be malfunctioning. In some cases, pushbuttons have a propensity to stick as they wear. For inspection, these are conditions that should be monitored:

- Cracked or broken pushbutton hardware
- Pedestrian signal heads or push buttons that are turned askew
- LEDs in pedestrian signal heads that are fading in conspicuity
- Vegetation obscuring pushbuttons or pedestrian signal heads

Inspection processes provide a perfect opportunity to check button mounting locations and how current accessibility standards are being maintained. Although more of an operations issue, agencies should remember to change signal timings for pedestrian signals when they change cycle length timings as part of intersection signalization updates and upgrades.

Inspection regimes may need to be changed with the installation of Accessible Pedestrian Signals (see below).

Accessible Pedestrian Signals

Accessible Pedestrian Signals may be required for all pedestrian signal systems as the PROWAG become finalized into law. Agencies will need to take seriously their responsibilities for these new signal adaptations and take steps to ensure proper operation and maintenance. Fortunately, APS devices work with existing traffic signal controllers and usually require no additions to equipment in the signal controller cabinet for installation and operation. The NCHRP report *Accessible Pedestrian Signals: A Guide to Best Practices* indicates that agencies will have to monitor these new devices for malfunctions relating to WALK indication, locator tone, and signal interaction which may fail to work correctly, to avoid dangerous crossings for pedestrians with vision impairments. The overseeing agency should conduct an audit or checkup of APS installations on a regular basis, and more frequently if the weather is harsh. At a minimum, APS should be inspected every 6 months, after repairs to the intersection signals, poles or controller, and after changes to signal timing.

Occasionally an agency may receive a complaint that a locator tone on an APS is too loud or needs maintenance. The volume of the tones and messages can be adjusted and should only be audible 6-10 feet from the signal pole. The volume adjusts according to ambient noises, but if the environment around the pole changes significantly, the volume settings may need adjusting. Pushbutton manufacturers should be contacted with questions or ongoing problems.

Newer technologies – most associated with APS – will improve the day-to-day performance of pedestrian signals. It is recommended that agencies become acquainted with these technologies by surveying new devices offered by many vendors.

LED Technology

The replacement of signal heads with LEDs has significantly reduced the need for replacement of light fixtures in signal heads and has been the single most maintenance-reducing improvement related to pedestrian signals in the past 10 years. LED lights last for approximately 100,000 hours, many times the life of incandescent bulbs.

However, there are new maintenance considerations with LED lights. First, LEDs generate so little heat that they do not melt off accumulated snow and/or ice as readily as incandescent systems. Second, because LEDs last much longer than incandescent bulbs, regular lens

cleaning and LED fading may become an issue. The frequently asked questions on the MUTCD website address this issue:

“Agencies using LED-based signals should be aware that these signals need to be monitored for adequate brightness of the signals and for needed replacement, typically well before the signals fail totally. LEDs have a long life before total failure, but the LEDs gradually become dimmer over time and may become so dim that they cannot be adequately seen under all lighting conditions. This is in contrast to signals using incandescent bulbs, which usually remain sufficiently bright over their full lifetime and then fail completely by “burning out”. Agencies thus quickly become aware of and replace failed incandescent signals. Agencies need a different strategy for monitoring and replacing LED signals.”¹⁸

There are reasons from a maintenance perspective that agencies would want to consider the use of LED technology in traffic signals.

5.5 | MAINTENANCE OF PEDESTRIAN SIGNAGE

Wear and tear on signs results in discoloration and loss of retroreflectivity. Signs that act as wayfinding devices for pedestrians are no exception to this on-going maintenance problem. Unlike markings, signs have a much longer life – quite often more than 10 years. Several factors tend to lessen the life of signs - ultraviolet radiation and airborne pollutants can dramatically degrade a sign’s useful life. Vandalism is also a significant maintenance problem for signs in general. Sign replacement for pedestrian-related signs (wayfinding, street signs, etc.) tends to take a lower priority to the maintenance of signs for regulatory and warning purposes, such as stop and yield signs. Regulatory and warning signs also communicate messages to non-vehicular users and regulate movements at intersections of paths and sidewalks with streets.

According to the MUTCD, maintenance activities should consider proper position, cleanliness, legibility, and daytime and nighttime visibility. The MUTCD requires signs to be conspicuous and legible. Agencies should anticipate costs associated with keeping signs well maintained. At the same time, any changes required by the MUTCD can be incorporated. To assure adequate maintenance of pedestrian signs the following actions should be taken:

- **Scheduled inspections.** These should occur during daylight hours, but also during nighttime hours to check retroreflectivity.

¹⁸ http://mutcd.fhwa.dot.gov/knowledge/faqs/faq_part4.htm#q22

- **Clean signs.** This includes power washing signs to maintain their visibility.
- **Enlist help from other public employees.** Employees of the agency including law enforcement, public works, highway department, etc. who are traveling the roadways should be encouraged to report any damaged, deteriorated, or obscured signs at the first opportunity.
- **Replace signs.** Signs have a life of about 10 years and need to be replaced on that cycle or close to that cycle. Damaged or vandalized signs also need to be replaced.
- **Vegetation removal.** Trees, bushes, and weeds need to be removed or trimmed so they do not block the visibility of signs.

Retroreflectivity is one of the most important aspects for sign maintenance and is covered in depth in the MUTCD. It requires agencies to use an assessment or management method that is designed to maintain sign retroreflectivity at or above minimum levels cited in the MUTCD (Section 2A.08 *Maintaining Minimum Retroreflectivity*). Five assessment or management methods are recommended in Paragraph 4 of Section 2A.08 in the MUTCD for possible use. The MUTCD minimum retroreflectivity standards cover many pedestrian signs, but some sign types can be excluded from this requirement including path signs that are intended for exclusive use by bicyclists or pedestrians. Another good resource for information on retroreflectivity can be found at the *FHWA Sign Retroreflectivity Toolkit* at:

http://safety.fhwa.dot.gov/roadway_dept/night_visib/retrotoolkit/requirements/index.htm.

5.6 | SEASONAL MAINTENANCE

Section 5.2 through 5.5 covered the maintenance techniques and approaches necessary to tend to the wear and tear on sidewalks, crosswalks, signals and signs. However, most people associate maintenance of pedestrian facilities with clearing snow and debris that blocks such facilities. This means sweeping, vegetation removal and control, and snow and ice removal. This connection to maintenance is ever apparent to property owners living adjacent to sidewalks because most state laws and/or municipal ordinances make this day-to-day maintenance their responsibility. This section will discuss the most common types of everyday maintenance and the techniques that are used.

5.6.1 | Vegetation Removal and Control

Street trees and other plants adjacent to the sidewalk are a beneficial street amenity for a variety of reasons, including provision of shade, carbon dioxide reduction, increased property value, stormwater control and visual interest. Trees are considered by communities as one of their most important assets in the street right-of-way. However, vegetative growth encroaching upon sidewalks or paths is a serious condition that requires maintenance. Sightlines to driveways and intersections must also be maintained for pedestrian safety. In

addition, the surface of the sidewalk must be kept free of vegetative debris. Many communities require adjacent property owners to keep a sidewalk free of vegetation or property owners are doing so on their own without any prodding. The main problems associated with vegetation are identified in Section 3.2.2.

Recommended Practices

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 require property owners to obtain a permit in order to plant anything other than grass between the sidewalk and the curb so that proper sightlines and the pedestrian clear zone are maintained. Many communities employ arborists who provide expert assistance on inspection and trimming of trees which will help in the maintenance of this planting strip.

While many communities, especially moderate to large sized cities, have ordinances regarding the maintenance of vegetation, they are often not very well enforced or there is poor reporting of problems. It is strongly recommended that municipalities enforce those ordinances to maintain vegetation along the sidewalk on private property and in the public right-of-way. For those communities lacking an ordinance, it may be difficult to find support for efforts to manage vegetation near sidewalks and paths; thus, the passage of an ordinance is a recommended first step. There are several demonstrated techniques to control vegetation: edging, limb trimming, vegetation debris management, and vegetative planting.

Edging

Certain types of grasses or a combination of grass and soil will build up on the outer edges of the sidewalk. Edging is a technique that cuts back the vegetation to the outside limits of the sidewalk. Edgers are both motor powered and hand powered. A wheel rests on the sidewalk as the devices are used on the edges of the pavement. These machines are capable of trimming the vegetation all the way back to the edge of the sidewalk and are especially effective if this task is done routinely. Vegetative build-up

Vegetation Maintenance Wilsonville, Oregon

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

on sidewalk edges is often an under-identified problem, but can result in serious issues on narrow sidewalks or where drainage is affected.

Limb Trimming

Branches can quickly grow into the pedestrian accessible route of a sidewalk or path. According to accessibility guidelines, objects protruding more than four inches into the pedestrian circulation path must be at least 80 inches above the surface of the walkway. Objects closer than that must be trimmed back. A variety of tools can be used to trim branches such as long handled pruners, pruning shears and saws. The AASHTO guide for bicycle facilities should also be consulted for shared-use paths. The minimum vertical clearance for paths is 92 inches.

Vegetation Material Management

The most important task related to cleaning up vegetation is the removal and collection of leaves in the fall. Leaves can lead to very slippery conditions when wet and they can easily cover up tripping hazards. Communities and property owners rely on the obvious tools to maintain sidewalks including rakes and leaf blowers. Agencies often have specially equipped trucks with baskets to collect piled leaves.

5.6.2 | Sweeping

While most communities sweep streets free of debris, very few have an active citywide, sidewalk-sweeping program. It is much more common to have communities support sidewalk sweeping through business improvement districts aimed at downtowns and commercial business districts. For example, the City of Perry, GA, sweeps sidewalks in the core business district three times per year. On State Street in Madison, WI, it is done weekly. The City of Concord, NH, sweeps sidewalks citywide every spring. In the absence of a coordinated citywide or Business Improvement District approach to sweeping, adjacent property owners more commonly perform this work and are often required to by a community ordinance.

The typical tools for sweeping sidewalks depend on the scale of the effort. Communities will often use a power driven rotating broom mounted on a tractor or skid-steer loader if sidewalks are swept clean on an area or community-wide basis. Although this tends to be a fast way to clear the sidewalk, the swept material is very difficult to control and is usually just simply pushed to another location. This option may be preferred if the material, such as soil or sand, is simply being returned to a tree buffer where it was initially situated.

Small scale efforts include using leaf blowers to corral dirt and refuse into a pile or windrow to be swept up later. A simple broom is the tool of choice for adjacent property owners who occasionally need to sweep a messy sidewalk.

There are several conditions that communities must pay special attention to when considering sweeping needs. Curb ramps and low sections of sidewalks or multi-use paths where water settles provide conditions for dirt to settle as well. When still wet, the silt that remains is extremely slippery. Secondly, paths must be closely observed for sweeping needs or swept on a weekly or bi-weekly basis. Paths are sometimes plagued with broken glass which is especially troublesome for bicyclists' tires. Given the unpredictable nature of debris or refuse left on paths, relying on reports from users is often a viable maintenance approach, assuming communities respond quickly to reports.

5.6.3 | Snow and Ice Removal

Following a snowfall, snow and ice must be cleared from sidewalks, curb ramps and crosswalks promptly 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 create puddles at curb ramps, patches of ice that create slip hazards, and stretches of snow and ice covering sidewalks. Jurisdictions should have policy and action plans that address these key issues.

While the proposed ADA Guidelines for the Public Rights-of-Ways specify that sidewalks have 48 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 clear widths for snow

Community-wide Snow Removal Halifax, Nova Scotia

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. 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 of snow events. 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, compliance 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.

removal. Other ordinances allow the use of aids such as sand, ash or salt on ice to prevent slip hazards while others require the breaking out of ice. Some ordinances specify the maximum allowable height of snow banks and forbidden zones for snow piles, to maintain proper visibility of pedestrians. Some jurisdictions require snow removal from specific features such as fire hydrants, benches, driveways and curb ramps.

In the event of a snowfall, communities need to make streets and sidewalks passable to pedestrians. Removing snow and ice should be thought of as a community responsibility that covers the entire public right-of-way. And since sidewalks are part of the public right of way, efforts to remove snow and ice need to occur in a reasonable time period following a snowfall. Elements of an effective snow and ice removal program include: timeframe for removal, responsibility for removal, ordinances, compliance efforts, and planning and outreach strategies.

Timeframe

Removing snow and ice within a 24 to 48 hour period following the culmination of a snowfall is considered a reasonable timeframe for removal. In regions where snowfall is infrequent and the climate is very temperate, many communities rely on a quick melting method or a “melt strategy” for responding to most of their snowfalls. Rather than remove snow and ice, a community may rely on warmer temperatures shortly after a storm to melt snow and ice before mobility becomes an issue. Although this may be a reasonable approach for light snowfalls or those that occur in relatively warm weather, communities still need to have a contingency plan in place (or have it clearly covered in an ordinance) to deal with snow and ice that remains longer than the 24 - 48 hour time period. Snow that falls in the coldest and darkest months will have a much greater tendency to stay frozen (or thaw and freeze) and presents more problems compared to snowfalls in November, March, and April.

In parts of the country where snowfall is more frequent, communities will need to be prepared to respond to all snowfalls. Expecting snow to melt without impacting pedestrian travel is not realistic. It is also common and appropriate to require a shorter timeframe to respond to snowfalls in high pedestrian zones such as in business districts, around college campuses, school areas, and where pedestrians need to access transit. Rather than establish a time period for removal (i.e., 24 to 48 hours after snowfall culmination) another strategy is to set a specific time for when all snow must be cleared. For instance, a time of day can be set. Ann Arbor, MI, requires that any snowfall accumulation before 6 AM must be removed by noon while Alexandria, VA, requires different timeframes depending on the category of storm. The larger the storm the more time allotted for snow removal. All of these are responsible and recommended approaches for responding to snowfalls. All timeframes must balance the needs

of pedestrians and provide a reasonable amount of time for the agency and property owners to remove snow.

Responsibilities, Laws and Ordinances

Sidewalks are the most common pedestrian facility, and although the removal of snow and ice from them is considered to be a very important safety issue, removal of accumulations from curb ramps, crossings in medians islands, and transit stops are equally important. A failure to remove snow from one of these facilities can easily disrupt or even stop a pedestrian trip from occurring. Similar to the maintenance of sidewalks, curb ramps and median crossings are potential problem areas that have to be addressed by communities through ordinances and public snow removal practices.

A common practice 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 and often that will include adjacent curb ramps. This allows city crews to focus on priority locations for snow removal such as in business districts, school zones, transit stops, bridges, median crossings, along property it owns, and other priority locations. 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 of the community. Strong and efficient enforcement is also instrumental for compliance to snow removal ordinances. Within ordinances, there are varying degrees of

Citywide Public Snow Clearance Burlington, Vermont

The City of Burlington, Vermont, Public Works Department is responsible for all snow and ice removal from all city streets and sidewalks. This city of approximately 43,000 people has almost twice the mileage of sidewalk (150 miles) as it does street (90 miles). 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. 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 by 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. The city has found that snow removal costs and hazards decrease significantly when parking banned to allow for 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 averages \$750,000 annually for all snow removal operations – street and sidewalks. This is an equitable and recommended practice that ensures the compliance of city standards for snow removal of walkways.

requirements, guidance, inspection and enforcement provisions to ensure that sidewalks are cleared. The ADA now requires pedestrian facilities to be cleared of snow and allows only temporary closures. The most comprehensive programs, and those recommended by this guide, specify requirements such as removing snow and ice from curb ramps and crosswalks as well as sidewalks.

Most snow removal practices are established by local ordinances. State laws typically enable communities to establish ordinances covering maintenance practices for sidewalks or for the entire street right-of-way including sidewalks. In other cases, state law or established case law may establish the responsibility for snow clearance at the state level. Communities are encouraged to become knowledgeable regarding relevant state laws and be especially aware of local ordinances addressing sidewalk maintenance. For instance, 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.¹⁹ This places the responsibility for 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.”

There are several additional factors that tend to negatively impact the success of snow removal by adjacent property owners and need special attention: the presence of rental properties, especially in areas near colleges or universities, and the presence of elderly or

Preparing Snow Removal in Low-Snow Areas Seattle, Washington

The City of Seattle receives only minor amounts of snow each year. There are some years it receives no snow. However the city 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. 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 and provides a winter weather fact sheet online and in print in six languages.

¹⁹ New Hampshire State Title XX section 231:113 <http://www.gencourt.state.nh.us/rsa/html/XX/231/231-113.htm>

disabled households that require assistance to remove snow. Factors that tend to positively impact snow removal are enforcement mechanisms and the ability of communities to respond in a timely fashion to non-compliance with ordinances. In smaller communities, it is common for neighbors to informally help each other remove snow, where larger communities tend to develop snow removal assistance programs.

Having adjacent property owners assume responsibility for clearing sidewalks is a common and economically efficient (for the community) technique for snow removal as long as abutting owners are informed and held responsible for removal. Furthermore, the community must be prepared to step in to remove snow and ice when property owners fail to do so, as well as remove snow from intersections and its own sidewalk and path property. Although this is a time-honored practice, it has been called into question on equity grounds. Arguments have been directed at this approach because 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. While communities remove snow and ice from adjacent streets using general fund or transportation fund dollars, adjacent property owners with sidewalks are responsible for removal using their own resources. Property owners who do not have sidewalks have no such responsibility or burden yet benefit from the use of cleared sidewalks in the parts of the community that do have sidewalks.

Jurisdictions that take on the full responsibility of snow removal from sidewalks will assume increased levels of efforts or cost in exchange for more consistent and potentially convenient snow removal programs. When communities take on snow removal they can do so with relatively few pieces of equipment in contrast to every property owner with sidewalks having to respond to snowfalls with their own equipment. There are several measures that will streamline the process: having appropriate equipment for removal, parking restrictions to expedite simultaneous plowing of streets and sidewalks (when sidewalks are immediately adjacent to the parking lane or agencies need to remove snow from buffer zones in commercial areas) and the use of performance based contracts to balance the costs of annual sidewalk snow removal when contractors are used. Some of the additional benefits to communities in providing community-wide snow and ice removal are: increased confidence among pedestrians who can expect uniform level of service (having just a couple of property owners not remove snow and ice can significantly disrupt a trip), curb ramps and medians can also be cleared at the same time, and agencies can anticipate and inform constituents of clearance completion schedules helping residents with their own trip and transit planning.

When property owners are required to remove snow from abutting properties, communities will still have the responsibility to remove snow from sidewalks adjacent to public lands. This

should be 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 a 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.

Prioritization

Very few communities have a prioritized system for sidewalks to be cleared of snow and ice by city crews, but it is a recommended practice. Either as part of or after streets are plowed, many communities will focus attention on clearing sidewalks near schools, transit stops and business districts. This scheme of establishing priority routes for clearing sidewalks can function when communities themselves are solely responsible for the clearing of snow from pedestrian facilities or when adjacent property owners are responsible. For the latter, the community would ensure that all sidewalks are suitably cleared of snow and ice and if they are not the community's crew would clear the sidewalks and charge the adjacent property owner. The City of Alexandria, VA, prioritizes sidewalks in the following order: 1) schools, 2) high transit use areas, 3) city facilities and 4) bus stops.

Yet another positive development over the past 20 years is the creation of Business Improvement Districts (BIDs) and Special Improvement Districts (SIDs) and the ability to use these districts to provide basic maintenance of walkways including snow and ice removal. Businesses are responsible for a special tax that among other things, funds maintenance activities such as snow and ice removal from sidewalks by a hired contractor. This is also a clever way for communities in low snowfall areas to ensure removal of snow from sidewalks in the busiest pedestrian areas.

Compliance Efforts

For those communities that require property owners to remove snow and ice from walkways, proper and prompt enforcement is the key to a successful snow removal program. Most communities are granted the power to fine property owners or charge them the cost to remove snow and ice from their sidewalks if they fail to do so themselves. Although it may seem like a callous action, using fines or charges is a recommended approach.

Communities that combine education efforts with strict enforcement of snow removal are more successful at having snow removed from walkways by adjoining property owners. Communities can use police, public works staff, and inspectors to issue citations to non-compliant properties. Typically, a public works employee or inspector is the most sensible choice. Communities will often have a code enforcement person who writes notices for other code violations such as property violations (grass too long, junk cars on premises, vegetation encroachment) so the same person that handles summer complaints can handle snow and ice complaints in the winter. One strategy that should be considered with apprehension is the issuance of warnings before citations. This process can elongate the time that the sidewalk remains impassable to pedestrians and creates additional work for the enforcing agency. In the end, pedestrians may be presented with longer periods with winter sidewalk hazards.

Fines can also be increased over time since residents would rather shovel snow than face increasing fines. The goal is to move toward compliance so it may be necessary to escalate fines to make this possible. A fee structure can include 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 collected from the fines should remain in the 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.

Successful enforcement programs should 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.

Work Plan

A snow removal plan or policy 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 important 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:²⁰

²⁰ http://www.clrp.cornell.edu/workshops/manuals/snow_and_ice_control.pdf

- Stress the need for continuous improvements 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 aid in efforts to preserve air and water quality
- Identify and program major snow removal equipment

Jurisdictions should include the most comprehensive information available when developing or updating a plan. It is also recommended to consider making the plan an all-season plan by including vegetation removal for sidewalks and paths. Often sidewalk ordinances include year-round maintenance provisions and the compliance efforts will be the same whether the problem is snow or vegetation. 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:

- 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 communities with outstanding plans for sidewalk snow removal.²¹
- *Snow and Ice Control* is a workbook that provides a comprehensive overview of the elements of a snow removal plan in Minnesota²²

Outreach, Problem Reporting, and Help Programs

One of the most critical ways that a community will communicate with residents after a snowfall is through a problem reporting mechanism. Residents and visitors can use an online service and a call-in number. Although this type of reporting is valuable year-round to report any pedestrian facility problem, having it available to report unshoveled walkways and impassable curb ramps and medians is absolutely essential to successful winter maintenance. Communities need to be responsive to problems including making a visit to the location to confirm the problem. Depending on the system the community has in action, the adjacent property owner is either fined or charged with removal of snow and ice from the sidewalk or curb ramp. In other cases, it may be the community itself that has failed to undertake its responsibilities for snow and ice removal. Clearing of snow and ice should occur within a 24 to 48 hour period after the report is made.

²¹ <http://www.ipa.udel.edu/publications/SnowRemoval.pdf>

²² <http://www.mnltap.umn.edu/publications/handbooks/documents/snowice.pdf>

A Guide for Maintaining Pedestrian Facilities for Enhanced Safety

Figure 33: 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	\$200*	\$200*	\$150*
Residential with More than 16 Units	\$100*	\$150*	\$100*
Residential with 16 or Fewer Units	\$50*	\$100*	\$50*

*Each day that a violation exists is considered a separate and distinct violation

Many municipalities have programs to assist low-income elderly or disabled people with sidewalk, walkway and driveway snow removal. Snow Angels,²³ Snow/Ice Busters,²⁴ Snow Buddy,²⁵ and Shovel our Snow²⁶ 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 groups or volunteers. Assistance programs, whether highly organized or informal, not only help elderly or disabled residents 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 often treated differently than sidewalks after snow events. In many communities they are either not plowed or have a very low priority of being plowed. Seldom do communities require adjacent property owners to maintain them. Some communities, counties, and states deliberately do not clear pathways to allow for winter activities such as skiing or snowmobiling. Decades ago, very few paths were maintained for year-round use. However, as more and more paths became true transportation facilities and are funded with transportation funding, that practice began to change. Several factors need to be considered when deciding on removal of snow from paths.

²³ Pittsburg, PA <http://www.pittsburghpa.gov/servepgh/snowangels/>

²⁴ Aurora, CO <https://www.auroragov.org/LivingHere/GivingBack/SnowBusters/>

²⁵ Boulder Colorado. Link no longer available.

²⁶ Brookline MA, http://www.brooklinema.gov/index.php?option=com_content&view=article&id=193&Itemid=877

- **Bicyclist and pedestrian demand for the facility.** Facilities located in remote areas will have little winter demand while those located within urban areas will see continued demand throughout the winter, especially from pedestrians.
- **Presence of nearby pedestrian facilities.** If there are no nearby sidewalks that parallel the path and can act as an alternate facility, having a path maintained year-round becomes more important.
- **Community support.** Are neighborhoods, bicyclists, and pedestrians asking that the facility be cleared of snow and ice? Are there many requests for maintaining the path for winter use?
- **Connectivity.** The more neighborhoods and commercial areas the path connects to, the more valuable the path will be for year-round use.

Paths that are located within the public right-of-way often substitute for a sidewalk and need to be cleared of snow and ice in the same timeframe as sidewalks. Since paths are wider than sidewalks, wider pieces of equipment can service it such as pick-up trucks with mounted plows. This is also a reason why paths should be designed with appropriate widths and loading characteristics to accommodate light-duty equipment (see sections 6.1 and 6.2).

Snow and Ice Removal – Conclusion

Depending on the region, snow and ice removal can be a major seasonal effort for communities of all sizes. The preceding sections include the

Clearing Snow from Paths

Minneapolis, Minnesota

Madison, Wisconsin

Columbia Association, Maryland

Not all agencies will remove snow and ice from shared use paths. However, there are many communities which have exemplary snow and ice removal programs for this type of maintenance. The City of Minneapolis, Minnesota will remove snow and ice on paths on a comparable schedule to that of snow removal on streets. The Park Board is responsible for removal on most of the longer paths in the city.

The City of Madison, Wisconsin uses one of three departments to remove snow and ice from paths. When assigning a department and unit, the location of the path is considered. This enables two efficiencies: the clustering of paths under specific units and the assignment of rather remote sections of paths to a Streets Department unit rather than expecting only the Department of Parks and Recreation to handle the entire system. This helps expedite snow-removal, and in many cases, improves upon response times when compared to removal on residential streets.

Columbia Association, Maryland, is one of the largest homeowners associations in the country and manages and maintains over 93 miles of pathways and 25 miles of sidewalks. This includes the winter maintenance of all of these facilities.

basic elements of a recommended snow removal program. Most of these elements can at least in part be employed in communities of all sizes.

The most equitable means of removing snow and ice from sidewalks and paths is to have a community-sponsored program. This will better ensure a consistent removal of snow and ice. In many states, the local community is ultimately responsible for snow removal, but has shifted the initial responsibility to the adjacent property owner. Although community sponsorship of snow removal is recommended based on its fairness, the vast majority of communities will still require adjacent property owners to remove snow and ice. When that is the case, communities have several primary responsibilities:

- Clear snow and ice from their own sidewalk facilities, median crossings, and splitter islands
- Ensure through compliance measures that snow is being removed
- Remove snow and ice from sidewalks, bridges and curb ramps where adjacent property owners fail to do so
- Provide education programs on importance of removal and proper ways of removing snow and ice
- Coordinate with other public entities to make sure all jurisdictions are providing for removal on their publically owned facilities
- Provide a problem reporting system both on-line and via phone
- Sponsor assistance programs for people who cannot remove snow and ice themselves

Sidewalk Snow Removal

Chicago, Illinois and Cambridge, Massachusetts

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.”¹ 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 educate and enable neighbors to work together to perform their responsibilities.

<http://www.cityofchicago.org/city/en/depts/mayor/snowportal/chicagoshovels.html>

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:

<http://www.cambridgema.gov/theworks/ourservices/snow/whatyoucando/snowclearing.aspx>

<http://www.cambridgema.gov/theworks/ourservices/snow/Resources/Publications.aspx>

<https://www.cambridgema.gov/iReport/reportanunshoveledsidewalk.aspx>.

6 | Construction Techniques to Lessen Maintenance for Sidewalks and Paths

The best way to maintain sidewalks and other pedestrian facilities is to start by building them to last. 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. This chapter will highlight specific construction techniques that can lengthen the standard lifespan of pedestrian facilities.

Initial design and construction methods greatly influence the long-term maintenance and lifespan of sidewalks. Historically concrete has been the material of choice by many jurisdictions because of its ease of installation, durability, reliability and availability of materials. The thickness of the sidewalk material, use of reinforcing bars or mesh use of aggregate base, depth of sub-base 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 : Approximately 80 years
- Bricks and interlocking concrete pavers: Approximately 80 years
- Asphalt: Approximately 40 years

Although the lifespans noted above are achievable, many cities consider 25 years to be an expected lifespan for concrete sidewalk. While some data exists on construction methods that can mitigate the potential for future damage, more research is needed on sidewalk construction best practices for reduced maintenance. There is an opportunity for increased research in this area.

Sidewalk Failure

As discussed in chapter 3, sidewalks and paths fail for a variety of reasons including damage due to:

- Poor base soils and sub-base preparation causing differential settlement
- Nearby trees roots causing displacement or cracks
- Heavy Vehicle loading on sidewalks not designed to take such loads
- Insufficient concrete thickness or lack of reinforcement where design dictates

Much of this damage can be avoided or delayed by using proper construction techniques that take into account the type of soils underlying the sidewalk, seasonal conditions that impact soils underlying sidewalks, tree type and placement and sidewalk design (thickness, use of aggregate, sub-drainage, and reinforcement).

6.1 | 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 sidewalk failure and the underlying soil type than between sidewalks and the presence of nearby trees. Providing an adequate subgrade below sidewalks may deter many of these failures by providing stability and good drainage, helping the sidewalk be more resistant to seasonal changes. Subgrade design and preparation should be carefully considered and based on local soil conditions and policies. Although there is not one specific design solution for every situation, Canadian national guidance²⁷ provides the following general best practices:

- 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 material²⁸
- 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, as detailed below.

6.2 | PAVEMENT THICKNESS

6.2.1 | Concrete

Sidewalk thickness is just another aspect of the overall sidewalk “pavement” design, and should take into consideration expected loading, local soil conditions and policies. In the United States, concrete sidewalk thicknesses in warm climates that do not need to support

²⁷ *Sidewalk Design, Construction, and Maintenance: A Best Practice by the National Guide to Sustainable Municipal Infrastructure.* Federation of Canadian Municipalities and National Research Council.

²⁸ Ibid.

heavy vehicles may be as low as 3.5 inches; areas that experience a winter freeze and must accommodate heavy vehicles (known as vehicle loading) may require thicknesses of 6 inches or more. In theory, the thicker the sidewalk, the less likely it will fail prematurely; however, adequate research does not exist to support this claim in the case of 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. In some cases reinforcement (usually with a welded wire mesh or re-bar) can be used to increase the



Figure 34: Five inches of concrete sidewalk

loading capacity of sidewalks. Similar to subgrade design, there is not one specific design solution for every situation; however, the following provides general practices for sidewalk thickness. FHWA's Pedsafe Guide recommends a minimum of 4 inches for concrete slab depth.

- Concrete slab thickness²⁹
 - Four inches for light axle loading over sand/gravel
 - Five inches for light axle loading over silt/clay
 - Five to six inches for heavy axle loading over sand/gravel
 - Six inches or slightly greater for heavy axle loading over silt/clay

Based on research conducted for this report, municipalities commonly follow these cited practices by requiring the following sidewalk thicknesses: 5 inches standard depth, 6 inches at driveways, 7 inches at commercial driveways. State DOTs require thicknesses of 4 or 5 inches for most sidewalk sections and 6 to 8 inches for sidewalk sections crossing driveways (consistent with the depth of the driveway aprons). Additional thickness may also need to be considered where off-tracking by trucks occurs on curb ramps.

²⁹ *Ibid.*

6.2.2 | Asphalt

Asphalt is commonly used on paths and for shoulders used as pedestrian facilities. Asphalt thicknesses for shared use paths can be as low as two inches if laid on top of an adequate aggregate depth of 4 inches and if only very light duty equipment will use the path. If laying asphalt without a base and an expectation that only medium duty trucks may use the facilities, 8 inches may be needed. According to a recent report by the Illinois Center for Transportation - *Best Practices for Bicycle Trail Pavement*



Figure 35: Inadequate shoulders on a path resulting in edge damage.

Construction and Maintenance in Illinois, a minimum hot-mix asphalt thickness for paths that can support regular- heavy-duty trucks is 3 inches over 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. It is also important for the paths to be at least 10 feet wide to support truck wheels at the edges. Larger maintenance vehicles – especially when the edge of the path cannot be seen very well by drivers – can cause significant edge damage if wheels ride at the edges.

6.3 | 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. Accessibility requirements prescribe a maximum cross slope of two percent. This provides adequate drainage, but does not adversely impact access for people with disabilities.

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

6.4 | CONTROL JOINTS AND SCORING PATTERNS

Control and expansion joints should be provided in all concrete sidewalks and paths to minimize cracking and guide where cracking should occur. However, decorative jointing/scoring should be minimized to avoid jarring bumps for pedestrians using wheelchairs. Also, saw cutting control/contraction joints is recommended because it provides a smoother

surface 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.³⁰

Full depth expansion joints should be placed adjacent to existing rigid structures such as 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 or construction joints, allow shrinkage to occur during drying in a way that does not affect the appearance of the sidewalk. It is generally recommended that control joints be spaced 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 (8 feet) 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.

Asphalt sidewalks typically do not need joints or scoring patterns.

6.5 | CURB RAMPS & DETECTABLE WARNING FIELDS

Curb ramps and detectable warning surfaces present unique maintenance needs. The primary issues with detectable warning fields are debris collection, detachment from the sidewalk, or damage to the domes in the warning fields themselves. Detectable warning fields tend to collect dirt and debris between raised domes where pooling occurs during rain events. During the design, it is important to maintain a gutter slope that allows water entering the curb ramp to drain and carry away the debris. The primary solution to this issue is frequent sweeping. 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. Extending the life of these fields can be accomplished by material selection. A few manufacturers are now providing cast iron detectable warning fields that are significantly heavier and stronger than those manufactured from stainless steel, alloy, concrete pavers, thermoplastic or pressed directly into the concrete. The cast iron detectable warning fields may be excessive for areas that do not experience

³⁰ *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.

significant snowfall, but may provide reduced maintenance and replacement costs in areas with snowfall.

Detectable warning surfaces pressed directly into fresh concrete are not recommended because they suffer from two problems. First, it is common for some of the concrete domes to be only partially 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, and even household snowblowers, can cause damage to concrete domes. If concrete detectable warning fields are used, a regular inspection schedule should be developed to monitor the integrity of the fields and perform necessary maintenance. In accordance with ADA Guidelines, domes that are pressed into concrete must be painted a contrasting color to aid those with visual disabilities. The contrasting paint rarely adheres to the domes for very long.

6.6 | STREET TREES

Street trees are important in enhancing the aesthetics of a corridor, providing shade and green space in urban environments and helping define the character of a corridor. The presence of mature street trees also increases the value of adjacent properties.³¹ However, street trees can also cause damage to sidewalks and walkways when either the trees or sidewalks are poorly sited. In many communities this is the primary cause of sidewalk damage and replacement. Proper site conditions, including soils, tree selection and location are all essential to ensure that the trees thrive in their location and do not interfere with nearby utilities, sidewalks or streets. Trees should typically be “limbed up” ensuring branches grow above and away from the sidewalk. Trees with drooping or low growing branches can create hazards for nearby pedestrians or vehicles.

The following guidance on street trees is impacted by urban design standards, such as planting strip widths, right-of-way widths, sidewalk widths and even the presence of curb and gutter. Along with the following guidance focused directly on street trees, agencies need to address deficiencies in their urban design standards that can help promote better street designs for trees and sidewalk preservation. At the national level, the *AASHTO Guide for Planning, Design, and Operation of Pedestrian Facilities* has some guidance as well as ITE's *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*. Many state agencies will also have street design handbooks that can provide guidance on urban design standards.

³¹ Wolf, Kathleen, City Trees and Property Values, Arborist News (August 2007), PP. 34-36

6.6.1 | Soil Selection

One of the best ways to support healthy street trees and protect against sidewalk damage is provision, selection and management of proper soils. Often trees in the right-of-way are planted in existing soils compacted to support motor vehicles. Roots in compacted soil will migrate toward the surface for air and water, causing sidewalk to crack and heave. These soils can ultimately lead to damage of underground utilities, sidewalks and roadways. To abate costly maintenance issues it is important to consider the relationship between soils, street trees and sidewalks. Important factors to consider include the amount of soil provided (discussed later in the chapter), the soil content and the maintenance of soils over time:

- Use soils that have high organic content, air space and provide tree roots with nutrients, water and oxygen. Soils that are heavily compacted can be improved by amending them to improve aeration, and moisture content. Soil selection will be specific to location.
- Test soils before planting. This will help determine if the soil is adequate for plantings, needs amendment, is compacted or is unsuitable for healthy tree growth.³²
- When there is room for sufficient soil volume, use structural soils or engineered soils to meet the load bearing requirements of urban sidewalks while still maintaining adequate pore space and organic content to support healthy vegetation. With new street trees, install structural soil below the sidewalk and parking zone to maximize soil volume. Trees can grow in confined areas with paved surfaces above the root systems, provided there is a way for water to enter the structural soil mixture.
- Soils should be regularly tested after installation on a regular maintenance schedule to ensure conditions are suitable for healthy tree growth.

6.6.2 | Soil Volume

Street trees need adequate space to grow to maturity. Tree roots do not survive in confined space and compacted soils so it is important to maximize soil volume appropriate to street tree species. In the confined street right-of-way this is often challenging and expensive but provision of appropriate soil volume enables the tree to grow a mature, healthy canopy and lessens the chance that roots will damage underground utilities or the adjacent sidewalk. Published research suggests that increasing soil volumes is one of the best ways to enable larger and healthier trees in cities. Soil volume recommendations range from a minimum of 400 cubic feet to more than 1000 cubic feet based on the sidewalk width.³³ One of the first steps is to simply determine the soil volume requirements per tree volume. Volume will vary

³³ Casey Trees, *Tree Space Design*, 2008, PP. 3

depending on climate, soil type and desired tree species. The following diagram provides some general guidance.

Techniques for Supporting Adequate Soil Volume

A variety of innovations in engineered soils to support root growth have been developed primarily for streets in urban and suburban locations with curb and gutter where plantings are desired in spatially constrained conditions. These strategies adopted from *Up By Roots* by Jim Urban³⁴ are intended to increase the volume of rooting soil while maintaining accessible sidewalks:

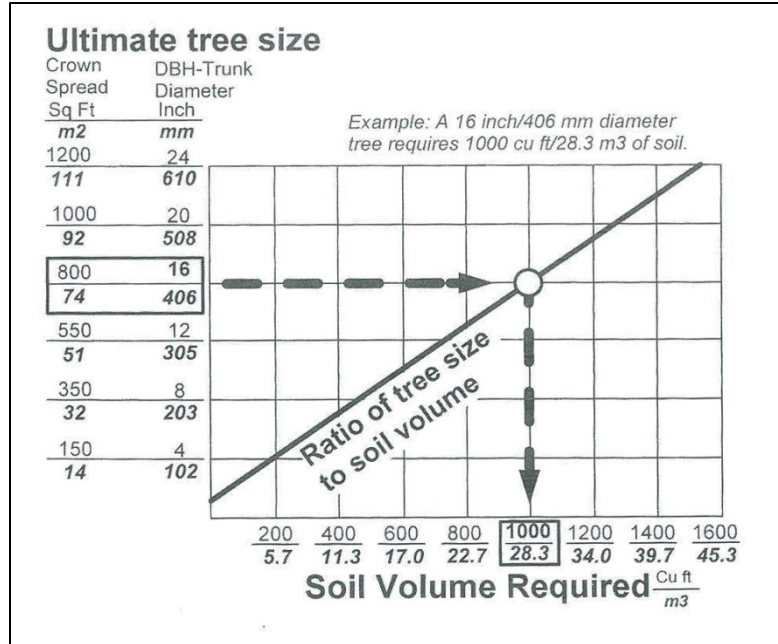


Figure 36: Tree size to soil volume relationship. Urban, Table 2.4.1, page 205, 2008.

- **Open Tree Trenches:** Tree trenches are a common strategy used in areas where existing soil is not suitable for tree growth. Continuous soil trenches are planted with multiple trees and the trenches are covered with mulch, groundcover grass or other plantings; this works where parking turnover is not high so that soils are seldom traversed or compacted. Five feet of width is a good rule of thumb. Open tree trenches are normally installed in urban conditions where space is constrained.
- **Covered Tree Trenches:** In areas where parking turnover is high or where there is a high volume of foot traffic, covered tree trenches are a good option. A continuous soil trench is covered with structural reinforced concrete around and between trees, enabling passive irrigation. As noted below, tree trenches can be integrated with the pedestrian furniture zone. Covered trenches are durable, in part because the soil under the concrete will settle and create an air gap that gives roots space to grow without damaging the sidewalk. This is a more expensive option but one that requires less day-to-day maintenance open tree trenches, which require management of mulch and vegetation. Covered tree trenches are normally installed in urban conditions with high pedestrian volumes and where space is constrained.

³⁴ Urban, Jim, *Up By Roots: Healthy Soils and Trees in the Built Environment*. International Society of Arboriculture, Champaign, IL. 2008.

- **Root Paths:** These sub-concrete trenches are often dug underneath existing sidewalks to allow roots to spread into new soil areas. They should be 4 inches wide by 12 inches deep, filled with amended soil and lined with strip drain board. Root paths are low cost and are often a retrofit application. They can be installed with curb and gutter or on curbsless streets.
- **Structural Soils:** Void space for tree root growth can also be introduced by using structural soils, which are substrate mixes composed of soil and stone aggregate. This is more often an option for plantings for new construction or reconstruction projects. However, the aggregate means there is less soil to the tree, so a large volume of structural soil must be used. As a result, structural soils are not appropriate for use in tree pits, and their use is often extended under sidewalks and parking areas. Due to the required volume of soil, structural soil is often not as cost effective as other options. Structural soils can be used for plantings on streets with or without curb and gutter.
- **Soil Vaults:** Soil vaults are large soil-filled, enclosed, often precast concrete structures that fully contain the root system of a tree to protect underground utilities and sidewalks. They are a costly option and should be properly sized to provide adequate space for mature tree root systems.
- **Structural cells:** Structural cells are prefabricated, perforated, stackable, soil filled boxes with a removable cap that allows for air space at the surface so that tree roots can be easily accessed and pruned. Cells are load bearing and other vegetation can be planted on top.

6.6.3 | Tree Pits

Tree pits are used where space or resources do not permit the use of open or covered tree trenches. This option is less desirable for new construction than the techniques described above because it often does not allow for adequate soil volume. However, tree pits are often an existing condition that can be improved with the addition of amended soils. For new construction, tree pits should be as large as possible to provide maximum rooting volume while maintaining appropriate clear width for sidewalks. The sides of the pit below the sidewalk should be open to the surrounding subgrade to allow for root penetration and drainage beyond the pit. Tree pits are often covered by grates to minimize soil compaction and trip hazards, but the grates require maintenance to adjust for tree growth and to correct for settlement that may cause a tripping hazard. Open tree pits, and in some cases covering them with tree grates, are acceptable treatments with proper maintenance.

The preferred size for a tree pit is at least 4 feet by 10 feet by 3 feet deep for 120 cubic feet. According to published research, trees need 1 to 2 cubic feet of soil volume for every square foot of crown area spread. Smaller tree pits, as narrow as 2'-6" wide, may be appropriate if sidewalk constraints prohibit the construction of a full size tree pit and sufficient soil volume is provided. However, tree pits are often the cause of sidewalk damage; trees can outgrow the pit and buckle the sidewalk. Solutions to small existing tree pits include using high-nutrient amended soils, installing permeable pavers around the tree pit, expanding the opening of the tree pit or introducing mulch. Rubber sidewalks can also alleviate sidewalk buckling adjacent to tree pits. Modular rubber sidewalks and flexible porous pavements allow for root growth while reducing tripping hazards by providing a rounded rather than buckled surface.



Figure 37: Modular plastic pavers near a tree.

6.6.4 | Tree Placement

Planting street trees in appropriate sites will help promote 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 Streets³⁵:

- 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 narrow 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 trenches with true permeable pavers (standard interlocking pavers are not permeable).
- Establish wide furniture zones or planting strips and provide additional space for snow storage in snowy climates.

³⁵ Bogart, S; Snyder R. et al. The Los Angeles County Model Design Manual for Living Streets, Los Angeles County, 2011. <http://www.modelstreetdesignmanual.com>

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- If the above options are not feasible, provide adequate volume of non-compacted soil, structural or gap-graded soil (angular rock with soil-filled gaps) to a depth of 3 feet or greater beneath the adjacent sidewalk (in the furniture, planting strip, frontage, and pedestrian sidewalk zones).
- Space trees appropriately. Spacing will vary with species, site conditions, and desired aesthetic appearance of corridor. 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 isolated trees exposed to heat from all sides, which can desiccate isolated trees.
- If open trenches are used, the planting sites should be graded, (but not overly compacted) so that the soil surface slopes downward toward the center, forming a shallow depression to collect water. The crown of the tree should remain 2 inches above finished grade. 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 level surface.
- Use tree grate guards, pavers and compacted aggregate along streets with heavy pedestrian traffic. Covered tree trenches can also be used to increase the width of the sidewalk in high use areas. Along streets with limited foot traffic and in less urban environments, mulch and ground cover may be used in lieu of tree grates.
- Provide a gravel sub-base below sidewalks near street trees; this has been shown to reduce pavement damage and root growth immediately below pavement on well drained sites.
- Where appropriate soil volume is available, install vertical barriers next to sidewalks (DeepRoot or poly sheets) to reduce root growth under pavement which may reduce long-term sidewalk damage from roots.
- Use porous surfaces for adjacent driveways and patios to improve infiltration of water. Minimizing impervious surfaces and maintaining the natural grade also encourages tree growth.

Where space is limited between the curb and the sidewalk consider planting street trees on private property adjacent to a sidewalk. Doing so can increase the tree setback from the sidewalk, reduce the likelihood of root damage, and give roots more room to grow.

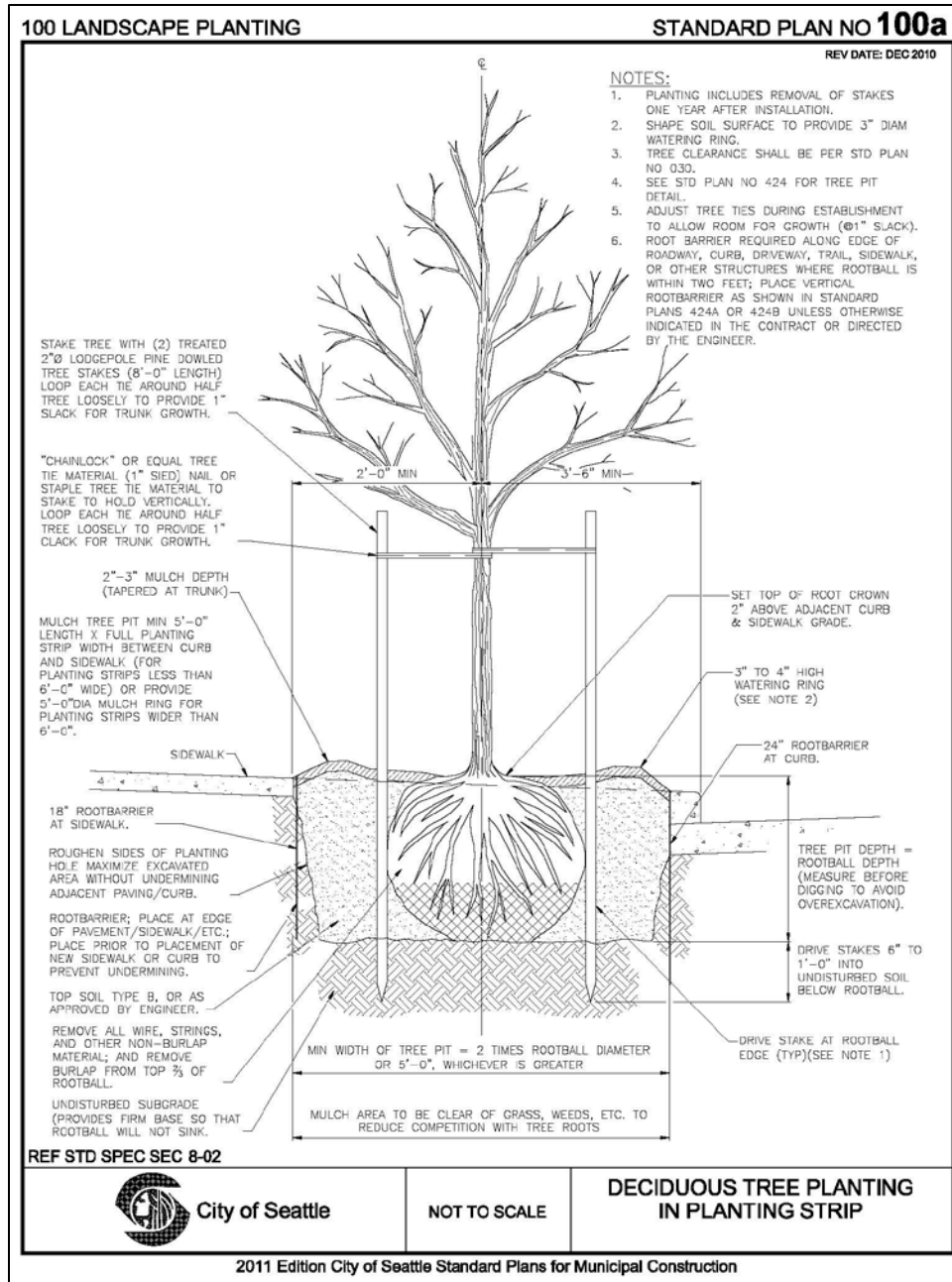


Figure 38: Standard specification for street tree planting. Seattle Department of Transportation, 2011.

6.6.5 | Tree Selection

Street trees should be carefully selected to ensure that they will be compatible with their surroundings and will minimize the potential of future damage to sidewalks. Since appropriate trees will vary from location to location, work with an arborist horticulture specialist, landscape architect or other qualified professional to help assess the site and conditions that apply to the selection of proper tree species. Below are some points for identifying desirable features:

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- 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. Because an individual city, and more commonly a county or state, may span several climatic zones it is important for an arborist to assist with street tree species selection, planting requirements and lifespan maintenance requirements. Street tree selection should address the following criteria for species selection: climate, temperature and water requirements, available height clearance and growth characteristics, susceptibility to disease or infestation, light requirements, heat and wind tolerance, environmental pollutants and amount of debris the tree creates.
- 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. Tree selection should be performed by a qualified professional to determine acceptable and appropriate trees for the conditions due to multiple factors. For example, Acer’s (maple), Quercus (Oaks), Ulmus (Elm’s) and Tilia (Lindens) are typically good candidates for many of the climatic zones in the U.S., but planting conditions, soil availability, and the climate can influence the habitat of each tree.
- Trees with large trunk flares should be avoided next to pavement and in narrow planting areas. For example, many conifers are not suitable street trees due to low branches or thick, flared trunks. Large trunks should be avoided near street corners to preserve sight lines for pedestrians and vehicles.
- Local municipalities should consult a qualified professional 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. The City of Seattle provides residents with a list of recommended street streets. The list includes the physical characteristics of the tree e.g. fall color, height, compatibility with overhead utilities and planting strip requirements.

Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Flower Color	Fall Color	Comments
<i>Cercis siliquastrum</i> Judas Tree	25	30	Yes	5			Deep pink flowers on bare twigs in spring – drought resistant
<i>Cornus alternifolia</i> Pagoda Dogwood	25	25	Yes	5			Small white flowers in flat clusters – fall color is varied. Great Plant Pick
<i>Cornus kousa</i> ‘Chinensis’ Kousa Dogwood	20	20	Yes	4			Does not do well on harsh, dry sites. Great Plant Pick

Figure 39: Partial list of approved street trees. Seattle Department of Transportation.

- Choose trees that are compatible with overhead utilities if they occur on the same street. Conflicts can be minimized citywide if the jurisdiction considers placing power lines underground or running them along alleys. Another option is to only plant trees on the opposite side of the street from power lines. Many tree species can be pruned to accommodate power lines. For example, *Platanus x acerifolia* (London Plane Tree) and similar trees are generally easy to prune around overhead wires because of their open canopy and trainability. However, trees such as *Populus* (Poplar), *Alnus* (Alders) and *Betula* (Birch) and similar species are not recommended under overhead utilities due to their dense growth habits and poor reaction to pruning, which can be severe in some cases.
- Although use of a single tree species can provide a strong identity to a corridor or neighborhood, street tree species should be varied to provide resistance to disease and insects.

7 | Funding

7.1 | METHODS OF FUNDING INSPECTION AND MAINTENANCE PROGRAMS

A variety of sources are available to fund pedestrian facility inspection and maintenance programs. In general, funding strategies can be split into two categories: programs that are funded by abutting property owners, and programs funded by community taxes, funds and fees.

7.1.1 | Community-Paid Repair and Maintenance Programs

Many communities treat pedestrian facilities as a community-wide asset, and fund their repair and maintenance directly. Typically, these funds come from a municipality's general fund or transportation fund. A community-paid program eases administrative costs compared to assessment programs and spreads the costs for pedestrian facility maintenance over the entire community. The primary concern with community-paid maintenance programs is that funds must be budgeted for the program. Fees and taxes that are commonly used to fund pedestrian facility maintenance programs are briefly discussed below.

General Fund

Sidewalk repair and replacement is commonly paid for through the general fund, which is typically funded by property and sales tax revenues. This is consistent with the way street many agencies consider the funding of street repairs. Generally, sidewalk maintenance is considered separately from road repair funding; in some cases, several sidewalk maintenance projects (e.g. typically sidewalk 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. Sidewalk repair and replacement programs should have the same priority of other types of street repairs and should not fall victim to budget cuts or shifting priorities.

Communitywide Assessments: Ann Arbor, Michigan

The City of Ann Arbor, Michigan, has a voter-approved sidewalk millage tax that generates \$560,000 or more per year for sidewalk repair and replacement. The tax 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 in local taxes.

Winter maintenance is also commonly funded through the general fund. Typically, cities set aside a discrete amount for snow and ice removal. The uncertainty of the need for snow and ice removal each winter, cities may end up with a surplus or may need to pull additional money from the general fund. Most cities return surpluses back to the general fund or carry the funds over for the following year.

Improvement Districts

Many communities have downtown or other business district areas that (i.e. Business Improvement Districts, Community Improvement Districts, Business Improvement Area, transportation improvement districts, etc.) have assumed responsibility of sidewalk maintenance, including winter maintenance. These special districts may fund sidewalk maintenance through their general funds or may assess local property owners for general sidewalk maintenance as well as necessary repairs and replacements.

Homeowners Associations

Homeowner associations are one of the most significant participants in the provision and maintenance of pedestrian facilities. Homeowners' associations are formal legal entities created to maintain common areas. These common areas often include sidewalks and paths that are open to the public. Homeowners associations are usually created when a new development is opened. Their popularity is increasing especially for condominium and townhouse developments. In parts of the U.S. many newer single-family subdivisions are organized around a homeowners association.

Their means of financing activities is similar to improvement districts or business improvement districts typically through some form of assessment based on valuation. For example, Columbia Association of Columbia, Maryland assesses an annual fee of 50 cents on \$100 of fair market valuation, but just on 50% of the total valuation of a property. This association offers a complete set of community services and as part of those services; it provides maintenance for 93 miles of path and walkways. While other services may require an additional user fee, the infrastructure for pedestrians is considered a public commodity that is included in the base assessment paid by all residents and businesses. Other homeowner associations provide a much more limited set of services but it is common for these associations to completely fund maintenance services for pedestrian facilities if walkways have been included in the development.

State Aid Funds

State-aid funds are aimed at distributing a portion of state fuel taxes and vehicle license fees and taxes to local governments for transportation projects. In some cases such funding is only available for transportation projects within state-aid eligible rights-of-way. In other cases, such funds are set-aside for communities to draw on for specific transportation purposes such as safety projects. In yet other cases, such funds are set up as reimbursement programs in which a portion of costs that local jurisdictions incur in fixing sidewalks may be reimbursable by the state.

The availability of this type of program to local communities varies from state to state and may not be available for maintenance activities.

Special Communitywide Assessments

Some communities are able to target the funding of pedestrian facilities with voter-approved levies or special property tax assessments. Not all states have state-level enabling legislation making such levies or district assessments possible. The levies typically involve asking voters to approve a temporary fee or tax that will be dedicated to a specific use such as sidewalk repair. Benefit assessment districts can be established in some states and used for general sidewalk maintenance and repair, ADA compliance, pedestrian safety improvements or other specific programs. The City of Ithaca, NY has just passed legislation creating sidewalk assessment districts covering most properties in the city. All properties will pay a yearly assessment (ranging from \$70 to \$140 annually) to be used toward sidewalk replacement and construction, including corner curb cuts. The City has discontinued special assessing individual adjacent property owners for sidewalk repairs, however, homeowners can receive credit for work they paid for in the past 20 years.

Bonds

Bonds are often used by governments to address significant funding gaps by leveraging existing revenues to pay for large capital expenditures. Communities in some states use bonding to fund sidewalk repair or replacement programs, usually for an entire neighborhood or large section of the community. These bonds often have to be approved by residents through a referendum.

Utility Fees

Utility fees are used by some municipalities to fund street and sidewalk maintenance. Often such fees are voter-approved. Typically the utility fee an individual household pays is relatively small, but the steady funding source enables municipalities to plan and execute maintenance activities in a systematic way. Utility fees may be specific line items, such as a sidewalk maintenance fee collected directly by the municipality, or may be a tax on electric or natural gas service collected by the utility.

Sales Tax

Many communities indirectly use sales tax revenues to fund pedestrian facility maintenance by way of the general fund. Additionally, many states allow local municipalities or counties to impose a small local sales tax that could be earmarked for pedestrian facility maintenance. Sales tax revenue, direct or indirect, 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 availability of this program to local communities is typically covered by state law and varies from state to state.

Utility Fees

Corvallis, Oregon

Cheney, Washington

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. Prior to the imposition of the utility fee, property owners paid for repairs to sidewalks in the public right-of-way along their property. Now, the City will use the money raised by the 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.

Gas Tax

State gas tax revenues are a common component of sidewalk maintenance funding. Though not common, some states give local governments 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, many states share a portion of state-generated gas tax revenues with local communities to fund street improvements, often through state aid programs as described above. The availability of this program to local communities is typically covered by state law and varies from state to state.

Vehicle License, Wheel tax, and Parking Fees

Funding pedestrian facility maintenance using revenues from vehicle license fees or parking fees is not common based on information gathered from agency discussions. Seattle was the only 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. Some states, such as Wisconsin allow for the collection of a wheel tax at the time of vehicle registration with the stipulation that that tax revenue be used for "transportation" purposes.

Enforcement Camera Revenues

Funding pedestrian facility maintenance using revenues from red light or speed 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 percent of this revenue goes towards new sidewalk construction and 25% goes towards repairing existing sidewalks. However, red-light and speed cameras are becoming a more common enforcement method and more communities may choose to dedicate some of the revenue to sidewalk repair. Montgomery County, MD uses some red-light and/or speed enforcement revenue to fund pedestrian safety programs which are not directed at regular sidewalk maintenance, but has been used for facility safety improvements especially around schools.

Federal Funds

Federal transportation funds are a common source for financing 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. Common federal grant funding sources used for pedestrian facilities by communities include Community Development Block Grants and Safe Routes to School and Transportation

Enhancement grants (the last two programs have been combined into the Transportation Alternatives program and discussed in more detail below). A comprehensive federal website is www.grants.gov.

One of the more common programs to correct ADA and Section 504 (of the Rehabilitation Act of 1973) deficiencies is the Transportation Alternatives Program (TAP). Funds apportioned under the program to a State per MAP-21, may be used to correct deficiencies that may also address maintenance problems for facilities in the public-rights-of-way (e.g., sidewalks and curb ramps). These may be identified in the State's or local government's ADA/Section 504 transition plan. The Transportation Alternatives Program (TAP), authorized under Section 1122 of MAP-21 (23 U.S.C. § 213), provides funding for projects or activities, including: transportation alternatives, as defined at 23 U.S.C. § 101(a)(29); the recreational trails program under 23 U.S.C. § 206; the safe routes to school program under section 1404 of SAFETEA-LU; and the planning, design or construction of boulevards and other roadways largely in the right-of-way of former Interstate System routes

Tax Incremental Financing (TIF)

Some communities use tax incremental financing (TIF) as a means to address pedestrian facility maintenance needs in commercial areas undergoing extensive development or redevelopment. TIF is a method to use future expected gains in taxes to subsidize current improvements. TIF districts operate in most states and are typically targeted toward making improvements in distressed, underdeveloped or underused parts of a jurisdiction to encourage new development.

Piggy-Back Funding

One of the best ways to maintain sidewalks is to piggy-back sidewalk repair/replacement projects with other improvements within the public right-of-way. For example, a municipality may require utilities to install or replace sidewalk segments within a certain distance of a project that involves digging up the right of way. The cost of replacing sidewalks can also be folded into large projects such as utility line replacements and street resurfacing. Also, accessibility-related improvements could also target sidewalks, curb ramps, and paths most in need of repair.

7.1.2 | Property Owner Assessment for Repair

Assessment programs assess abutting property owners for the costs of maintaining or replacing pedestrian facilities. Property owners may be held responsible for the full cost of the maintenance or the jurisdiction may pay part of cost. The jurisdiction's portion may be raised through any of the alternatives highlighted in section 6.1.1. Popularity of this funding tool varies from state to state. This is a common means of financing sidewalk replacements in some states, but is nearly non-existent in other states.

The primary benefit of an assessment program is that it allows a community to directly recover costs for pedestrian facility maintenance as maintenance is performed. Assessments also allow property owners to see and directly benefit from payments that they are making to the municipality; general fees or taxes that may fund transportation improvements are not as visible to those paying the fee or tax. However, a number of concerns arise in systems that assess abutting property owners for the costs of pedestrian facility maintenance.

Political Concerns

If a community does not have a history of assessing property owners for pedestrian facility maintenance, it can be very difficult politically to begin an assessment program. Typically, elected officials are loath to impose a new fee on their constituents, particularly one that may only apply to a select number of people each year. In communities with an ongoing assessment program, political considerations may become a factor in issuing the unpopular assessments, with a negative impact on sidewalk quality.

Administrative and Timeliness Concerns

An assessment program requires that the municipality have a system in place to assess property owners for the costs of maintaining abutting pedestrian facilities. If such a program is not in place, a community may be hesitant to set up the administrative structure needed to run the program. Such programs have ongoing administrative costs for communities that do use assessment programs, including time and expenses for the initial assessment and ongoing

Sidewalk Assessments

Madison, Wisconsin

Madison, Wisconsin, actively assesses property owners for costs associated with sidewalk replacement. Typically assessments for replacement occur when the adjacent street is being repaved or reconstructed. Assessments will also occur for sidewalk replacements made as part the City's *Sidewalk Repair and Rehabilitation Program*.

Under the assessment program, property owners are responsible for 50% of the cost of sidewalk replacements. Property owner assessments fund approximately one quarter of the City's million dollar plus sidewalk program. The remainder of the city's sidewalk program is funded with general obligation bond funds.

costs for assessment collection. Taking property owners through a long process to ultimately assess them for sidewalk repairs can significantly delay repairs, prolonging hazardous conditions.

Equity

Assessing abutting property owners for maintenance and repair of pedestrian facilities places a greater burden on homeowners in lower-income neighborhoods who are less able to pay. Many older parts of communities are the most affordable and housing is the least expensive and may be populated by those with lower incomes. However, sidewalks in these areas may need the most maintenance because they are older. This, coupled with the fact that these areas may have a lower density of cars per household and have more pedestrians that need to use the sidewalks for their daily trips to work, shopping, etc. contribute significantly to a need for the facilities among those who can least afford to maintain and repair it.

Pedestrian facilities are part of a community's transportation network, and improvements to the facilities serve not only the abutting property owner, but the public at large. Maintenance and repairs of the travel and parking lanes of streets are rarely funded in this manner.

Abutting Property Owner-Paid Repair and Maintenance

In some communities, property owners are directly responsible for maintaining sidewalks, and city ordinances mandate that they schedule and pay for repairs on their own. The municipality has the administrative burden of inspecting the work and enforcing these ordinances, as discussed in Chapter 4. The drawbacks of this system are the same as those for assessment, with the additional concern over the potential for uneven quality in the repair work, unpredictable schedules for completion, and the potential for a higher cost burden placed on homeowners than other systems taking advantage of economies of scale.

7.2 | FUNDING SUMMARY

If a municipality already has a functioning assessment program in place, it is likely that the program will be the simplest way for the municipality to continue to fund pedestrian facility repairs and maintenance. However, if a municipality does not have an assessment program, or if there are concerns about the equity of an assessment program, a shared or community-paid program may be the best way to fund maintenance and repairs. Municipalities should be creative in drawing on a variety of funding sources to keep their sidewalks in good repair.

8 | Conclusion

This guide is one of the first of its type to research pedestrian facility maintenance practices nationwide and to suggest recommended practices based on that research. Pedestrian facilities that were selected for this study include sidewalks, paths, curb ramps, crosswalks, signals, and signs and constitute the primary set of facilities that are used by pedestrians on a daily basis.

The guide provides a comprehensive set of reasons to support the maintenance of pedestrian facilities ranging from safety to access to liability. One of the main challenges conducting research and developing the guide was the variation in practices throughout the country. There is no simple way to explain how and to what extent pedestrian facilities are maintained in the United States because the quality and timing of maintenance, inspection standards, funding, and even ownership of facilities varies considerably across the country. Practices of over a hundred agencies, including cities, villages, counties, state transportation agencies, and homeowners associations were studied. The research identified many examples where a municipality or a state agency is the maintaining authority for all aspects of pedestrian maintenance. However, the research also identified many examples where pedestrian facility maintenance becomes the responsibility of adjacent property owners; this shift changes the dynamic of pedestrian facility maintenance and causes the need for enforcement processes to be put in place to ensure consistent and timely maintenance.

The most variation in maintenance practices occurred *between* states. Several state transportation departments (Alaska and Florida) and many communities assumed total control of sidewalks and paths including winter maintenance. On the other end of the spectrum, many agencies simply considered sidewalks as strictly a property owner responsibility and provided little or no maintenance. A significant percentage of agencies simply relied on reported mishaps or serious problems before they addressed maintenance of sidewalks.

Maintenance of pedestrian facilities is split into two broad categories: day-to-day maintenance (sweeping, vegetation removal, and snow/ice removal, etc.) and structural maintenance requiring repair work (patching, wedging, minor sidewalk replacement, etc.). As sidewalk replacement increases in scope and scale, the activity moves beyond the common definition of maintenance. There are a number of deformation forces which impact the condition of sidewalks and paths. These forces cause cracking, heaving, or sinking of pavements which will ultimately affect the surface quality, and in many cases, present immediate hazards to pedestrians. Inspection is one of the most important aspects of a maintenance program and perhaps the one element that has changed the most in the past 10 years with improved technology, methods and changes in inspection criteria.

Maintenance projects do not automatically trigger the need bring the pedestrian facility up to current ADA standards. However, maintenance activities provide opportunities to comply with ADA and should be used to make facilities as accessible as possible. The guide supports the use of the ADA criteria as the best source of standards related to cross-slope, running grade, displacements, and other measurers. The guide also acknowledges that not every maintenance repair can comply with every ADA standard.

There are common forms of maintenance repair for sidewalks and paths. Each repair has an appropriate use and a typical lifespan. Sidewalks and paths are the focus of much of this guide because they represent the vast majority of the pedestrian system. However, curb ramps have the same set of maintenance issues as sidewalks and paths plus additional maintenance considerations related to the detectable warning fields (truncated domes). The maintenance of markings is also important and is the major maintenance need for crosswalks. The type of marking material - paint, epoxy, thermoplastic, tape - used will be a major factor in how often the marking will have to be maintained to achieve an acceptable level of conspicuity.

The types of funding used for maintenance facilities have broadened somewhat in the past 20 years. However, in simple terms, the maintenance of pedestrian facilities is covered by a community's or agency's general fund, through special assessments, or directly by adjacent property owners when they provide maintenance themselves – especially for day to day maintenance such as snow and ice removal. State and federal funds rarely cover maintenance costs. The research for this guide has uncovered several new and innovative methods to pay for maintenance. Many agencies are requiring adjacent property owners to pay for repairs of sidewalks, particularly the replacement of sidewalk sections and the day-to-day maintenance of sidewalks and curb ramps. Although this is often an effective way of providing safer and more accessible facilities, there are legitimate concerns about the equity of these arrangements. In many communities streets are maintained by various maintaining agencies, but sidewalks that fall within the same right-of-way become the responsibility of adjacent property owners. Shifting to a system where all sidewalk repairs – especially sidewalk replacements – are totally funded by the maintaining agency responsible for the street will be a funding challenge, but communities have succeeded at making this switch.

The best approach to reducing the cost of maintaining pedestrian facilities is to build pedestrian facilities with maintenance in mind. Sidewalks and paths with a suitable base course and pavement thickness will last longer than those that are not well constructed. Concrete surfaces that have been properly finished with a very slight cross-slope will provide slip resistance and shed water (which can become ice). The placement and selection of the

type of street trees will have a profound effect on how the trees' root systems will impact sidewalks and paths and require maintenance.

There are many pedestrian facility maintenance topics that need be further studied. State and local laws and ordinances have a considerable effect on how agencies treat sidewalk maintenance. The research conducted for this guide uncovered the labyrinth of laws and practices for a number of states, but did not provide a state-by-state comparison or an assessment of how those laws were being put in practice. Another topic for continued study involves keeping abreast of new technologies that will continue to improve the efficiency and accuracy of inspections. Finally, an entire mini-guide could be written on how street trees impact sidewalks and how sidewalk replacement can be handled to increase the survivability of trees.

Communities must continue to make their pedestrian systems safer, more accessible and well-maintained. These three goals are inextricably linked as discussed and presented as recommendations in this guide. Simultaneously, many of the recommendations in this guide will lead to improved efficiencies and often cost savings for communities and agencies charged with maintenance.

Appendix A: Model Sidewalk Inspection Policy

League of Minnesota Cities

RISK MANAGEMENT INFORMATION

LMCIT MODEL SIDEWALK INSPECTION POLICY

Introduction

The city of _____, Minnesota has ___ miles of public sidewalks. Public sidewalks vary in age and in quality of condition. Not every mere inequality or irregularity in the surface of the sidewalk rises to the level of a defect. The city recognizes that some sidewalk conditions create unreasonable hazards for pedestrians and other sidewalk users.

The city has limited employee and financial resources and cannot reasonably replace all sidewalks needing replacement or repair in the same year the sidewalk is identified as needing replacement and repair. Sidewalk replacement and repair can be costly. Comprehensive sidewalk surveys are expensive and require the use of limited city personnel and other resources. Under appropriate circumstances, some or all of the cost of sidewalk replacement may be passed to the adjacent property owner.

Accordingly, the city and its Public Works Department must exercise both discretion and professional judgment in determining whether and when sidewalks need to be replaced or repaired. The city expects that its agents, employees, and city officials will exercise discretion in identifying conditions requiring replacement and repair, in the scheduling of replacement and repair and in establishing priorities for replacement and repair.

Sidewalk inspection procedures

The _____ (Street Superintendent/Director of Public Works/City Engineer) shall establish procedures for regular sidewalk inspection. Those procedures will include:

- An initial city wide sidewalk survey to be completed by _____ (date)
- A schedule for routine sidewalk inspections on a regular basis
- Criteria for determining whether a particular sidewalk condition is in need of replacement or repair. Those criteria will include, but not necessarily be limited to, a deviation or difference in elevation greater than _____ ($\frac{1}{2}$, $\frac{3}{4}$, 1) inch, as determined at the time of inspection.

Sidewalk replacement and repair policy

Upon completion of the initial sidewalk survey, the _____ (Street Superintendent/Director of Public Works/City Engineer) shall establish a replacement and repair schedule. This schedule is subject to modification based both on sidewalk conditions and the availability of resources for sidewalk replacement and repair.

The sidewalk replacement and repair schedule will:

- Divide the city into sections or otherwise prioritize replacement of the sidewalks identified as needing replacement or repair so all sidewalks identified in the initial sidewalk survey as needing replacement or repair are replaced or repaired by _____ (date).
- Take into consideration and weigh the following factors:
 - Sidewalk location and amount of pedestrian traffic
 - Proximity of sidewalk identified as needing replacement or repair to other sidewalks also needing replacement or repair
 - The nature and severity of the condition needing replacement or repair
 - The city's budget for replacement or repair of sidewalks
 - Whether, or to what extent, the cost of repair can be recovered from adjacent property owners
 - Availability of employees, equipment, and other resources for sidewalk replacement or repair
 - Public safety
 - History of prior accidents or complaints
 - Schedules of independent contractors and work necessary to prepare bids and bid specifications if work is to be performed by independent contractors

Sidewalk maintenance policy

City employees will be responsible for removing snow from sidewalks that abut city-owned buildings or parking lots. Adjacent property owners, including other public entities, are responsible for removing snow and ice from sidewalks that abut their property (see City Ordinance No. _____). The city may, as a public service and for reasons of public safety, remove snow and ice from sidewalks. The _____ (Street Superintendent/ Director of Public Works/City Engineer) will identify sidewalks from which the city will remove ice and snow.

Review and modification of policy

The City Council may modify or clarify this policy at any time. Where the city council has delegated responsibility or authority to any city employee or official for development or implementation of any portion of this policy, that employee or official shall have full authority to modify that portion of the policy at any time.

Review of policy

The _____ (Street Superintendent/Director of Public Works/City Engineer) will keep on file comments and complaints received regarding this policy. The policy will be reviewed periodically. Any review will consider comments and complaints since the last review and any other factors affecting the policy or its implementation.

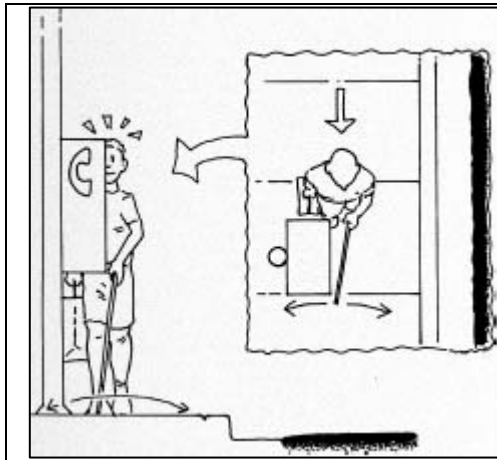
Effective date of policy

This policy shall be effective as of _____ (date). Modifications of the policy shall be effective on the date said modifications are approved by city council resolution or the date city employee or official (with authority granted by the city council) has approved the policy modification or change.

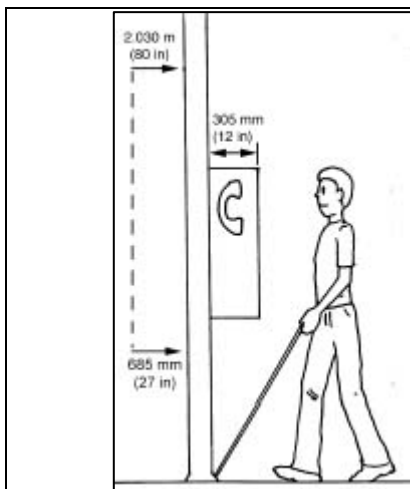
Appendix B: Protruding Objects Summary Sheet

Protruding objects - From Designing Sidewalks and Trails for Access - Part II of II: Best Practices Design Guide. Section 4.1.3

Objects that protrude into the sidewalk corridor but are higher than 2.03 m (80 in) are not a problem for people with vision impairments because most pedestrians require less than 2.03 m (80 in) of headroom. In addition, people with vision impairments who use long white canes to navigate (if they are of adult stature and using their canes skillfully) will usually detect and avoid objects on the sidewalk that extend below 685 mm (27 in). However, obstacles that protrude into the sidewalk between 685 mm (27 in) and 2.03 m (80 in) and do not extend to the ground, are more difficult to avoid because the long white cane is unlikely to contact the object before the person contacts the object. Guide dogs take their owners around obstacles.



POTENTIAL PROBLEM: This pedestrian who is blind is approaching the telephone kiosk from the side. When obstacles mounted on posts can be approached from the side they should not protrude more than 101mm (4 in). This pedestrian does not detect the obstacle, which could cause him to collide with the obstacle.

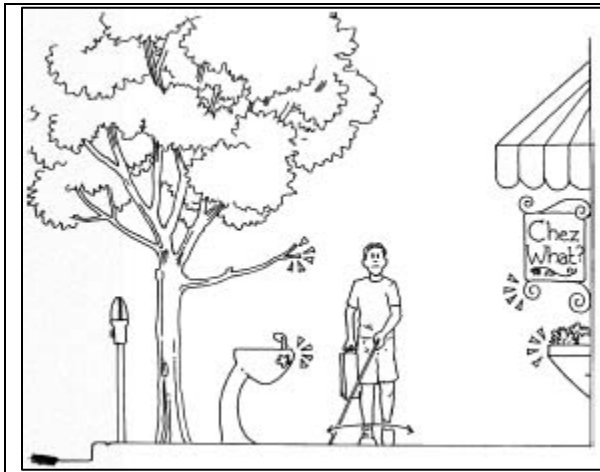


This pedestrian who is blind is able to avoid colliding with this telephone kiosk because he detects the pole with a cane before coming in contact with the phone. Pole mounted objects that can only be approached from the front should not protrude more than 305 mm (12 in) into the sidewalk corridor.

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Pedestrians with vision impairments often travel close to the building line. According to the Americans with Disabilities Act Accessibility Guidelines (ADAAG) Section 4.4, if an object is mounted on a wall or the side of a building, it should not protrude more than 101 mm (4 in) into the sidewalk corridor (ADAAG 4.4, U.S. Access Board, 1991). If an object is mounted on a post that can only be approached from the front, it can protrude up to 305 mm (12 in) because the angle of the long white cane allows a pedestrian who is blind to identify the post before bumping into the protruding object. However, if the post-mounted object can be approached from the side, it should protrude no more than 101 mm (4 in) into the sidewalk corridor. Signs mounted on two posts should have a crossbar at 305 mm (12 in) above the walking surface so that a pedestrian using a long white cane can readily detect the sign. Stop signs mounted on a single post should be no lower than 2.03 m (80 in) or be placed outside of the paved portion of the sidewalk corridor (e.g., in a planting strip).

The least possible amount of protrusion should be used in each situation. Furthermore, because pedestrians with vision impairments do not always travel in the pedestrian zone, protruding objects should be eliminated from the entire paved portion of the sidewalk corridor. Protruding objects do not need to be eliminated from the planter/furniture zone if it is separated from the sidewalk with a planting strip or other type of setback.



This pedestrian, who is blind, is walking down a sidewalk that contains a number of obstacles that are difficult to detect using a long white cane, because they protrude into the path of travel between 685 mm (27 in) up from ground level and below 2.03 m (80 in) in height.

Appendix C: City of St. Michael Sidewalk and Trail Inspection and Maintenance Policy

1. Introduction

The city of St. Michael has many miles of public sidewalks and trails. Public sidewalks and trails may vary in age and in quality of condition. Not every mere inequality or irregularity in the surface of the way rises to the level of a defect. The city recognizes that some sidewalk and trail conditions can create unreasonable hazards for pedestrians and other sidewalk and trail users.

The city does not have unlimited employee or financial resources and cannot reasonably replace all sidewalks or trails needing replacement or repair within the same year the sidewalk or trail is identified as needing replacement and repair. Sidewalk and trail replacement and repair can be costly. Comprehensive sidewalk and trail surveys are expensive and require the use of limited city personnel and other resources. Under appropriate circumstances, some or all of the cost of sidewalk or trail replacement may be passed to the adjacent property owner.

Accordingly, the city and its Public Works Department must exercise both discretion and professional judgment in determining whether and when sidewalks and trails need to be replaced or repaired. The city expects that its agents, employees, and city officials will exercise discretion in identifying conditions requiring replacement and repair, in the scheduling of replacement and repair, and in establishing priorities for replacement and repair.

2. Sidewalk and trail inspection procedures and repair policy

The City of St. Michael sidewalks and trails shall be divided into four inspection districts split into quadrants by County Road (CR) 19 (running north-south) and TH 241/CR 35/CR 36 (running east-west). The City Engineering Department shall inspect one of the four sidewalks and trails districts each year beginning in 2005 with the NW quadrant and working clockwise along the quadrants so that every sidewalk or trail in St. Michael will be inspected at least once every four years.

The sidewalk or trail inspector shall mark and record on a list any deviation or difference in elevation greater than one-half inch, as determined at the time of inspection. Such list will then be given to the Public Works Supervisor who will determine the extent, prioritization, and schedule of the potential repair and replacement. This schedule is subject to modification based both on sidewalk conditions and the availability of resources for sidewalk replacement and repair. The sidewalk replacement and repair schedule will take into consideration and weigh the following factors:

- Sidewalk or trail location and amount of pedestrian traffic
- Proximity of sidewalk or trail identified as needing replacement or repair to other sidewalks or trails also needing replacement or repair
- The nature and severity of the condition needing replacement or repair
- The city's budget for replacement or repair of sidewalks or trails
- Whether or to what extent the cost of repair can be recovered from other sources (adjacent property owners, builders, contractors, or developers)
- Availability of employees, equipment, and other resources for sidewalk or trail replacement or repair.
- Public safety
- History of prior accidents or complaints
- Schedules of independent contractors and work necessary to prepare bids and bid specifications if work is to be performed by independent contractors

4. Sidewalk and trail maintenance policy

City employees and/or private contractors will be responsible for removing snow from sidewalks and trails that abut or are located within city-owned streets, buildings, or parking lots. Adjacent property owners, including other public entities, are responsible for removing snow and ice from sidewalks and trails that abut or are located within their property. The city may, as a public service and for reasons of public safety, remove snow and ice from sidewalks and trails. The Public Works Supervisor will identify sidewalks and trails from which the city will remove ice and snow and the prioritization for snow and ice removal subject to the Public Works Supervisors discretion. The city will remove ice and snow those sidewalks and trails first that are high pedestrian volume and higher traffic routes that connect major sections of the city. The second priority sidewalks and trails are those providing access to schools and commercial businesses. The third priority sidewalks and trails are along low volume residential streets and along park areas.

5. Review and modification of policy

The city council may modify or clarify this policy at any time. Where the city council has delegated responsibility or authority to any city employee or official for development or implementation of any portion of this policy, that employee or official shall have full

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Appendix D: Risk Management Information



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Sidewalk Inspection and Maintenance Policies: They Are All They're Cracked Up to Be

Cities should develop and adopt sidewalk inspection and maintenance policies if such policies do not already exist. Sidewalk inspection and maintenance policies serve many useful purposes including providing guidelines to city employees, conveying information to city residents, and preventing and/or minimizing lawsuits and exposure.

There are five common misconceptions and myths about sidewalk inspection and maintenance policies.

1. The city has no sidewalk maintenance policy.
2. A good written sidewalk maintenance policy need only say, "The city regularly inspects and maintains its sidewalks, and responds to resident complaints."
3. If a city doesn't have any money, it doesn't need to do anything about sidewalk maintenance or worry about the Americans with Disabilities Act or other similar federal or state laws.
4. If a person falls on a sidewalk and city employees determine the sidewalk where the person fell is defective, city employees shouldn't fix the defect because it will look bad if the injured person sues.
5. Documenting problems with sidewalks, including accidents, can come back to hurt the city.

This memo addresses these misconceptions and myths, highlighting how to avoid common pitfalls and how to develop effective sidewalk inspection and maintenance policies.

No Sidewalk Maintenance Policy

If your city regularly inspects and maintains sidewalks, most likely it has a policy for sidewalk maintenance. However, this policy may be unwritten. Most likely, your city has a sidewalk maintenance policy if city employees:

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- Periodically inspect and/or rate all city sidewalk segments.
- Prioritize what city sidewalks to repair and/or replace.
- Decide whether to repair and/or replace a sidewalk based on certain criteria (i.e. difference of height between two slabs of concrete of one inch or more).
- Respond to resident complaints and concerns.
- Inspect sidewalks when performing other work, such as trimming trees or inspecting streets.
- Balance sidewalk maintenance duties with other public works functions.

While an unwritten policy is better than no policy, a written policy is better than an unwritten policy. A written policy serves to:

- Guide the city's inspection and maintenance efforts by providing guidance and direction for city employees, providing information for responding to citizen concerns, and serving as a tool for long-term planning and budgeting.
- Preserve the "statutory/discretionary immunity" record. Under Minn. Stat. § 466.03, subd. 6, a city is immune from liability for discretionary policy-level decisions that are based on a balancing of political, social, and economic factors. In other words, a claimant cannot recover where she/he alleges negligent maintenance if the city balanced social, economic, and political factors in formulating its sidewalk maintenance policy. In maintaining sidewalks, a city typically balances political (cost of and resistance to assessment), social (public safety, desire to provide safe sidewalks to residents, desire to encourage downtown shopping), and economic (limited number of employees, limited budget for sidewalk maintenance, cost of repair/replacement) factors.
- Minimize the city's liability exposure in lawsuits. Even if a city is not entitled to an immunity defense (which provides immunity from suit, not just liability), if a city establishes and follows a sidewalk maintenance policy, the city can prove that it exercised reasonable care in the maintenance of its sidewalks.
- Communicate to the public. Specifically, a written policy (1) informs property owners about how the city treats sidewalks; (2) helps taxpayers understand the economic implications of sidewalk inspection and maintenance; (3) allows the public to comment on and seek modification of the policy; and (4) may assist in decreasing the likelihood of lawsuits resulting from claims resulting from minor, non-defective sidewalk deviations or conditions.

A Good Written Sidewalk Maintenance Policy Needs No Detail

The ideal written sidewalk inspection and maintenance policy contains several critical components, including (1) identification of defective conditions; (2) development of an inspection procedure and schedule; (3) prioritization of replacement and repair; (4) development of cost recovery mechanisms; and (5) response to resident complaints and concerns.

Identification of Defective Conditions

A city should identify defective conditions on its sidewalks by:

- Conducting an initial survey. Typically, the city should conduct an initial survey to inspect and evaluate all its sidewalks and document its findings.
- Conducting follow-up surveys. After the initial survey, the city should periodically conduct follow-up surveys and document its findings. The frequency of follow-up surveys may depend on the availability of city employees and the city's budget. The frequency of follow-up surveys can also vary for residential and downtown areas.
- Establishing criteria for defective sidewalks. The city should establish criteria for defective sidewalk by considering the location of the sidewalk, the amount of pedestrian traffic, the city resources for repair or replacement, the appropriateness and effectiveness of a temporary repair, and the wishes of the city council. The city must also define when a sidewalk is defective and requires repair or replacement considering deviations in elevations, missing sections, holes, spalling, and other conditions. The city should determine who is responsible for determining that a city sidewalk needs repair or replacement.

Development of an Inspection Procedure & Schedule

A city should establish a sidewalk inspection procedure and schedule. In formulating an inspection procedure and schedule, the city should consider:

- Conducting an initial survey if the city has not conducted a survey in the past five years.
- Whether city employees will survey the whole city at once or survey the city area by area.

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- Frequency of sidewalk re-inspecting, considering the location of the sidewalk, the amount of pedestrian traffic, and available city resources.
- City employees' informal inspections when performing other work. A city needs to determine how a city employee can report a sidewalk problem even if she/he is not formally inspecting the sidewalk and the city's response to such reports.

Prioritization of Repair and Replacement

A city should prioritize sidewalk repair and replacement by:

- Establishing priority criteria, considering location of sidewalk, amount of pedestrian traffic, overall condition of sidewalks in the area, cost versus effect, and resident complaints.
- Establishing a repair and replacement schedule. The schedule should be realistic, within budget, and take into consideration the resources needed, the length of the construction season, and the amount of work to be done. The schedule should indicate whether sidewalks are to be replaced area by area and whether they are to be replaced based on severity of condition regardless of location.
- Establishing a mechanism for modifying the repair and replacement schedule, considering budget, time, resource limitations, and changed priorities.
- Determining whether city employees or contractors will perform the repair and replacement work.
- Providing information to property owners, including work schedule and contact information for complaints and concerns.

Development of Cost-Recovery Mechanisms

A city can pay for sidewalk repairs and replacements or assess the costs to benefited property owners. If a city decides to assess the cost of sidewalk repair or replacement to benefited property owners, it needs to formulate clear policies and procedures for assessing costs to property owners. A city can follow various procedures including (1) notifying property owners that they need to repair/replace sidewalk by a specified date or the city will perform the work and assess the property owner; or (2) providing that city employees perform the work in all cases and assess the property owner.

Response to Resident Complaints and Concerns

A city's sidewalk inspection and maintenance policy should contain a component for responding to resident complaints and concerns. A city should consider taking the following actions in responding to complaints:

- Complete an accident/incident report.
- Inspect the sidewalk after the accident or complaint and document the inspection. A city should describe the condition of the sidewalk before repair, take photographs, take measurements, and compare the post-accident sidewalk condition with the condition at the last inspection.
- Determine if post-accident sidewalk condition constitutes a defective condition or warrants repair or replacement under the city's policy.
- Determine whether to repair, replace, take temporary action, or do nothing. If the city decides to do nothing, the city should state its reasons for doing nothing.
- Communicate with the injured party. The city can acknowledge the accident, but should not admit fault or liability. The city should inform the injured party what the city has done in the past (inspection and maintenance policy) and what it will do in the future in response to his/her complaint. Before undertaking repair, the city should consult its city attorney and/or the League of Minnesota Cities Insurance Trust and notify in writing the injured person (or his/her attorney).

Adoption of the Policy

After the city or city employees formulate a sidewalk inspection and maintenance policy (1) the city council should adopt the policy via a resolution; and (2) city employees should follow the policy.

Limited Resources & Federal and State Laws (Americans with Disabilities Act)

If a city has limited resources, the city cannot simply ignore sidewalk maintenance. Instead, the city needs to formulate a policy that effectively utilizes the resources it does possess. For instance, if budget issues require that the city trim its sidewalk budget, the city should alter its inspection and maintenance schedule accordingly; it should not completely eliminate the schedule. Moreover, the city should document its decision. For instance, the city should show that it

balanced social, political, and economic factors in formulating or modifying its sidewalk inspection and maintenance policy.

Nor can a city avoid compliance with state and federal accessibility laws on the sole grounds that it possesses limited funds. Instead, the city must prioritize sidewalk projects and other public works projects to ensure compliance with state and federal accessibility laws. Moreover, because state and federal accessibility laws frequently change (because of amendments or court decisions), a city should consult with its city attorney to ensure compliance.

Fixing Defects

This myth contains some truth. City employees should not repair a sidewalk where an individual fell until the city consults with its city attorney and/or the League of Minnesota Cities Insurance Trust. Typically, it is a good practice to allow time for the city's agents and representatives to investigate the incident and take photographs of the sidewalk in question. However, assuming that the city's agents have already conducted an investigation, if a city determines that a sidewalk where an individual fell is defective, the city need not wait until the end of litigation to repair the defect for fear the claimant will use the information against the city. In general, the Rules of Evidence prohibit a claimant from introducing evidence that a city repaired a sidewalk to prove that the city was negligent in not repairing the sidewalk beforehand. *Minn. R. Evid. 407.*

Documentation

It is very helpful if a city documents its sidewalk inspection and maintenance policy and sidewalk problems. In the event of a lawsuit, the city's attorneys can use these documents to prove the existence of city policies and the city's adherence to the policies. They can also show that the city exercised reasonable care in inspecting and maintaining its sidewalks. Sometimes, individuals believe that if they do not document policies or problems, there will be no paper trail to hurt them later on. However, what they fail to understand is that judges and juries can draw negative inferences from a lack of documentation. Documentation shows that a city deliberately and conscientiously made decisions.

Jana O'Leary Sullivan 1/09

Revised: 04/10

Appendix E: Eau Claire, Wisconsin Sidewalk Ordinance

City of Eau Claire, Wisconsin Ordinances – Sidewalk and Sidewalk Maintenance

Chapter 13.04

CONSTRUCTION AND REPAIR*

Sections:

13.04.010 Installation of sidewalks--General.

13.04.020 Deferral of sidewalk construction.

13.04.025 Procedures for deferral of sidewalk construction.

13.04.030 Design and construction of sidewalks.

13.04.010 Installation of sidewalks--General. This chapter is adopted pursuant to the authority provided in Wis. Stats. 66.615(7). Subject to other provisions of this chapter, sidewalks shall be constructed as follows:

A. Within new subdivisions, as provided in Section 17.12.280 of this code. The provisions of s. 13.04.020, entitled "Deferral of sidewalk construction," and s. 13.04.025, entitled "Procedures for deferral of sidewalk construction," shall not apply to this subsection A. for the construction of sidewalks within new subdivisions.

B. Abutting any lot described on a certified survey map under Wis. Stats. s. 236.34, or any other unplatted lot, at the time when the main building on the lot is initially constructed or when it is entirely reconstructed or replaced. Prior to issuance of a building permit for such construction, reconstruction or replacement, the property owner shall execute and file with the city Administrator of Inspections and Zoning a written document certifying installation of a public sidewalk abutting such lot or execute a petition to the city for such installation and the levy of special assessments in connection therewith and waiving notice and hearing pursuant to Wis. Stats. s. 66.60 (18).

C. Along streets lying within one-half mile of a public or private elementary or secondary school;

D. Along any street or portion of street which is classified by the city council as a collector street or arterial street under the functional street classification system of the city;

E. Where the installation of a sidewalk will connect previously constructed and existing sidewalks within the immediate area;

F. When property owners who own over one-half of the frontage along a street file a petition with the city requesting that sidewalks be installed along such frontage; and

G. At such other locations where the city council determines that one or more of the following conditions exist:

1. Vehicular and pedestrian conflicts present a potential danger to the health and safety of persons; or
2. The number of small children, senior citizens or other persons having special needs reside on a street and require a sidewalk to assure their safety; or
3. Parks, playgrounds or other locations exist which are attractive to large numbers of children and are not served by sidewalks thereby resulting in an immediate danger to the health and safety of such children. (Ord. 6285 §1, 2002; Ord. 4510 §1, 1984).

13.04.020 Deferral of sidewalk construction. Sidewalk shall be constructed in all locations as outlined in section 13.04.010, except the city council retains the authority to review any sidewalk proposal and to designate procedures to defer the construction thereof whenever it is deemed necessary and desirable. A deferral shall not constitute a permanent waiver of sidewalk construction, and the city council may review and reconsider the need for construction at any time. Sidewalk construction may be deferred in the following situations:

- A. Where the construction would be along a cemetery, outlying industrial property, or in any other area where little or no pedestrian use is reasonably anticipated;
- B. Where the owner of the property adjacent to the street elects to provide an alternative pedestrian facility which is acceptable and approved;
- C. When it is determined that the construction of sidewalk is not feasible or practical due to topographical or other physical constraints; or
- D. When it is found that construction of sidewalk would not serve the public interest, safety or convenience. (Ord. 4981, 1989; Ord. 4510 §2, 1984).

13.04.025 Procedures for deferral of sidewalk construction. All requests for deferral of sidewalk construction shall be submitted in writing to the department of public works. Applications for deferral of sidewalk construction shall be processed as follows:

- A. The director of public works is authorized to approve the deferral of sidewalk construction under the following circumstances:
 1. Where the location is on a cul-de-sac or dead-end street of 750 feet or less in length and no other sidewalk exists on the cul-de-sac or dead-end street segment;
 2. Where development is substantially complete in the area and no other sidewalk exists on the street segment;

3. Where the location is a remote rural area and no sidewalk exists or is planned to be constructed in the near future;
4. In locations where the city has programmed or scheduled street construction as part of the capital improvement program; or
5. Where topography, street grades or physical constraints make the construction impractical.

B. Decisions rendered by the director of public works may be appealed by the applicant to the city council for consideration and determination by the council.

C. All applications for deferral of sidewalk construction for reasons not included in subsection 13.04.025 A. shall be submitted to the city council for review, consideration and determination.

D. Locations where construction of sidewalk is deferred shall be subject to the following conditions:

1. A concrete sidewalk section shall be constructed at the time the driveway is constructed in the location and at an elevation established by the department of public works which is calculated to accommodate a possible future sidewalk in the location.
2. The terrace and yard area shall be graded to meet a possible future sidewalk in the location and elevation established by the department of public works. This subsection shall not apply where sidewalk construction is not practical for topographic reasons. (Ord. 4981, 1989).

13.04.030 Design and construction of sidewalks.

A. Sidewalks shall be constructed in accordance with city specifications as established by the Department of Public Works. Subject to the provisions of subsection B, and unless as otherwise directed by the Director of Public Works, the width of all sidewalks in residential areas shall be 5 feet. The sidewalk width in all other areas shall be established by the Director of Public Works.

B. The design of sidewalks shall be flexible and shall be adapted to suit the particular needs of the area within which they are constructed. The materials used and designs employed in connection with sidewalk construction shall be consistent with topography and aesthetics. Trees shall not be removed in order to construct sidewalks unless their removal is reasonably necessary in order to accommodate such construction, as determined by the Director of Public Works. If a boulevard exists, as much space as possible shall be retained on it to provide for the storage of snow. (Ord. 4510 §1, 1984).

13.16.010 Obstructing--Littering--Vegetation control.

A. No person shall place, deposit or cast or cause to be placed, deposited or cast upon any street, alley, gutter, sidewalk or public ground within the city any grass clippings, leaves, ashes, rubbish, paper, snow or ice or anything or substance whatever which may obstruct any such street, alley, gutter, sidewalk or public ground, or impede, hinder or endanger travel thereon, or which shall or may injure or disfigure the same, or tend to the injury or disfigurement thereof, or tend to render the same unclean or a nuisance; nor shall any person cause or suffer any motor vehicle or other vehicle, or any box, crate, bale, package, merchandise or other thing to stand or be in or upon any such street, alley, sidewalk or public ground longer than may be actually necessary, under a penalty of up to fifty dollars for each and every offense.

B. No person shall permit any vegetation growing on premises owned or controlled by him to obstruct or impede, hinder or endanger travel upon any street, sidewalk, or alley under like penalty. (Ord. 4246 §4, 1982; Ord. 3936 §4, 1978; Ord. 3639, 1976; prior code §5.01).

13.20.010 Cleaning of snow and ice required.

A. The owner of every lot or parcel of land shall keep the public sidewalk adjacent to said premises reasonably free and clear from snow and ice and shall clear the snow from such sidewalk within twenty-four hours following a snowfall. Any owner violating the pro-visions of this section shall be subject to a forfeiture of not less than five dollars nor more than fifty dollars for each offense. Upon the failure of an owner to clear any sidewalk as required under this section, the City shall cause the sidewalk to be so cleared and shall cause the cost thereof to be levied as a special tax chargeable to such lot or parcel of land to be collected like other taxes upon real estate, as prescribed in Wis. Stats. s. 66.615

B. "Sidewalk" as used in this chapter means any sidewalk, path, walk or way regularly used by pedestrians along any opened and established street and within the boundaries of such street. (Ord. 4262, 1982; Ord. 3599 (part), 1976; prior code §5.12).

* For provisions of general municipality law authorizing city councils to require sidewalks and to provide rules for their grade, construction, maintenance and repair, see WSA 66.615; for provisions of general charter law regarding street improvement and repair, see WSA 62.16.

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Appendix F: Des Moines, Iowa Sidewalk Ordinance

City of Des Moines, Iowa Sidewalk Maintenance Ordinance

Sec. 102-42. Maintenance.

(a) The owner of any property abutting a public sidewalk shall maintain the sidewalk in a safe condition, in a state of good repair, and free from defects. The abutting property owner may be liable for damages caused by failure to maintain the sidewalk.

(b) In the sole discretion of the department director and if funds and personnel are available for the same, the city inspector may, but is not required to, conduct voluntary inspections of city sidewalks following receipt of a sidewalk complaint to assure that the owners of property abutting sidewalks are complying with the maintenance requirements imposed above.

(c)

(1) If, through sidewalk complaint and voluntary inspection or otherwise, it comes to the attention of a city inspector that an owner of property abutting a sidewalk is not complying with the maintenance requirements imposed above, then the city inspector may cause to be served upon the property owner, by certified mail at the property owner's last known address as shown by the records of the county auditor, notice of the sidewalk defect and of the requirement to cure said defect and/or reconstruct the defective sidewalk or a portion thereof within 180 days from the date of said notice.

(2) In response to said notice, the property owner may submit a written request to the city inspector for an 180 day extension of time to cure the sidewalk defect and/or reconstruct the defective sidewalk, for a total period, as extended, of up to 360 days from the date of the notice to cure and/or reconstruct.

(3) Said notice, if given, shall also state the nature of any immediate or interim repairs or precautions required to be undertaken by the property owner following notice but prior to repair of the sidewalk defect, including but not limited to temporary asphalt wedges, barricading, and placement of protective devices.

(4) Said notice, if given, shall also state that if the property owner does not make the required immediate or interim repairs, and/or cure the sidewalk defect and/or reconstruct the sidewalk within 180 days from the date of the notice or within such extended time as approved by the city inspector, the city may pursue action against the property owner for civil infraction, and/or may give notice and take action pursuant to sections [102-83](#) and [102-84](#) of this Code, and/or may pursue any other legally available remedy. Failure of the abutting property owner to

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complete the maintenance within 180 days from the date of the notice or within such extended time as approved by the city inspector may be punishable as a municipal infraction by a civil penalty pursuant to [section 1-15](#) of this Code.

(d) Curing of sidewalk defect and/or sidewalk reconstruction as ordered by this section shall be undertaken by property owners in accordance with division 2 of this article, except that the following code sections shall not apply: sections [102-71](#), [102-74](#), [102-81](#), [102-91](#), [102-92](#) and [102-93](#)

(e) The department director may, in his or her sole discretion, establish policies and procedures relating to income-based subsidies, and to reimbursement of part or all of the cost to repair a sidewalk defect determined by the city inspector at time of inspection to have been caused by city activities and/or city trees, for property owners receiving notice of sidewalk defect. Any subsidies or reimbursements authorized in accordance with such policies shall be subject to funding availability, as determined by the department director in his or her sole discretion.

(f) In the sole discretion of the department director and if funds and personnel are available for the same, the public works department, at the request of the city inspector, may, but is not required to, place barricades or other devices or materials in such places as may serve to protect the public from sidewalks not in compliance with the maintenance requirements imposed above. If such protective devices are placed by the department, they shall not be removed until all sidewalk defects are corrected. Premature removal of the protective devices may be punishable as a municipal infraction by a civil penalty pursuant to [section 1-15](#) of this Code, which penalty shall be available to the city as a remedy in addition to all other legally available remedies.

(g) The department director shall keep records of all sidewalk complaints received, all voluntary sidewalk inspections conducted, notices of defects sent, protective devices placed and sidewalk work done by the city for a period of three years from the date of the action and shall, to the extent required by open records law, make the same available to all persons who claim to have been damaged or injured as a result of the failure to maintain a sidewalk by an abutting property owner.

(h) This section shall not apply to multi-use recreational trails as defined pursuant to [section 114-1](#) of this Code.

(i) Nothing set forth in this section shall be construed so as to prevent or preclude the city, or the department(s) and department director(s) responsible for enforcement of this article, from

taking any emergency action or nuisance abatement action, including but not limited to notice and assessment of costs, as deemed appropriate pursuant to [chapter 42](#) of this Code in the event that sidewalk defects are determined by the department director to constitute a nuisance.

(C85, § 23-2.01; O.11,361; C91, § 23-2.01; O.13,314, 14,092, 14,164, 14,800, 15,107)

Sec. 102-43. Definitions—Maintenance of sidewalks.

As used in divisions 1 and 2 of this article, the following words have the following meanings:

Defect or defective condition means a public sidewalk has a defect or defective condition when it exhibits one or more of the following characteristics:

- (1) Vertical separations equal to three-fourth inch or more;
- (2) Horizontal separations equal to three-fourth inch or more;
- (3) Holes or depressions equal to three-fourth inch or more;
- (4) Spalling over 50 percent of a single square or panel of sidewalk with one or more depressions equal to one-half inch or more;
- (5) A single square or panel of sidewalk cracked in such a manner that no part thereof has a piece greater than one square foot, or is cracked in such a manner that it constitutes danger or potential danger to the public;
- (6) A sidewalk with any part thereof missing to the full depth;
- (7) A deviation on the staked and constructed grade equal to three-fourth inch or more;
- (8) Covered in whole or in part with weeds or other plants, garbage, junk, rubbish, debris, solid waste, bird or animal droppings or any nuisances, obstructions or hazards which makes or tends to make pedestrian travel either dangerous or impractical.

City inspector means any city employee designated by the department director to undertake the city's inspection and notice actions as set forth in divisions 1 and 2 of this article.

Department director means the director of any city department charged with enforcement of any section of divisions 1 and 2 of this article, or his or her designee. Maintain or maintenance means the duty to remove and replace a public sidewalk, or a portion of a public sidewalk, all work to be performed in accordance with established city specifications in effect at the time the work is commenced, so as to render the sidewalk free from defect.

Property owner or owner means the record holder of legal title, and the contract purchaser, if there is one of record, and may be referred to as "person" in division 2 of this article.

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Sidewalk means the paved portion of that area between the curb lines of the roadway and the adjacent property lines intended for the use of pedestrians.