

# **Pedestrian Accommodations in Work Zones: Systematic Literature Review and Research Needs**

**Final Report  
October 2021**

**SWZDI**   
Smart Work Zone Deployment Initiative

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The preparation of this report was financed in part through funds provided by the Iowa Department of Transportation through its "Second Revised Agreement for the Management of Research Conducted by Iowa State University for the Iowa Department of Transportation" and its amendments.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Iowa Department of Transportation or the U.S. Department of Transportation Federal Highway Administration.

**Technical Report Documentation Page**

<b>1. Report No.</b> Part of SWZDI TPF-5(295)	<b>2. Government Accession No.</b>	<b>3. Recipient's Catalog No.</b>	
<b>4. Title</b> Pedestrian Accommodations in Work Zones: Systematic Literature Review and Research Needs		<b>5. Report Date</b> October 2021	
		<b>6. Performing Organization Code</b>	
<b>7. Author(s)</b> John W. Shaw (orcid.org/0000-0001-5929-5120) and Nicole L. Oneyear (orcid.org/0000-0002-1328-9099)		<b>8. Performing Organization Report No.</b> Part of InTrans Project 19-535	
<b>9. Performing Organization Name and Address</b> Center for Transportation Research and Education Iowa State University 2711 South Loop Drive, Suite 4700 Ames IA 50010		<b>10. Work Unit No. (TRAIS)</b>	
		<b>11. Contract or Grant No.</b>	
<b>12. Sponsoring Organization Name and Address</b> Smart Work Zone Deployment Initiative and Iowa Department of Transportation 800 Lincoln Way Ames, Iowa 50010		<b>13. Type of Report and Period Covered</b> Final Report	
		<b>14. Sponsoring Agency Code</b> Part of TPF-5(295)	
<b>15. Supplementary Notes</b> Visit <a href="https://swzdi.intrans.iastate.edu/">https://swzdi.intrans.iastate.edu/</a> for color pdfs of this and other Smart Work Zone Deployment Initiative research reports.			
<b>16. Abstract</b> <p>Each year, billions of dollars are spent by public agencies, utilities, and private developers for projects that affect pedestrian safety and mobility during construction. A systematic literature review was conducted to identify previous research related to work zone pedestrian safety and mobility deficiencies and potential solutions. Studies published between 2004 and mid-2021 (17½ years) were eligible for inclusion. Only nine studies meeting the inclusion criteria were found. One study summarized research conducted prior to 2006, five discussed physical design and traffic management for temporary pedestrian facilities, and three discussed electronic mobility aids for visually impaired pedestrians. None of the identified studies provided quantitative evaluations of the effectiveness of proposed design solutions. The qualitative findings described in the studies are often subjective, and the study designs have significant risk of bias.</p> <p>A supplemental literature review compared the work zone design guidance issued by state departments of transportation (DOTs). The guidelines ranged widely in scope and specificity. The most detailed guidance tended to be issued by more urbanized states and was mainly derived from a temporary pedestrian access handbook prepared by the Minnesota DOT around 2011.</p> <p>Several research needs related to pedestrian safety and mobility in work zones were identified. For example, there is currently virtually no information on positive or negative effects of relaxing design standards when a pedestrian facility will be used for only a short duration. In addition, current design guidance for temporary facilities is not tied to objective criteria such as pedestrian traffic volume, motor vehicle traffic volume, traffic speeds, facility type, or work duration.</p> <p>A Pedestrian Test Track is proposed as a potential method for gathering information about user acceptance of proposed design solutions.</p>			
<b>17. Key Words</b> pedestrian facilities—pedestrian safety and mobility—work zone safety		<b>18. Distribution Statement</b> No restrictions.	
<b>19. Security Classification (of this report)</b> Unclassified.	<b>20. Security Classification (of this page)</b> Unclassified.	<b>21. No. of Pages</b> 142	<b>22. Price</b> NA



# **PEDESTRIAN ACCOMMODATIONS IN WORK ZONES: SYSTEMATIC LITERATURE REVIEW AND RESEARCH NEEDS**

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October 2021**

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Sponsored by the Smart Work Zone Deployment Initiative and  
the Federal Highway Administration (FHWA) Pooled Fund Study TPF-5(295):  
Iowa (lead state), Illinois, Kansas, Missouri, Nebraska, and Wisconsin

Preparation of this report was financed in part  
through funds provided by the Iowa Department of Transportation  
through its Research Management Agreement  
with the Institute for Transportation  
(InTrans Project 19-535)

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## ACKNOWLEDGMENTS

This research was conducted under the Smart Work Zone Deployment Initiative (SWZDI) and Federal Highway Administration (FHWA) Pooled Fund Study TPF-5(295), involving the following state departments of transportation:

- Iowa (lead state)
- Illinois
- Kansas
- Missouri
- Nebraska
- Wisconsin

The project was guided by a technical advisory committee (TAC) comprised of the following individuals:

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- Meg Robertson, Massachusetts Commission for the Blind (retired)
- Dan Sprengeler, Iowa Department of Transportation
- Eryn M. Stone, City of Cedar Rapids (Iowa)
- Kevin Vrchoticky, Iowa Department of Transportation

The authors would like to thank the TAC members, the FHWA, the Iowa Department of Transportation, and the other pooled fund state partners for their financial support and technical assistance.



## EXECUTIVE SUMMARY

Each year, billions of dollars are spent on projects that directly affect pedestrian safety and mobility during construction. These include roadway projects, utility installation and repair, and private sector projects such as building construction and land development. Although the resulting issues affect all pedestrians, they have disproportionate impacts on people with disabilities, who currently comprise about a quarter of the noninstitutionalized US adult population (Okoro et al. 2018).

To help reduce adverse impacts, the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD) established some basic criteria for work zone pedestrian accommodations. These include requirements to maintain “adequate” pedestrian access and walkways during construction, provide advance notice of sidewalk closures, provide barriers that can be detected by visually impaired pedestrians at sidewalk closures, and provide accessibility and detectability for pedestrians with disabilities if the existing route has those features (FHWA 2009). Noncompliance with these requirements is widespread; for example, a member of the project panel reported that in many cities there is no advance notice of closed sidewalks and there are no pedestrian accommodations in work zones.

Approximately 120 pedestrian fatalities in work zones are reported by law enforcement agencies in the United States each year, and nonfatal injuries are a substantial problem. Pedestrian accommodation deficiencies can generate complaints from pedestrians and admissions to hospital emergency departments. Many of these cases are slip-and-fall injuries that are not reported to law enforcement. On average, each *nonfatal* pedestrian injury results in approximately \$52,000 in losses (CDC 2021, U.S. Bureau of Labor Statistics 2021). A Swedish study reported that 30% of vulnerable road user crashes occur in work zones (Liljegren 2014), but no similar figure was found for the US. Assuming that 15% of nonfatal US pedestrian casualties occur in work zones, the estimated annual number of nonfatal injuries is **31,900**, resulting in approximately **\$1.7 billion** in financial losses to insurers, government healthcare programs, injured people and their families, and employers. Nevertheless, many transportation practitioners are unaware of the extent of the problem because they rely on law enforcement data that are mainly limited to vehicle-pedestrian crashes.

A systematic literature review was conducted to locate work zone pedestrian safety research published from 2004 to mid-2021 (17½ years). Only nine relevant studies were found. One publication summarizes the work zone pedestrian safety research completed before 2004. Five publications address the physical design or management of temporary facilities. Three focus on conveying detour information to visually impaired pedestrians.

With the exception of a sign comprehension analysis, almost all of the results reported in the primary studies were qualitative, and many were subjective, leading to substantial risk of bias. The small scale and short duration of the studies precludes quantitative analysis of the effects of the interventions on casualties and mobility, both within individual primary studies and for the body of research as a whole.

Several publications identify or discuss shortcomings in the design and implementation of temporary pedestrian accommodations for work zones (Morelli et al. 2005, Ullman et al. 2007, Ellis et al. 2008, Bilton 2012, Shaw et al. 2016, Attanayake et al. 2017, Shaw et al. 2018). Typical problems include sidewalk closures without alternate routes or detours, unmarked or poorly marked closures, excessively long detours, pedestrians cutting through the construction area, lack of separation between bystanders and work areas, tripping hazards, falling hazards such as open manholes, inadequate lighting, and inappropriate use of temporary traffic control devices. Some studies have proposed solutions for these problems, but **no formal evaluations of the effects of these interventions were found**. As a result, the effectiveness of the solutions in improving pedestrian safety and mobility remains unknown.

A supplemental search of state transportation agency design guides found that the guidance provided to practitioners varies widely in scope. Agencies in predominantly rural states tend to provide less guidance than those in more urbanized states. In general, the states with relatively detailed guidance have mainly derived it from a set of recommendations and device drawings developed by the Minnesota Department of Transportation a decade ago. With the exception of North Carolina, no guidelines were found that relate the design of temporary accommodations to objective criteria such as pedestrian traffic volume, motor vehicle traffic volume, roadway speed, roadway type, land use, or project duration.

Currently, there are many research needs related to pedestrian safety and mobility in work zones. Here are a few examples:

- Data on the characteristics and needs of pedestrians with disabilities could help inform the development, testing, and selection of temporary pedestrian accommodations.
- There is a need for research exploring the extent to which design criteria (dimensions, slopes, etc.) for permanent pedestrian facilities can be relaxed or adjusted for temporary installations. For example, guidance in the 2009 MUTCD seems to imply that temporary pedestrian surfaces should be made from wood or surfaced with asphalt or concrete. This is problematic for smaller projects because the fabrication or paving of temporary surfaces could take longer than the main work. When technical requirements are overly stringent, practitioners appear to forego temporary pedestrian accommodations. In some cases, this may be related to the cost and complexity of shifting pedestrian facilities onto adjacent private land. In other cases, it is possible that practitioners expect the work to be completed before affected road users begin making complaints.
- Pedestrians with visual, sensory, and cognitive disabilities tend to navigate based on landmarks learned through previous experience, which can be disrupted by construction (Williams et al. 2013). Research from the interdisciplinary field of space syntax can offer some insights on how facility changes affect these pedestrians (van Ness and Yamu 2021), but additional work is needed to identify and test practical solutions. For example, disseminating real-time information on the status of sidewalk closures appears to be technically feasible (Liao 2014), but systems for acquiring up-to-date data are required (Qin et al. 2018). Perhaps these systems could leverage technologies originally developed for real-

time dissemination of motor vehicle lane closures, such as RDS-TMC or TPEG (see discussion in Shaw and Venkatachalapathy [2021]).

To begin addressing these issues and opportunities, the project team developed the concept for a Pedestrian Test Track, which would allow temporary surfacing materials, curb ramps, railings, and small vertical transitions to be tested in a realistic but traffic-free setting. Due to delays related to the COVID-19 pandemic, the Pedestrian Test Track could not be implemented in a timeframe compatible with the administrative requirements of the Smart Work Zone Deployment Initiative (SWZDI) funding. Nevertheless, the Pedestrian Test Track concept could be applied to future research to help quantify the safety and mobility effects of temporary pedestrian accommodation alternatives.



## INTRODUCTION

Each year, billions of dollars are spent on construction projects that directly affect pedestrian safety and mobility during construction. Although these issues affect all pedestrians, they have disproportionate impacts on people with disabilities, who currently comprise about a quarter of the noninstitutionalized US adult population (Okoro et al. 2018). To help reduce adverse impacts, the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD) established some basic criteria for work zone pedestrian accommodations. These include requirements to maintain “adequate” pedestrian access and walkways during construction, provide advance notice of sidewalk closures, provide barriers that can be detected by visually impaired pedestrians at sidewalk closures, and provide accessibility and detectability for pedestrians with disabilities if the existing route has those features (FHWA 2009).

Noncompliance with MUTCD requirements is widespread and can be observed not only where there is roadway construction but also in utility work zones and at building construction sites (Figure 1). Frequently observed problems range from inconveniences, such as lack of signage in advance of the closure, to evident hazards, such as unfenced open manholes, to long detours that result in fence-jumping near live traffic, as well as standards violations, such as concrete barriers deployed without crashworthy end treatments (Bilton 2012, Shaw et al. 2016). Other effects can be subtle and hard to measure, such as social isolation when people with disabilities are unable to go out as a result of inadequate accommodations (Williams et al. 2013).



(a) Children playing in work activity area  
Peter Amakobe, WisDOT



(b) Open trench demarcated only by tape  
© [User:ŠJů / Wikimedia Commons / CC BY-SA 3.0](#)



(c) Sidewalk closure without advance notice  
WisDOT



(d) Tripping hazard  
John Shaw, used with permission



(e) No pedestrian access to properties  
Peter Amakobe, WisDOT



(f) Transit passengers discharged into closed area  
WisDOT

**Figure 1. Typical pedestrian deficiencies in work zones**

Many roadway, utility, and building construction projects have stakeholder objectives that compete with pedestrian safety (Bilton 2012). Examples include maintaining traffic capacity to limit motorist and pedestrian delays, providing vehicular and pedestrian access to properties

adjacent to the work zone, and limiting the acquisition of rights-of-entry or temporary easements for the use of adjoining private property during construction. Conversely, loss of pedestrian access can have economic impacts on businesses that depend on foot traffic (Attanayake et al. 2017). In addition, conflicts with pedestrian traffic can affect the efficiency and safety of materials deliveries to work areas (CLOCS 2019).

Design guidelines can help manage these conflicts by clarifying expectations for temporary pedestrian facilities, but these expectations need to be established carefully to avoid unintended effects. For example, if the existing right-of-way is narrow and an agency has promulgated a generous minimum width for temporary walkways, this can have the effect of requiring the temporary walkway to be shifted onto adjacent private land, resulting in additional cost and complexity to acquire right-of-entry agreements or temporary easements. Similarly, guidance related to the slope of temporary walkways can influence the width available for traffic lanes. In areas where pedestrian traffic is light, there is often little or no temporary accommodation, perhaps because compliance is perceived to be too costly or complex.

To avoid situations where the perfect is the enemy of the good, two major issues arise. The first is lack of clarity about the differences between the *desirable* characteristics of temporary accommodations (slopes, dimensions, materials, etc.) and those that are *minimally acceptable* for basic pedestrian mobility. The second is that the work zone design guidance that currently exists has often been prepared without the benefit of formal research into pedestrian needs.

## **Existing Guidance**

Due to the risk of falling debris and dropped objects, many cities require walkways to be covered when they adjoin sites where structural demolition or vertical construction is underway. Beyond the MUTCD requirements discussed above, there is very little national guidance on pedestrian accommodations during roadway construction. The main exception is the Public Rights-of-Way Accessibility Guidelines (PROWAG), a draft federal regulation that stalled in the rulemaking process in the early 2010s (U.S. Access Board 2011). Due to this status, the enforceability of PROWAG is uncertain, but many agencies treat it as a recommended practice document.

PROWAG provides very little guidance about temporary situations (Shaw et al. 2018). It is derived mainly from earlier rules developed for architectural site planning and building interiors. The conditions in work zones often differ. For example, commercial building floors frequently have smooth surfaces (vinyl, terrazzo, varnished wood, etc.) that do not provide as much friction as the materials typically used in outdoor applications (concrete, asphalt, etc.). As a result, acceptable slopes and cross slopes could differ in the two environments.

Another significant challenge is that in its current form, PROWAG addresses new construction, while temporary work zone accommodations are usually retrofitted within an existing, space-constrained environment. PROWAG contains language indicating that its requirements can be relaxed for “alterations” of existing facilities, but the magnitude of acceptable relaxations is unclear. A 2007 U.S. Access Board report on alterations in the public right-of-way offers

numerous design suggestions for difficult site conditions but focuses on the post-construction condition (PROWAAAC 2007).

## **Gaps in Guidance and Practice**

In many jurisdictions, both public sector work crews and private contractors seem to struggle to comply with the requirements of the MUTCD and the recommendations in PROWAG. Although this is often attributed to lack of awareness of regulations or to insensitivity to pedestrian needs, even the best-informed and most well-intentioned attempts can fall short of meeting pedestrian needs.

Previous efforts to develop additional design guidance for work zone pedestrian accommodations identified substantial gaps in knowledge and practice (Bilton 2012, Shaw et al. 2016, Attanayake et al. 2017). For instance, the existing MUTCD typical application drawings show methods for detouring pedestrians around a sidewalk closure, but this is often unsatisfactory because pedestrians may seek access to homes and businesses in the closure area. The scale of this problem was documented in a study of five urban work zones in Florida; the study found almost half of all pedestrians violating the work zone closure by crossing mid-block into the closure, walking through the work zone on a closed sidewalk, or entering the work area (Ellis et al. 2008). Similar behaviors were observed in Texas pedestrian closures (Ullman et al. 2007).

These issues are often heightened for pedestrians with disabilities, such as wheelchair users, people with walking or gait difficulties (including people with foot or leg injuries), people with visual impairments (low vision or blindness), and people with cognitive problems such as dementia. The challenge of accommodating pedestrians in work zones is further accentuated by the diversity of sidewalk users. “Pedestrians” comprise not only people on foot but also “pedestrians on wheels,” such as wheelchair users, people pushing baby strollers or tugging wheeled suitcases, and delivery personnel using hand trucks (Jiménez et al. 2018). Work zone deficiencies also present heightened risks for intoxicated pedestrians, particularly near establishments that sell or serve alcohol (Bilton 2012).

Work zone pedestrian risks are affected by factors such as motor vehicle traffic volumes, traffic speed, roadway geometrics, and adjoining land use. Pedestrian exposure (pedestrian volume) varies widely from site to site and by time of day. To date, however, these factors have only rarely been considered in temporary pedestrian design guidance (Bilton 2012).

Due to space and budget constraints, work zone pedestrian accommodation situations often require innovative approaches. Nevertheless, workable solutions, such as using commercial scaffolding systems to vertically separate pedestrians from construction, are often overlooked (Bilton 2012). In part, this could be due to a tendency to leave temporary pedestrian facilities decisions to the discretion of field engineers or contractors (Attanayake et al. 2017), whose options are often further constrained by a lack of suitable bid items in the construction contract (Shaw et al. 2016). For example, resolving problems with a temporary walkway that is excessively dark at night can be difficult if there is no bid item for temporary pedestrian lighting.

In the absence of evidence-based guidance, the designer or builder of temporary pedestrian facilities is often left with little more than conjecture to guide efforts to address these diverse needs. Nevertheless, the designer/builder faces multiple challenges to meet road user needs within the physical constraints of the site and the time and cost constraints for facilities that will be used only briefly. Further, the situation often demands flexibility so that the accommodations can be reconfigured frequently as construction progresses.

## **Work Zone Pedestrian Casualties**

Several groups have attempted to quantify work zone pedestrian casualties based on local, state, or national crash report data (Shaw et al. 2016, Oxley et al. 2018, Ellis et al. 2008, Bhatti et al. 2011, Liljegren 2014). The most recent data from the National Highway Traffic Safety Administration (NHTSA) Fatal Accident Reporting System (FARS) indicates that from 2015 to 2019, an average of **120.4 work zone pedestrian fatalities per year** were reported by law enforcement agencies in the United States. Perhaps 20% of these are workers on foot (mainly flaggers) (Pegula 2013). Based on data from the National Automotive Sampling System General Estimates System (NASS-GES) and Crash Report Sampling System (CRSS), NHTSA *estimates* that a national average of **1,127 nonfatal work zone pedestrian injuries per year** were reported by law enforcement over that time period.

Shaw et al. (2016) analyzed narrative reports for 219 bicycle and pedestrian crashes of all severities that occurred in Wisconsin work zones over a 10-year period (2004–2013). Only 28% of the crash reports contained enough information to determine whether work operations contributed to the crash. Among these, the most common issues were as follows:

- Drivers hitting a worker on foot (usually a flagger)
- Discontinuous or inadequate pedestrian or bicyclist accommodations
- Visual obstructions such as signs, delineation devices, materials, or equipment that interfered with the ability of drivers and pedestrians/bicyclists (or workers) to see each other
- Vehicle intrusions into the work zone

One difficulty with the use of law enforcement crash reports is the underreporting of both pedestrian crashes and work zone crashes (Amoros et al. 2006, Cottrill and Thakuriah 2010, Doggett et al. 2018, Medury et al. 2019, Sayed et al. 2021, Ullman and Scriba 2004, Blackman et al. 2020). Another major difficulty is that law enforcement reports seldom capture pedestrian injuries that do not involve a vehicle, such as slip-and-fall injuries resulting from deficient infrastructure.

Oxley et al. (2018) compared police report data with hospital records for all pedestrian injuries (work zone and non-work zone) in the state of Victoria, Australia, which has a population of approximately 6.7 million. Although 12% of all police-reported road fatalities and serious injuries in Victoria involve pedestrians, police reports were usually prepared only when a pedestrian was struck by a vehicle. Only 85 fall-related incidents were reported in the police data, but pedestrian falls while walking in the road environment accounted for an average of

1,680 hospital admissions and 3,545 emergency department presentations each year. Older pedestrians (age 65+) were significantly overrepresented among fall-related injuries that required hospital admission and had the highest rate of emergency department presentations per distance walked. Bone fractures were common, a concerning finding because fractures often trigger long-term health and mobility declines for elderly patients.

The U.S. Centers for Disease Control and Prevention (CDC) collects data on the number and causes of emergency department visits and hospital admissions in the United States. As shown in Table 1, based on these data, the CDC estimates that in 2010 there were over 210,000 nonfatal pedestrian injuries in the United States, resulting in economic losses totaling over \$11 billion per year (CDC 2021). There are two main cost elements: nearly \$3.7 billion in medical costs (typically borne by insurers, government healthcare programs, and crash victims or their families) and approximately \$6.8 billion in lost income and productivity (typically borne by employers, injured persons, and families). On average, a single nonfatal pedestrian injury results in approximately \$52,000 in losses. (The costs in the CDC’s Web-based Injury Statistics Query and Reporting System [WISQARS] are expressed in 2010 dollars and were adjusted to 2021 dollars based on the Medical Care component of the Consumer Price Index [U.S. Bureau of Labor Statistics 2021]).

**Table 1. Estimated number of nonfatal emergency department visits due to pedestrian injuries, United States, 2010**

<b>Injury Severity</b>	<b>Number of Casualties</b>	<b>Medical Costs</b>	<b>Work Loss Cost (2021 dollars)</b>	<b>Combined Cost (2021 dollars)</b>
Nonfatal pedestrian injury resulting in treatment and release at hospital emergency department	175,885	\$748 million	\$739 million	\$1.487 billion
Nonfatal pedestrian injury resulting in hospital admission	36,574	\$2.996 billion	\$6.555 billion	\$9.551 billion
<b>Total nonfatal injuries</b>	<b>212,459</b>	<b>\$3.744 billion</b>	<b>\$7.924 billion</b>	<b>\$11.037 billion</b>

Data sources: CDC/WISQARS (CDC 2021) and U.S. Bureau of Labor Statistics (2021)

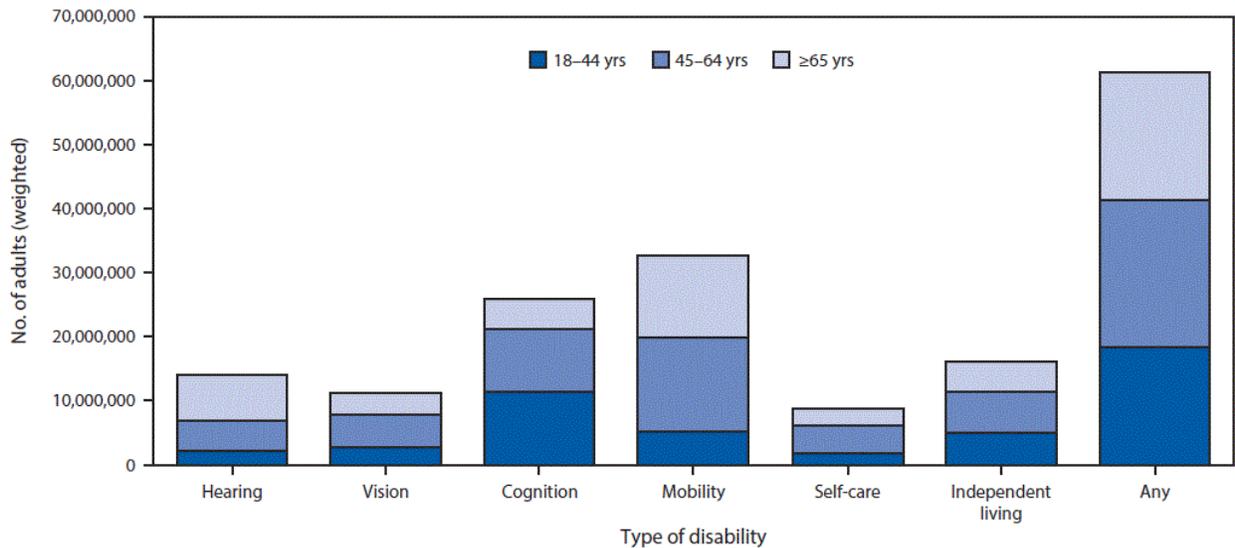
The proportion of nonfatal pedestrian injuries that occur in work zones in the United States is not known. In Sweden, 30% of hospital-reported casualties involving vulnerable road users (pedestrians, bicyclists, moped riders, and motorcyclists) occur in work zones (including winter maintenance zones) (Liljegren 2014). Assuming that 15% of nonfatal US pedestrian casualties occur in work zones, the estimated annual number of nonfatal injuries is **31,900**, resulting in financial losses of approximately **\$1.7 billion**.

### **Sidewalk Users**

The challenge of accommodating pedestrians in work zones is accentuated by the diversity of sidewalk users. “Pedestrians” comprise not only people on foot but also “pedestrians on wheels,”

such as people pushing baby strollers or pulling wheeled suitcases, delivery personnel with hand trucks, and people on skates, skateboards, hoverboards, and so forth (Jiménez et al. 2018).

According to telephone surveys conducted for the CDC, 25.7% of the noninstitutionalized US adult population has some type of disability (Okoro et al. 2018). Mobility (serious difficulty walking or climbing stairs) was the most prevalent disability type (13.7%), followed by cognition (serious difficulty concentrating, remembering, or making decisions, 10.8%), independent living (difficulty doing errands alone, 6.8%), hearing (serious difficulty hearing, 5.9%), vision (serious difficulty seeing, 4.6%), and self-care (difficulty dressing or bathing, 3.7%) (Figure 2).



Okoro et al. 2018

**Figure 2. Estimated number of adults with any disability, by specific type of disability and age group**

Pedestrians with disabilities are diverse: some cannot hear traffic, some cannot see well, and some cannot see at all. Some experience pain, stiffness, shortness of breath, or vertigo while walking. To compensate, some use mobility aids ranging from assistance animals and walkers to manual wheelchairs, electric wheelchairs, scooters, and more. Sensory and cognitive disabilities present an additional set of challenges, such as disorientation when the built environment is altered or distraction from the noise and clutter of a work zone.

Williams et al. (2013) interviewed 30 visually impaired pedestrians (blind people and people with low vision). Some participants had guide dogs, while others used white canes. The two groups differed significantly in their approach to navigation. As one participant explained, “A cane is [for] obstacle detection, a dog is [for] obstacle avoidance.” Some of the participants also used electronic mobility aids designed specifically for visually impaired people, mass-market mobile phone apps such as Apple Maps or Google Maps, or both. Participants reported that they often must find alternate routes to avoid work zones. Even when a visually impaired person is able to pass through the area, loud noise from work operations can be a major problem:

construction noise can drown out the tapping sounds cane users use to assess the conditions ahead and can distract or disorient guide dogs. Electronic navigation aids often lack information about construction zones or provide obsolete information, and the global positioning system (GPS) signal is often lost if a route involves going indoors (e.g., cutting through a building). Visually impaired pedestrians also expressed concerns about unknown hazards in inactive construction sites.

Although it can be difficult to develop nonoverlapping categories of pedestrians with special requirements, a list based loosely on Jiménez et al. (2018) follows:

- Pedestrians without specific use requirements
- Pedestrians with specific requirements related to movement:
  - Pedestrians with wheeled equipment (baby strollers, rolling luggage, hand trucks, etc.)
  - Pedestrians who require extra space to move (carrying packages, assisted by guide dog, physically large people, etc.)
  - Pedestrians with requirements due to stability and support (using crutches, etc.)
  - Pedestrians with specific ergonomic requirements (loss of one hand, etc.)
  - Pedestrians with limited effort capacity (difficulty traveling long distances, difficulty climbing steep grades, etc.)
- Pedestrians with specific requirements related to perception or cognition:
  - Pedestrians requiring extra perception-reaction time
  - Pedestrians with special requirements for identifying route elements (e.g., visually impaired)
  - Pedestrians who have difficulties understanding public spaces (e.g., perceptual or cognitive issues)
  - Pedestrians with special communication requirements (e.g., unable to read text on traffic signs)
  - Pedestrians with special requirements for identifying and understanding potentially dangerous situations (children, people with cognitive disabilities, intoxicated pedestrians, etc.)

## DESIGN PRINCIPLES AND NATIONAL GUIDELINES

### Manual on Uniform Traffic Control Devices

Chapter 6D of the 2009 MUTCD established a basic set of criteria for pedestrian accommodations in work zones (FHWA 2009). The chapter notes that a wide range of pedestrians can be affected by temporary traffic control, including children, elderly people, and people with disabilities. The *regulatory* (mandatory) requirements are as follows:

- The people implementing temporary traffic control that affects pedestrians and workers must be “knowledgeable” (e.g., trained and/or certified).
- Pedestrians must be given advance notice of sidewalk closures.
- “Adequate” pedestrian access and walkways must be provided (the document does not define adequacy).
- If the project affects an *accessible and detectible* pedestrian facility, a comparable level of accessibility and detectability must be provided during construction. In other words, features supporting the mobility of people with disabilities must be maintained during construction. For example, if existing curb ramps have truncated domes at approaches to traffic lanes, truncated domes must also be provided on any alternate route or temporary walkway.
- If a sidewalk that is normally used by visually impaired pedestrians is closed, the barrier must extend across the full width of the sidewalk and be detectible with a long cane.

The MUTCD includes the following nonmandatory *guidance* (recommendations) that seeks to avoid leading pedestrians into conflicts with vehicles, equipment, and work operations:

- Alternate routes should replicate the desirable conditions along the original routes as closely as possible.
- Pedestrian routes should not be closed or discontinued to support nonconstruction activities such as parking.
- Indirection should be avoided and the number of places where pedestrians must cross a street should be minimized, particularly if the traffic volume is high.
- Signs redirecting pedestrians should be placed well in advance so that pedestrians do not need to double back.
- Access to transit stops should be maintained. Alternative transportation such as free bus service can be provided if it is not feasible to provide pedestrian accommodations during construction.

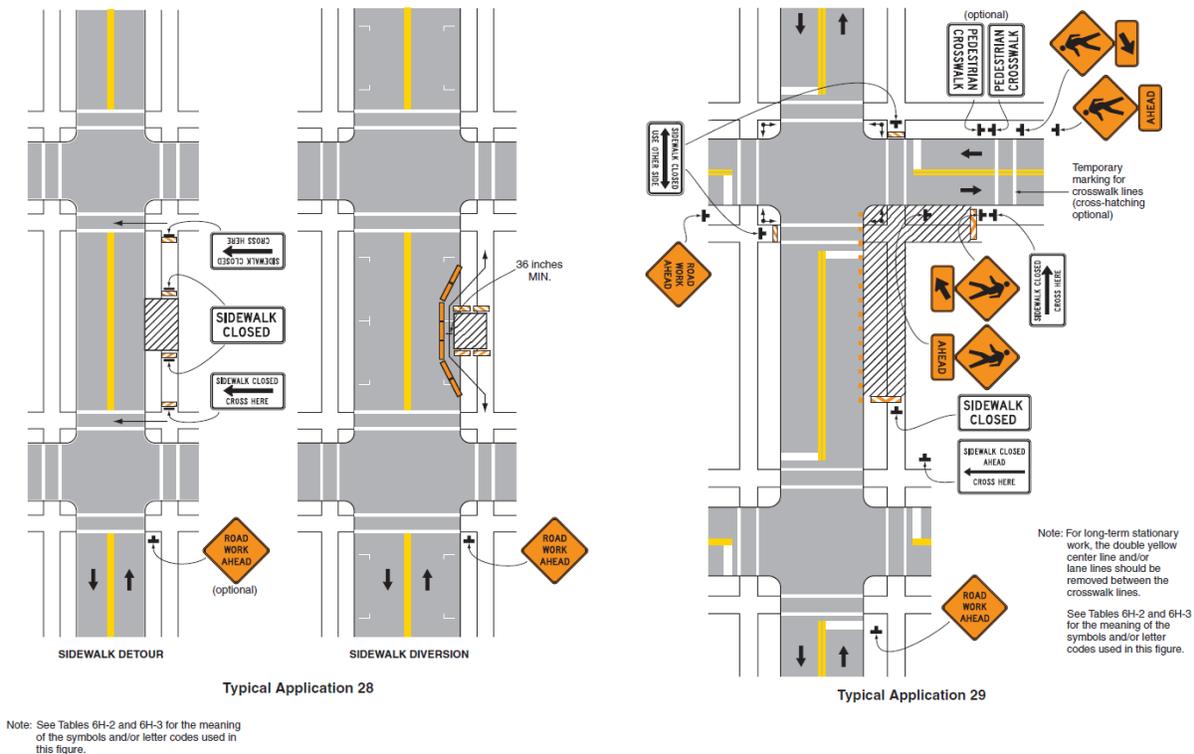
The MUTCD offers the following design *guidance* for temporary walkways:

- “A smooth, continuous hard surface” should be provided.
- No curbs or abrupt changes in grade or terrain should be present that could cause tripping hazards or impair wheelchair use.
- Grades and slopes should meet the requirements of the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities. (This is potentially problematic

because it refers to a standard written primarily for permanent indoor facilities and exterior entranceways for public buildings.)

- The walkway should have a minimum width of 60 inches, or alternatively a 60-inch x 60-inch passing space every 200 feet.
- Channelized pedestrian pathways should be equipped with continuous edging that can be detected with a long cane.
- Signs mounted lower than 7 feet should not project more than 4 inches laterally into an accessible pedestrian facility.
- Signs and audible annunciators should be used to communicate information about blocked routes, alternate crossings, and pedestrian phases of traffic signals.

The 2009 MUTCD encourages pedestrian accommodations to be incorporated into project temporary traffic control plans. Two typical application (TA) drawings are provided (Figure 3). TA-28 illustrates a “sidewalk detour” that diverts pedestrians to the opposite side of the street and a “sidewalk diversion” that utilizes a closed parking lane as the pedestrian pathway. TA-29 is a more elaborate version of the sidewalk detour that provides signage recommendations when the sidewalk closure goes around a corner. In comparison, a French temporary traffic control guidebook issued in 2011 offers 11 typical application drawings for situations that affect pedestrian walkways and incorporates pedestrian traffic management in several TAs that are mainly concerned with motorized traffic (Certu 2011).



FHWA 2009

**Figure 3. Typical Applications 28 and 29 from the 2009 MUTCD**

## **Draft Manual on Uniform Traffic Control Devices 11th Edition**

In December 2020, the Federal Highway Administration issued a notice of proposed rulemaking for the 11th edition of the *Manual on Uniform Traffic Control Devices*. The agency is currently analyzing thousands of comments that were received on the draft.

Although most of the content from the 2009 MUTCD related to nonmotorized road user accommodations in work zones has been retained, the content has been reorganized. In addition, the following notable changes have been proposed:

- The draft standard stipulates that “temporary ramps shall provide a 12:1 (8%) or flatter slope, with a slip-resistant surface. The ramp landing area shall provide a 48-inch x 48-inch minimum area with a 2% or flatter cross slope.” This appears to be stricter than the ADA accessibility guidelines for permanent construction, which allow some flexibility for short ramps or when a 1:12 slope cannot be provided due to site constraints.
- In Typical Application 28, a note has been added stipulating a minimum clear width of 60 inches when a sidewalk is diverted into a closed lane or parking lane. The drawing has also been revised to emphasize the importance of covering rough, soft, or uneven ground.
- New Typical Applications 47 through 51 have been introduced illustrating typical closures for bicycle lanes and mixed-use paths.
- When work operations block a pedestrian path, the draft allows the option of quickly moving out of the way to let a pedestrian through. In addition, workers may help pedestrians get through the work area.
- Guidance has been rephrased to emphasize the need to minimize conflicts between vehicles and pedestrians.
- Guidance has been added emphasizing the need to avoid situations where work equipment backs into pedestrian pathways.
- Dimensions for the top and bottom rails of detectable pedestrian barricades have been standardized.

## **Americans with Disabilities Act**

The ADA is a landmark civil rights law passed in 1990. The law is implemented through a series of design standards and guidelines issued by the U.S. Access Board. Facilities that are open to the public (except certain religious facilities and private clubs) are generally subject to ADA requirements. In general, new facilities must be designed in full compliance with ADA guidelines, while renovated facilities must be upgraded in proportion to the scope of the project.

Several different sets of ADA standards affect transportation projects to different degrees:

- **ADA Accessibility Guidelines (ADAAG).** Originally issued in 1991 and last updated in 2010, these standards primarily focus on architectural projects, i.e., the design and site planning of buildings such as apartments, offices, and shopping centers. The primary

emphasis is on the indoor environment, though some elements of the guidance touch on exterior facilities such as ramps and walkways near building entrances.

- **ABA Standards.** A special version of the ADA guidance, these standards are specific to facilities designed for the U.S. General Services Administration, U.S. Department of Defense, and U.S. Postal Service.
- **ADA Standards for Transportation Facilities.** Published in 2006, this document focuses on the architectural design of airports, bus and train stations, ferry docks, and similar permanent facilities.
- **Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Rights-of-Way (Public Rights-of-Way Accessibility Guidelines, or PROWAG).** Issued in draft form in 2011 by the U.S. Access Board, PROWAG has not been finalized but is often used as interim guidance for the pedestrian design aspects of public streets and highways. The current draft focuses mainly on permanent facilities.

In general, these documents address the dimensions and slope requirements for design elements such as walkways, curb ramps, building access ramps, crosswalks, street furnishings, bus stops, pedestrian signals, and parking spaces. The main requirements of PROWAG are summarized in Table 2.

**Table 2. Selected dimensions and clearances from draft PROWAG guidance**

Design Element	Criteria	Notes	PROWAG Section	
Pedestrian Access Route	Width	Min 4.0' (1.2m)	Median/island: Min 5.0' (1.5m) R302.3	
	Grade	Matching street grade	Where feasible, max 5% R302.5	
	Cross slope	Max 2%	R302.6	
	Surface	Firm, stable, slip resistant	R302.7	
	Vertical discontinuities	Max 0.5" (13 mm)	Beveled with a slope less 50% (0.25' (6.4mm) - 0.5' (13mm)) R302.7.2	
	Horizontal openings	Max 0.5" (13 mm)	R302.7.3	
	Flangeway gaps	Max 2.5" (64 mm)	Nonfreight rail track	R302.7.4
		Max 3.0" (75 mm)	Freight rail track	
Passing spaces	Min (5.0' by 5.0' [1.5 m]) Interval Max 200' (61 m)	Necessary where the clear width is less than 5.0' (1.5 m)	R302.4	
Perpendicular Curb Ramp	Width	Min 4.0' (1.2 m)	R304.5.1	
		Min 3.0' (915 mm)	With handrails (between handrails) R407.4	
	Rise	Max 2.5' (760 mm)	R407.5	
	Grade breaks	Perpendicular to the direction of the ramp	Not permitted on the ramp runs, turning spaces R304.5.2	
	Cross slope	Max 2%	R304.5.3	
	Counter slope	Max 5%	R304.5.4	
	Turning space	Min (4.0' by 4.0' [1.2 m])	Top of the curb ramp R304.2.1	
	Running slope	Min 5%, Max 8.3%	Max ramp length: 150' (4.5 m)	R304.2.2
Running slope (turning space)	Max 2%			
Slope (flared sides)	Max 10%		R304.2.3	

Design Element		Criteria	Notes	PROWAG Section
Parallel Curb Ramp	Width	Min 4.0' (1.2 m)		R304.5.1
		Min 3.0' (915 mm)	With handrails (between handrails)	R407.4
	Rise	Max 2.5' (760 mm)		R407.5
	Grade breaks	Perpendicular to the direction of the ramp	Not permitted on the ramp runs, turning spaces	R304.5.2
	Cross slope	Max 2%		R304.5.3
	Counter slope	Max 5%		R304.5.4
	Turning space	Min 4.0' (1.2 m) by 4.0' (1.2 m)	At the bottom of the curb ramp	R304.3.1
	Running slope	Min 5%, Max 8.3%	Max ramp length: 150' (4.5 m)	R304.3.2
	Running slope (turning space)	Max 2%		
Blended Transitions	Width	Min 4.0' (1.2 m)		R304.5.1
	Grade breaks	Perpendicular to the direction of the ramp	Not permitted on the ramp runs, turning spaces	R304.5.2
	Cross slope	Max 2%		R304.5.3
	Counter slope	Max 5%		R304.5.4
	Running slope	Max 5%		R304.4.1
Transit Stops	Clear length	Min 8.0' (2.4 m)	Perpendicular to the street	R308.1.1.1
	Clear width	Min 5.0' (1.5 m)	Parallel to the street	
	Grade (parallel street)	Same as the street		R308.1.1.2
	Grade (perpendicular street)	Max 2%		
	Surface	Firm, stable, slip resistant		R308.1.3.1
Landings	Slope	Max 2%	Any direction	R407.6.1
	Width	Min the widest ramp		R407.6.2
	Length	Min 5.0' (1.5 m)		R407.6.3
	Direction change	Min 5.0' (1.5 m) by 5.0' (1.5 m)		R407.6.4
	Surface	Firm, stable, slip resistant		R407.7
	Handrails	Required	Rise greater than 6' (1.5 m)	R407.8

“Reasonable accommodation” is a cornerstone of the ADA. This principle requires designers to exercise judgment and balance conflicting requirements, such as trade-offs between different categories of road users (e.g., pedestrians versus bicyclists). In addition, needs may differ for people with different types of disabilities. Many projects also have trade-offs between extending the construction duration to provide better temporary accommodations versus getting permanent accommodations in place quickly.

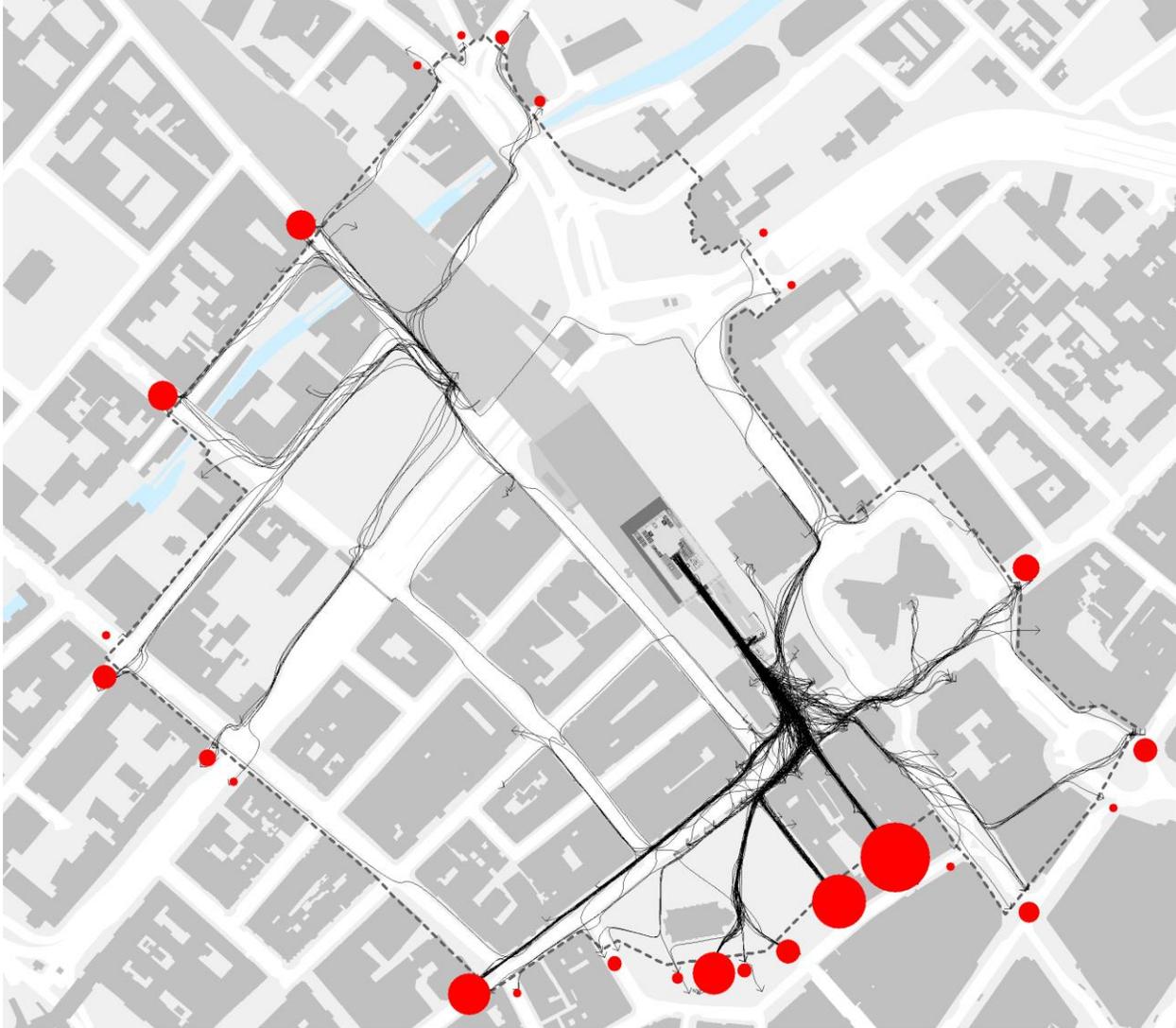
## Space Syntax

Work zones frequently require changes in the way pedestrians are routed through the built environment. This can result in sensory and cognitive challenges for visually impaired people and people with cognitive disabilities (Williams et al. 2013).

Space syntax is a systematic method for analyzing and describing the way people navigate indoor and outdoor spaces, including the way a street or pedestrian pathway interrelates with nearby features of the built environment (van Ness and Yamu 2021). This line of research examines the relationships between the physical configuration of a space and the way people use it. For example, many before-after studies have been conducted to determine how modifications of a pedestrian space reshape patterns of use. In this way, space syntax provides a framework for understanding the social and economic effects of construction-related changes in pedestrian routing and identifying situations that are likely to be problematic.

The results of space syntax research have been used by architects to improve the liveliness of large buildings such as shopping centers, subway stations, and airports. These principles have also been applied to enhance the vitality of parks, plazas, squares, neighborhoods, and commercial districts. For example, in the 1970s many of the plazas at major commercial buildings in New York City were desolate and crime ridden. With modest design changes, these were transformed into popular spaces where pedestrians are at ease (Whyte 1980). Space syntax is also of interest to property managers, as the level of connectivity between pedestrian traffic generators and the ease (or difficulty) of figuring out how to make these connections tends to shape “hot spots” and “dead zones” for retailing, outdoor advertising, and other commercial endeavors. From this perspective, the effects of work zones are not limited to pedestrian safety and mobility; they can also disrupt the quantity and distribution of foot traffic, with potential financial effects on businesses.

Figure 4 is an example of one of the typical products of a space syntax study. In this case, the study area (identified by the dashed black line) is anchored by the Snow Hill commuter rail station in Birmingham, England. Streets and alleys are shown in white, with block boundaries shaded in light grey. Medium-grey shading identifies the location and shape of each building. Solid black lines identify the routes used by pedestrians exiting the station. The number of pedestrian trips is proportionate to the size of the red circles representing each destination. A multitude of overlapping black lines indicate that foot traffic is particularly heavy in the plaza near the station’s main entrance. One implication is that a construction closure near the main entrance would heavily impact commuters, with ripple effects on the shops and restaurants that encircle the plaza. If such a closure is unavoidable, the analysis could also be helpful in identifying alternative routes that are likely to be least objectionable to commuters and business owners.



Maximo Martinez/spacesyntax.com

**Figure 4. Route traces for pedestrians exiting a commuter train station (Snow Hill Station, Birmingham, UK)**

Space syntax practitioners use several methods to determine and analyze pedestrian path choice and the intensity of pedestrian circulation. These include direct on-site observation of pedestrian activities, time-lapse video studies, and (increasingly) data derived from cell phones and other GPS-equipped electronic devices carried by pedestrians (Lakmali et al. 2020). Walking speed is sometimes used as a proxy for pedestrians' level of interest in their surroundings: fast walking can be indicative of disinterest or concerns about personal security in the space.

The concept of *topological depth* is an important theoretical aspect of space syntax. As explained in van Ness and Yamu (2021), a main street has a topological depth of 0, a cross street that can be accessed from the main street has a topological depth of 1, and a back street that can be accessed only from a cross street has a topological depth of 2. This hierarchy can continue as a

street layout becomes increasingly labyrinthine. For instance, a street may have a topological depth of 6 yet be physically very close to the main street with a topological depth of 0.

This concept suggests that humans tend to build relatively simple mental models of the spaces they use (Bafna 2003, van Ness and Yamu 2021). It appears that people tend to think in terms of a major street that serves as the primary axis of circulation, side streets that connect to the major street, and back streets that can be reached only from side streets. Pedestrians are unlikely to follow routes that require branching multiple times, probably because the resulting cognitive complexity increases the fear of getting lost. In other words, actual route choices involve striking a balance between choosing the shortest route and minimizing the number of turns.

Topological depth helps explain some of the pedestrian behaviors observed in work zones. For example, studies indicate strong overall reluctance to use pedestrian detours (Ullman et al. 2007, Ellis et al. 2008). Space syntax suggests that this occurs not only because of the extra distance and travel time but also because of increased route complexity, which could be particularly acute for pedestrians with visual or cognitive disabilities.

## SYSTEMATIC REVIEW OF ACADEMIC LITERATURE

### Methodology

Engineering literature reviews often use a “snowball” search technique. In many cases, an investigator identifies about a dozen studies that are known to be relevant to the topic at hand, and the references cited in these studies are used to identify additional sources. This iterative process continues until the investigator is satisfied that the information is sufficient to satisfy reviewer expectations.

In contrast, a systematic literature review is designed to minimize the risk of overlooking relevant sources by following a predefined process for locating, compiling, evaluating, and synthesizing the relevant evidence for the topic of interest. Although not entirely new, the systematic review process was formalized in the 1970s to help ensure that medical practice is based on the best available scientific evidence. Over time, the systematic review process has gradually been adopted in other fields such as the social sciences, public policy, and (increasingly) engineering.

The systematic review process supports developing a full understanding of what is already known about the topic and can help identify knowledge gaps. The process typically encompasses five main steps (Khan et al. 2003):

1. Framing questions for a review (defining the research question, determining search terms, and identifying relevant databases)
2. Identifying relevant publications (retrieving, winnowing, and compiling primary studies)
3. Assessing the quality of the studies
4. Summarizing the evidence
5. Interpreting the findings

Due to the labor-intensive nature of the systematic review process, it is important to avoid duplication of effort. To this end, five databases of systematic reviews were searched to identify any previous systematic reviews related to pedestrian safety in work zones. As shown in Table 3, none were found.

**Table 3. Search matrix for previous systematic reviews**

<b>Search Term</b>	<b>Campbell Collaboration</b>	<b>CDC Community Guide</b>	<b>Cochrane Library</b>	<b>Google Scholar</b>	<b>Prospero Registry</b>
footpath OR footway OR “pedestrian pavement” OR sidewalk OR walkway	NR	NR	NR	NR	NR
“pedestrian safety” AND roadworks	NR	NR	NR	NR	NR
“pedestrian safety” AND “work zone”	NR	NR	NR	NR	NR

NR: No results or results not relevant

As shown in Table 4, seven engineering-oriented scholarly databases were searched to identify studies related to pedestrian safety and mobility in work zones. The corresponding search terms are also listed. Since the various search engines handle wildcards in different ways, variations of the search terms were required, as indicated in the table. All publication types were eligible for inclusion, such as studies, conference papers, and research reports published in English (including reports published in other languages with sufficiently detailed summaries in English).

**Table 4. Search matrix for systematic review: search terms and databases**

Search Term	Database						
	SafetyLit	TRID	Ebsco Host Academic Search Ultimate	Google Scholar	PubMed	Web of Science	Science Direct (Elsevier)
(blind OR disabled OR disability OR disabilities OR handicapped OR low vision) AND (roadwork OR roadworks OR work zone) AND (accident OR casualty OR crash OR incident OR mobility OR safety) NOT "blind spot"	NR		NR	NR	Manually selected from unfocused results		
(blind OR disabled) AND (roadworks OR work zone) AND (accident OR casualty OR crash OR safety)						UR	UR
(pedestrian OR vulnerable road user) AND (roadwork OR roadworks OR work zone) AND (accident OR casualty OR crash OR incident OR mobility OR safety)	✓		NR	NR	Manually selected from unfocused results		
(pedestrian OR vulnerable road user) AND (roadworks OR work zone) AND (accident OR casualty OR crash OR safety)						UR	UR
roadworks non-motorised safety		NR					
roadworks non-motorized safety		NR					
roadworks pedestrian safety		NR					
work zone "vulnerable road user" safety		✓					
work zone non-motorized safety		✓					
work zone pedestrian safety		UR					
"work zone pedestrian safety"		NR					
"work zone" "pedestrian safety"		✓					

**Legend**

✓	Search completed
NR	No results or results not relevant
UR	Unfocused results (not usable due to excessive number of off-topic results)

A handful of work zone pedestrian safety and mobility studies were conducted in the 1980s, 1990s, and early 2000s, and the results of this early work were summarized by Morelli et al. (2005). Therefore, the present review was limited to publications since 2004. This is the year the federal Work Zone Safety and Mobility Rule was published and provides some overlap to catch any studies that were in press at the time of the review conducted by Morelli et al. (2005).

## Search Results

As shown in Table 5, searches of the seven databases yielded a total of 91 papers and reports, of which 14 were excluded as duplicates. Title and abstract screening was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach (PRISMA 2021) on the remaining 77 studies using the inclusion and exclusion criteria shown in Table 6 and Table 7. A total of 54 studies were eliminated through this process. This left 23 studies that were eligible for full-text screening. Based on the full-text screening, 14 studies were excluded, leaving 9 studies suitable for extraction. Five of the studies excluded during full-text screening were not specific to pedestrians, three provided only casualty prevalence information without any design recommendations, two were not specific to work zones, and two are addressed in the grey literature chapter of this report. One reference included only the project description, with no discussion of its results, and full text could not be obtained for one reference.

**Table 5. PRISMA statistics**

91 references imported for screening
14 duplicates removed
77 studies screened against title and abstract
54 studies irrelevant
23 studies assessed for full-text eligibility
14 studies excluded
5 not specific to pedestrians
3 incidence or prevalence of work zone casualties; no design recommendations
2 included as grey literature (see next chapter)
2 not specific to work zones
1 description of project only; no results provided
1 unable to obtain full text
9 studies included

**Table 6. Study inclusion criteria**

<b>Inclusion Criteria</b>
Pedestrian or vulnerable road user safety in work zones
Publication date 2004 or later

**Table 7. Study exclusion criteria**

<b>Exclusion Criteria</b>
Not related to pedestrian safety in work zones
Not specific to pedestrians
Incidence or prevalence of pedestrian casualties in work zones without design or policy guidance
Incidence or prevalence of road worker casualties
Personal protective equipment for road workers
Summary articles / nontechnical publications
Driving simulator studies and other computer simulations
Bicycling (only)

## **Systematic Review Results**

### *Early Publications*

**Morelli et al. (2005)** summarized the results of the few studies on pedestrian safety and mobility in work zones that were published in the 1980s, 1990s, and early 2000s. The main points are as follows:

- Researchers documented the work zone guidance and practices that were prevalent at the national, state, and local levels in the 1970s to 1990s. Findings were based on techniques such as design manual reviews, interviews with public officials, and site visits. In general, the agency documents, practices, and attitudes prevalent at that time focused almost exclusively on motorized traffic. Lack of concern for pedestrians was consistent across roadway, utility, and public works projects, as well as building construction sites. Many officials believed that pedestrians were rare in their work zones, but field observations showed the opposite: pedestrians were present at almost every site. Lack of awareness and empathy for pedestrian needs was particularly acute at the local government level.
- Pedestrian accommodations were usually provided only in urban areas, primarily at sites where there were perceived problems with pedestrian volume or safety. Often the main motivation for accommodating pedestrians was to protect the contractor or developer from legal liability for pedestrian injuries. The selection and placement of temporary traffic control devices was based primarily on the judgment of construction supervisors and was highly inconsistent from site to site. There were wide variations in the size, color, material, and placement of pedestrian signs and other temporary traffic control devices. Where delineation was provided between pedestrian facilities and traffic lanes or work areas, it was often in the form of cones, drums, or barricades, which were sometimes connected by tape or rope. There was very little awareness of the needs of pedestrians with disabilities, and very little guidance was available to practitioners, except in a few progressive cities.
- Specific problems observed in the field included the following:

- Partial blockages or closures of sidewalks and other pathways with no alternate routes identified or adequate information provided
  - Improperly placed traffic control devices (signs, barriers, and separators) that created hazards and tended to confuse both pedestrians and motorists
  - Inconsistent techniques between different sites and even between different areas on the same site
  - Failure of construction managers to modify techniques to meet changes in work zone environments over time
  - Inadequate consideration of the needs of pedestrians with disabilities, children, parents pushing strollers, or indeed anyone who was not a healthy young adult
  - Heavy equipment parked unnecessarily on sidewalks
- Although the state of the practice was generally poor, there were bright spots. In some cities, progressive building codes, building permit processes, design manuals, or specifications provided actionable and enforceable guidance for pedestrian traffic management during construction. In addition, some communities had (or were beginning to develop) methods for good coordination between state and local agencies and between engineers, law enforcement, and contractors.

The results of these early studies were influential in shaping the policy and guidance now provided in the *Manual on Uniform Traffic Control Devices*.

By the early 2000s, some work zone pedestrian accommodation guidance was available, including a set of recommendations in the 2003 MUTCD. Agency surveys and field visits conducted by Morelli et al. (2005) found that the implementation of this guidance was spotty, selective, and inconsistent. Nevertheless, the situation appeared to be improving, with about half of the 50 field sites rated “good” or “very good.”

#### *Work Zone Pedestrian Deficiencies and Recommended Solutions*

**Ullman et al. (2007)** investigated several aspects of work zone pedestrian traffic management. The components of the study were as follows:

- **Survey of current practices.** Telephone interviews were conducted with transportation engineers in 23 Texas Department of Transportation (TxDOT) districts, transportation engineers from other state departments of transportation (DOTs), and traffic engineers from several Texas cities. The engineers generally stated that pedestrian accommodation needs were rare in their projects, except in urban or downtown areas, near schools, or near traffic signals. Only a minority of the respondents felt there was a need for additional pedestrian design guidance.
- **Field evaluation of pedestrian traffic control strategies.** Direct observation and video recordings were used to study pedestrian behavior at an unspecified number of pedestrian closures within Austin and Houston. In the absence of physical barricades to impede travel or

a clear description of the appropriate path to take through the construction area, pedestrians felt free to walk around signs and through the work zone to make their way to their chosen destination. Pedestrians typically proceeded as normal until coming upon a barrier that impeded their progress, such as a traffic control device, vehicular traffic, or construction equipment. Pedestrians then adjusted their route enough to travel around the barrier while still proceeding toward their desired destination.

- **Pedestrian guidelines checklist.** The researchers developed a checklist to help designers identify the pedestrian accommodations required during construction. The guideline utilized a four-stage design process: determining site conditions and constraints, determining whether the final permanent pedestrian accommodations are complete in terms of the elements required for accessibility, determining the pedestrian accommodations to be included in the temporary traffic control plan, and conducting field reviews to ensure the adequacy of the temporary accommodations during construction. The guideline was published as a standalone document.
- **Pedestrian signing evaluation.** This element of the project evaluated road user comprehension of eight traffic sign faces intended for pedestrian closures, detours, and wayfinding. While waiting for services at Texas driver licensing offices, a total of 668 participants completed a computer-based survey to assess their sign comprehension and likely actions after seeing each sign.
  - Six text-based signs with variations of the messages SIDEWALK CLOSED USE OTHER SIDE and SIDEWALK CLOSED CROSS HERE were tested. All had comprehension rates of 85% or higher.
  - Two versions of a SIDEWALK CLOSED sign with a graphic of a walking person and an arrow pointing to the left were tested. The comprehension rates were 74% and 80%. Follow-up discussions with participants indicated that the action the pedestrian was expected to take was unclear. The sign was not recommended for use.
  - Distances on pedestrian signs were recommended to be expressed in blocks, with distances in feet as a fallback for areas where blocks are not an appropriate metric.
  - Sign color did not affect comprehension of the messages, but intent to comply improved when the signs were presented in black-on-orange compared to the previous black-on-white designs. Orange was recommended to better distinguish the work zone signs from permanent signage.
  - Sign shape (diamond versus rectangle) did not affect comprehension. Road users did not have difficulty distinguishing signs intended for pedestrians from those intended for motorists.
- **Wayfinding aids for visually impaired pedestrians.** This element of the project was also published as a standalone research paper and is described in a subsequent section of this review. See Ullman and Trout (2009).

**Ellis et al. (2008)** conducted video observations of 1,052 pedestrians in five urban work zones in Florida. About 52% of pedestrians complied with the closure by using the crosswalk to detour

around the work zone or taking another alternate route. The remaining 48% violated the work zone closure, either by crossing into the closure mid-block, walking through the work zone on a closed sidewalk, entering the work area, or walking in a vehicular lane. The behavior of bicyclists was broadly similar.

Ellis et al. (2008) observed 66 conflicts where a vehicle had to reduce speed to avoid a pedestrian, a pedestrian had to run to avoid a car, a pedestrian became trapped in the median of the coned-off area, or a driver did not see a pedestrian.

Ellis et al. (2008) recommended changes to the Florida DOT (FDOT) guidance, such as the inclusion of a standard detail drawing for temporary mid-block pedestrian crossings and temporary mid-block bicycle crossings, as well as the provision of a double ramp for bridging over missing sidewalk slabs or places where hoses, cables, or wires need to cross an existing sidewalk. The group also recommended further study of work zone design requirements near transit stops.

**Bilton (2012)** offered personal observations of some pedestrian traffic management challenges resulting from major urban construction projects in the state of Queensland, Australia. Bilton (2012) noted that there was very little existing design guidance for temporary pedestrian facilities and that existing design approaches do not take into consideration the variations in risk arising from differences in pedestrian and vehicular traffic volumes, traffic speeds, road design, land use, and similar factors.

Bilton (2012) described conflicting stakeholder interests that can compromise pedestrian safety during construction, such as the desire to avoid using land outside the transportation right-of-way, the desire to maintain high traffic capacity and high operational speeds, and conflicts at driveways and other access points. In Bilton's (2012) view, these conflicts were not being managed in a manner consistent with the Safe System approach described in a subsequent section of this report.

Bilton (2012) noted that even without construction, there are problems with illegal and unsafe pedestrian behavior, especially in tourism, entertainment, and student areas. Bilton (2012) hinted that it was naïve for agencies to assume such behavior would not occur during construction.

Bilton (2012) advocated limited, judicious use of barriers in urban work zones due to the potential for pedestrians to climb over the barriers to avoid indirect routes or to walk on top of the barriers for amusement. The crash tests for concrete barrier systems are based on mainline freeway or highway applications, and Bilton (2012) noted the uncertainty of the barriers' safety performance when relatively short barrier runs are used as channelizers to separate pedestrian and motor vehicle traffic in urban work zones. Additionally, Bilton (2012) noted that crashworthy end treatments are seldom provided when barriers are used on urban streets, it is often infeasible to provide the minimum length stipulated in crash tests, and there is seldom sufficient working width for deflection of the barrier when it is struck.

Bilton (2012) called for quantitative research in several areas. These included pedestrian risks and risk factors, appropriate speeds for work zones with high pedestrian volumes, the effects of adjoining land use on pedestrian needs and behavior, maximum tolerable pedestrian detour distances, the safety effects of using temporary barriers as channelizers in environments with many cross streets and driveways, the effects of wayfinding signage on pedestrian route choice, pedestrian lighting for work zones including its relationships to crime prevention, and the use of temporary overpasses or similar structures to accommodate pedestrians.

**Shaw et al. (2016)** identified several common problems based on crash reports, practitioner interviews, road user complaints published online, and other grey literature (described in the following chapter). The main issues (Figure 1) included the following:

- **No alternative route.** A pedestrian route is closed or restricted, but no temporary accommodation or alternate route is provided.
- **Unmarked or poorly marked closures.** A pedestrian facility closure is unmarked or is marked only with a drum, nondetectable barricade, caution tape, rope, or similar methods. As a result of temporary signage deficiencies, pedestrians are sometimes directed toward a closed walkway or into a live motor vehicle lane.
- **Lack of separation between bystanders and work areas.** Children or other pedestrians can freely enter areas where construction equipment is in operation or where the surface is unsuitable for walking.
- **Open manholes, open trenches, and other falling hazards.** No fences or railings are in place to isolate pedestrians from open manholes, uncovered electrical boxes, open trenches, holes, and so forth. Frequently, such a hazard is delineated only with rope or caution tape, rendering it undetectable to people with visual impairments.
- **Tripping hazards.** Objects such as loose electrical cables, hoses, tools, or construction materials are present on the walking surface. This category includes material stockpiles that spill over to the sidewalk and can also include debris.
- **Inadequate lighting.** Nighttime illumination is inadequate for safe pedestrian circulation or safe motorist observation of pedestrians, due to either low overall illumination levels or uneven light distribution and the resulting glare. For example, Shaw et al. (2016) included a photograph of a work zone where a single high-intensity luminaire was used to illuminate a crosswalk; the lighting was extremely bright in one corner of the intersection and extremely dark in the opposite corner.

Agencies in the United States often leave the layout of temporary pedestrian and bicyclist (ped/bike) accommodations to the discretion of inspectors, field engineers, or other construction staff. Based on discussions with such personnel, Shaw et al. (2016) identified several difficulties arising from this practice:

- **Lack of options.** After a construction contract has been awarded, options for managing ped/bike traffic are generally quite limited. Often, temporary accommodations that would have been feasible if considered during the design phase are no longer achievable due to timing or administrative constraints.

- **Staffing constraints.** Field staff may or may not have the skills necessary to design safe, efficient interim ped/bike accommodations. Even when field personnel have appropriate expertise, designing the accommodations takes time away from construction oversight and contract management, which are typically their primary duties.
- **Land acquisition.** Temporary easements necessary to locate interim ped/bike facilities on private property might not have been obtained.
- **No appropriate bid items.** The contract might not include the bid items necessary for building temporary or interim ped/bike facilities. This can potentially result in substitution of contractual bid items intended for permanent use, resulting in unnecessary expense. In the extreme case, the contractually available materials may be too durable and additional costs may be incurred to demolish temporary facilities that were used for only a short time.
- **Inconsistency with contractor expectations or expertise.** The contractor might not be expecting to build temporary ped/bike facilities. Consequently, equipment and personnel appropriate to the task might not be readily available, resulting in costly change orders.

Shaw et al. (2016) proposed several methods for addressing these challenges:

- **Traffic control devices and products.** Commercial products that address some of the frequently encountered pedestrian situations are available. For example, more widespread use of lightweight portable fences could help channelize pedestrian traffic, separate pedestrians from active work areas, and keep nonmotorized users away from trenches and open manholes.
- **Low-cost surfacing options.** In private conversations, highway agency officials expressed concerns about the cost of temporary surfacing for ped/bike accommodations. Often, this appeared to reflect the assumption that surfacing would be done in asphalt or concrete. To address this, Shaw et al. (2016) suggested alternatives such as reusable textured plastic panels placed over grass or dirt for a limited duration, textured plywood panels, stabilized soil/cement, soil/polymer, or controlled low-strength material (CLSM), a concrete-like mixture that provides a firm surface but can be removed easily.
- **Minimally invasive construction techniques.** Shaw et al. (2016) suggested wider use of construction techniques that reduce the need for trenching to reduce impacts on bike/ped facilities. One example is the “core and vac” technique for utility repairs, which involves sawing out a circular piece of pavement (up to 2 feet in diameter) and vacuuming up the soil using the same apparatus typically used for cleaning storm drain inlets. After utility repairs are completed, the soil is replaced and the original pavement circle is grouted back at its original location.
- **Process changes.** Shaw et al. (2016) suggested that moving the layout of ped/bike accommodations into the project design phase could be advantageous. Solutions that require the temporary use of private property are generally more feasible when there is ample time to acquire temporary easements. Similarly, the staging (sequencing) of pedestrian and bicycle facility construction could be integrated into the overall project staging plan to minimize ped/bike impacts. Traditionally, sidewalks have often been constructed as the final stage of a project, but in some cases it might be preferable to invert the sequence, i.e. constructing the permanent sidewalk on a new alignment at the beginning of the project.

- **Creative Use of Alternate Access.** Shaw et al. (2016) suggested reconsideration of the way access to properties is provided during construction. For example, many older commercial districts have zero setback and narrow sidewalks that immediately abut the roadway, leaving little space for rerouting pedestrian traffic. If the area has an alley behind the properties, temporary pedestrian access could be provided from the alley. To support this, alley improvements such as drainage upgrades and resurfacing could be completed prior to the main construction activities (Figure 5).
- **Temporary Pedestrian and Bicyclist Lighting.** Many pedestrian and bicyclist crashes occur during low-light conditions, and permanent street and highway lighting systems are sometimes taken out of service during construction. The use of temporary lighting systems could enhance ped/bike safety, particularly in commercial and nightlife areas.



Shaw et al. 2018

**Figure 5. Conversion of alley to shared-use facility providing back door access during construction**

**Attanayake et al. (2017)** prepared a detailed report describing difficulties with existing practices for nonmotorized traffic management in work zones and an overview of some potential solutions. The report was also summarized in poster format (Mazumder et al. 2017). Based on a comparison of current work zone practices in the United States and western Europe, both documents discussed some of the difficulties that occur when pedestrian traffic management is left to the discretion of the contractor. The authors noted that “sidewalks and streets are [often] completely closed without providing alternate routes within or around construction zones. As a result, safety and accessibility of the pedestrians and cyclists are compromised.”

Attanayake et al. (2017) gathered case examples and provided good-practice overviews of several techniques for managing nonmotorized mobility during construction. For example, the report discusses various trenchless construction technologies, greater use of prefabrication, and accelerated bridge construction in the context of reducing the physical extent and duration of pedestrian impacts. Formal assessment tools such as a work zone mobility management framework and pedestrian level of service (LOS) analysis are also discussed. The authors also conducted a survey of traffic engineers from cities they considered to be pedestrian mobility leaders, but there were only eight responses.

Attanayake et al. (2017) compared US and European pedestrian traffic management practices. One particularly striking difference was the frequent use of fences to separate pedestrians from work areas in European work zones, a point also raised by Shaw et al. (2018). Shaw et al. (2018) listed several types of work zone fences and highlighted the lightweight interlocking three 1-meter (39-inch) tall fence panels that are widely used in Australia, New Zealand, and the United Kingdom (Figure 6). Attanayake et al. (2017) favored the use of 4-foot-tall metal fences for the separation of pedestrians and work areas (Figure 7).



[user:Ingolfson](#) / [Wikimedia Commons](#) / Public Domain

**Figure 6. Portable 39-inch-tall fence**



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**Figure 7. Four-foot-tall temporary fence**

In addition to tall fences, specific suggestions in Attanayake et al. (2017) (listed from most desirable to least desirable) included temporary crosswalks based on a Minnesota DOT (MnDOT) typical application drawing, covered walkways to protect pedestrians from falling objects at vertical construction sites, temporary pedestrian pathways on repurposed bike lanes or traffic lanes, narrowing traffic lanes to provide space for an on-street pedestrian pathway, and temporary bridges. Pedestrian detours were suggested as the least desirable option.

As noted earlier, Bilton (2012) suggested the use of commercial scaffolding systems to allow vertical separation of pedestrians and work activities or motorized traffic. This requires stairways in most cases. Attanayake et al. (2017) favored the use of electric stair lifts to allow people with disabilities to make use of these separations. The group also suggested developing a pedestrian traffic management manual oriented toward small contractors and small municipalities.

**Foster-Smith et al. (2018)** presented a conference paper discussing vulnerable road user guidelines developed in response to major construction activities in Melbourne, Australia. According to the abstract, the paper provides background on the current issues being experienced in practice, legislation, and the guidelines that were developed. The full text of the paper could not be obtained, so it was excluded from this review.

### *Tools for Visually Impaired Pedestrians in Work Zones*

**Ullman et al. (2007)** and **Ullman and Trout (2009)** noted that work zones are challenging for visually impaired pedestrians because familiar landmarks used as wayfinding aids are often disrupted. The 2009 MUTCD supports the use of audible annunciators to provide navigational information to visually impaired pedestrians but provides very little implementation guidance. Previous research on the way visually impaired pedestrians navigate indicates that if messages are long or complex, listeners “load shed” and focus on only the items they perceive to be the most important.

To assess how visually impaired people use and remember work zone audio messages, Ullman and Trout (2009) conducted a laboratory survey and a field test of recorded audio messages in a mock work zone. A total of 15 messages were tested in the laboratory covering three scenarios: alternate route on opposite sidewalk, alternate route in the roadway, and warning messages. The laboratory testing involved 50 visually impaired participants. In the field tests, message characteristics were refined through field testing with seven visually impaired people, who used work zone annunciators to listen to prerecorded messages while walking through a mock work zone.

A few of the main findings were as follows:

- Message wording should be as clear and simple as possible.
- It is critical that an alternate-route message clearly state that the path will lead the pedestrian to the sidewalk on the opposite side of the street.
- Critical message elements for navigation of alternate routes were the initial turning or crossing instruction and the distance that pedestrians would need to continue on that path.
- The existence of a large number of driveways can affect the ability of the visually impaired to count the number of blocks they have traveled; this should be considered when alternate routes are established.
- Information overload is a concern, and certain message elements appear to have a disproportionate impact on recall. For example, participants struggled when distances were expressed in feet. When distances expressed in blocks or the number of intersections, participants were more likely to understand the distance and could devote more of their attention to other aspects of the message.
- While it is important to provide warning messages about features for the visually impaired walking through or near a work area, it is critical to state clearly that the path is available (i.e., “sidewalk is open”).

**Liao (2014)** developed a prototype smartphone application (app) to provide work zone navigation information to visually impaired pedestrians. Based on a survey of 10 visually impaired people, Liao (2014) recommended the electronic transmission of four data elements through audio messages that would be played by the app:

1. Brief announcement to get the pedestrian's attention, e.g., "Attention eastbound Washington Avenue pedestrians."
2. Location of pedestrian, e.g., "You are at southeast corner of Washington and Church."
3. What and/or where (such as accessible path availability and construction duration), e.g., "Road construction on Washington from Church Street to Huron for 7 blocks."
4. Advisory action, e.g., "Protected pedestrian path open on this side."

Liao (2014) designed the app to run as a background service on an Android phone. The phone's GPS was used in combination with Bluetooth beacons installed near the work zone to trigger a navigational message specific to each quadrant of the intersection. The locational triggers were used to activate a text-to-speech algorithm that read the appropriate navigational advice aloud.

Functionality testing and system validation of the smartphone app were performed by attaching four Bluetooth beacons to light posts near a construction site in St. Paul, Minnesota. A research student carried the smartphone with the app and walked around the test sites repeatedly from different directions to validate the audible messages, Bluetooth communication, and other user interfaces. The app was not tested by visually impaired road users.

**Qin et al. (2018)** observed that the pedestrian network is dynamic and in a constant state of change. Temporary obstructions, construction detours, surface irregularities, and other mobility barriers make it difficult for individuals with a mobility impairment or vision impairment to use pedestrian infrastructure. To make navigation easier for people with disabilities, the authors suggested providing information about transient and permanent navigation obstacles through accessibility mapping systems.

Sidewalk closures and other sidewalk deficiency data could potentially be obtained through crowdsourced geospatial data collection applications that operate on mobile phones, similar to the commercial Fix311 and SeeClickFix apps already in use in some municipalities. Data could be disseminated to visually impaired users through integration with existing research tools or possibly through further development of the commercial "talking GPS" products marketed to visually impaired people. A key prerequisite is a highly detailed basemap of the existing pedestrian infrastructure.

Currently, the process for identifying and prioritizing sidewalk repairs is usually informal and ad hoc, potentially leading to suboptimal use of resources. To address this issue, Qin et al. (2018) proposed analytical approaches that can assist public works and transportation departments with prioritizing efforts to correct pedestrian infrastructure deficiencies. For example, data from mobile apps could be used to estimate pedestrian volumes in a prioritization algorithm. Based on an implicit assumption that sidewalk repairs are independent of street repairs, the authors then

derived logic for area-wide optimization of a sidewalk capital improvement program, subject to budget constraints.

### **Risk of Bias (Quality of Studies)**

Cochrane Training (2021) defines *bias* as a systematic error or deviation from the truth in study results. Biases can arise for various reasons, including the actions of primary study investigators, conflicts of interest, or unavoidable constraints on the way research is conducted. Bias differs from imprecision (i.e., lack of clear outcomes) and lack of external validity (i.e., difficulty generalizing the results of a study to a broader set of situations). In recent years, study quality assessments have tended to focus on elements of study design that lead to a *risk* of bias rather than claiming with certainty that a specific study is (or is not) biased.

Methodologies that can potentially be applied to evaluate the suitability of work zone pedestrian solutions include the following:

- Pedestrian surveys or focus groups (including consultations with people with disabilities)
- Direct observation of conflicts between motorized and nonmotorized road users (treating conflicts as surrogate measures of safety)
- Before-after studies that compare pedestrian mobility and safety outcomes prior to and after implementation of a new feature or design approach
- Paired comparisons of similar work zones (or similar parts of the same work zone) where different design solutions have been applied
- Randomized control trials where different solutions are applied in work zones that are otherwise similar in terms of design and traffic characteristics, for instance, when a program of similar pedestrian improvements is completed citywide

The ergonomics of interactions between pedestrians and temporary pedestrian infrastructure are integral to fall prevention and pedestrian comfort, particularly for pedestrians with disabilities. Studies of surfacing materials, ramps, handrails, vertical transition details, and similar design elements could be conducted through test track studies or mock work zones. Surprisingly, the Ullman and Trout (2009) study of wayfinding aids for visually impaired pedestrians appears to be the only previous example of this study design in the work zone pedestrian safety domain.

Systematic searches were conducted using seven electronic databases to identify peer-reviewed publications published from 2004 to mid-2021 related to pedestrian safety in work zones. Since the focus of the present systematic review is temporary pedestrian facilities design, studies reporting only crash prevalence were excluded.

Only a handful of studies meeting the inclusion criteria were found. These included only five studies that addressed the general design of pedestrian accommodations in work zones, along with three on the subject of navigational aids for visually impaired pedestrians.

Although numerous quantitative study approaches are possible (as described above), most of the research conducted to date has been *qualitative* and many of the findings have been subjective. Some publications lacked clearly defined study goals, and metrics for assessing success were rare. In most cases, only a small number of sites were included, which precludes randomization of treatment options. Together, these factors contribute to a high risk of bias in the reported results.

Several publications focus on shortcomings of the state of practice. Some of the academic publications (and most of the grey literature described in the next chapter) offer design or administrative solutions intended to address known problems. In some cases, it is unclear how the solutions were derived from the problems. Moreover, there do not appear to have been any formal evaluations of the effectiveness of these solutions in meeting pedestrian safety and mobility goals. For example, none of the studies found by the systematic literature search included follow-up evaluations of the success of the recommended design solutions under field conditions.

Much of the research sidesteps potential trade-offs between pedestrian *mobility* in work zones and pedestrian *safety* in work zones. Although some situations impact both mobility and safety negatively, there could also be situations where road users deem the work zone so unsafe that pedestrian trips are shifted to other modes or suppressed entirely. This can lead to a perception that pedestrian safety is not a problem, because there are no pedestrians. The almost universal lack of pedestrian volume data makes it nearly impossible to control for the effects of exposure on work zone safety outcomes.

Taken as a whole, the evidence base for work zone pedestrian safety interventions is very limited, and the effectiveness of proposed solutions is largely untested. Nearly all of the studies that have been completed lack the scale necessary to produce quantitative results. Together, these factors suggest that the funding allocated to pedestrian work zone safety research has been sparse.

### **Synthesis of Systematic Review Findings**

The available studies of pedestrian safety in work zones are few in number and small in scale. As a result, the methodologies lack the robustness that would be expected for a subject that affects the health and wellbeing of millions of people each year.

A substantial portion of the research literature (largely excluded from the present review) focuses on enumerating pedestrian casualties in work zones. Although the number of fatalities is relatively small compared to the fatalities associated with problems such as speeding, intoxicated driving, and nonuse of seatbelts, the fatality statistics alone do not tell the whole story. Based on the work done by Oxley et al. (2018) and the statistical data from CDC's WISQARS system, it is likely that slip-and-fall injuries in work zones result in billions of dollars of medical expenses and lost work each year.

Several authors identify and categorize the pedestrian accommodation deficiencies based on field experience, public complaints, crash reports, and similar sources. These findings suggest widespread deficiencies but carry a risk of bias due to the subjective nature of the reporting. With the exception of one early study, none of the research makes use of systematic inspections to quantify the frequency or severity of various deficiency types. Rigorous evaluations could help establish policy and enforcement priorities.

There has also been a small amount of research on various electronic technologies for communicating work zone navigation information to visually impaired pedestrians. With the exception of annunciators that play a prerecorded message at the push of a button, these solutions are in the early stages of technical development. No comparable research has been conducted for other types of disabilities.

Several authors have proposed pedestrian design solutions aimed at helping resolve the deficiencies encountered in the field. The resulting documents span a wide range of techniques and topics, such as pedestrian fencing, traffic channelization, temporary walkway surfacing materials, dimensions and slopes for curb ramps, temporary railings, temporary lighting, altering the sequencing of construction activities to reduce pedestrian impacts, and making use of less invasive construction techniques to reduce impacts or shorten their duration. In many cases, the studies have influenced standards, guidelines, and recommended practices. Nevertheless, there has been very little follow-up to verify that the proposed solutions are effective or even to assess their acceptability to pedestrians. This results in major research gaps, which are discussed in a subsequent chapter of this report.

## SUPPLEMENTAL REVIEW OF GREY LITERATURE

Grey literature includes documents such as agency guidelines, technical standards, and informal reports. Some of these items were found through the systematic review process, while others were obtained from supplemental searches of agency websites.

### Guidelines from the United States

Publicly available documents were searched to identify the work zone pedestrian accommodations recommended by state DOTs. The search identified wide variation in the extent to which temporary pedestrian accommodations are addressed in design manuals and similar publications. For instance, no mention of work zone pedestrian accommodations was found in the publicly available DOT publications from Arkansas, Kentucky, Nebraska, or Rhode Island, though in some cases guidance could exist in formats accessible only to agency personnel. At the other end of the spectrum, some states have produced large documents that discuss recommendations and requirements for temporary pedestrian access routes (TPARs).

For some states, the guidance is quite limited. For instance, the Alabama DOT (ALDOT) guidance currently says only that “the contractor shall make provisions for the safety of pedestrian traffic crossing the work zones during construction” (Alabama General Traffic Control Plan Notes §723). Similarly, the 2018 Idaho Transportation Department (ITD) *Work Zone Safety and Mobility Program* only briefly mentions the need to take pedestrians into account in temporary traffic control design. The wording in the North Dakota DOT (NDDOT) roadway design manual is similar.

Many states follow the MUTCD guidance, including Arizona, Colorado, Delaware, Illinois, Kansas, Maine, Michigan, Mississippi, Missouri, Montana, Nevada, New Hampshire, Ohio, Oklahoma, South Carolina, South Dakota, Texas, and Wyoming. Many of these states use typical applications TA-28, Sidewalk Detour or Diversion, and/or TA-29, Crosswalk Closures and Pedestrian Detours. In some cases, the typical applications have been renamed under the state’s standard plans. Other states refer to portions of the MUTCD guidance in their documentation. For example, the Connecticut DOT (CTDOT) specifically calls out Section 6D.01 (04) relating to maintaining detectable and accessible routes if they were provided prior to construction. Similarly, the West Virginia DOT (WVDOT) includes the wording from 6D.02 (03) within its *Manual on Temporary Traffic Control for Streets and Highways* (West Virginia DOT 2006).

Some states choose to follow the MUTCD standards but provide their own standard plans. For example:

- FDOT drawing 102-660 provides standard temporary traffic control plans for sidewalk closures including pedestrian detours, temporary pedestrian ways, and temporary pedestrian way diverting traffic into the traveled way.

- Illinois DOT (IDOT) standard plans for Sidewalk, Corner or Crosswalk Closure (Standard 701801-06) are similar to the MUTCD typical applications but feature a specific drawing for crosswalk closures.
- The Iowa DOT (drawings TC-601 and TC-602), Pennsylvania DOT (PennDOT) (PATA 129 and 217), and New York DOT (NYSDOT) all have standard plans for pedestrian detours and sidewalk diversions that appear to be based on the typical applications from the MUTCD but with changes in the signage or the minimum width of the path on the diversion.
- The Louisiana Department of Transportation and Development (LaDOTD) (drawing TTC-10) illustrates sidewalk closures in urban areas with speed limits under 40 mph.
- The Maryland DOT (MDOT) (drawing 104.06-09A through 104.06-09D) includes plans for various speeds and work durations.
- The Tennessee DOT (TDOT) (Standard Drawing T-WZ-55) provides three drawings for a sidewalk diversion, a sidewalk closure (mid-block), and a sidewalk closure (corner), which appear to follow TA-28 and TA-29, along with a plywood curb ramp detail.

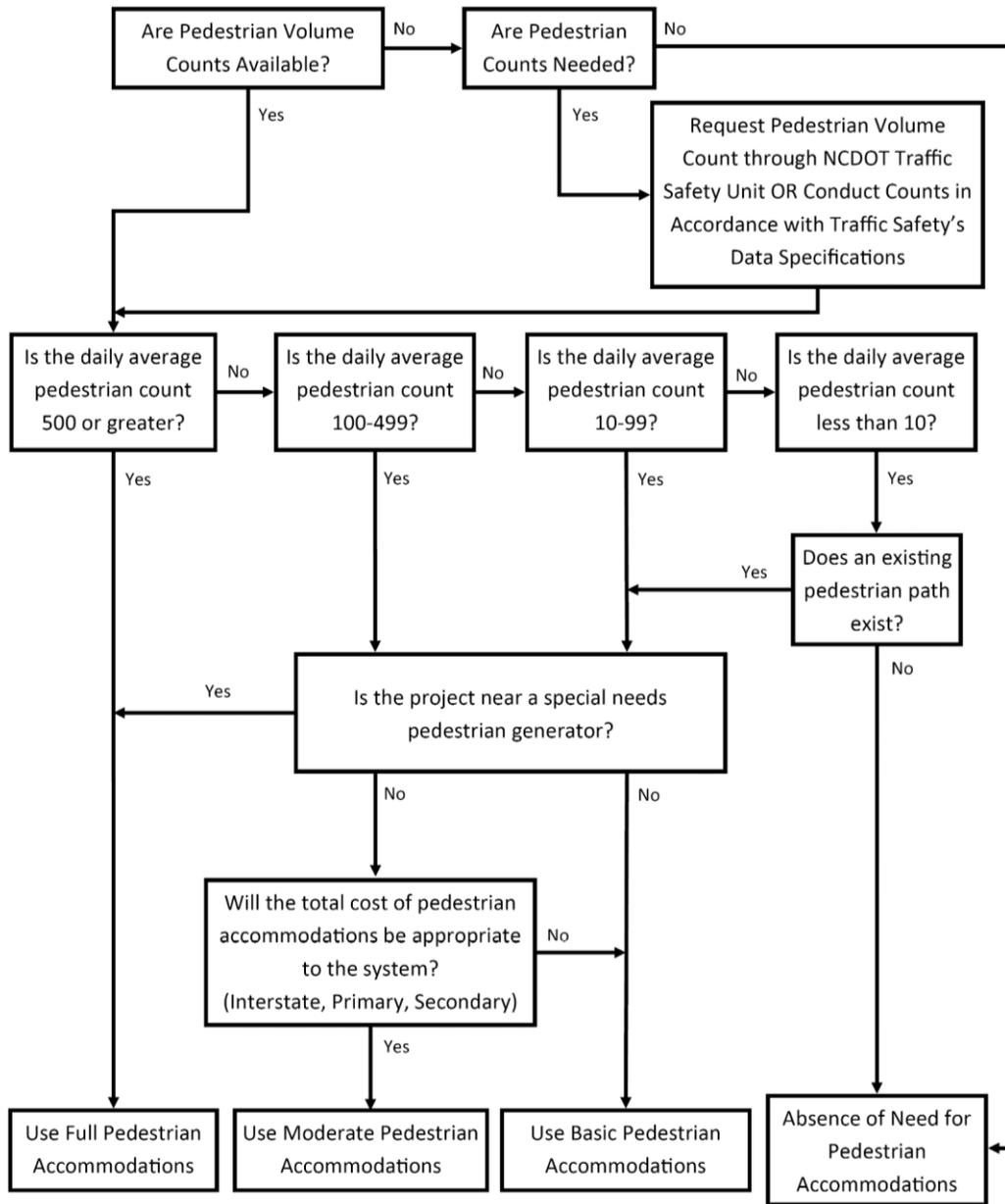
Other states provide slightly more guidance. For instance:

- The Alaska Department of Transportation and Public Facilities (DOT&PF) has various standard drawings related to pedestrian traffic control in work zones. These are included in a standard plan (TCP Details 5) and represent a variety of intersection related and mid-block pedestrian sidewalk, path, and shoulder closures. Both the intersection and mid-block closures have three potential plans, with an order of preference for each. This order of preferences starts with detour away from road (most preferred), detour to a closed parking or traveled way, and finally detour to the other side of road (least preferred). The plan notes follow MUTCD requirements but also indicate that when pedestrian traffic control devices required by the current traffic control plan are not in place, a worker should be provided to direct pedestrians through the area.
- The Washington State DOT's (WSDOT's) approach is similar to Alaska's. In addition to following MUTCD guidance, Washington recommends consideration of the use of a flagger if a large pedestrian generator such as a school is in or near the work zone.
- The Hawaii DOT (HDOT) and New Mexico DOT (NMDOT) provide plans that are similar to the MUTCD typical applications, but their sidewalk diversion specifies the use of temporary ramps when pedestrians use the parking lane for travel.

The Georgia DOT (GDOT) provides three construction details for pedestrian accommodations in work zones (drawings T-20 to T-22). These include plans for sidewalk diversion through on-street pavement, sidewalk diversion behind closed sidewalks, sidewalk detour and mid-block crossing, and sidewalk detour. In addition, Georgia includes guidance on temporary pedestrian facilities in its special provisions. These include temporary walkways with detectable edging, temporary curb cut wheelchair ramps, and temporary audible information devices. All these must meet the requirements of the ADA Accessibility Guidelines for Buildings and Facilities.

As shown in Figure 8, the North Carolina DOT (NCDOT) provides a flowchart for determining the extent of necessary temporary pedestrian accommodations. Factors that influence the decision include daily average pedestrian counts, the presence of existing pedestrian paths,

proximity to a special-need pedestrian generator, and costs in relation to the category of the roadway (Interstate, primary, or secondary). This results in recommendations ranging from an “absence of need for pedestrian accommodations” to a basic, moderate, or full use of pedestrian accommodations. The range of accommodations appears to fall within the recommendations of the MUTCD.



NCDOT

**Figure 8. Level of pedestrian accommodation flowchart (NCDOT)**

The New Jersey DOT’s (NJDOT’s) *Pedestrian Compatible Planning and Design Guidelines* contain considerations that should be made when accommodating pedestrians in work zones. For

instance, they seek to prevent water ponding due to inadequate drainage and provide advice on the use of pedestrian ramps for large grade differentials.

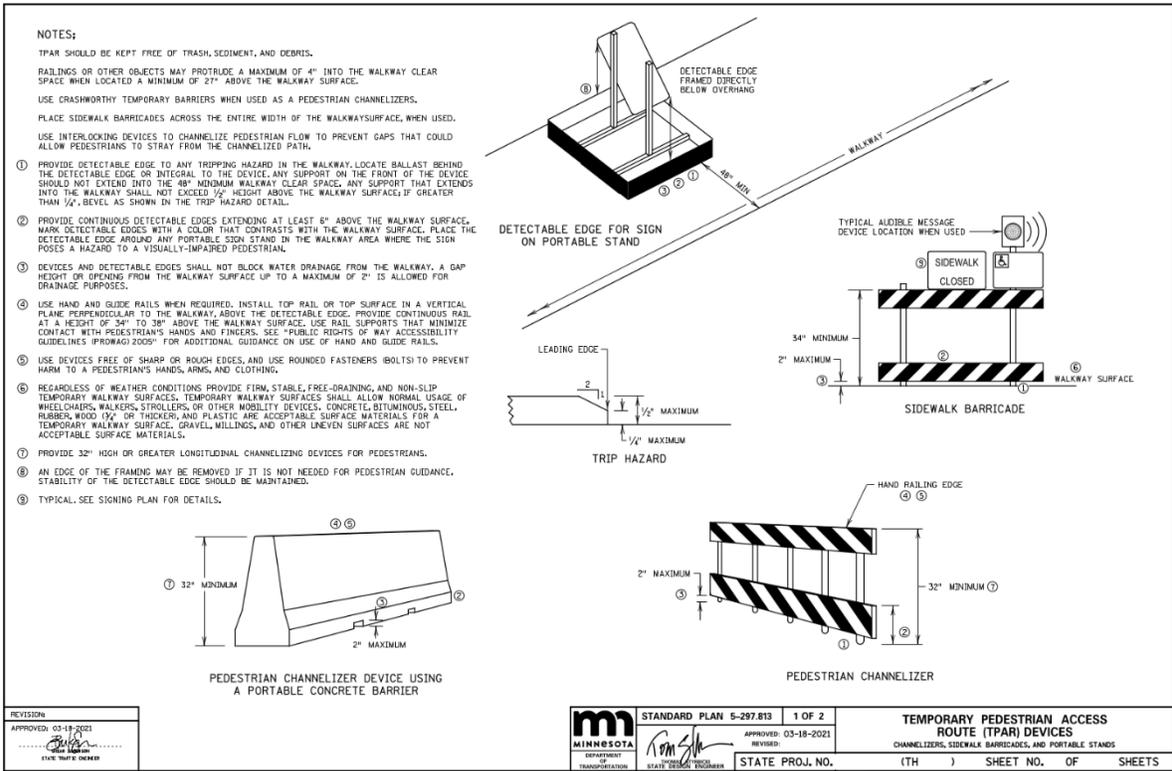
Some states go a step further by including not only guidelines and standard drawings for TPARs but also drawings of the specific devices and accommodations utilized. As summarized below, many of these documents appear to be derived from the MnDOT TPAR guideline that was originally published around 2011.

#### *Minnesota Department of Transportation Temporary Pedestrian Access Routes*

Alternate pedestrian routes (APRs) are the MnDOT designation for temporary routes established to replace pedestrian facilities that require accessibility features consistent with those that existed prior to construction. MnDOT also has TPARs, which are temporary pedestrian routes that are fully accessible and meet PROWAG recommendations. TPAR *devices* are pedestrian elements that meet the parameters defined in PROWAG. Accessibility features included in an APR need to be TPAR devices.

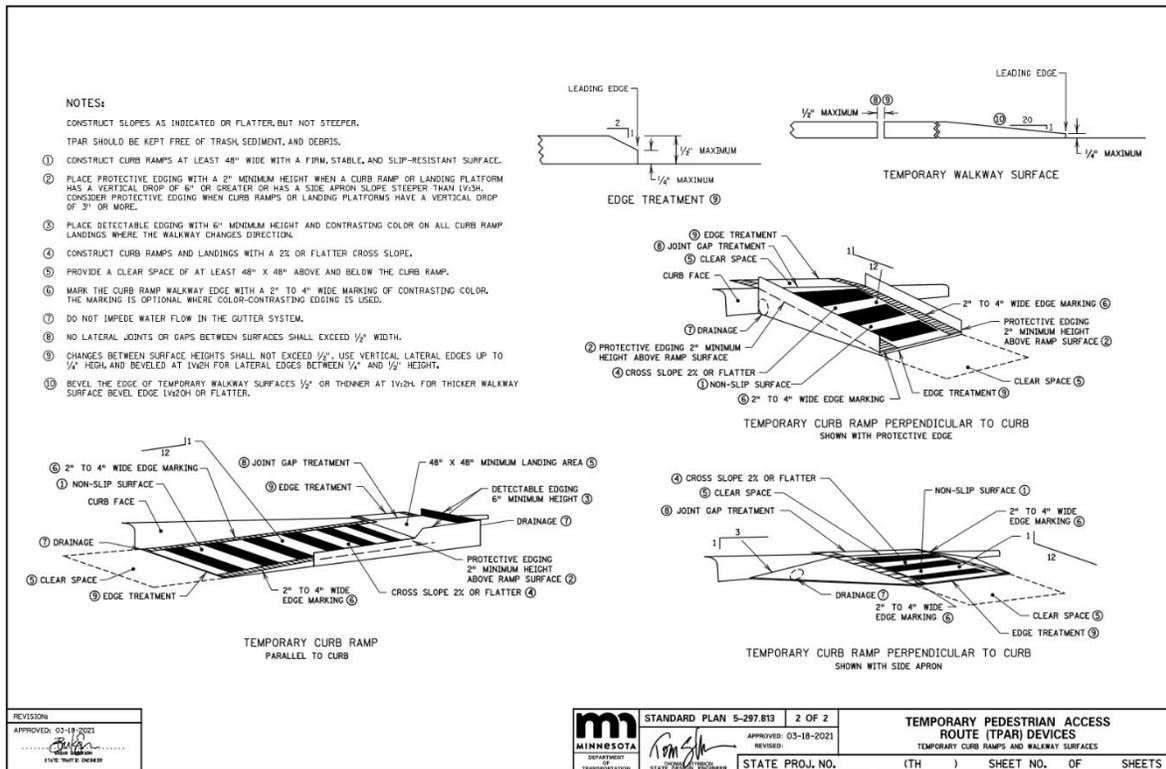
Minnesota MUTCD Chapter 6D (Pedestrian and Worker Safety) includes a checklist titled “Pedestrian Accessibility Considerations in Temporary Traffic Control Zones” (Figure 6D-1). This checklist is to be completed when it is reasonable to expect that pedestrians will be present in the vicinity of the proposed temporary traffic control zone and is utilized to document decisions related to the temporary pedestrian accommodations.

MnDOT has also developed standard plans for various APRs (drawing 5-297.811) and temporary pedestrian access route devices (drawing 5-297.813). As shown in Figure 9 and Figure 10, the agency provides standard drawings for items such as sidewalk barricades, pedestrian channelizers, detectable edges for portable signs, temporary walkway surfaces, and temporary curb ramps.



MnDOT

Figure 9. Minnesota Temporary Pedestrian Access Route (TPAR) Devices, Sheet 1 of 2

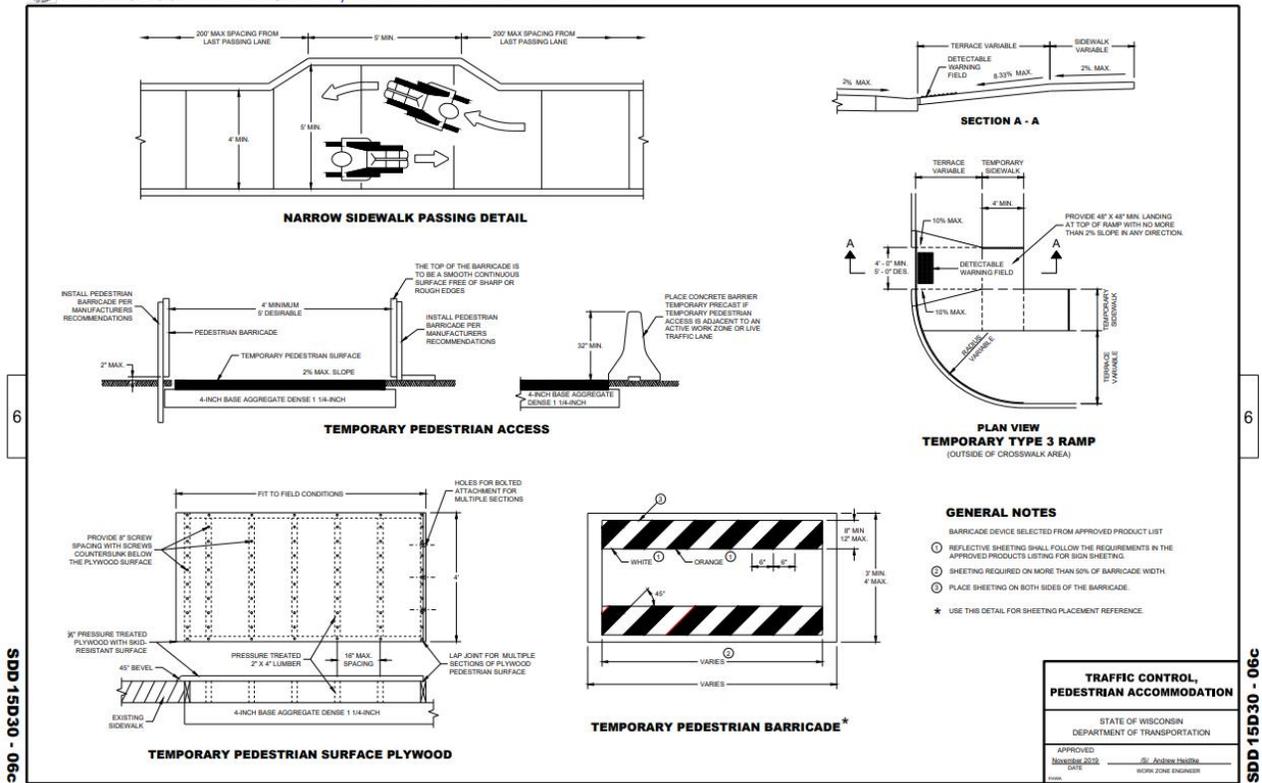


MnDOT

**Figure 10. Minnesota Temporary Pedestrian Access Route (TPAR) Devices, Sheet 2 of 2**

*Wisconsin Department of Transportation Standard Plans for Traffic Control, Pedestrian Accommodation*

The Wisconsin DOT (WisDOT) publishes standard plans for Traffic Control, Pedestrian Accommodation (drawings SDD 15D30-06a to SSD 15D30-06c). The set includes typical alternate pedestrian route layouts and details for temporary curb ramps; the designs appear to be derived from the MnDOT standard plans discussed in the previous section. Sheet 06c also includes additional detail drawings for pedestrian accommodations not found in the Minnesota drawings. As shown in Figure 11, these include details for narrow sidewalk passing areas, temporary pedestrian surfaces fabricated from plywood, and a third type of temporary curb ramp. These are complimented by section 145.13 of WisDOT's *Construction and Materials Manual*, which provides information on work zone inspection, including a thorough checklist to ensure the pedestrian accommodations are meeting any required accessibility requirements.



WisDOT

Figure 11. WisDOT Traffic Control, Pedestrian Accommodation Standard Drawings

Virginia Department of Transportation Work Zone Pedestrian and Bicycle Guidance (2016)

Guidance from the Virginia DOT (VDOT) includes information on treatment devices that are not standard but are current practice for developing temporary traffic control plans that accommodate pedestrians and people with disabilities. The guide includes illustrations of typical ADA-compliant pedestrian devices such as detectable edge channelizers, barriers, and temporary curb ramps. It also provides flowcharts to assist with selection of appropriate pedestrian traffic management techniques and devices based on the operation being performed. The guide also includes drawings of various ADA-compliant work zones, along with “Accessibility Checklists,” which appear to be derived from those published in the Minnesota MUTCD.

Utah Department of Transportation 2020 Standard Temporary Pedestrian Access Route (TPAR) Plans

For 2020, the Utah DOT (UDOT) provides four sets of standard plans related to TPARs. These include ramp details (drawing TC-6A), walkway and device details (TC-6B), diversion plans (TC-6C) and detour plans (TC-6D). The details for ramps, walkways, and devices are similar to the MnDOT TPAR designs.

*Vermont Agency of Transportation Bicycle and Pedestrian Work Zone Traffic Control Guide (2018)*

This document published by the Vermont Agency of Transportation (VTrans) provides guidance on methods to accommodate pedestrians in work zones. The document includes a section on work zone design for pedestrians. Per the guide, “the TTC [temporary traffic control] must provide specific traffic control measures and accessible features to accommodate all pedestrian traffic.” The VTrans guide includes components of an accessible pathway and provides a list of TPAR devices that can be utilized. It includes standard details for curb ramps and pedestrian channelizing devices similar to the MnDOT designs, along with information on device placement.

*Oregon Department of Transportation Temporary Pedestrian Accessible Routes (TPAR) Overview and Traffic Control Plans Design Manual*

The overview of TPARs in Oregon notes that TPARs are required for all projects along the state highway system (SHS), projects funded by the federal-aid highway program, projects contracted through the Oregon DOT (ODOT) (including those off the SHS), and all projects delivered by ODOT workforces off the SHS. ODOT requires a pedestrian-specific temporary traffic control plan when accommodating pedestrians in highway work zones. It also notes that a TPAR that meets or exceeds the existing level of accessibility shall be provided and must meet applicable ODOT and MUTCD requirements. The ODOT *Traffic Control Plans Design Manual* notes that a TPAR should feature accessible and detectable features. It refers to standard drawings for curbs, islands, sidewalks and driveways for details on ADA accessible sidewalk ramps, sidewalk grades and cross slopes.

*Massachusetts Department of Transportation Standard Plans*

The Massachusetts DOT (MassDOT) provides standard plans for alternate pedestrian routes including pedestrian detours and diversions (drawings PED-6 and PED-7), details for temporary curb ramps (drawings PED-1 and PED-2), and pedestrian channelizing devices similar to MnDOT.

*California Department of Transportation Temporary Pedestrian Access Routes Handbook*

Published in 2020 by the California DOT (Caltrans), this handbook provides general requirements for TPARs, as well as some general considerations. Caltrans requires TPARs for temporary pedestrian pathways due to sidewalk or pathway closure. To the fullest extent possible, TPARs must meet the existing accessibility accommodations. The designs provided in the handbook are similar to those published by MnDOT, including standard plans for sidewalk and crosswalk closure detours and diversions along with details for TPAR devices such as channelizing device options, channelized temporary pedestrian routes, temporary curb ramp options, and pedestrian push buttons. The document also includes checklists that can be used to document TPAR compliance.

*Guidelines for Work Zone Designers – Pedestrian and Bicycle Accommodation (Shaw et al. 2018)*

This document provides extensive guidance on the design of temporary ped/bike accommodations. It was intended to help highway agencies develop their own work zone ped/bike traffic management guidance, either as a section of an agency roadway design manual or as a standalone document. It includes an overview of the Safe System approach in the context of work zone design, describes the characteristics of work zone ped/bike crashes, discusses design principles for temporary ped/bike facilities, outlines various legal and regulatory considerations, and provides numerous textual and graphical examples of temporary pedestrian design options.

An important theme throughout the document is the extent to which standards applicable to permanent pedestrian facilities can be relaxed for short durations. For example, the preferred slope for permanent pedestrian ramps is 1:12 (8.3%) or flatter. The document suggests that although a 1:12 slope is desirable, the temporary use of a ramp with a 1:10 (10%) slope is usually preferable to the complete loss of access to a property abutting the work zone.

Another major theme is the use of lower cost materials for temporary pedestrian facilities. For example, to prevent damage from snow and ice removal, many agencies in the Midwest specify cast iron truncated dome panels for permanent curb ramps. The guide suggests using less expensive plastic, rubber, or concrete truncated dome panels for short-term, fair-weather curb ramps. The guide also suggests exploration of alternative surfacing materials such as T1-11 plywood, stabilized earth, CLSM, and well-compacted crushed stone.

A graphical problem-solution section offers side-by-side photos comparing poor practice and good practice, with an emphasis on situations that frequently result in noncompliance with MUTCD requirements. A related section of the document illustrates various options and materials for fabricating temporary curb ramps on site, along with several types of commercially produced temporary pedestrian accommodation products such as portable fences, manhole guards, trench covers, double ramps for pipe and cable crossings, prefabricated pedestrian bridges, channelizers, and water-filled plastic barriers. Design options for transit stops, temporary pedestrian signals, and temporary pedestrian lighting are also discussed.

A chapter of the document is devoted to the design process for temporary pedestrian facilities. This is followed by a chapter discussing seven options for staging the construction of pedestrian facilities, with the objective of limiting pedestrian impacts by choosing the most favorable sequence of construction activities. For example, the document proposes that in some cases permanent sidewalks can be built as the first stage of construction, instead of the traditional process of removing sidewalks early in a project and replacing them at the end. Another option proposed in the document is the rehabilitation of existing alleys to provide back-door access to businesses and residences while front-door access is disrupted (Figure 6).

A key limitation throughout the document is the lack of previous public acceptance testing of many of the suggested designs, surfacing materials, and commercial products.

## European Guidelines

*European Conference of Ministers of Transport – Improving Transport Accessibility for All (2006)*

The European Conference of Ministers of Transport (ECMT) produced a good practice guide titled *Improving Transport Accessibility for All*, which focuses on access to public transportation vehicles and stations for people with disabilities (OECD-ECMT 2006). The guidebook includes a short section on roadworks (work zones) near public transportation facilities. It includes the following recommendations:

- The work area should be barricaded off with a continuous rail about 1 meter (39 inches) above ground and a tapping rail below this. Audible warnings and lamps should be provided and where a detour or alternate route is necessary; the needs of wheelchair users should not be forgotten.
- Temporary footways (walkways) should never be less than 1,200 mm (47 inches) wide and, wherever possible, at least 1,800 mm (71 inches, approximately 6 feet) wide.
- Where scaffolding or other temporary structures are erected on or adjacent to a pedestrian way, it is essential that their presence is made apparent to visually impaired people. There should be a minimum passage width of 1,100 mm (43 inches) where scaffolding is erected over a footway (more if possible). Corner poles must be padded, and all vertical supports should have a band of contrasting color about 150 mm (6 inches) in depth and with the lower edge 1.5 to 1.7 m (59 to 67 inches) above ground level. Lighting and audible warning should be provided.

*British Department for Transport – Traffic Signs Manual, Chapter 8 (2009)*

The *Traffic Signs Manual* is roughly the British counterpart to the MUTCD. Chapter 8 is devoted to work zones and is published in two volumes: Part 1 (335 pages) provides design advice while Part 2 (231 pages) approaches work zone traffic management from an operations and field engineering perspective (DfT 2009a, DfT 2009b).

Most British cities and towns have substantial pedestrian traffic. Pedestrian considerations are embedded throughout the *Traffic Signs Manual*, with the word “pedestrian” appearing more than 150 times in the text. The document also makes a number of specific points about pedestrian traffic management in work zones, including the following:

- Pedestrians must not be forced into dangerous situations and should be protected from the works (construction area) and vehicular traffic by means of continuous barriers that clearly delineate the works and warn pedestrians of their presence. Continuous barriers surrounding the site must be erected if it is unattended. Specific strength requirements apply to pedestrian fences adjacent to excavations more than 300 mm (11.8 inches) deep in areas with moderate to high pedestrian flows.

- Obstructions on the footway (sidewalk or walkway) should be well guarded by continuous barriers or fences, with the addition of warning lights at night. Pedestrian routes diverted onto the roadway should be clearly defined by continuous barriers or fences. Traffic cones are not an acceptable barrier system.
- When a pedestrian route is diverted into the roadway, ramps are required to connect the two vertical levels. Ramps should have a slip-resistant surface and should slope gently enough to enable users to negotiate it without difficulty. When possible, the layout should include a platform at curb level to allow wheelchair and scooter users to turn through 90° before descending the ramp. According to Part 2, the maximum ramp slope is 1:20 (5%).
- The minimum width for temporary pedestrian paths is 1 meter (39 inches), but the width should be at least 1.2 meters (47 inches) in ordinary situations and, wherever possible, should be at least 1.5 m (59 inches).
- If sufficient width cannot be maintained on existing footways, alternative measures should be put in place. Options include placing a temporary path in the roadway, on the terrace, or on the other side of the road or escorting pedestrians through the works using signing and staff. The measure chosen should be based on a site-specific risk assessment.
- The manual identifies specific signs to warn pedestrians and motorized traffic of each other's presence. Signs with the legend ROUTE FOR PEDESTRIANS should be provided if the pedestrian route is not obvious. In addition, a CROSSING NOT IN USE sign is required when a pedestrian crossing is temporarily taken out of use.
- Where the footway is diverted into a divided highway, it is necessary to provide a safety zone between the outer pedestrian barrier and the live traffic. If the works themselves are adjacent to or in the roadway, a safety zone needs to be provided.
- When pedestrians are diverted into the roadway, advance warning similar to the traffic control for lane closures is necessary.
- The need for signing and guarding for pedestrians should be assessed if a contraflow operation is introduced on a divided highway, particularly in an urban area.
- Acceptable temporary pedestrian surfacing options include well-secured timber planking (free of projections), compact fine-grained material, or asphalt. Unbedded flagstones or "hardcore" (rubble or coarse gravel) are not acceptable.
- When cable is pulled from a drum or coil, caution should be taken to avoid injuries caused by recoil and tripping hazards.
- Footways should be kept clear of mud and loose material.

### *Construction Logistics and Community Safety Standard*

The Construction Logistics and Community Safety (CLOCS) standard is a multilateral initiative to reduce casualties between construction vehicles and other traffic (including vulnerable road users) in the United Kingdom (CLOCS 2019). The CLOCS standard sets out high-level goals to improve coordination between public agencies, private developers, prime contractors, and fleet operators. The standard applies "to all construction projects/programs."

Each project is required to develop a construction logistics plan (CLP) that provides a framework for understanding and managing construction vehicle activity into and out of a proposed work site. The CLP gives the oversight authority an overview of the expected logistics activity during

construction. Although the CLP is somewhat analogous to the transportation management plans (TMPs) for highway projects in the United States, in one sense the scope is narrower, since the CLP only addresses construction-related traffic. Conversely, the domain of application is much broader: CLPs are applicable to privately funded developments and building construction sites as well as projects initiated by public agencies and utilities.

Points to be considered in CLPs include the routing of construction vehicles, site ingress and egress, holding areas, delivery scheduling, consolidation of deliveries to minimize the number of trips to the site, freight deliveries by rail and water, use of prefabricated/precast components, reuse of materials on site, coordination with nearby construction sites, and trips generated by construction employees. “Clients” (developers and other project sponsors) are expected to include language in their procurement contracts to ensure that contractors and subcontractors comply with the arrangements described in the approved CLP. Mishaps, including near misses, must be reported.

Although one of the goals of the CLP process is to reduce conflicts between construction site traffic and pedestrians, the goals of CLOCS are clearly much wider, encompassing all types of crashes involving construction equipment along with air quality, emissions, and reduction of the total number of trips. The process is also intended to help avoid reputational risk to agencies, developers, contractors, and trucking companies.

Several related initiatives are being conducted by the CLOCS consortium. For example, the group has developed training and registration for “site access traffic marshals” who control the entry and exit of vehicles from a construction site. The group is also active in promoting truck safety upgrades, such as sideguards that help prevent pedestrians and cyclists from becoming caught under the wheels in the event of a sideswipe collision.

## RESEARCH NEEDS

### Introduction

#### *Issues and Opportunities*

Many of the publications identified through the systematic literature review discuss substantial shortcomings in the design and implementation of temporary pedestrian accommodations for work zones (Morelli et al. 2005, Ullman et al. 2007, Ellis et al. 2008, Bilton 2012, Shaw et al. 2016, Attanayake et al. 2017, Shaw et al. 2018). Typical problems include sidewalk closures without alternate routes or detours, unmarked or poorly marked closures, excessively long detours, pedestrians cutting through the construction area, lack of separation between bystanders and work areas, tripping hazards, falling hazards such as open manholes, inadequate lighting, and inappropriate use of temporary traffic control devices.

Although pedestrian fatalities in work zones are rare, analysis of hospital data suggests that deficient pedestrian accommodations result in thousands of slip-and-fall injuries each year. The resulting costs to insurers, government healthcare programs, injured people, and their employers almost certainly total billions of dollars each year.

Complaints gathered from personal interviews, social media, and blog posts indicate that many pedestrians, especially those with disabilities, are frustrated by being cut off from their intended destinations or find themselves unable to leave home safely (Williams et al. 2013, Shaw et al. 2016). Attempts to resolve these problems began in the 1970s (Morelli et al. 2005), but many difficulties persist.

Several academic authors have proposed solutions aimed at improving pedestrian safety and mobility in work zones, and considerable efforts to find workable solutions are reflected in the grey literature. Commercial products addressing some of the most common problems have also been developed. Based on the systematic literature review, it appears that none of the primary design solutions (ramps, railings, surfacing materials, etc.) have ever been formally evaluated for effectiveness or user acceptance. In fact, the only quantitative results found in the review are from a single study of pedestrian signage comprehension (Ullman et al. 2007).

#### *Reasonable Accommodation*

Due to lack of hard evidence on pedestrian needs in work zones, many of the designs and design guidelines that currently exist appear to be based mainly on opinion and conjecture, resulting in considerable uncertainty, inconsistency, and disagreement among practitioners. A crucial unresolved issue is the extent to which guidelines developed for permanent construction can be relaxed in temporary situations.

The ADA standards for architectural construction have existed for more than two decades. Most building code enforcement agencies recognize that the principle of “reasonable accommodation”

must be interpreted in the context of both the scope of a project and its site constraints. For example, it is often infeasible to bring older buildings into full compliance with ADA requirements due to conflicts with structural elements, mechanical systems, or architectural features integral to the character of the building. When this occurs, oversight agencies typically prioritize improvements that have the greatest value to the general public (such as building entrances and ground-floor restrooms) over those with limited use (private offices, storage areas, mechanical rooms, etc.).

There is also recognition that compliant accommodations cannot always be provided continuously. For example, although most multistory buildings are required to have at least one elevator for ADA compliance, it is also recognized that elevators must periodically be taken out of service for essential maintenance. At these times, building users with disabilities are inconvenienced, sometimes severely.

Bilton (2012) suggested that design criteria for temporary pedestrian accommodations should be aligned with objective criteria. Examples include pedestrian traffic volumes, motor vehicle volumes, roadway type and geometrics, traffic speeds, work duration, and work type (e.g., bridge work versus mainline work). To date, only NCDOT appears to have taken this approach. Although space constraints are clearly a problem at some sites, there are also few distinctions between solutions intended mainly for urban areas and those more applicable to suburban or exurban environments.

A few examples of the research needs that result from the lack of definitive research on pedestrian needs for temporary work zone accommodations are discussed below.

### **Who Are We Building For?**

Currently, only very limited information is available to identify the user population for temporary pedestrian facilities and the corresponding mobility needs. Although about a quarter of the noninstitutionalized adult population in the United States has some type of disability (Okoro et al. 2018), the proportion of pedestrians with a disability that requires consideration in facility design appears to be unknown. Some people with severe disabilities cannot utilize sidewalks under any circumstances. In other cases, a disability could be mild enough that it has no effect on facility design.

Understanding the spectrum of users and the proportions of different types of mobility limitations could help set priorities for temporary facilities design. For example, the members of this project's technical advisory committee noted that agencies currently have no information about the maximum acceptable length and grade for pedestrian detours. Examples of some factors that could influence agency decisions for detour design, including when to provide paratransit or other alternative transportation, include the following:

- The proportion of pedestrians with disabilities
- The types and severity of disabilities encountered

- The types of assistive devices used by pedestrians with disabilities, e.g., manual wheelchairs, electric wheelchairs, scooters, guide animals, and so on
- Typical trip lengths for pedestrians with disabilities
- The extent to which these characteristics vary based on land use, degree of urbanization, time of day, project duration, and so forth

A closely related issue is the proportion of people with disabilities who would use temporary pedestrian facilities if the accommodations were better suited to their needs. Broadly speaking, this requires user acceptance testing to determine whether the designs currently in use are appropriate, to assess potential design modifications aimed at opening up use to more people, and to determine whether there are opportunities to reduce cost and complexity without sacrificing mobility. This type of information could also assist agencies in determining when to attempt to maintain pedestrian walkways during construction and when providing alternative services such as temporary shuttle buses is better suited to user needs.

### **Extent and Reasons for Noncompliance with Technical Guidance**

Numerous researchers, engineering practitioners, and pedestrian advocates have reported widespread noncompliance with MUTCD requirements and other technical guidelines (Figure 12). Nevertheless, no recent studies quantifying the extent and severity of the noncompliance were found. Additional research could assist the developers of technical guidelines, technical training, contractual documents, and regulations with understanding and resolving the factors that contribute to noncompliance. For example, it is currently unknown whether noncompliance could be reduced through designs that make it easier to install/remove temporary accommodations.



Carolyn Dvorak, used with permission

**Figure 12. Pedestrian mobility impacted by nontransportation use of sidewalk area**

### **Project Phasing and Staging**

When viewed from the space syntax perspective, MUTCD typical application drawings TA-28 and TA-29 and similar state DOT standard detail drawings are not entirely satisfactory. In a broad sense, the approach taken in these drawings is to restrict access along at least one side of a corridor, which sometimes conflicts with the MUTCD requirement to provide “adequate pedestrian access” (MUTCD section 6D.01 [04]). A further complication is that many roadways currently have sidewalks on only one side, particularly in suburban areas.

Shaw et al. (2018) proposed four potential solutions for this problem:

- Using temporary walkways to provide interim access while permanent sidewalks are being built.
- Pedestrianizing existing alleys to provide back-door access to properties during construction. Typically, this would involve resurfacing the alley and adding appropriate signage and pavement markings to limit the speed and volume of motorized traffic using the alley.
- Using “checkerboard” construction to split sidewalks into two or more construction stages. In many cases, this could allow a narrow sidewalk to be maintained during construction, eventually followed by a wider permanent sidewalk.
- Making changes in construction staging to reduce or eliminate time periods when sidewalks are unavailable. For example, instead of the traditional process of building motor vehicle

lanes first and adding sidewalks at the end of a project, new permanent sidewalks could be installed in the first construction stage to provide access throughout the duration of the project. Potentially, the new sidewalks might be built in parallel with any existing pedestrian facilities; the old sidewalks could then be demolished to provide space for other traffic or construction activities.

Research is necessary to evaluate the feasibility of these solutions and their applicability to various pedestrian traffic management and construction use cases.

### **Surfacing Materials**

Existing guidelines use distinctly different language to describe the surfacing materials for pedestrian walkways. Guidance in the 2009 MUTCD calls for “a smooth, continuous hard surface,” which appears to imply that temporary pedestrian walkways must be paved or made from wood products. With permanent walkways in mind, PROWAG describes the required characteristics as “firm, stable, [and] slip resistant.” The British *Traffic Signs Manual* is somewhat more specific (DfT 2009b):

Where a temporary footway is provided, its surface shall be of an adequate standard. Well-secured timber planking (free of projections), compact fine-grained material or tarmac [asphalt] are acceptable, but unbedded flagstones or loose hardcore [rubble or coarse gravel] are not.

Shaw et al. (2018) proposed the use of various alternative surfacing materials. These included T1-11 plywood, which offers more surface friction than standard CDX plywood, or oriented strand board (OSB) placed textured side up. The authors also suggested cementitious materials such as CLSM (also known as concrete slurry) or soil-cement. Similar to the *Traffic Signs Manual*, Shaw et al. (2018) also suggested that well-compacted soil or open-graded (breaker run) gravel could also provide an adequate walking surface, particularly for short durations.

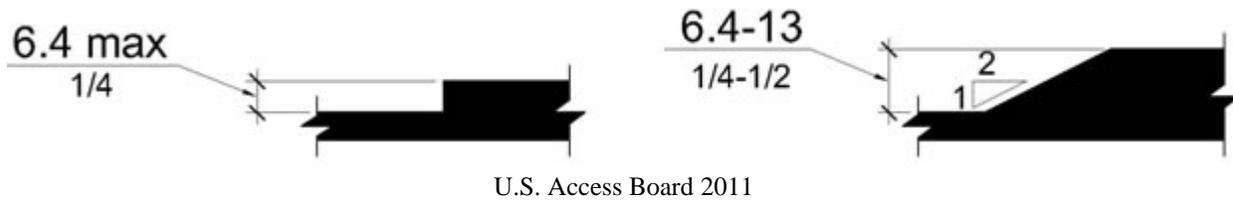
Relationships between material choice and duration of use require consideration. For example, paving a temporary pedestrian walkway with concrete or asphalt typically requires a day or two for preparation and installation, plus curing time if concrete is used. This potentially leaves the site with no walkway for a few days. As a result, paving does not appear to be a logical solution if a temporary walkway itself is needed for only a few days.

Research is needed to assess the acceptability of various surfacing materials in terms of user acceptance, slip resistance, and durability and the relationships between duration of use and the appropriate materials.

### **Small Vertical Transitions**

The 2011 PROWAG draft adopted the same limits on small vertical transitions as the “indoor” ADA guidance. Specifically, it limits the elevation difference between two adjacent walking

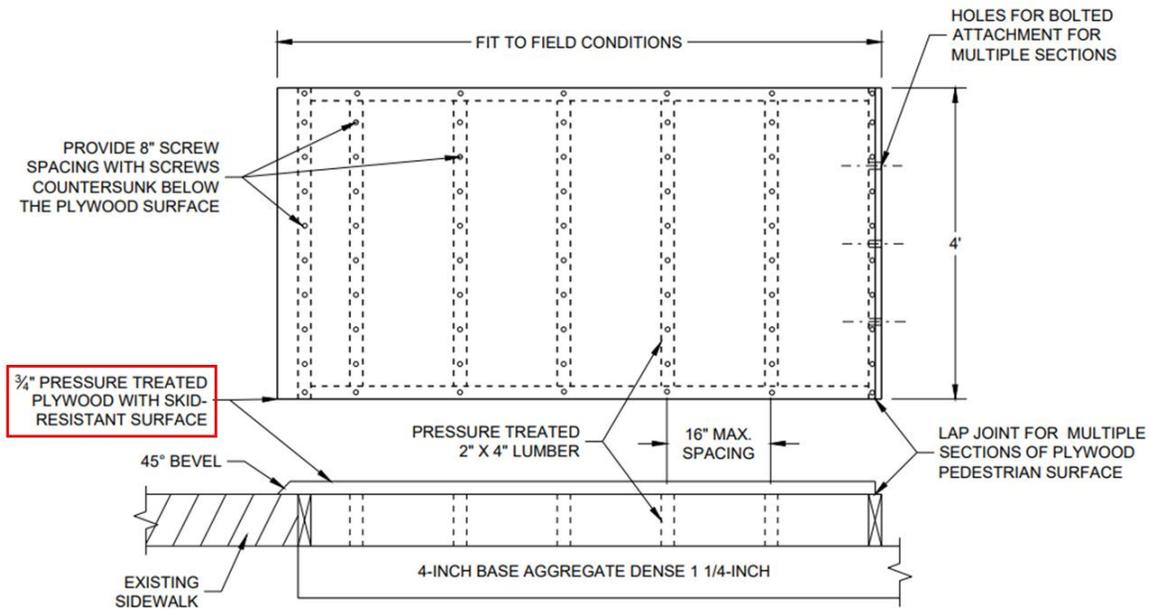
surfaces to 1/2 inch and requires the transition to be beveled at a 2:1 slope if the difference exceeds 1/4 inch (Figure 13).



**Figure 13. PROWAG requirements for small vertical transitions, with large numbers indicating dimensions in millimeters and small numbers indicating dimensions in inches**

Sidewalk slab faulting is extraordinarily common in most cities and very often exceeds 1/2 inch. Elevation differences develop gradually when adjacent slabs of a permanent sidewalk are lifted by tree roots, settle into the subgrade, or crack at driveway crossings. A Midwestern mayor who advocates walkable cities asserted that most municipalities do not attempt to repair vertical faults smaller than 1/2 inch because the cost of repairs is excessive (Norquist 1998). In addition, he asserted that increasing the vertical deviation tolerance from 1/4 inch to 1/2 inch had “no noticeable effect on our [liability] claims.”

For work zone applications, the 1/2 inch small vertical transition limit complicates the selection of surfacing materials for temporary curb ramps and walkways. Standard 1/2 inch plywood lacks sufficient rigidity for many applications, and in effect PROWAG guidance does not allow 3/4 inch plywood from being used at the interface with an existing flat surface. A pragmatic solution adopted in the WisDOT standard detail drawing shown in Figure 14 is beveling the edge of the 3/4 inch plywood at a 45° angle. Another potential solution is to chamfer the edge with a router to make the height change in two 3/8 inch increments. Both options appear to be noncompliant with the draft PROWAG guidance for permanent construction, and PROWAG is silent on whether the requirement can be relaxed in work zones.



WisDOT

**Figure 14. WisDOT standard detail drawing for temporary plywood pedestrian surfaces**

Alternative materials and methods for implementing small vertical transitions also require consideration. For example, wedges of cold-mix asphalt are frequently used to address height differentials at interfaces between old and new construction. The minimum thickness of these wedges is related to the aggregate size and often appears to be in the range of 3/8 to 3/4 inch. The edges of the wedge tend to ravel over time. Pedestrian acceptance does not appear to have been formally evaluated.

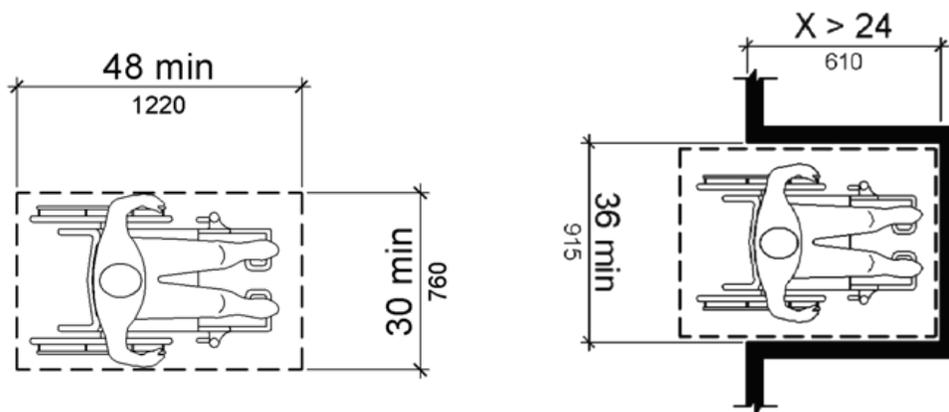
Research is needed to assess the small vertical transition heights that are acceptable in temporary walkways, evaluate various methods and materials for smoothing the transition, and identify appropriate transition details for various construction materials.

### Walkway Width

Inconsistent guidance on the appropriate minimum width for temporary pedestrian walkways is another example of the effect of insufficient research evidence. Consider the following:

- Industrial catwalks are sometimes as narrow as 12 inches at the walking surface, with a minimum width of 21 to 22 inches at shoulder level (Packard 1981).
- Federal Aviation Administration regulations (25 C.F.R. § 25.815) require the walkways on most commercial passenger aircraft to be at least 15 inches wide at floor level, widening to 20 inches above the seat armrests. In practice, aisles on most jets are usually 17 inches wide at floor level. This is narrower than the 26 inch width of a standard wheelchair. In commercial aviation, trained personnel use special transfer chairs to assist wheelchair users with boarding.

- To provide space for the user’s hands, a manual wheelchair requires 30 inches of usable width (Figure 15). Doorway widths of 36 inches are preferred in commercial construction and facilities designed specifically for people with disabilities. In residential construction, a 32 inch minimum doorway width is typical. When retrofitting old buildings, 30 inches is sometimes considered minimally acceptable.
- A worker-oriented British guideline titled *Safety at Street Works and Road Works: A Code of Practice* states, “In no circumstances must the footway [sidewalk] width be reduced below 1.0 meters [39 inches]” (DfT 2013). The guideline then suggests that this figure may be unachievable in some cases and advises workers to “consult your supervisor, manager or other competent person [if] the minimum footway width of 1.0 m cannot be maintained.”
- PROWAG stipulates a minimum width of 48 inches for permanent sidewalks, a figure adopted in many Iowa cities (SUDAS 2014).
- WisDOT’s *Facilities Development Manual* advises designers to “maintain a 5 foot [60 inch] wide path, 4 foot [48 inches] minimum, for wheelchair access and provide temporary curb ramps where necessary” (WisDOT 2020).
- WSDOT calls for a sidewalk width of 5 feet (60 inches) to be maintained in work zones (Ellis et al. 2008).



U.S. Access Board 2011

**Figure 15. PROWAG wheelchair width requirements: actual working width (left) and minimum width for alcoves (right)**

The wide range of norms suggests a degree of confusion about the widths that are *minimally acceptable* and those that are *desirable*. Lateral space is often scarce in work zones. The temporary pedestrian walkway width that is selected can have significant implications for walkway feasibility and cost. When providing the space required for pedestrians requires narrowing the motor vehicle lanes to less than about 10 feet, the safety and mobility of motorized traffic can be affected, with possible spillover effects on pedestrians.

Research is needed to assess the acceptability of various widths to road users, evaluate relationships to pedestrian traffic volumes, and assess the overall effects of adjusting temporary pedestrian pathway width on pedestrian and motorized traffic, construction costs, and similar considerations.

## **Curb Ramps**

Ordinarily, a curb ramp has a maximum slope of 1:12 (which is equivalent to 8.33% or a vertical angle of 4.76°). For a typical curb height of 6 inches, this means the ramp must be at least 6 feet long. If such a ramp is placed at the back of an existing vertical-face curb, it will extend 6 feet into the roadway. In most cases a ramp will be required on both sides of a street, taking up a total of 12 feet of space, or the entire width of a typical traffic lane. As noted in the previous example, lateral space is often quite limited in urban work zones, potentially limiting the number of lanes available for motorized traffic. In some cases, closing another lane will affect traffic flow, potentially resulting in congestion that is undesirable for both motorized and nonmotorized road users.

The central question is whether 1:12 is actually the maximum safe slope for a curb ramp. Could road users tolerate a somewhat steeper slope, at least for a short time? For example, if a vertical angle of 10° (or 1:5.67) is tolerable, the typical length of a temporary curb ramp can be reduced to less than 3 feet, which would be much easier to incorporate within site constraints.

Alternatively, this research question can be phrased in terms of what might be done to improve the safety of curb ramps in situations where a 1:12 slope is infeasible. For example, if a high-friction surface treatment such as calcined bauxite is applied to a 10° ramp, will it be acceptable and safe for temporary use?

Research is needed to assess the effect of curb ramp slope on pedestrian safety and mobility, including the effects on people with disabilities. Relationships to surface friction and material type require consideration. These relationships are likely to be influenced by weather, perhaps necessitating more stringent requirements if snow/ice is likely to occur while the curb ramp is in service.

## **Edge Protection for Curb Ramps**

As noted in the grey literature synopsis, several states have adopted the TPAR curb ramp designs originally developed by MnDOT. Some (but not all) of the ramp designs include edge protectors (side guards), evidently intended to prevent wheelchair users from rolling off the edge of the ramp. The TPAR guidance stipulates a minimum height of 2 inches for the edge protectors, with no maximum. In permanent construction, edge protection is often provided on long ramps at building entrances but is rarely provided for curb ramps.

A potential problem is that ambulatory pedestrians approaching the low end of the temporary curb ramp at an angle could trip over the edge protectors or snag clothing, possibly resulting in injuries. In a busy central business district, the number of ambulatory pedestrians can be substantial, and it is not unusual to observe people walking with their eyes focused on phone screens or the bus they are running to catch. In addition, the complex shape of a curb ramp with edge protectors might be confusing to long cane users, potentially causing them to misjudge the height or position of the ramp.

Research is needed to evaluate the appropriate height and positioning of curb ramp edge guards in a realistic setting. The potentially conflicting requirements of ambulatory, wheelchair, and visually impaired users require investigation.

### **Fencing**

The fences used in work zones range from short plastic “snow fences” to tall, sturdy fences topped with razor wire. There appears to be a need for guidance that can assist designers in specifying fencing that is appropriate to the hazard level, taking into consideration excavation depth, pedestrian volumes, and other situational factors.

### **Transit Stops**

Many of the instances of pedestrian nonconformance with work zone closures arise in the vicinity of public transportation stops (Ellis et al. 2008). Additional study and design guidance appears to be needed to provide practical solutions for managing conflicts between pedestrians, buses, and other motorized traffic.

### **Wayfinding**

The pedestrian wayfinding signage and typical application drawings in the 2009 MUTCD are designed for relatively simple detours to the other side of the street or an adjacent closed roadway lane. Some work zones require more complicated pedestrian detours (Figure 16), but the research on pedestrian wayfinding aids for these situations is very limited.



TDOT

**Figure 16. Long pedestrian detour in Knoxville, Tennessee**

In the MUTCD, there appears to be an implicit assumption that the graphic design of pedestrian signage should be similar to that of motor vehicle signage. This overlooks the inherent advantages of pedestrians' lower speed and physical closeness to signs. For example, map-type signs and complex diagrams are often difficult to comprehend while driving at speed. Conversely, maps and diagrams can be placed in locations where pedestrians can safely stop to study the route for a minute or two.

Another option is to use channelizing devices such as pedestrian barricades as a wayfinding aid. This practice is relatively common in Europe and Australia. While this technique appears to increase the clarity of the route, the channelizers can also impede access to properties adjoining the alternate route. User acceptance testing could help guide decisions related to this approach.

Various pedestrian wayfinding techniques might also be adapted from other environments. For example, colored lines are often painted on hospital corridor floors to guide pedestrians to specific destinations. In airports, wayfinding signage is repeated frequently to reassure pedestrians that they are on the correct path and redirect those who are not. In large parking garages, specific paint colors are often selected for each vertical level, sometimes augmented with memorable graphics (e.g., frogs on level 4, giraffes on level 5). More subtly, the interior design of shopping centers often includes landmarks such as large plantings or sculptures that help orient pedestrians and serve as reference points when giving directions.

## **Work Zone Navigation and Navigational Aids for People with Visual, Sensory, and Cognitive Disabilities**

Pedestrians with visual, sensory, and cognitive disabilities tend to navigate based on landmarks learned through previous experience, which can be disrupted by construction (Williams et al. 2013). A few previous studies have explored electronic work zone navigation assistance devices for visually impaired pedestrians, which are recommended in the MUTCD but appear to be used only rarely. An early study identified potential technical and operational problems with annunciators, the most widely used technology (Ullman and Trout 2009).

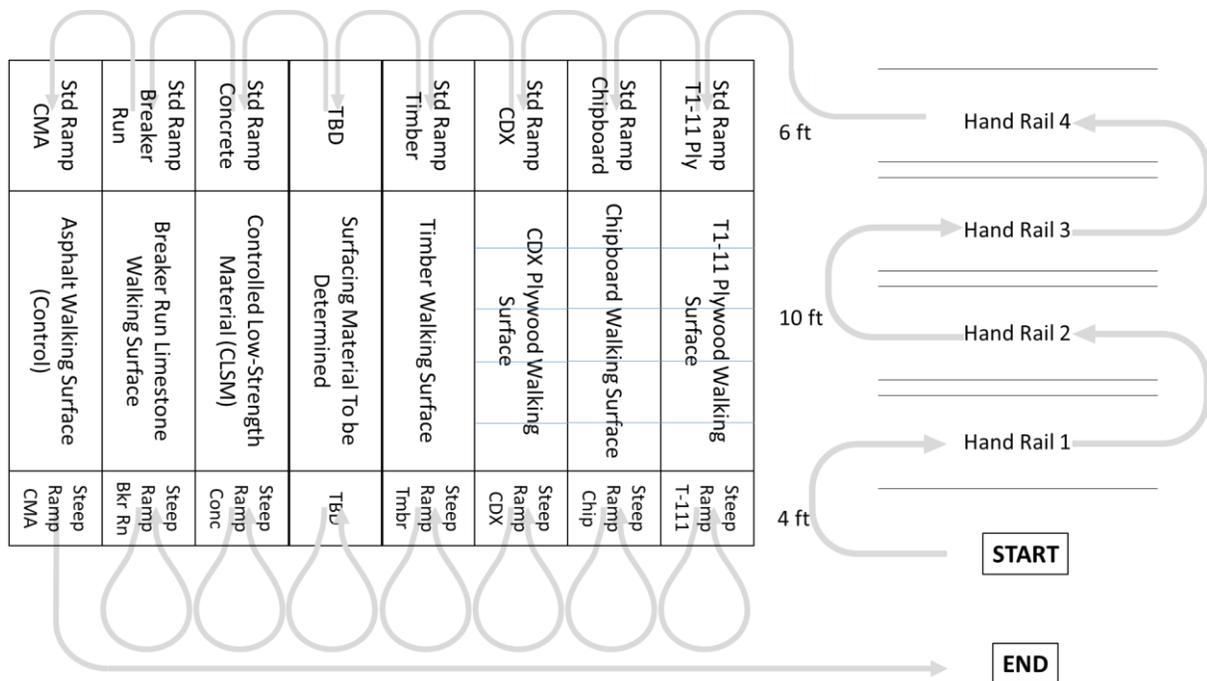
Research from the interdisciplinary field of space syntax can offer some insights into how facility changes affect these pedestrians (van Ness and Yamu 2021), but additional work is needed to identify and test practical solutions. For example, disseminating real-time information on the status of sidewalk closures appears to be technically feasible (Liao 2014), but systems for acquiring up-to-date data are required (Qin et al. 2018). Perhaps these systems could leverage technologies originally developed for real-time dissemination of motor vehicle lane closures, such as Radio Data System-Traffic Message Channel (RDS-TMC) or Transport Protocol Experts Group (TPEG) (see discussion in Shaw and Venkatachalapathy [2021]).

## **PEDESTRIAN TEST TRACK**

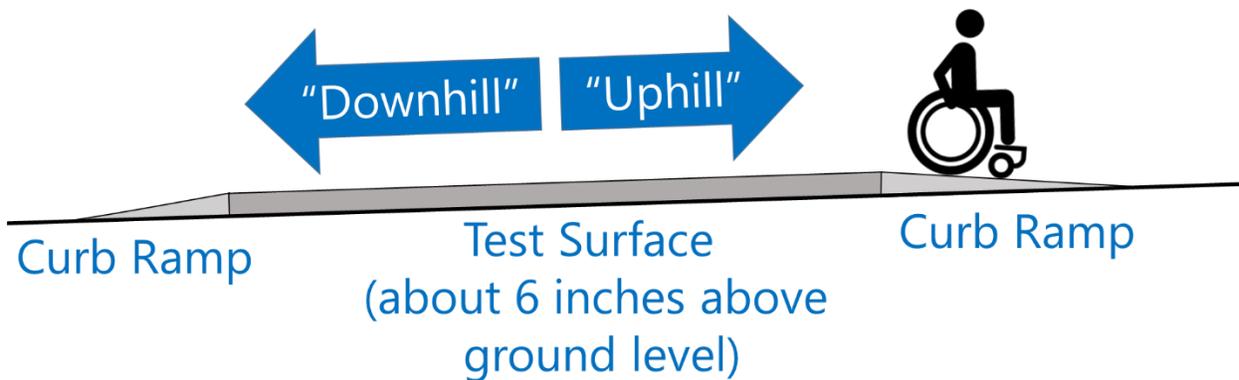
The present project was intended to begin addressing some of the research needs identified in the previous section. The project was initially envisioned as a field study of pedestrian accommodation alternatives, which would have taken place in summer 2020 at selected urban work zones in Iowa, such as the convention center area in Cedar Rapids. This proved infeasible due to the COVID-19 pandemic, which resulted in the cancelation of convention center events and wide fluctuations in pedestrian traffic volumes. The COVID-19 situation also allowed contractors to accelerate construction due to reduced conflicts with road users, reducing the duration of data collection windows.

With no immediate resolution of the COVID-19 situation in sight, the need for an alternate study design became clear. This led to development of the Pedestrian Test Track concept, which could allow various work zone accommodation elements to be tested in a well-controlled environment. By scheduling subjects for self-directed walk-throughs, use of the test track could be limited to one person at a time, and cleaning protocols could be implemented to minimize COVID-19 transmission risks. Additionally, the test track could be built in a traffic-free environment such as a closed parking lot to reduce the risk of participant injury.

Figure 17 provides a conceptual plan for the Pedestrian Test Track, with multiple lanes to allow testing of various combinations of small vertical transitions, curb ramps, surfacing materials, and guidance handrails. Figure 18 illustrates conceptually the cross section of the test track, which could include ramps that meet the slope requirements proposed in PROWAG along with steeper ramps to assess the effects of surfacing material and friction on acceptability to ambulatory pedestrians and people with various types of disabilities.



**Figure 17. Conceptual plan view of Pedestrian Test Track, showing test lanes and direction of pedestrian circulation**



**Figure 18. Conceptual cross section of Pedestrian Test Track, assuming implementation on a gently sloping surface**

The Pedestrian Test Track was envisioned to consist of several types of temporary surfacing materials, ramps, and pedestrian channelization devices. Participants would arrive at the test track by appointment for a self-guided walk-through. Along the walk, there would be numbered stations identifying each test surface, ramp, and channelizer. Participants would use a preprinted form to rate the suitability of each surface/device in the context of their personal abilities. Each participant was anticipated to make two walk-throughs, one with the track in dry condition and a second after it was sprayed with water to simulate a rainfall event. The project team also intended to interview some participants by telephone to get additional information about their perceptions of the suitability of the devices.

Examples of the surfacing materials that could have been tested included the following:

- Type CDX plywood, “C” graded side up (control)
- Type CDX plywood, “D” graded side up
- Type T1-11 plywood, grooved side up
- Oriented strand board, rough side up (OSB is a plywood-like material made from pressure-laminated wood flakes)
- Timber planks
- Pallets with infill boards
- Pallets with plywood overlay
- Cold-mix asphalt (control)
- Stabilized earth (also called soil-cement)
- Compacted breaker run limestone
- Low-strength concrete (also called CLSM or slurry)

Asphalt and CDX plywood were included in the project as experimental controls because these are currently the most commonly used materials.

Examples of the pedestrian channelization devices to be tested could have included the following:

- MnDOT two-rail TPAR design (MnDOT Figure 6K-5)
- Three-rail barricade based on MnDOT TPAR design
- Plastic snow fence with timber top rail
- Site-fabricated wood channelizer
- Concrete blocks, dry stacked and tied
- Prefabricated plastic (commercial product)

Detailed protocols were developed for the Pedestrian Test Track, including participant recruitment, risk disclosure, informed consent, and data collection forms. Additionally, a preliminary plan for recruiting ambulatory subjects and people with disabilities was developed. These protocols received approval from Iowa State University’s Institutional Research Board (IRB) in 2021. The project team also developed an extensive set of protocols aimed at mitigating COVID-19 transmission, which varied depending on whether the test track would be built indoors or outdoors.

The following materials related to implementation of the Pedestrian Test Track are presented in the appendix to this report:

- IRB application form
- Participant recruitment flyer
- Participant self-nomination form
- Script and workflow for screening participants by telephone

- Informed consent form
- Data collection form
- Cost estimate for test track materials

Numerous delays were encountered with Pedestrian Test Track implementation due to the COVID-19 situation. Chiefly, this was the result of a moratorium on human subjects research at Iowa State University. Uncertainties stemming from the moratorium also led to lengthy delays in the IRB approval process, resulting in major revisions to reflect changes in the IRB's role in limiting COVID-19 transmission.

Identifying a suitable site for the Pedestrian Test Track was also challenging. Although many Iowa State University classes were delivered remotely, those requiring in-person instruction were heavily reliant on the few large indoor spaces available on the campus. As a result, no indoor facilities large enough for the test track were available on the Iowa State University campus during the winter of 2020–2021. A plan for implementing the test track outdoors in the summer of 2021 was developed, but it was subsequently determined that the resulting project completion date would conflict with Smart Work Zone Deployment Initiative (SWZDI) funding requirements. Consequently, the project was scaled back to the literature review, conceptual development of the Pedestrian Test Track, and associated IRB applications described in this report.

## CONCLUSIONS AND RECOMMENDATIONS

Each year, billions of dollars are spent on construction projects that directly affect pedestrian safety and mobility. These projects include not only street and highway construction, but also utility work, commercial and residential building construction, and other private developments.

Pedestrian accommodation deficiencies are known to generate complaints from pedestrians and admissions to hospital emergency departments. Many of these cases are slip-and-fall injuries that are not reported to law enforcement. On average, a single *nonfatal* pedestrian injury results in approximately \$52,000 in losses (CDC 2021, U.S. Bureau of Labor Statistics 2021). Assuming that 15% of nonfatal US pedestrian casualties occur in work zones, the estimated annual number of nonfatal injuries is **31,900** resulting in approximately **\$1.7 billion** of financial losses to insurers, government healthcare programs, injured people and their families, and employers. Among transportation practitioners, awareness of the scale of this problem is low due to reliance on law enforcement reports that generally capture only vehicle-pedestrian collisions.

A systematic review was conducted using seven electronic databases to locate peer-reviewed work zone pedestrian safety research published from 2004 to mid-2021. Only nine studies that met the inclusion criteria were found. One publication reviewed the work zone pedestrian safety research conducted prior to 2006, five publications addressed the physical design of temporary facilities, and three addressed communication with visually impaired pedestrians. Almost all of the results reported in the primary studies were qualitative, and many were highly subjective, leading to substantial risk of bias.

Nearly all of the publications identify or discuss shortcomings in the design and implementation of temporary pedestrian accommodations for work zones (Morelli et al. 2005, Ullman et al. 2007, Ellis et al. 2008, Bilton 2012, Shaw et al. 2016, Attanayake et al. 2017, Shaw et al. 2018). Typical problems include sidewalk closures without alternate routes or detours, unmarked or poorly marked closures, excessively long detours, pedestrians cutting through the construction area, lack of separation between bystanders and work areas, tripping hazards, falling hazards such as open manholes, inadequate lighting, and inappropriate use of temporary traffic control devices. Some of the studies proposed solutions for these problems, but **none** included follow-up to determine whether the solutions were effective in improving safety or mobility.

A supplemental search of transportation agency guidelines and other grey literature indicates that the extent of agency guidance for temporary pedestrian accommodations is somewhat proportionate to the level of urbanization in each state. That is to say, the most detailed guidance has generally been issued by relatively urbanized states such as California, Massachusetts, Minnesota, Virginia, and Wisconsin. Many of the guides are based on recommendations developed by MnDOT a decade ago. The tendency for guidance to be copied (often almost verbatim) from agency to agency has resulted in proliferation of designs that do not appear to have been vetted through any type of formal testing.

Many states seem to face a disconnect between the organizations that are typically responsible for developing temporary pedestrian accommodation guidelines (mainly state DOTs) and those

that typically implement projects with pedestrian impacts (mainly municipalities, utility companies, and private real estate developers). In most states, the DOT design manual sets the tone for how construction is done on both state and local projects. DOTs typically allocate a substantial portion of their resources to the Interstate highway system, where pedestrians are usually prohibited. In most states, the conventional roadways under DOT jurisdiction are mainly rural or suburban in character, with relatively few pedestrians to be accommodated. As a result, DOT standards developers could be largely unaware of the challenges faced by practitioners in urban areas with heavier pedestrian traffic.

The evidence base for work zone pedestrian safety interventions is very limited, and the effectiveness of proposed solutions is largely untested. Nearly all of the studies that have been completed lack the scale necessary to produce quantitative results. The few studies that have been conducted are all quite limited in scope and duration, indicating probable underfunding.

Taken as a whole, it is likely that the scope and quality of the existing research base would be considered unacceptable in the public health or medical domains. This is particularly notable given the scale of annual expenditures on construction projects that affect pedestrian safety and mobility, as well as the number of pedestrian injuries that result in emergency department visits and hospital admissions. The lack of evidence-based design criteria potentially results in unnecessary pedestrian casualties, which equates to avoidable costs that are currently being incurred by transportation agencies, government healthcare programs, private insurers, and pedestrians themselves.

Methodologies that can potentially be applied to evaluate the suitability of work zone pedestrian solutions include the following:

- Pedestrian surveys or focus groups (including consultations with people with disabilities) to assess user needs and user acceptance of proposed solutions
- Direct observation of conflicts between motorized and nonmotorized road users (treating conflicts as surrogate measures of safety)
- Before-after studies that compare pedestrian mobility and safety outcomes prior to and after implementation of a new feature or design approach
- Paired comparisons of similar work zones (or similar parts of the same work zone) where different design solutions have been applied
- Randomized control trials where different solutions are applied in work zones that are otherwise similar in terms of design and traffic characteristics, for instance, when a program of similar pedestrian improvements is completed citywide

Several research needs were identified. Relatively little is documented about the characteristics of temporary pedestrian facility users, their abilities, and their accommodation needs. There is also a definite need for research on the basic elements or “building blocks” of pedestrian mobility such as small vertical transitions, ramp slopes, pathway widths, and acceptable surfacing materials. Such evidence could help resolve ambiguity on the extent to which standards developed for permanent construction can be relaxed in short-term situations. The outcomes are

likely to influence the cost of temporary facilities and their space requirements, which in turn help establish the road space available for motorized traffic.

The absence of typical application drawings that cover the full range of temporary pedestrian traffic management situations is also notable, given the existence of such drawings in European practice (Certu 2011).

Other important research needs include rational guidance for the selection of pedestrian fencing and creative solutions for managing motorized and nonmotorized traffic in the vicinity of public transit stops during construction.

A few studies exploring work zone navigational assistance devices for visually impaired pedestrians were found. Additional research appears to be needed to address the navigational needs of pedestrians with visual, sensory, and cognitive disabilities. Insights from space syntax research could help guide these efforts.

To begin addressing some of these research needs, the project team proposed the development of a Pedestrian Test Track. The track would have allowed ambulatory pedestrians and people with disabilities to experience various temporary pedestrian facility elements in a realistic setting that was free of motor vehicle traffic. These could have included a variety of designs for curb ramps, small vertical transitions, and guidance railings, along with various temporary surfacing materials. Regrettably, the COVID-19 pandemic resulted in a series of delays in implementation of the Pedestrian Test Track. These ultimately resulted in cancellation of the test track due to conflicts with administrative constraints on the use of SWZDI funding.

In spite of these difficulties, the Pedestrian Test Track appears to remain as a viable method for obtaining quantitative data on the performance of various temporary pedestrian accommodation elements. Future research of this type could lead to improvements in pedestrian mobility, reductions in pedestrian injuries, and cost savings for transportation agencies, insurers, government healthcare programs, and pedestrians themselves.

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## **APPENDIX: MATERIALS RELATED TO IMPLEMENTATION OF THE PEDESTRIAN TEST TRACK**

The following materials related to implementation of the Pedestrian Test Track are presented in this appendix:

- Institutional Review Board (IRB) application form
- Participant recruitment flyer
- Participant self-nomination form
- Script and workflow for screening participants by telephone
- Informed consent form
- Data collection form
- Cost estimate for test track materials

Institutional Review Board (IRB) Application  
for Human Subjects Research

## View xForm - IRB Application

## IRB Application - v1.4 Most Reasonable Person

## Application Data Entry

- Submitted 11/03/2020 3:20 PM ET by Shaw, John MUP

## Basic Study and PI Information

## IMPORTANT NOTICE

**!** After a temporary halt, Iowa State has implemented a phased approach to safely resume research that requires face-to-face interactions with research participants. Information about the current phase and planning resources can be found on the [COVID-19 & Research](#) web page. Please also carefully review [IRB Guidance - Special Considerations During Covid-19](#).

Please be aware that the IRB will not assess whether your research is permitted under the current phase. Instead, research will be approved with the condition that only activities permitted during the current phase may proceed. This allows proactive submission and approval of future projects.

If you wish to begin your study soon, please review the requirements associated with the current phase and ensure this IRB application reflects relevant phase criteria (e.g., remote procedures whenever possible). Researchers are responsible for ensuring congruence between IRB applications and applicable elements of your COVID-19 Risk Mitigation Plan. **Any face-to-face procedures included in this application can proceed only when all criteria for the current allowable phase are met.**

## This application applies to the following:

- A **Human Subjects Research Project** overseen by the ISU IRB.
- **Creating/Maintaining a Recruitment Registry AND/OR Data or Specimen Repository.**
- **Request to Rely on an External IRB** for oversight of a Human Subjects Research Project.
- **Request for Preliminary IRB Determination** only for funded projects that lack definite plans for the involvement of human subjects because time after the award is needed to develop the final protocol and related study materials.

## Please select the application type below.

Human Subjects Research Project

## Note about Recruitment Registries or Data/Specimen Repositories:

- A stand-alone IRB protocol is required when [establishing](#) a recruitment registry AND/OR data or specimen repository.
- If you are obtaining data from an [existing](#) repository, or using an existing recruitment registry as part of a Human Subjects Research Project, check "Human Subjects Research Project".

## Basic Study Information

## Submitter

Shaw, John MUP

Email: jwshaw@iastate.edu

Business: 515-294-4366

## Title of Project (If funded, use proposal/award title.)

Work Zone Pedestrian Accommodations Testing

## Please enter the email address of the principal investigator.

*If you are the principal investigator, please enter your own email address.*

Shaw, John MUP

Email: jwshaw@iastate.edu

Business: 515-294-4366

## CITI Human Subjects Training Expiration

05/24/2118

Additional PI and Study Information 

## PI Level

P&amp;S Employee, P37 &amp; above

## PI's Department Chair

Hallmark, Shauna

Email: shallmar@iastate.edu

Phone:

**Select the Department overseeing this research.**

*This is typically the department of the PI unless the study requires a Supervising Investigator. In that instance, it should be the Supervising Investigator's department.*

Institute for Transportation

**Department Chair for this Research**

Hallmark, Shauna

Email: shallmar@iastate.edu

Phone:

**Alternative Department Chair**

No answer provided.

**Is or will the project be externally funded?**

Yes

*External funding may come from federal funds, state or local government agencies, non-profit institutions, or for-profit businesses. Internal department funding is not considered "external" funding.*

**Will researchers at other institution(s) be involved in any human subjects research activities?**

No

Select "**yes**" if individuals at other institutions will be involved as **researchers** on the project who do one or more of the following:

- Direct recruitment of research participants,
- Obtaining informed consent from research participants,
- Interacting with research participants to collect data,
- Administering any research interventions, tests, procedures, etc., or
- Access to identifiable research data.

Select "**yes**" if:

- You wish to have an IRB at another institution oversee the project.

Select "**no**" if:

- You are conducting research at a collaborating site, but the only role of persons at that site is to **serve as research participants**, or
- Activities of collaborating researchers do not involve human subjects (e.g., contributing to methodology, analysis of de-identified data, etc.).

**Key Personnel**

Key personnel include any individuals who will be involved with collecting data from participants, involved with recruitment or obtaining informed consent, or who have access to their private and identifiable data. For details about who must be listed as key personnel, please see [Human Subjects – Persons Required to Obtain IRB Training](#).

All key personnel other than the PI and/or Supervising Investigator working on this study will need to be listed in response to one of the two questions below. This information is intended to inform the committee of the training and background related to the specific procedures that each person will perform on the project.

**Please be sure to select the appropriate table for the personnel:**

- **Table 1** - ISU Faculty and P&S Staff ONLY, OR
- **Table 2** - All Other Personnel (i.e., ISU research assistants, ISU student personnel, hourly staff, transcribers, coders, non-ISU investigators, etc.)

**NOTE:** All ISU Faculty and P&S Staff listed on this application will receive an automated email from IRBManager after the PI or Supervising Investigator Signature stages instructing them to indicate if they have any Significant Financial Interest(s) related to this study. All will be prompted to verify with electronic signature prior to the form moving to the Department Chair Signature stage.

**Do you have any personnel other than the PI and Supervising Investigator who are responsible for the design, conduct, reporting of the human subjects aspects of this research, or are involved in any human subjects research activities?**

No

**Funding****Funding Types****Please identify all types of sources from which the project is funded.**

Federal Agency (including federal flow-through or federal subrecipient agreements)  
State/Local Government Agency

**Funding Source****Please provide the complete names of the funding sources; please do not use acronyms.**

Iowa Department of Transportation - Multi-State Pooled Funds Study with flow-through of Federal Highway Administration funding.

**Please provide the title of the proposal(s) as it will be submitted to the funding agency.**

SWZDI Work Zone Pedestrian Accommodations Field Testing

**Please provide the federal proposal or award number(s).**

TPF-5(295)

**Please provide either the non-federal proposal/award number(s) or the goldsheet number(s).**

474-76-20

**Some federal agencies have specific requirements. Please select the agency(ies) from the list below that fund or support this study. This allows agency-specific questions to appear within this application.**

Other federal agency

**Is ISU considered to be the Lead or Prime awardee for this project?**

Yes

**Is the PI on this IRB application the lead ISU PI on the proposal/award for this funding source?**

Yes

**Are there or will there be any subrecipient agreements issued to others for this project?**

No

**Is or will this project be funded by a subrecipient agreement issued by another entity?**

No



The IRB is no longer required to review funding proposals to ensure congruence with IRB applications. As a reminder, be sure to seek prospective IRB approval or determination of exemption for any human subjects research activities that are carried out under funded proposals.

**General Overview - Purpose and Expected Benefits****Research Objectives - Briefly explain in language understandable to a layperson the purpose and specific aim(s) of the study.**

*Note: If copying text from any other sources or programs into the field below, please right-click and only "paste as plain text" to avoid inclusion of any code (e.g., html, css, etc.) that may affect visibility of your response in this web-based form.*

Pedestrian accommodations for roadway construction projects are often problematic for ambulatory people and people with disabilities. The objective of this project is to evaluate the suitability of various temporary surfacing materials, temporary ramps, and temporary pedestrian channelization devices intended for use in roadway work zones.

**Broader Impacts/Significance - Explain in language understandable to a layperson why this research is important and how the information gained in this study is expected to advance knowledge and/or serve the good of society.**

*Be sure to include justification as to why this study is necessary.*

*Note: If copying text from any other sources or programs into the field below, please right-click and only "paste as plain text" to avoid inclusion of any code (e.g., html, css, etc.) that may affect visibility of your response in this web-based form.*

Inadequate pedestrian accommodations at roadway work zones adversely impact personal mobility for ambulatory people and people with disabilities, and discourage the use of active (non-motorized) transportation. There is a longstanding and pervasive problem with work zones that do not meet the requirements of the federal Manual on Uniform Traffic Control Devices (MUTCD) or the intent of the Americans with Disabilities Act (ADA). This project is intended to address the underlying causes of these problems by evaluating improved materials and methods for accommodating pedestrians in work zones.

**Benefits to Participants - Are there any expected direct benefits to research participants from participation in the research?**

Compensation (i.e., monetary, course credit, etc.) is **not** considered to be a benefit of participation in research.

No

**Research Plan - Participant Characteristics****Inclusion Criteria - Describe the specific characteristics of persons that will be included in your study, and provide justification for these requirements.**

Ambulatory adults and adults with mild to moderate physical disabilities such as wheelchair use, low vision, or palsy.

**Exclusion Criteria - Describe the characteristics of any persons who will not be allowed to participate in your study, and provide justification for their exclusion.**

Due to risk of injury, potential participants with the following characteristics be EXCLUDED from the study:

1. People with severe physical or cognitive disabilities such as advanced dementia.
2. People who ordinarily would not attempt to navigate urban spaces as pedestrians.
3. People who are unable to walk a distance of approximately 600 feet without the support of another person (guide dogs, wheelchairs, and other mobility devices are allowable)
4. People who are unable to walk a distance of approximately 600 feet without symptoms such as dizziness, vertigo, or shortness of breath.
5. People who are prone to slips, trips, or falls, especially if they have osteoporosis (brittle bones).

**Do you intend, or is it likely that your study will include any persons from the following populations? Please check all that apply.**

Other vulnerable populations, given the setting of your research

**Please describe the "other" population you plan to include in your research.**

People with mild to moderate physical disabilities.

**Participant Enrollment**

Please indicate the maximum number of participants you expect to enroll in your study. This number should include the total number of participants across all groups and account for any enrollment that may be needed due to attrition, withdrawals, screen failures, etc. 150

Please include details about the planned enrollment numbers such as how many you expect to include in any groups or conditions, how many you expect to screen versus fully enroll in the study, etc.

Recruitment and selection will be designed to provide a cross-section of adults with various types of mild to moderate physical disabilities, such as wheelchair use, palsy, and low vision, along with ambulatory adults.

**Research Plan - Data Collection Procedures****Research Procedures**

**Using layperson's terminology, please describe in detail your plans for collecting data from participants. Include a description of all procedures, tasks, or interventions participants will be asked to complete during the research** (e.g., random assignment, any conditions or treatment groups into which participants will be divided, mail survey or interview procedures, observation protocols, sensors to be worn, amount of blood drawn, etc.).

*Please ensure that references to materials attached throughout the application are clear. We recommend that attachments (i.e., surveys, interview protocols, copies of stimuli, instructions for tasks, etc.) are clearly named and when mentioning them in this section those names are used.*

*Note: If copying text from any other sources or programs into the field below, please right-click and only "paste as plain text" to avoid inclusion of any code (e.g., html, css, etc.) that may affect visibility of your response in this web-based form.*

A "pedestrian test track" will be constructed in Ames. The test track will consist of several types of temporary surfacing materials, ramps, and pedestrian channelization devices. Participants will arrive at the test track by appointment for a self-guided walk-through of the pedestrian test track. Along the walk there will be numbered stations identifying each test surface, ramp, and channelizer. Participants will use a pre-printed form to rate the suitability of each surface/device in the context of their personal abilities. Each participant will make one or two walk-throughs, typically one with the track in dry condition and a second after it has been sprayed with water to simulate a rainfall event (if the participant arrives on a rainy day, only the wet condition test will be conducted). With participant consent, the project team will also interview some of the participants by telephone to get further information about the suitability of the devices.

The test track will be designed to emulate situations frequently encountered in urban work zones.

- "Ramps" as used in this application means curb ramps, i.e. inclined surfaces with a vertical rise of approximately 6 inches, as would typically be encountered at street corners. We do not anticipate testing the much longer/higher ramps typically required for building entrances.

- We anticipate testing pedestrian channelization devices intended to provide guidance for visually-impaired pedestrians. We do not anticipate testing any fall-protection handrails.

- Pedestrian channelization devices, or directional guidance railings, are more like a fence than a railing. They help direct users through the work zone but don't provide support, balance, or fall protection. In this photo (follow link) there are pedestrian channelizing devices on the left, and a permanent handrail on the right.

[https://commons.wikimedia.org/wiki/Category:Pedestrian\\_barriers#/media/File:Wastewater\\_Pipeline\\_Works\\_In\\_Grafton.jpg](https://commons.wikimedia.org/wiki/Category:Pedestrian_barriers#/media/File:Wastewater_Pipeline_Works_In_Grafton.jpg)

- All of the anticipated vertical grade differences will be 6 inches or less, which does not invoke the use of fall-protection railings in current practice (proposed Federal design guidance for permanent facilities, PROWAG sections R408.6 and R409.1, does not require railings unless the rise exceeds 6 inches).

The surfacing materials to be tested are as follows:

- Type CDX Plywood, "C" graded side up (control)
- Type CDX Plywood, "D" graded side up
- Type T1-11 plywood, grooved side up
- Oriented strand board, rough side up (OSB is a plywood-like material made from pressure-laminated wood flakes)
- Timber planks
- Pallets with infill boards
- Pallets with plywood overlay
- Cold mix asphalt (control)
- Stabilized earth (also called soil-cement)
- Compacted breaker-run limestone
- Low-strength concrete (also called controlled low-strength material or slurry)

Asphalt and CDX plywood are included in the project as experimental controls, since these are currently the most commonly used materials.

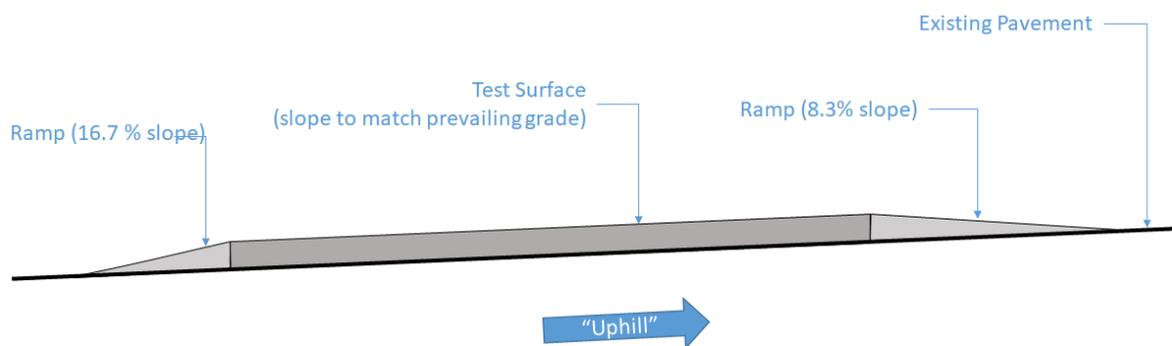
The pedestrian channelization devices to be tested include:

- Minnesota DOT two-rail TPAR design (MnDOT Figure 6K-5)
- Three-rail barricade based on MnDOT TAPR design
- Plastic snow fence with timber top rail
- Site-fabricated wood channelizer
- Concrete blocks, dry stacked and secured with cable ties
- Prefabricated plastic (Plasticade Crowdcade Deluxe, Oxford Plastics Avalon, or similar)

Understanding the interaction between curb ramp slopes and surface type is an important goal of this project. In general, the maximum slope used for permanent curb ramps is about 8.3% (1:12). This means for a typical street-to-sidewalk elevation change of 6 inches, a ramp must be at least 6 feet long. Such slopes are technically infeasible in most work zones due to space constraints, because in most cases a 6 foot long ramp would extend into the traffic lane. Since shorter/steeper ramps are routinely used in actual work zones, we anticipate testing the interaction between surfacing material type and ramp slopes up to 16.6% (1:6).

The elevation difference between the top surface of the test track and the adjoining parking lot surface is expected to be 6 inches or less, mimicking the typical height of a curb or sidewalk above the adjoining street. As noted earlier, existing design standards for permanent construction only require railings or other fall-protection devices for elevation differences greater than 6 inches. If the final configuration of the test track requires a location with an elevation difference of more than 6 inches, that section will be equipped with a standard fall-protection railing, which will not be a test article.

Due to cost constraints, the current plan is to build the test track outdoors at an existing parking lot. Such facilities are always sloped for stormwater drainage. Participants will be asked to walk both the uphill and downhill directions of these modest slopes.



If the data collection extends into the winter (which is not currently planned), weather issues will be discussed with participants during scheduling and they will be reminded to dress appropriately for the outdoor setting. We do not anticipate covering the test track. If participants arrive when the track is wet, for example due to rain, they will only complete the wet test. The weather and surface condition at the time of the participant's visit will be noted. Our goal is to complete the data collection before winter. If the data collection extends into the winter, the track will receive typical winter sidewalk maintenance (such as manual snow removal and salting) prior to participant walk-throughs. Should data collection extend into the winter, any weather event that results in closure of the Ames Public Schools or Iowa State University will also result in postponement of participant walk-throughs.

**Will your research include any types of recordings that may capture private or identifiable information?**

*These selections must be described in detail in the research procedures above.*

Video recordings  
Photographs

**Secondary Use of Data or Information from Records, Repositories, Databases, or Similar Sources**

**Does your study involve obtaining information or data about people from records, (e.g., student records, medical records, etc.), repositories (e.g., tissue banks, biospecimen repositories, etc.), or other similar sources (e.g., government databases, data from other studies, etc.)?**

No

**Will any devices be used for data collection (i.e., eye trackers, activity monitors, heart rate monitors, EEG, MRI, DEXA, other sensors, etc.)?**

No

**Does the research involve collection of data from observation of people's behaviors or activities?**

Yes

**If you plan to use an observation protocol or matrix, please attach it here.**

*This attachment does not replace a complete response to the following questions.*

*No answer provided.*

**Please describe the specific behaviors or activities that will be observed.**

A member of the project team will observe the pedestrian interactions with each walking surface, ramp, and handrail to look for any signs that the materials or device design are problematic, such as hesitation or deliberately skipping a device or surface that the participant considers problematic.

**How will you record information during observation (e.g., field notes, audio/video, etc.)?**

The research team will collect field notes about the participant interactions with the devices, and video recordings will be conducted to provide a record of each walk-through. Camera angles will be selected to minimize images of participants' faces, as the objective of the research is to learn about interactions with the participants' hands and feet, and the tires/treads of assistive devices such as wheelchairs.

**Will any identifying information about participants be recorded during the observations?**

No

**Will participants give informed consent to be observed?**

Yes

**Will participants be *deceived or misled* about anything during the study, and/or do you plan to *intentionally withhold* information from participants, such as the full purpose of the study, a full description of procedures, etc.? Check all that apply.**

NO - ALL participants will be fully informed about the study.

**Will your participants consume any substances for purposes of your research (e.g., food, beverage, dietary supplements, drugs, vitamins, etc.)?**

No

**Does this project involve prospective collection of human biospecimens (e.g., blood components, body fluids, excreta, tissues, hair, teeth, etc.)?**

No

**Do you expect to generate any clinically relevant results from your research (e.g., from blood or urine tests, scans, diagnostic assessments, etc.)?**

No

**Will the research take place in an international setting?**

No

**Do you believe your study may qualify for exemption?**



No

**Data Collection Materials**

**Attach any materials related to the data collection and screening procedures (e.g., survey questions, interview questions, medical history questionnaire, focus group protocols, descriptions of stimuli, descriptions of tasks, etc.) you will use for this study.**

- DO NOT attach recruitment and informed consent materials here. If required, you will be asked to attach these items in later sections of the form.
- If you have already attached data collection materials (i.e. observation protocol, etc.) as a response to another question, you do not need to upload it here.

Participant Response Questionnaire Surveys/Questionnaires  
 Participant Screening Form Surveys/Questionnaires

**Clinical Trials**

**There are special requirements related to conducting Clinical Trials, including training on Good Clinical Practices, trial registration and results-reporting at ClinicalTrials.gov, and in some cases, approval from the Food and Drug Administration. These requirements differ depending on the funding agency and/or type of clinical trial. The following questions are intended to identify research that is subject to these requirements.**

**Does your study involve research on any of the following:**

None

**Please answer the following questions to assess whether or not your study meets the definition of a Clinical Trial:**

*A research study in which one or more human subjects are prospectively assigned to one or more interventions (which may include placebo or other control) to evaluate the effects of those interventions on health-related biomedical or behavioral outcomes.*

**Is your study funded in whole or in part by any federal agency?**

Yes

**Is any of the funding from the National Institutes of Health or any of its institutes, centers, or offices?**

No

**Does the study involve the use of one or more *interventions*?**

Guidance (per NIH): An *intervention* is defined as a manipulation of the subject or the subject’s environment for the purpose of modifying one or more health-related biomedical or behavioral processes and/or endpoints. Examples include

- strategies to change health-related behavior (e.g., diet, cognitive therapy, exercise, development of new habits);
- treatment strategies;
- prevention strategies;
- diagnostic strategies;
- drugs/small molecules/compounds;
- biologics;
- devices;
- procedures (e.g., surgical techniques);
- delivery systems (e.g., telemedicine, face-to-face interviews)

No

**Is your study a FDA Applicable Clinical Trial, for which registration at [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov) is required? Please check [this flowchart](#) before responding.**

No

**ClinicalTrials.gov Registry**



If you plan to publish the results in a member journal of the International Committee of Medical Journal Editors (ICMJE), please be aware that ICMJE requires clinical trial registration in a public registry such as [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov) to be a condition for publication. For more information see: <http://icmje.org/about-icmje/faqs/clinical-trials-registration/>.

**Discomfort or Risk to Participants**

**Discomfort or Risk**

**Are there any foreseeable discomfort or risk to participants from taking part in your research?**

Yes

**Do you foresee any physical discomfort/risk to participants?**

*Examples may include: injury, bruising from a blood draw, pain, side-effects from drugs administered, allergic reactions, etc.*

No

**Do you foresee any psychological discomfort/risk to participants?**

Examples may include: emotional discomfort from answering questions, stress or anxiety from procedures, mood alterations, viewing offensive or "shocking" materials, etc.

No

**Do you foresee any informational or social discomfort/risk to participants?**

Examples may include: harm if information collected about the participant were disclosed or overheard, such as embarrassment, retribution, harm to reputation or stigmatization, disruption of personal or family relationships, disruption of employment or workplace relationships, etc.

No

**Do you foresee any legal discomfort/risk to participants?**

Examples may include: criminal liability if information about participants' illegal behaviors is collected, etc.

No

**Do you foresee any other discomfort/risk to participants, given the setting of your research?**

Yes

**Please describe the other discomfort/risk and explain how each will be mitigated or minimized.**

To minimize overall risk, the test track site will be located well away from live traffic. While this eliminates the main source of pedestrian casualties, there is a slight risk of participant slip/fall injuries while walking the test track. This is similar to the slip/fall risks that routinely exist while walking in actual roadway work zones.

A walking surface made of type CDX plywood is planned as a "control" condition, since this surfacing material is routinely used in current practice. The surfacing materials to be tested (such as type T1-11 plywood, which has a rough surface) are expected to provide skid-resistance and other walking characteristics that are superior to the CDX plywood that is currently the de-facto industry standard.

Members of the study team will pre-test all walking surfaces under wet and dry conditions on foot and using a wheelchair; modifications such as grab bars will be added if necessary. Additionally, a member of the project team will monitor the site at all times that participants are present, and will contact qualified emergency services personnel immediately in case of a slip/fall or other mishap.

Participants will not be required to complete all elements of the test track; items that are skipped will be tabulated as indicators that a surface is potentially perceived as unsuitable.

As discussed in the confidentiality section, videos and still photos will be collected to document participant interactions with the test articles. Faces and other identifying features will be redacted from any photos used in publications resulting from this project. In addition, if participants are recognized, no personal information (other than ability to navigate the test track) would be disclosed, and as a result participation poses limited (if any) potential discomfort or risk.

**Data and Safety Monitoring**

**Is a data safety and monitoring plan required for this study?** (This relates primarily to Clinical Trials.)

No

**Recruitment and Informed Consent****Recruitment Process** 

**Describe the process you will use to identify and invite people to take part in your study.** Your response should include how you will obtain contact information for your potential participants AND how you will contact them.

Examples of how you will obtain contact information for your potential participants: review of public records (e.g., voter lists, utilities lists, phone directory, ISU directory, etc.), review of private records (e.g., medical records, student records, etc.), purchased mailing lists, personal contacts/knowledge, "snowball" sampling, participant responses to posted advertisements or flyers, etc.)



Examples of how you will contact them: letter or email, phone call, posting flyers, posting announcement on a website, posting on a SONA system, distribution of email or ads via Listserves or online bulletin-boards, television or radio advertisements, personal or verbal announcements, informal personal communication, etc.

Participants will be recruited through emails, flyers, and announcements on selected Facebook sites. Some of these communications will be directed to general ISU and Ames-area communities, while others will be targeted toward groups for people with mild to moderate disabilities such as low vision, palsy, and wheelchair use. The email content will be the same as the flyer content, but the email will be in HTML format. To assist readers with low vision, alternative text descriptions (alt text) will be provided for all images, and the document text will be scalable.

Participants will be invited to express interest by filling out a Qualtrics survey with pre-screening questions (uploaded below in the Recruitment Materials section).

Based on the preferences expressed in the pre-screening questionnaire, participants who meet the pre-screening criteria will be contacted by phone, text messaging, or email for screening and scheduling, and to obtain a consent form (uploaded in the Data Collection Materials section earlier in this application).

Schedule reminders will be sent a day or two in advance of the visit.

## Recruitment Materials

Attach **all** materials you will use to recruit or invite participants to take part in your study. Documents must be PDFs or Word documents.

*For example: phone scripts, advertisements, flyers, letters, emails, verbal talking points, etc.*

Participant Recruitment Flyer      Recruitment Ad/Flyer/Web Posting  
Participant Pre-Screening Survey      Recruitment Email/Letter

## Assessing Participant Eligibility

What is your **process** for determining whether or not all potential participants are eligible to participate prior to including them in your study?

*The information provided here should explain how you will ensure that participants are eligible based on the inclusion and exclusion criteria you have assigned for this study. Please be sure to include information on any screening procedures you may be conducting prior to enrollment.*

*If you will ask participants to do something specific (e.g., fasting, abstaining from activity, etc.) prior to their formal enrollment, you must first obtain their informed consent. Your description of the consent process(es) must include plans to obtain consent prior to any screening or eligibility assessment activities.*

*Formal informed consent may not be required prior to screening when procedures are limited to obtaining information through oral or written communication (e.g., questionnaires, interviews, etc.) or obtaining data from records.*

Prospective participants will contact the project team by filling out a short pre-screening questionnaire to assure that the volunteer is age 18 or older, can handle the physical tasks of walking on the test track, and can arrange their own transportation to the test track. This form will also obtain phone and email contacts so that the participant can be contacted for screening and scheduling.

After screening and scheduling the participant will be sent a consent form by mail or email. Extra copies of the consent form will also be available at the test site.

## Consent Process for Adult Participants

In most cases, people cannot participate in a research study without first obtaining their informed consent. Obtaining informed consent is much more than asking people to sign a document; in fact, in many instances, no signatures are required. Instead, it is an **ongoing process between researcher and participant** where information is conveyed, in an appropriate manner and setting, to allow persons to voluntarily consider and choose whether or not to participate.

People can truly give informed consent, only when:

- **Meaningful information** about the study is conveyed in a **clear manner, understandable to the participant** (e.g., well-organized, concise, no scientific jargon, appropriate reading level and language, etc.)
- The participant has **sufficient opportunity to consider** the information, ask questions, discuss it with others, etc.
- Consent is given **freely**, and under the circumstances that **eliminate or minimize undue influence or coercion**.
- In cases where adult participants are **unable to consent for themselves**, such as those with impaired decision making capacity due to disease, dementia, life-threatening situations, etc., informed consent must be obtained from the participants' **Legally Authorized Representative**. Additionally, participants must be given an opportunity to assent (affirmatively agree) to the extent possible.

Please describe the **process(es) you will follow** to obtain the voluntary, informed consent of ADULT participants. Your response must include sufficient information regarding how your planned consent process(es) address the points above.

*Note: If copying text from any other sources or programs into the field below, please right-click and only "**paste as plain text**" to avoid inclusion of any code (e.g., html, css, etc.) that may affect visibility of your response in this web-based form.*

After participants have been pre-screened, as described above, a member of the project team will then contact the potential participant to explain the project, answer any questions, complete the screening questionnaire, discuss compensation and travel expense reimbursements if relevant, and schedule the test track visit. Copies of the consent form and response form will then be sent to the participant by mail or email. To assist readers with low vision, an alternative text descriptions (alt text) will be provided for the image used in the electronic version of the document, and the electronic document text will be scalable. A large print version of the consent form will be available in hard copy. Researchers will collect signed hard copy consent materials from participants before the data collection session begins.

**In very limited instances, human subjects may be involved in research without their informed consent.** For example, consent may not be obtained from those who are third-parties in an observation process, or when research involves obtaining existing records, etc. Anytime informed consent will not be obtained, the IRB must grant a waiver of the typical, informed consent requirement. A waiver is generally allowable with sufficient justification that your study meets **special criteria**.

**In your study, will informed consent be obtained from ALL participants before they complete any research procedures?**

YES - Informed consent will be obtained from ALL adult participants.

**The informed consent process is typically documented with the hand-written signature of the adult participant. For many low-risk studies, the IRB can waive the requirement to obtain a signature.** This is common in online surveys,

telephone interviews, for preparatory activities prior to an initial lab visit (e.g., fasting), etc. and allowable if **special criteria** are met.

**Will consenting participants be asked to physically sign a consent document prior to completing any research procedures (including screening interventions)?**

YES - ALL consenting participants will be asked to physically sign the consent document before completing any research procedures (including screening interventions).

**Consent Documents** 

**Entered:** 11/04/2020 **By:** Agnitsch, Kerry

Large print version obtained from PI via email, and uploaded below.

**Attach all materials you will use to obtain the informed consent of adult participants prior to their enrollment in your study. Documents must be PDFs or Word documents. Word documents are preferred.**

*Please upload individual documents for each participant group in the study. They must be labeled clearly to denote the participant group or phase to which each document applies.*

*If your study involves children, you will be asked to upload assent documents and parental permission documents in the relevant section of the application.*

Informed Consent Form - large print    Informed Consent - Adults  
Informed Consent Form (Revision 2)    Informed Consent - Adults

**Translation**

**Translation of Information or Materials**

In order to facilitate meaningful informed consent, recruitment and informed consent materials must be in a language understandable to the participants. If your study will include individuals who do not read or speak English, recruitment and consent materials must be translated into the appropriate languages.

**Please check the following to describe your plans.**

All participants are expected to be fluent in English. Translation is not required.

**Compensation**

**Compensation**

**Will participants receive any compensation (i.e., monetary, course credit, etc.) for their participation in your research?**

Yes

**Select the type(s) of compensation that will be provided.**

Gift cards  
Reimbursement for expenses (e.g., costs of travel to lab, child care, meals, etc.)

**Describe the specific amount of compensation to be provided.**

*For example, the specific amount of money or gift card, value of gifts, points of course credit, etc. If course credit will be provided, and the number of points will vary by course, provide the percentage of overall course grade that will not be exceeded (e.g., credit/extra credit will range from 0.5 to 1% of overall course grade).*

Gift cards in the amount of \$25 will be provided to compensate participants for their time. Participants who self-identify as people with disabilities at the time they complete the screening questionnaire will be reimbursed up to \$25 for the cost of bus/taxi/Uber/Lyft transportation to the site.

To avoid potential conflicts of interest, participants who are affiliated with the ISU Institute for Transportation will not be eligible for gift cards. This restriction also applies to employees and on-site contractors of the five project sponsors, which are the Iowa, Kansas, Missouri, Nebraska, and Wisconsin Departments of Transportation.

**Participants CANNOT be required to fully complete all study procedures to receive compensation. Please explain how compensation will be provided if the participant fails to complete some procedures or withdraws prior to completion of the study.**

Participants who come to the pedestrian test track but are unable to complete it (or only partially complete it) will receive the same gift card and travel expense reimbursements as those who fully complete the experiment. No-shows will not be compensated.



*To meet record-keeping requirements of the State of Iowa and IRS, the ISU Controllor's Office requires completion of a Research Participant Receipt Form (RPRF) by research participants who receive compensation. Compensation types vary; examples include cash, checks, gift certificates, personal property, or other items of value. More information and links to the RPRF form can be found on the ISU [Controllor's Department](#) website.*

## Privacy

### Privacy and Confidentiality Guidance

*As you prepare your privacy and confidentiality plans for working remotely and the use of MTurk, please review the following guidance:*

- [Working Remotely with Human Subjects Research: Privacy and Confidentiality Considerations](#)
- [Research Using Mechanical Turk](#)

### Describe how participants' privacy will be protected during recruitment and data collection.

*For example, discussions/procedures will be conducted in private locations, messages regarding the research will not be left on answering machines without permission of participant, how documents or recordings will be kept secure while in the field and during transmission, etc.*

Participants will be recruited through bulk emails such as campus-wide announcements, and announcements on social media groups oriented toward people with disabilities. The researchers will not join private or closed Facebook groups solely for the purpose of recruiting for this study, but instead will ask moderators/group owners to share recruitment materials within those groups. Social media users will be asked to forward/share information with others through private/direct messages, instead of tagging or naming individuals in response to a recruitment post. If necessary, additional recruitment will be done through targeted online advertising such as Facebook posts or Google ads. Follow-up communications will be by email and telephone. Scheduling-related messages will not be left on voicemail without the participant's consent.

We anticipate using a bulk email service such as MailChimp to send project announcements. This service creates a separate email to each participant, which has only one sender and one recipient. The BCC function will be used if this cannot be done for mailings to internal lists.

If recruitment emails are forwarded by third parties, participants will be instructed to directly contact the research team with any questions (or use a provided link to do so), instead of following up through the person who forwarded the email.

The project team will be reaching out to the Iowa Department of Human Services and other organizations that serve people with disabilities in Central Iowa for recommended email distribution lists and/or social media groups. Whether these groups are open or closed is not known at this time, but in all cases participants will be encouraged to respond by completing the Qualtrics pre-screening survey rather than contacting the research team by email. The researchers are not currently members of any relevant groups, except the general Ames People group on Facebook which is a fallback if more targeted groups cannot be identified.

Beyond Facebook, other platforms that might be used are unknown at this time, as this will depend on the platforms that have been selected by groups and organizations that have not yet been contacted. A revised IRB application will be submitted if additional social media sites need to be utilized. In all cases the social media platforms will be used for one-way communication to announce the call for volunteers, not to collect participant data.

Participants will be asked to respond by completing the pre-screening survey, not through email or in-forum discussions.

Paid advertisements on Google appear alongside search results. These advertisements are based on specific search terms and geographies. For example, if the project team is not successful in recruiting a sufficient number of wheelchair users, we might purchase ads based on a search term such as "wheelchair maintenance" and further targeted to users who access Google from servers located in Boone and Story Counties. When a user clicks on the advertisement, they will be taken to a web page with the HTML version of the project flyer, which will then link to the pre-screening survey.

As indicated in the recruitment materials, the test track will be outdoors. The courts have long held that there can be no expectation of privacy in public outdoor spaces. For example in *Oliver vs United States*, the Supreme Court wrote, "an individual may not legitimately demand privacy for activities conducted out of doors...except in the area immediately surrounding the home." Nevertheless, the anticipated test track location is rather secluded. This site is the overflow parking lot of Building 2 of the ISU Research Park on North Loop Drive in Ames, which is distant from activity centers such as downtown Ames and the ISU campus. The site is heavily-landscaped, has low pedestrian and motor vehicle traffic, and is set back quite far from the adjacent streets where it is not readily visible. Based on the physical distancing protocol, participants will be scheduled to arrive one at a time, making it unlikely that any conversations with companions will be overheard. In addition, the research involves no sensitive activities: the only action required of the participants is walking/wheeling outdoors. Since screening questions ask participants to affirm that this is an activity they already do on a regular basis, participating in the test track is highly unlikely to reveal anything that an observer would not discover if they saw the same person in any other public setting. In addition, the consent form includes a disclosure that the site is visible from nearby buildings and streets.

In accordance with the Institute for Transportation's established protocols, all electronic data (including video) will be stored in private folders on Cybox that are accessible only to project team members. Hard-copy information will be stored in locked filing cabinets accessible only to the project team. Newly-collected consent forms and response forms will be stored in a lockbox during transfer to the Intrans office.

## Data Security

### Minimum Data Security Standards

Iowa State University established a [data security policy](#) in 2015, which establishes minimum security standards. The policy has established four classifications of data (Restricted, High, Moderate, Low). Research data is classified as "moderate", as such, [security](#)

A12

standards outlined for moderate level data apply – unless the research data includes information that falls into one of the higher levels of classification (e.g. FERPA protected, HIPAA protected, etc.) Investigators should follow the Minimum Security Standards appropriate for the classification of their data.

You will first select the classification level that applies to your research. Appropriate classification is based on the nature and sensitivity of the data. You will next be asked to confirm your agreement to implement the applicable minimum security standards that apply to the data classification level selected for your research project. **Principal Investigators and Supervising Investigators are responsible for ensuring correct implementation of these standards.** You are strongly encouraged to work with departmental, college, or University IT staff as needed.

**Please select from the options below to indicate the sensitivity level/data classification that applies to your study.**

MODERATE - Includes: all research data, unless High or Restricted

**I agree to implement the Minimum Security Standards required for the Moderate Classification specified by ISU Policy for all electronic data/records for this research. I will consult with IT staff, as needed, to ensure these standards are implemented properly.**



**Examples of minimum security standards include, but are not limited to:**

- **Maintaining system patches and updates** to reduce the risk of security threats. Removing default passwords and configurations supplied by vendors.
- **Restricting user access.** Using multi-factor authentication when available. Controlling access and limiting to minimum necessary approved study personnel. Using least-privileged user accounts when possible.
- Implementing **encryption protection** (at rest and in transit) for research data. Encryption is required for Cloud storage, mobile or portable devices (e.g., laptops, tablets, flash drives, external hard drives, cell phones, etc.). **Cybox is an approved cloud-storage option.**
- Providing **awareness and training** to all personnel to safeguard system and information.
  - Ensuring personnel using shared devices (e.g., personal devices, devices in labs or public settings, etc.) understand and follow procedures to prevent unauthorized or unintentional access (e.g., log out of the system immediately after use, close browsers, etc.).
- Performing a risk assessment and providing contingency planning - including scheduled backups.
- **Labeling external media** (such as optical disks, flash drives, external hard drives) with contact information, in order to protect data.
- Reporting any Incident to the Solution Center of ITS within 24 hours.
- Enabling session timeouts and screen locks.

I agree.

**I agree to implement the following security measures for all identifiable physical data or records**

- Secure storage methods that prevent unauthorized access (e.g., locked cabinets, safes, drawers, freezers, etc.), except when being directly used by a member of the research team.
- Access is controlled and limited solely to the minimum necessary IRB-approved research team members or professional service providers (i.e., transcriptionists, translators, etc.)
- Identifying information (including "keys" linking identifiers to codes) must be securely and effectively destroyed as soon as it is no longer needed to complete the research or meet regulatory record keeping requirements.

I agree.

#### Use of ISU-Supported Digital Tools

Are all digital tools (email, data collection platforms, apps, cloud storage, software, programs, videoconferencing, communication, analysis tools, etc.) to be used during the study approved for use by ISU IT Services and accessed using *iastate.edu* credentials?

*Refer to ISU IT's [Approved Vendor List](#).*

Yes

#### Confidentiality

##### Identifiers

**Will you obtain any of the following identifiers about participants at any stage of the research (e.g., recruitment, informed consent, data collection, from existing records, to provide compensation, etc.)? Please select from the list below.**

Names  
 Phone/fax numbers  
 Email addresses  
 Physical addresses  
 Photographs that include people's faces or other identifiable characteristics  
 Video recordings that include people's faces or other identifiable characteristics

**Describe the reason it is necessary to obtain this identifiable information and how it will be used (e.g., recruitment, matching data across time points, only to verify informed consent, follow-up or reminders, etc.).**

Personally-identifiable information such as name, phone number, and email address will be obtained for scheduling purposes. In limited cases, the team will help people with disabilities arrange transportation to the test site through Heart of Iowa Public Transit (HIRTA), taxi, or Uber, which will require physical address information. The team will also collect information about each participant's self-identified age range and general level of physical ability (ambulatory or type of disability) to assure balanced representation of various types of disabilities. Detailed medical history will NOT be collected. The personally-identifiable information will be deleted/destroyed when it is no longer needed for scheduling purposes.

Photos and videos will be collected to document participants interactions with the test articles. These photos will not deliberately include faces or other identifiable characteristics, as our main interest is how participants use their hands and feet/wheels to interact with the test articles. Some raw photos and videos will be retained for use in future research; any future release of this information to other researchers will be accompanied by a requirement to redact faces and other personally-identifiable information. As noted elsewhere, this study will occur in a setting where privacy is not ordinarily expected and the identification of an individual as a study participant is extremely unlikely to have any adverse consequences for the participant.

In addition to recognizable faces, photos and videos may capture features that could directly or indirectly identify individuals, such as mobility devices, guide dogs, distinctive clothing, etc.

**Describe your process for ensuring confidentiality of participant identifiers during all stages of the research.**

*The description should include but is not limited to:*

- *Whether identifiers are ever linked to the data,*
- *Timing of de-identification in relation to data collection,*
- *Plans to de-identify video recordings or photographs, when applicable,*
- *Plans to de-identify transcriptions, when applicable,*
- *Any plans to replace identifiers with ID codes or pseudonyms,*
- *Whether or not you will retain a key linking identifiers with ID codes,*
  - *Where the key will be stored to maintain it's security,*
  - *When the key will be destroyed*
- *Secure disposal of identifiers such as recruitment lists, keys, etc.,*
- *Security measures for data that cannot be fully de-identified (e.g., video recordings, photographs, detailed case study information, etc.)*

Participant contact information will be used only for scheduling purposes, and will be destroyed after the participant completes the experiment. Contact information will not be linked with survey/ranking forms, unless participants voluntarily provide contact information for follow-up interviews.

Faces and other personally-identifiable features will be redacted from any published images, for example by cropping or blurring that portion of the image.

**Preventing Indirect Identification in Study Results**

**What specific steps will you take to ensure participants are not identifiable (directly or indirectly via deductive disclosure) when research results are reported? If you cannot or do not plan to maintain confidentiality, please explain.**

**If your data includes video recordings or photographs of people, you must describe whether or not these artifacts will be shared in reports of results and any measures you will take to disguise participants' identities.**

Faces and other identifiable characteristics will be redacted from any images used in project reports or publications. Project reports will refer to participants by demographic category, such as "an ambulatory person in her 60s" or "a person with low vision in his 20s." Names and contact information will not be included when results are reported.

Still images and short clips excerpted from videos may be used in project publications and presentations. As noted above, personally identifiable features will be redacted.

**Access to Study Data or Records**

**Will anyone other than those on the research team have access to any identifiable study data or records?**

No

**Will the audio or video recordings be transcribed?**

No

**Certificate of Confidentiality**

Certificates of Confidentiality (CoC) are designed to protect identifiable research records against forced disclosure (e.g., subpoena), and may be important to protect certain types of information (e.g., data on illegal behaviors, genetic information, certain kinds of diseases or mental health conditions, etc.). When a CoC is in place, there are restrictions on how identifiable information about research participants may be disclosed or shared. Researchers must comply with these restrictions.

**CoCs are obtained in one of two ways:**

- 1. For research funded by NIH or CDC** - Research that involves collection or use of individually identifiable, sensitive information is automatically issued a CoC, and is subject to the corresponding disclosure restrictions outlined in [NIH Policy](#) or [CDC Policy](#).
- 2. For other research** - CoCs can be sought from the National Institutes of Health (NIH) or Centers for Disease Control and Prevention (CDC) in certain circumstances. Visit the [Certificates of Confidentiality Kiosk](#) for more information.

**Have you or will you obtain a Federal Certificate of Confidentiality for this study?**

No

**Data Sharing or Future Use**

Sharing Data is becoming increasingly common. Data-sharing may be *required* by funding agencies or journals. You may wish to share de-identified data and/or biospecimens with other researchers for secondary analysis or provide data for inclusion in a data or biospecimen repository. You or your research team may also wish to use the data for a future study. Please carefully consider future plans before answering this question.

**Please select one of the following to indicate plans for sharing or using individual level data beyond the current research project.**

Individual-level data or biospecimens (including de-identified data or biospecimens) obtained during this study MIGHT be shared or used for future research, but we have no current plans or data-sharing requirements.

**Please describe the circumstances under which data or biospecimens may or will be shared or used beyond the current study. This includes describing any known plans for future use, such as those specified in data sharing plans, any known repositories, etc. Be sure to specify what will be shared or used beyond this research study (e.g., data only, actual biospecimens, and/or data from biospecimens). If plans are unknown, indicate this, but describe reasonably foreseeable plans.**

De-identified data such as participants device rankings and comments will be stored for potential comparisons in future studies. For example, the results of this study could lead to further design refinements that would be tested in future work. As required by the funding agencies, de-identified data (including any photos and videos that are retained at the end of the project) will be available to other researchers by request, but it is unlikely that this data will be requested by other research teams.

As noted previously, names and screening information will be destroyed after the participant completes their device rating response form. The names and contact information for participants who consent to being contacted for follow-up questions will be retained in the project files.

The photos and video collected for the project are part of the project record, and will be available to other research teams if requested. These images will not be linked to participant names or contact information. As discussed elsewhere, the risk of harm to participants is extremely low since participants only activities are walking/wheeling on the test track, similar to their ordinary use of public walkways. The US Supreme Court has clearly stated that there can be no expectation of privacy in such environments, and the consent form discloses that these images could be shared with other researchers.

We cannot envision any feasible re-purposing of the data that is being collected. The information being collected on user satisfaction with pedestrian accommodations survey-type public opinion data, differing only from non-IRB surveys in that it is being collected at a purpose-built test track.

**How will data be prepared to protect participants' confidentiality when shared or used in the future?****If shared data includes actual video recordings, photographs, biometric identifiers, biospecimens, etc., be sure to:**

- specify whether each type of data will be shared with others or used for future research;
- indicate which types will be shared or used (e.g., raw data, de-identified transcripts, actual biospecimens, etc.); and
- describe how each type will be prepared to ensure confidentiality.

Participants' de-identified device ratings and comments will be stored in a Microsoft Excel file for potential future use as described above. As noted above, participants names, contact details, and screening information will be destroyed after the participant completes their device rating response form, and the names and contact information for participants who agree to participate in follow-up discussions will be deleted when the project's final report is complete. Publications will indicate that test track was located in Ames, the research was conducted by ISU, and the project sponsor was the five-state alliance including Iowa DOT.

**How will you inform participants of plans for data sharing or use beyond the current study?**

The potential for future use of the data is disclosed in the consent form.

**Optional - Additional Considerations**

**Optional:** Please share any information that you feel would be appropriate in assisting the IRB with review of your study. Examples may include historical background that is relevant to this study, important information about the research site(s), etc.

**Please do not include information that should be included in prior questions within this application.**

A preliminary sketch of the pedestrian test track layout is attached.

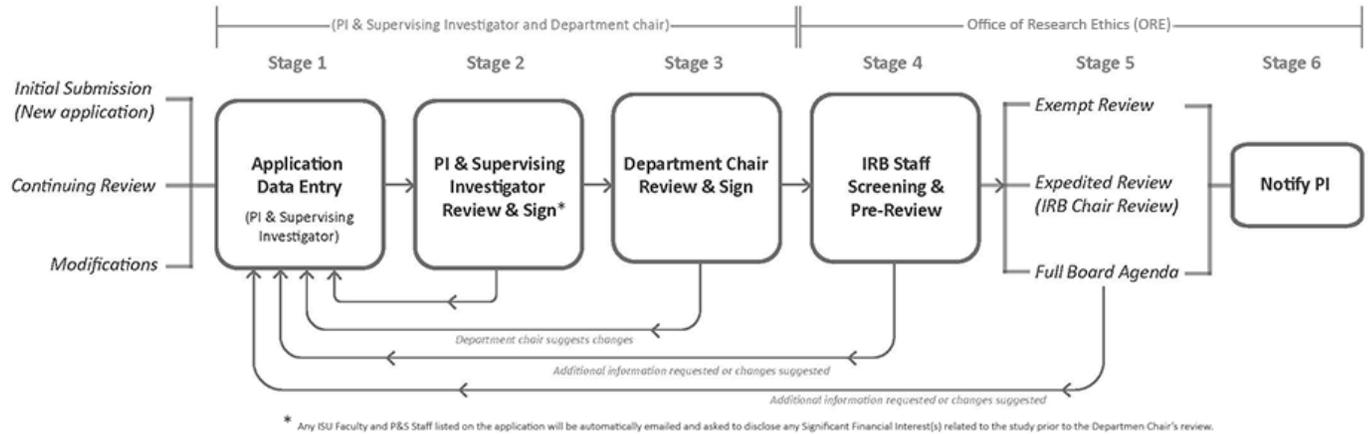
**Optional:** Attach any documents that you wish to share with the IRB to assist with the review of your study. Examples may include permission letters from research sites, supporting literature, etc.

Preliminary sketch of pedestrian test track layout Misc/Other

**Human Subjects Training CITI Check Summary**

All current as of 07/03/2020 6:17 PM ET

Overview of the IRB Application Process:



\* Any ISU Faculty and P&S Staff listed on the application will be automatically emailed and asked to disclose any Significant Financial Interest(s) related to the study prior to the Department Chair's review.

**Note: Please be sure to add [irb@iastate.edu](mailto:irb@iastate.edu) to your safe sender list to ensure emails sent from IRBManager are received and not directed to your spam folder.**

**PI Assurances and Signature for Self-Submission**

In most cases, IRB review proceeds much more smoothly and quickly when submitted applications are complete, internally consistent, and clear. Before submitting, principal investigators should verify that the application meets these criteria and that human subjects protection issues are addressed.

**Principal Investigator Assurances:**

**By electronically signing this application, I attest to the following:**

The information provided in this application is complete, accurately represents all research plans, and is consistent with any proposal(s) submitted to external funding agencies. Misrepresentation of the research described in this or any other IRB application may constitute noncompliance with federal regulations and/or academic misconduct.  
I agree.

I will provide proper oversight of this project and of project staff to ensure that the rights and welfare of the human subjects are protected and that the research is conducted in accordance with the IRB-approved protocol. I have the necessary qualifications to carry out this study in a manner that protects the rights and welfare of human subjects. If the project is subject to FDA regulations, I will follow all FDA requirements as required of the investigator or sponsor-investigator, as applicable.  
I agree.

No human subjects research activities will take place without prior review and approval by the IRB. The research activities proposed in this application will not begin until I receive written notification of IRB approval.  
I agree.

Any problems or noncompliance will be promptly reported to the IRB. For reporting requirements, see Reporting Adverse Events and Unanticipated Problems and Policy on IRB Review of Protocol Deviations and Noncompliance for Non-exempt Research.  
I agree.

Any changes to non-exempt research will receive IRB approval prior to implementation, unless the change is necessary to prevent an immediate hazard to subjects. If this research is granted exempt status, I agree that no changes will be made without prior IRB review that may increase risk to subjects or that could alter the exempt status of the study. I have or will review the document Modifications to Exempt Research, and will follow the specified guidelines.  
I agree.

If my formal affiliation with ISU ends, I will either ensure that the project is formally closed to IRB oversight, or I will notify the IRB of my intent to relinquish the role of principal investigator to another eligible researcher by sending a modification form with a change of principal investigator.  
I agree.

The IRB will be promptly informed of any addition of or change in federal funding for this study. I understand that approval of this application extends only to funding sources that are specifically referenced within and will not be used as documentation of approval for other funding sources.  
I agree.

The research will not take place without the receipt of permission from cooperating institutions, when applicable. I understand that IRB approval of this project does not grant access to any facilities, materials, or data on which this research may depend. Such access must be granted by the unit with the relevant custodial authority.  
I agree.

When appropriate for the study, approval will be obtained from other appropriate committees, such as the IACUC (if the research includes animals), the IBC (if the research involves biohazards), the Radiation Safety Committee (if the research involves DXA, x-rays

or other radiation producing devices or procedures), etc.; background checks for staff will be obtained when the research involves working with children.

I agree.

When the human subjects research is complete, I will formally "close" the project to IRB oversight.

I agree.

I will retain research records for at least three years after the study is complete as required by federal regulations.

I agree.

All activities will be performed in accordance with all applicable regulations and policies at the federal, state, local, and Iowa State University levels.

I agree.

**By entering my username and password, I am electronically signing this form.**

Signed Tuesday, November 3, 2020 3:19:08 PM ET by Shaw, John MUP

**Be sure to click "Submit" on the next screen in order for your form to move forward in the submission process.**

---

**COI Check - Initial Submission**  
**- Submitted 07/03/2020 6:21 PM ET by System, The**  
**Required Signatures**

Do you (as a person responsible for the design, conduct, or reporting of the findings of this protocol) have a Significant Financial Interest\* that is or could reasonably be perceived by non-experts as related to the research to be conducted under this protocol?

\*A Significant Financial Interest includes any of the following for the investigator, his/her spouse or domestic partner, and his/her dependent children:

1. For PHS-sponsored or PHS-flow-through research (e.g. NIH, CDC, FDA), a significant financial interest is payment exceeding \$5,000 in the past 12 months.
2. Payment exceeding \$10,000 in the past 12 months or anticipated in the next 12 months (excluding payments from ISU), including salary, honoraria, fees, or other forms of compensation or anything of value from any entity having a financial interest in this research.
3. An equity interest in any publicly or privately owned entity whose financial interests could be affected by this research, including but not limited to shares of stock or stock options. Do not include equity held in a mutual, pension, or investment fund over which you have no control with regard to investment decisions.
4. An inventorship or ownership interest in any intellectual property not owned by Iowa State University Research Foundation being tested, evaluated, developed in, or its commercial value will be affected by this research.

Additional guidance from the COI Office: [Management Role and/or Significant Financial Interest](#).

**Please do one of the following in order to proceed.**

- If you have **any** of the Significant Financial Interests listed above, complete the IRB COI Disclosure Form to acknowledge your Significant Financial Interest for this study. Do NOT enter your password below.
- If there is **no** Significant Financial Interest that needs to be disclosed for this study, please continue by signing the form below.

By signing below, I am attesting to not having any of the conflicts listed above and understand that if I do have a Significant Financial Interest related to this study in the future, it is my responsibility to notify the IRB.

Shaw, John MUP (manually added) - signed at 07/03/2020 6:27 PM ET

**Department Chair Review and Signature**  
**- Submitted 07/13/2020 8:48 AM ET by Hallmark, Shauna**  
**Department Chair Review**

**As department chair, it is your responsibility to verify the application is complete and that human subjects protections are adequately addressed prior to submission.**

**Based on your review, is the application complete and ready to send to the IRB for review?**

Yes

**Department Chair Assurances**

**By electronically signing this application, I certify that I have reviewed the application in its entirety, and I attest to the following:**

The research proposal is scientifically sound, likely to achieve its aim, and the knowledge that is expected to result has importance within the scientific discipline of the researchers.  
 I agree.

The research team has adequate time and resources, including personnel/staff, IT support, facilities and equipment, etc., necessary to complete the research and ensure human subject protection. The principal investigator and/or supervising investigator has adequate time to supervise the project.  
 I agree.

The principal investigator and research team are qualified (have the proper training and expertise) to carry out the research.  
 I agree.

The proposed research is not expected to adversely affect student education, faculty or staff employment, and all research plans are acceptable in terms of departmental and University policies.  
 I agree.

**By entering my username and password, I am electronically signing this form.**

Signed Monday, July 13, 2020 8:48:33 AM ET by Hallmark, Shauna

**Be sure to click "Submit" on the next screen in order for your form to move forward in the submission process.**

# Participant Recruitment Flyer

# Help Make Work Zones Better for Pedestrians



Photo: New York State DOT



Photo: Lloyd Alter/Twitter



Photo: Don Kostelec/Twitter

Construction in cities and towns often requires closing or re-routing sidewalks. To help engineers and contractors design better temporary pedestrian accommodations, we're looking for volunteers to give us feedback on new materials and designs. Volunteers will spend about half an hour at our outdoor "Pedestrian Test Track" where they will experience and rate various types of temporary walkway surfacing, curb ramps, and railings. Will you take a walk with us? Your ratings and suggestions will help us learn "what works" to design better pedestrian work zones.

We need volunteers age 18 or older, including **people with disabilities** and **people who don't have a disability**. You'll need to arrange your own transportation to the Pedestrian Test Track, located in the Iowa State University Research Park on the south side of Ames, near the US 30/University Avenue interchange and Cyrille bus route #6 (brown line). Test track visits will be by appointment, with cleaning and disinfection procedures in place. Volunteers will receive a \$25 gift card as a thank-you gift for their time, and bus/taxi expenses up to \$25 will be reimbursed for volunteers with disabilities.\*

**LEARN MORE OR VOLUNTEER**  
**[shortened URL]**  
**[email address]**

**Let's make work zones better for walkers and wheelers!**

This project is funded through the cooperation of the state Departments of Transportation from Iowa, Kansas, Missouri, Nebraska, and Wisconsin.

Principal Investigator: John Shaw, 515-294-4366, [jwshaw@iastate.edu](mailto:jwshaw@iastate.edu)

\*Volunteers associated with the Iowa State University Institute for Transportation, Iowa State Department of Civil, Construction and Environmental Engineering, or the sponsoring agencies are not eligible for gift cards.

## Participant Self-Nomination Form

## Study Participant Recruitment

# Help Make Work Zones Better for Pedestrians



Photo: New York State DOT



Photo: Lloyd Alter/Twitter



Photo: Don Kostelec/Twitter

## Work Zone Pedestrian Accommodations Testing

Construction in cities and towns often requires closing or re-routing sidewalks. Pedestrians tell us that temporary walkways don't always meet their needs, so we're looking for volunteers to try out some new materials and designs for temporary pedestrian accommodations. Will you take a walk with us?

Please complete this form if you are interested in volunteering to spend about half an hour walking our outdoor "Pedestrian Test Track" where you will try various types of temporary walkway surfacing, curb ramps, and railings. We will use your ratings and suggestions to help engineers and contractors understand what works best for pedestrians in work zones, including people with disabilities and people who don't have a disability.

**To get started, please answer a few questions to see if you are eligible to participate in the study.**

**Are you age 18 or older?**

- Yes
- No

**If response is "No" display the following text and exit:**

**Thank you for your interest in this project. We are not able to take participants younger than 18 at this time.**

**Are you able to get to the Pedestrian Test Track?** It is in the Iowa State University Research Park near the US 30/University Avenue interchange in Ames, Iowa. Free parking is available, and it is near Cyride bus route #6 (brown line).

- Yes, and I can arrange my own transportation to the site
- Yes, but I will need help with transportation to the site
- No

**If response is "No" display the following text and exit:**

**Thank you for your interest in this project. Since you're not able to get to the test track, we don't recommend trying to participate.**

Do you use sidewalks (or other public walkways) to travel at least 600 feet (about 2 city blocks) once a week or more?

- Yes
- No

**If response is "No" display the following text and exit:**

**Thank you for your interest in this project. At this time we are limiting participation to people who use public walkways regularly.**

Do have any medical condition that makes it difficult to use public walkways to travel 600 feet as a pedestrian or wheelchair user?

Yes

No

If response is "No" display the following text and exit:

Thank you for your interest in this project. The test track requires about 600 feet of walking or wheeling. Since it is difficult for you to travel that distance as a pedestrian or wheelchair user, we don't recommend trying to participate.

What is your name?

First Name

Last Name

How can we contact you? (please mark all that apply)

Phone (voice call)

Text message

Email

Other (please specify)

What is the best phone number to reach you for a voice call?

Voice Telephone Number

What is the best phone number for sending you a text?

Text Number

What is your email address?

Email Address

Are an Iowa State University student, staff, or faculty member?

- Yes, at the Ames campus
- Yes, but not in Ames
- No

Are you an Iowa Department of Transportation employee or on-site contractor?

- Yes, at the Ames office
- Yes, but not in Ames
- No

What is your age range?

- 18 to 39
- 40 to 59
- 60 to 79
- 80 or older

Which best describes your gender?

- Man
- Woman
- Custom
- Prefer not to answer

Do you currently use any mobility aids such as a cane, crutches, braces, walker, wheelchair, or guide dog?

Yes

No

Do you have any other medical condition that affects your use of outdoor pedestrian walkways?

Yes

No

Questions or Comments

**Thank you for your interest in being a Pedestrian Test Track participant. Your information has been recorded and a member of the project team will contact you soon.**

If you have immediate questions about this project, you can reach the Principal Investigator, John Shaw, at 515-294-4366 or [jwshaw@iastate.edu](mailto:jwshaw@iastate.edu)

Powered by Qualtrics

# Script and Workflow for Screening Participants by Telephone



Preview

Publish

## Work Zone Pedestrian Accommodations - Participant Pre-Screening

iQ Score: Fair

### ▼ Study Participant Recruitment

Q1

#### Work Zone Pedestrian Accommodations Testing - Participant Screening

Move 1 block

Hello, this is \_\_\_\_\_ calling from the Institute for Transportation at Iowa State University. I understand that \_\_\_\_\_ is interested in volunteering to participate in our pedestrian test track study. May I speak with (him/her/them) [refer to gender indicated on pre-screening form].

Hello, \_\_\_\_\_. this is \_\_\_\_\_ calling from the Institute for Transportation at Iowa State University. You indicated that you're interested in participating in our pedestrian test track, where you will be evaluating some surfaces and materials for temporary pedestrian accommodations. Before we get started, do you have any questions about this project?  
[Provide factual responses to participant questions]

Q2

Are you still interested in participating in this project?

- Yes
- No

Q3

#### ▼ Display this question

If Are you still interested in participating in this project? No Is Selected

#### ▼ Skip to

End of Survey if I understand. Since you're ... Is Displayed

I understand. Since you're no longer interested, I'll take you off our list.

Q4

iQ ☆

To confirm, I have your name listed as \_\_\_\_\_. Is that correct?

First Name

Last Name

Q5

☆

Are you age 18 or older?

Yes

Move 1 block

No

Q6

▼ [Display this question](#)

If Are you age 18 or older? No Is Selected

▼ [Skip to](#)

End of Survey if Thank you for your interest... Is Displayed

**Thank you for your interest in this project. We are not able to take participants younger than 18 at this time.**

Q7

☆

Are you an Iowa State University student, staff, or faculty member?

Yes

No

Q8

▼ [Display this question](#)

If Are you an Iowa State University student, staff, or faculty member? Yes Is Selected

Are you affiliated with the ISU Institute for Transportation or the Department of Civil, Construction & Environmental Engineering?

Yes

No

Q9



▼ [Display this question](#)

If Are you affiliated with the ISU Institute for Transportation or the Department of Civil, Construc... No Is Selected

Or Are you an Iowa State University student, staff, or faculty member? No Is Selected

Are you an employee or on-site contractor at the Iowa Department of Transportation or the Kansas DOT, Nebraska DOT, Missouri DOT or Wisconsin DOT?

Yes

No

Move 1 block  
Q10

▼ [Display this question](#)

If Are you affiliated with the ISU Institute for Transportation or the Department of Civil, Construc... Yes Is Selected

Or Are you an employee or on-site contractor at the Iowa Department of Transportation or the Kansas... Yes Is Selected

Since you're affiliated with Intrans/CCEE/DOT, we won't be able to offer you a financial incentive to participate in the project. Are you still OK with participating?

Yes

No

Q11

▼ [Display this question](#)

If Since you're affiliated with Intrans/CCEE/DOT, we won't be able to offer you a financial incentiv... No Is Selected

▼ [Skip to](#)

End of Survey if We understand that without ... Is Displayed

**We understand that without a financial incentive you might not want to participate. Thanks for considering it.**

Q12



Do you use sidewalks (or other public walkways) to travel at least 600 feet (about 2 city blocks) once a week or more?

Yes

No

Q13

▼ [Display this question](#)

If Do you use sidewalks (or other public walkways) to travel at least 600 feet (about 2 city blocks)... No Is Selected

▼ [Skip to](#)

End of Survey if Thank you for your interest... Is Displayed

**Thank you for your interest in this project. At this time we are limiting participation to people who use public walkways regularly.**

Move 1 block

Q14



Are you able to use public walkways to travel 600 feet as a pedestrian or wheelchair user?

Yes

No

Q15

▼ [Display this question](#)

If Are you able to use public walkways to travel 600 feet as a pedestrian or wheelchair user? No Is Selected

▼ [Skip to](#)

End of Survey if The test track requires abo... Is Displayed

**The test track requires about 600 feet of walking or wheeling. Since it is difficult for you to travel that distance as a pedestrian or wheelchair user, we don't recommend trying to participate. Still, we would like to thank you for your interest in the project.**

Q16



We want to make sure all of our participants are safe and comfortable at the test track. Please let me know if you have trouble with any of the following:

- Walking outside a distance of about 600 feet (2 city blocks) without someone helping you (using a guide dog, wheelchair, or other mobility device would be fine)
- Easily getting lost or confused when you are walking outside
- Becoming dizzy when you are walking outside
- Trouble breathing or shortness of breath while you are walking outside
- Likely to be seriously injured if you slip and fall (for example due to brittle bones)
- Prone to frequent slips, trips, or falls while walking
- Any other problem that would interfere with walking about 600 feet outside
- None of the above

Move 1 block

Q17

▼ [Display this question](#)

If We want to make sure all of our participants are safe and comfortable at the test track. Please l... Walking outside a distance of about 600 feet (2 city blocks) without someone helping you (using a guide dog, wheelchair, or other mobility device would be fine) Is Selected

Or We want to make sure all of our participants are safe and comfortable at the test track. Please l... Easily getting lost or confused when you are walking outside Is Selected

Or We want to make sure all of our participants are safe and comfortable at the test track. Please l... Becoming dizzy when you are walking outside Is Selected

Or We want to make sure all of our participants are safe and comfortable at the test track. Please l... Trouble breathing or shortness of breath while you are walking outside Is Selected

Or We want to make sure all of our participants are safe and comfortable at the test track. Please l... Likely to be seriously injured if you slip and fall (for example due to brittle bones) Is Selected

Or We want to make sure all of our participants are safe and comfortable at the test track. Please l... Prone to frequent slips, trips, or falls while walking Is Selected

Or We want to make sure all of our participants are safe and comfortable at the test track. Please l... Any other problem that would interfere with walking about 600 feet outside Is Selected

▼ [Skip to](#)

End of Survey if Based on your answers it lo... Is Displayed

**Based on your answers it looks like participating in the test track might be uncomfortable for you. Although we don't recommend participating, we'd like to thank you for your interest in the project.**

----- Page Break -----

Q18



Are you able to get to the Pedestrian Test Track? It is in the Iowa State University Research Park near the US 30/University Avenue interchange in Ames, Iowa. Free parking is available, and it is near Cyride bus route #6 (brown line).

- Yes
- No

Q19

▼ [Display this question](#)

If Are you able to get to the Pedestrian Test Track? It is in the Iowa State University Research Par... No Is Selected

▼ [Skip to](#)

End of Survey if Thank you for your interest... Is Displayed

**Thank you for your interest in this project. Since you're not able to get to the test track, we don't recommend trying to participate.**

Move 1 block

Q20

Will you need help arranging transportation to the test site?

Yes

No

Q21

iQ

▼ [Display this question](#)

If Will you need help arranging transportation to the test site? Yes Is Selected

Where would you need to be picked up?

Q22



▼ Display this question

If Are you able to get to the Pedestrian Test Track? It is in the Iowa State University Research Par... No Is Selected

Do you have any scheduling constraints, for example earliest or latest pick-up time, days of the week that you're not available, or something like that?

Move 1 block

Q23

▼ Display this question

If Are you able to get to the Pedestrian Test Track? It is in the Iowa State University Research Par... No Is Selected

Is it OK for us to contact you again to work out more details for getting to the test site?

- Yes
- No

Q24



You previously indicated that we can contact you by \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_. Are all of those still good ways to reach you? (Mark all that apply)

- Phone (voice call)
- Text message
- Email
- Other (please specify)

Q25

iQ ☆

▼ Display this question

If You previously indicated that we can contact you by \_\_\_\_, \_\_\_\_, and \_\_\_\_. Are all of those stil... Phone (voice call) Is Selected

You previously indicated that \_\_\_\_ is the best phone number to reach you for a voice call. Is that number still good?

Voice Telephone Number

Move 1 block

Q26

iQ

▼ Display this question

If You previously indicated that we can contact you by \_\_\_\_, \_\_\_\_, and \_\_\_\_. Are all of those stil... Text message Is Selected

You previously indicated that \_\_\_\_ is the best number for sending you a text. Is that number still good?

Text Number

Q27

iQ ☆

▼ Display this question

If You previously indicated that we can contact you by \_\_\_\_, \_\_\_\_, and \_\_\_\_. Are all of those stil... Email Is Selected

You previously indicated that your email is \_\_\_\_\_. Did we get that correctly?

Email Address

Q28

We'd like to ask you a few demographic questions to make sure we get a mix of all sorts of participants.

Q29



What is your age range?

- 18 to 39
- 40 to 59
- 60 to 79
- 80 or older

Q30



Which best describes your gender?

Move 1  Man

- Woman
- Custom
- Prefer not to answer

Q31

Do you consider yourself to be a person with a disability?

- Yes
- No
- Prefer not to answer

Q32



Do you currently use any mobility aids?

- Cane
- Crutches or braces
- Walker
- Human-powered wheelchair
- Electric wheelchair
- Guide dog
- White cane
- Other (specify)

- None of the above

Q33



Do you have any other medical condition that affects your use of outdoor pedestrian walkways?

- Yes
- No

Q34



▼ Display this question

If Do you consider yourself to be a person with a disability? Yes Is Selected

Or Do you have any other medical condition that affects your use of outdoor pedestrian walkways? Yes Is Selected

Are you willing to disclose the nature of your medical condition or disability?

- Yes (describe)

- No

----- Page Break -----

Q35



What are some good times for you to come to the Pedestrian Test Track? (Discuss available time slots and schedule the participant).

Q36

Your visit to the test track will be self-guided, but one of our students will be there to make sure everything goes smoothly. Will it be OK if they take photos or video of your walk-through?

- Yes
- Maybe (indicate stipulations)

- No

Move 1 block

Q37

Thank you for agreeing to participate in the Pedestrian Test Track. We have you scheduled to visit on \_\_\_\_\_ between \_\_\_\_\_ (AM/PM) and \_\_\_\_\_ (AM/PM). If you're running late, please give us a call on \_\_\_\_\_. You can also call that number if you have any trouble finding the site.

[If participant needs help with organizing travel, tell them that someone will be following up to confirm the schedule once the travel arrangements are settled].

I will send you an information packet that includes directions to the test track, a map of the different features we'd like you to rate, and a copy of the rating form we'll be using.

Let me go over a few details about your visit.

Move 1 block

When you arrive you'll notice that the track has several numbered stations. As you walk along we'd like you to pause at each station to give us your rating of that particular surface or device. For example the first part of the track has three different kinds of handrails that people might use to help find their way through a confusing area, and the form will ask you to tell us how well each railing meets your needs. For example some of the railings might be comfortable to hold, and others not as comfortable.

The track slopes a bit, so we'd like you to walk the main part of it twice, to experience each of the walking surfaces in both the uphill and downhill directions. Weather permitting, we'll also spray the track with water and ask you to do another walk-through to give us your impressions about how well the surfaces perform when they are wet. Of course if you arrive on a day when it's raining you'll be only be doing a wet walk-through. Do you have any questions? [Provide factual answers to questions]

The packet we'll be sending also includes a consent form. Before you start your walk we will need your written consent to participate in the project. Please read the form carefully and if everything is OK you can sign it at the bottom. It's quite important that we get a signed form **before** you start your walkthrough.

Due to covid we'll have to keep our distance, but you'll find a mailbox near the beginning of the track where you can drop off your signed consent form. It will be the same at the end of the track - there will be a second drop box for your completed rating sheet. We keep the two forms completely separate, so your responses will be completely anonymous unless you decide to put your name on the response form. Any questions about that process? [Provide factual answers to questions].

Q38

## ▼ Display this question

If Are you an employee or on-site contractor at the Iowa Department of Transportation or the Kansas... No Is Selected

Or Are you an Iowa State University student, staff, or faculty member? No Is Selected

Or Are you an Iowa State University student, staff, or faculty member? Yes Is Selected

And Are you affiliated with the ISU Institute for Transportation or the Department of Civil, Construc... No Is Selected

You're eligible for a \$25 gift card as a token of our appreciation for your participation in the study. That card will be at the end of the track next to the response form drop box.

Move 1 block

Q39

## ▼ Display this question

If Do you consider yourself to be a person with a disability? Yes Is Selected

Or Do you currently use any mobility aids? Cane Is Selected

Or Do you currently use any mobility aids? Crutches or braces Is Selected

Or Do you currently use any mobility aids? Walker Is Selected

Or Do you currently use any mobility aids? Human-powered wheelchair Is Selected

Or Do you currently use any mobility aids? Electric wheelchair Is Selected

Or Do you currently use any mobility aids? Guide dog Is Selected

Or Do you currently use any mobility aids? White cane Is Selected

Or Do you currently use any mobility aids? Other (specify) Is Selected

Since you indicated that you have a disability or use a mobility aid, you're eligible for reimbursement of up to \$25 of travel costs for taking a bus, taxi, or Uber to the test location. Would you like me to send you a travel expense reimbursement form?

Yes

No

Q40

Thank you for agreeing to participate in the test track and answering our questions. Before we go, I'd like to send you the documents we talked about: the directions to the test track, test track map, consent form, and response form [and reimbursement form if applicable]. Would you prefer to get printed copies in the mail, an email with the documents as PDFs, or both?

Email

Printed copy by mail

Both

Q41



▼ Display this question

If Thank you for agreeing to participate in the test track and answering our questions. Before we go... Printed copy by mail Is Selected

Or Thank you for agreeing to participate in the test track and answering our questions. Before we go... Both Is Selected

What is your mailing address?

Move 1 block

Q42

If you use an electronic calendar such as Outlook or iCal, I could send you calendar appointment for your test track visit. Would you like me to do that?

Yes

No

Q43

OK, to confirm I have you scheduled to visit the test track on \_\_\_\_\_ at \_\_\_\_\_ AM/PM, and I'm sending you an information packet and consent form. Any remaining questions? [Provide factual answers to questions]. Thank you again for agreeing to participate! We're looking forward to seeing you on \_\_\_\_\_.

Q44



Comments

Import from library

Add new question

Add Block

End of Survey

We thank you for your time spent taking this survey.

Your response has been recorded.

## Informed Consent - Standard Version

# INFORMED CONSENT FORM

**Title of Study:** Field Testing of Work Zone Pedestrian Accommodations

**Investigators:** Mr. John W. Shaw, Principal Investigator.

## Invitation to be Part of a Research Study

You are invited to participate in a research study. This form has information to help you decide whether or not you wish to participate—please review it carefully. Research studies include only people who choose to take part—your participation is completely voluntary and you can stop at any time.

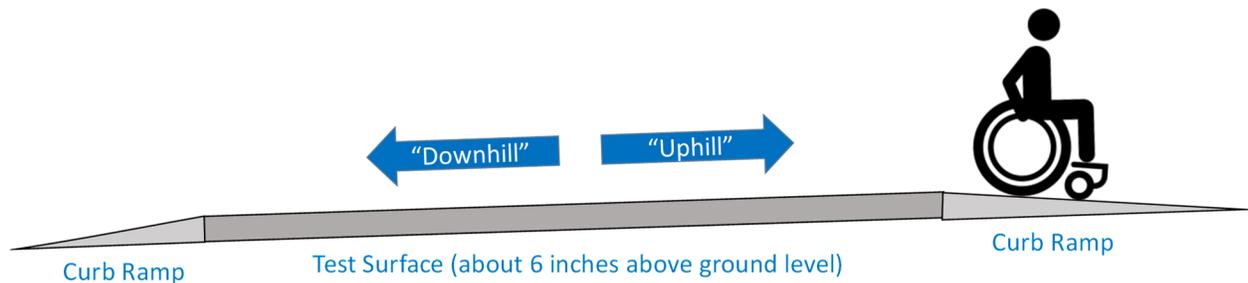
Please ask the project staff any questions you have about the study or about this form before deciding to participate.

## Introduction and Purpose of the Study

The purpose of this study is to identify better ways to provide temporary pedestrian facilities when permanent sidewalks are closed for construction. To do this, we are gathering information about how well different surfaces and devices meet the needs of pedestrians. If you choose to participate in the study, you will be invited to walk a “Pedestrian Test Track” that includes various items such as walking surfaces, curb ramps, and directional guidance railings. These items vary in design and materials. As the sketch below indicates, like most outdoor walkways, the test track has a moderate slope. We will ask you to rate each test item four times:

- Going uphill on a dry track
- Going downhill on a dry track
- Going uphill on a wet track
- Going downhill on a wet track

The total distance walked will be about 600 feet (equal to about 2 city blocks).



Funding for the study was provided through the cooperation of five state Departments of Transportation: Iowa, Kansas, Missouri, Nebraska and Wisconsin. This collaboration is called the Smart Work Zone Deployment Initiative.

## Eligibility to Participate

You are eligible to participate in this study if you are an adult (age 18 or older) who makes day-to-day use of outdoor walkways such as sidewalks. This includes ambulatory adults and people with mild to moderate disabilities. (The disability could be temporary or permanent). If you use mobility aids such as crutches, a wheelchair, or a guide dog, you should use them while participating in the study.

You should not participate in the study if you do not use outdoor walkways, for example due to a severe disability, or if you have difficulty walking approximately 600 feet (about two city blocks). You should not participate if you frequently experience dizziness, vertigo, or shortness of breath, if it would be confusing to follow a zigzagging path, or if you can only walk on flat (non-sloping) surfaces. Also, you should not participate in the study if you are prone to slips, trips, or falls, especially if you have osteoporosis (brittle bones).

If you are experiencing infectious disease symptoms such as fever, coughing, shortness of breath, sore throat, body aches, diarrhea, etc., please contact us so that we can reschedule your participation to a time when you feel better.

## Description of Study Procedures

If you agree to participate, you will be asked to:

- Complete a screening questionnaire to make sure you meet the study inclusion criteria.
- Provide demographic information such as your age and gender, indicate whether you have a disability, and tell us whether you use a mobility assistance device.
- Arrange your own travel to the test track site, which is located on the south side of Ames, Iowa near the US 30/University Avenue interchange. Parking is available nearby, and the site is near Cyride bus route #6 (brown line).
- Bring any mobility aids you ordinarily use when you are walking around town, and wear your usual walking-around shoes.
- Confirm that you are not under the influence of alcohol or other intoxicants at the time of your visit to the test track.
- Walk through the pedestrian test track up to four times (uphill and downhill, each with dry surface and wet surface). The total distance walked will be about 600 feet and includes some surfaces with moderate slopes. Most of the test surfaces will be about 6 inches higher than the adjacent ground (similar to the difference between street level and the top of the curb or sidewalk). You will be testing several types of curb ramps intended to make up this elevation difference.
- Fill out a response form to rate each of the test items (surfaces, ramps, and directional guidance railings) under all four conditions (uphill and downhill, each with dry surface and wet surface).
- With your consent, we might contact you to ask follow-up questions about the items that make up the test track.

Due to the Covid-19 situation, we are not able to provide an assistant for visually-impaired people who need help filling out the response form, but you are welcome to bring a person who currently lives or works with you. Please contact us for details.

### **Expected Time or Duration of Participation**

Your participation will last for approximately 30 minutes, and will be scheduled in advance.

### **Risks or Discomforts**

The Pedestrian Test Track is located in a parking lot that is closed to traffic. There is a slight risk of slipping and falling while participating in this study, similar to the risk you would experience while walking around town. This risk increases when the test track is wet, similar to walking on a rainy day. Please tell us if you want to do only the dry-track test. Depending on your current health and fitness, you might experience muscle soreness or joint pain from exercise.

### **Benefits to You and to Others**

It is hoped that the information gained in this study will benefit road users by helping engineers and construction contractors select better temporary pedestrian accommodations for work zones. You are not expected to directly benefit from participation in the study.

### **Costs and Compensation**

There is no charge to participate in this study. Participants who are affiliated with the Iowa State University Institute for Transportation or one of the project sponsors (Iowa Department of Transportation, Kansas DOT, Missouri DOT, Nebraska DOT, or Wisconsin DOT) will not receive any compensation. All other participants will receive a \$25 gift card. You will need to complete a form to receive payment. Please know that payments may be subject to tax withholding requirements, which vary depending upon whether you are a legal resident of the U.S. or another country. If required, taxes will be withheld from the payment you receive.

Participants with disabilities will be eligible for reimbursement of bus/taxi expenses up to \$25 in addition to the \$25 gift card.

### **Your Rights as a Research Participant**

Participating in this study is completely voluntary. You may choose not to take part in the study or to stop participating at any time, for any reason, without penalty or negative consequences.

You can skip any portions of the test track that you do not want to try, and can skip any questions on the response form that you do not wish to answer.

We may end your participation in the study if you seem to be having trouble using the test track, if we are concerned that you might slip/fall, or if we are concerned about other health or safety risks. We may reschedule your visit if you appear to have illness symptoms such as fever, coughing, shortness of breath, and so forth.

If you have any questions *about the rights of research subjects or research-related injury*, please contact the IRB Administrator, (515) 294-4566, [IRB@iastate.edu](mailto:IRB@iastate.edu), or Director, (515) 294-3115, Office of Research Ethics, Iowa State University, Ames, Iowa 50011.

## **Research Injury**

Please tell the researchers if you believe you have any injuries caused by your participation in the study. The researchers may be able to assist you with locating emergency treatment, if appropriate, but you or your insurance company will be responsible for the cost. Eligible Iowa State University students may obtain treatment from the Thielen Student Health Center. By agreeing to participate in the study, you do not give up your right to seek payment if you are harmed as a result of being in this study. However, claims for payment sought from the University will only be paid to the extent permitted by Iowa law, including the Iowa Tort Claims Act (Iowa Code Chapter 669).

## **Confidentiality**

Research records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available without your permission. However, it is possible that other people and offices responsible for making sure research is done safely and responsibly will see your information. The agencies funding this study (the Iowa, Kansas, Nebraska, Missouri, and Wisconsin Departments of Transportation and Federal Highway Administration), auditing departments of Iowa State University, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy study records for quality assurance and data analysis. These records may contain private information such as your address and phone number.

The records used to recruit and schedule participants will be kept separately from your ratings of the test track items, and you will not be required to provide your name or other personal information the form you will be using to rate the test items.

The Pedestrian Test Track is located outdoors at a site that can be seen from adjoining streets and buildings. Although we cannot assure complete privacy during your visit, the only activities you will be asked to do are walking/wheeling and filling out the rating sheet.

We will take photos and videos of you interacting with the test items. We will use these images to explore the ways participants use their hands, feet, arms, legs, service animals, and mobility assistance devices to interact with the test items. There is a chance that someone might be able to identify you from the images, especially if you are wearing something distinctive during your visit. We will blur any faces that are in photos we include in project reports and presentations.

## **Future Use of Your Information**

Your responses might be used for future pedestrian research studies at Iowa State or researchers at other institutions. We will make sure that your name or contact information is not linked to the information we share. Photos and videos of you might be included in the materials we share with other researchers. We will require them to blur any images of participants' faces that are

published. However, there is a chance that someone may be able to identify you. We will not ask you for additional permission before sharing the information.

### Questions

You are encouraged to ask questions at any time during this study. For further information *about the study*, contact John Shaw at 515-294-4366 or [jwshaw@iastate.edu](mailto:jwshaw@iastate.edu).

### Your Consent

By signing this document, you are agreeing to participate in this study. Make sure you understand what the study involves before you sign. If you have any questions about the study after you agree to participate, you can contact the research team using the information provided above.

*I am 18 years of age or over and agree to take part in this study.*

Participant's Name (printed) \_\_\_\_\_

\_\_\_\_\_  
Participant's Signature

\_\_\_\_\_  
Date

# Data Collection Form - Participant Rating of Surfaces and Devices

## Test Track for Temporary Pedestrian Accommodations in Work Zones

Draft 1 14-Aug-2020

Thank you for agreeing to participate in this study. Our goal is to identify better ways to provide temporary pedestrian facilities when sidewalks have to be closed or removed for construction. To do this, we need information about what works, or does not work, for pedestrians like you.

As you proceed along the “Pedestrian Test Track” you will find various items such as handrails, walking surfaces, and ramps. These items vary in design and materials. **Please rate each item based on your personal needs and abilities.** Each test item is marked with a sign like this:



As you walk the test track, please rate each item using the following scale:



**You can skip any items that are unsuitable for your needs. For example, if a surface seems too bumpy, too steep, or too slippery, skip it and mark **S** on your response form.**

The test track is built on a site that slopes a bit. Please walk the test track in both directions so that you experience each item going both uphill and downhill. For example, we have an asphalt surface with an uphill direction (Station 1A) and a downhill direction (Station 1B). After you complete your walk in dry conditions, we will spray the test track with water. If possible, please provide a second set of ratings for the same items when the track is wet.

**Your participation in this project is voluntary. You can stop at any time, and you are not required to complete the entire response form.** Benches are available if you need a break, and restrooms are available in the building nearby.

This project is being conducted by the Institute for Transportation at Iowa State University. Funding for the study was provided through the cooperation of five state Departments of Transportation: Iowa, Kansas, Missouri, Nebraska and Wisconsin. Questions about the project can be directed to the Principal Investigator, Mr. John Shaw at 515-294-4366 or [jwshaw@iastate.edu](mailto:jwshaw@iastate.edu). **Thank you for being involved!**

### Office Use

Date	Time	Temperature	Weather	Track Condition
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## About You – Study Participant Demographics

### Age Range

- 18 to 29
- 30 to 39
- 40 to 49
- 50 to 59
- 60 to 69
- 70 to 79
- 80 to 89
- 90 to 99
- 100 or older

### Gender

- Man
- Woman
- Nonbinary

### Employment

- Working full-time
- Working part-time
- Looking for work
- Caring for family (children, elders, etc.)
- Student
- Retired
- Not in the workforce
- Other (please explain):

**Do you consider yourself to be a person with a disability?**

- No
- Yes

**If yes, does your disability affect your ability to use sidewalks and other walkways?**

- No
- Yes

**If your disability affects sidewalk/walkway use, what issues do you experience? (Please mark all that apply)**

Issue	Not a problem	Minor problem	Moderate problem	Serious problem	Severe problem
Seeing signs, obstacles, vehicles, etc.	<input type="radio"/>				
Hearing the traffic	<input type="radio"/>				
Finding the way to my destination	<input type="radio"/>				
Keeping my balance	<input type="radio"/>				
Avoiding slips/falls	<input type="radio"/>				
Using my arms or hands	<input type="radio"/>				
Using my legs, knees, or feet	<input type="radio"/>				
Other (please explain):					

**Do you use mobility assistance devices (please mark all that apply)?**

- Assistance animal
- Cane (for finding the way)
- Cane (for stability)
- Crutches or braces
- Walker
- Regular wheelchair (human-powered)
- Electric wheelchair
- Mobility scooter
- Other (please explain):

**Is it OK to contact you with follow-up questions?**

- No
- Yes

**If yes, please provide your name...**

**...and tell us the best way to reach you**

- Phone # \_\_\_\_\_
- Text # \_\_\_\_\_
- Email \_\_\_\_\_



<b>STATION</b>  <b>5A</b>	Walking surface: T1-11 Plywood, gentle downward slope  <b>How well does this surface meet your needs?</b>						
	<table style="width: 100%; text-align: center;"> <tr> <td data-bbox="302 348 396 428"> <input type="radio"/> E Excellent         </td> <td data-bbox="412 348 506 457"> <input type="radio"/> V Very Good         </td> <td data-bbox="522 348 617 428"> <input type="radio"/> G Good         </td> <td data-bbox="633 348 727 428"> <input type="radio"/> F Fair         </td> <td data-bbox="743 348 837 428"> <input type="radio"/> P Poor         </td> <td data-bbox="854 348 1390 428" style="text-align: right;"> <input type="radio"/> S Skipped         </td> </tr> </table> <p><b>Comments:</b></p>	<input type="radio"/> E Excellent	<input type="radio"/> V Very Good	<input type="radio"/> G Good	<input type="radio"/> F Fair	<input type="radio"/> P Poor	<input type="radio"/> S Skipped
<input type="radio"/> E Excellent	<input type="radio"/> V Very Good	<input type="radio"/> G Good	<input type="radio"/> F Fair	<input type="radio"/> P Poor	<input type="radio"/> S Skipped		

***[Questions repeat for other surfaces and devices]***

**General Comments:**

## Second Walk: Starting at Station 15B and continuing downhill

<b>STATION</b> <b>15B</b>	Walking surface: concrete slurry, gentle downgrade
	<p><b>How well does this surface meet your needs?</b></p> <p>Ⓔ      ⒱      Ⓔ      Ⓕ      Ⓖ      Ⓢ</p> <p>Excellent    Very Good    Good    Fair    Poor    Skipped</p> <p>Comments:</p>

*[Questions repeat for other surfaces and devices]*

General Comments:

*[Questions repeat for the wet-condition walk-through]  
(print wet condition questions on colored paper)*

## Cost Estimate - Pedestrian Test Track Materials

## Pedestrian Test Track Materials Budget

26-May-21

Lane	Item	Quan	Units	Unit Cost	Total
1	3/4" T-111 Plywood		3 Sheets	\$109.99	\$329.97
2	3/4" OSB Sheathing		3 Sheets	\$71.99	\$215.97
3	3/4" CDX Plywood		3 Sheets	\$80.99	\$242.97
4	5/4" x 6" x 8' Pine Decking Board		21 Each	\$33.37	\$700.77
5	Surfacing material to be determined				\$250.00
6	Concrete mix (60 lb bag)		30 Bags	\$3.39	\$100.42
6	Multi-purpose gravel (0.5 cubic ft bag)		30 Bags	\$3.89	\$115.23
7	Breaker run gravel		1 Cu Yd	\$50.00	\$50.00
8	Cold mix asphalt (50 lb bag)		64 Bags	\$8.98	\$574.72
9	Railing 1				\$250.00
10	Railing 2				\$250.00
11	Railing 3				\$250.00
Various	2"x4"x8' Stud		8 Each	\$12.99	\$103.92
Various	2"x6"x8' Timber		9 Each	\$19.69	\$177.21
Various	2"x6"x10' Timber		8 Each	\$21.49	\$171.92
Various	Leveling sand (60 lb bag)		10 Bags	\$3.85	\$38.50
Various	Fasteners				\$75.00
	Hand tools				\$150.00
	Concrete mixer rental				\$150.00
	Signs				\$150.00
	Marking Paint				\$50.00
	Printing				\$100.00
	Cameras and memory cards		3 each	\$200.00	\$600.00
	Memory cards		3 Each	\$35.00	\$105.00
	Miscellaneous Supplies				\$250.00
	<b>Subtotal - Materials</b>				<b>\$5,451.60</b>
	Contingencies 15%				\$817.74
	<b>Total - Materials</b>				<b>\$6,269.34</b>
<b>Other Direct Costs</b>					
	Participant Incentives		50 people	\$ 25.00	\$1,250
	Travel Reimbursement		20 people	\$ 25.00	\$500
	<b>Total - Other Direct Costs</b>				<b>\$1,750.00</b>
<b>Grand Total - Materials and Other Direct Costs</b>					<b>\$8,019.34</b>