NATIONAL ACADEMIES Sciences Engineering Medicine

TRB TRANSPORTATION RESEARCH BOARD

TRB Webinar: Tactile Wayfinding—Improving Access for People with Vision Disabilities

September 11, 2024

2:00 – 3:30 PM

PDH Certification Information

1.5 Professional Development Hours (PDH) – see follow-up email

You must attend the entire webinar.

Questions? Contact Andie Pitchford at TRBwebinar@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Program. Credit earned on completion of this program will be reported to RCEP at RCEP.net. A certificate of completion will be issued to each participant. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the RCEP.

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Purpose Statement

This webinar will discuss the requirements for successful tactile wayfinding. Presenters will review the results of three experiments on detectability, discriminability, and application of TWSIs along with guidelines for planning, designing, constructing, and maintaining TWSIs in different transportation settings.

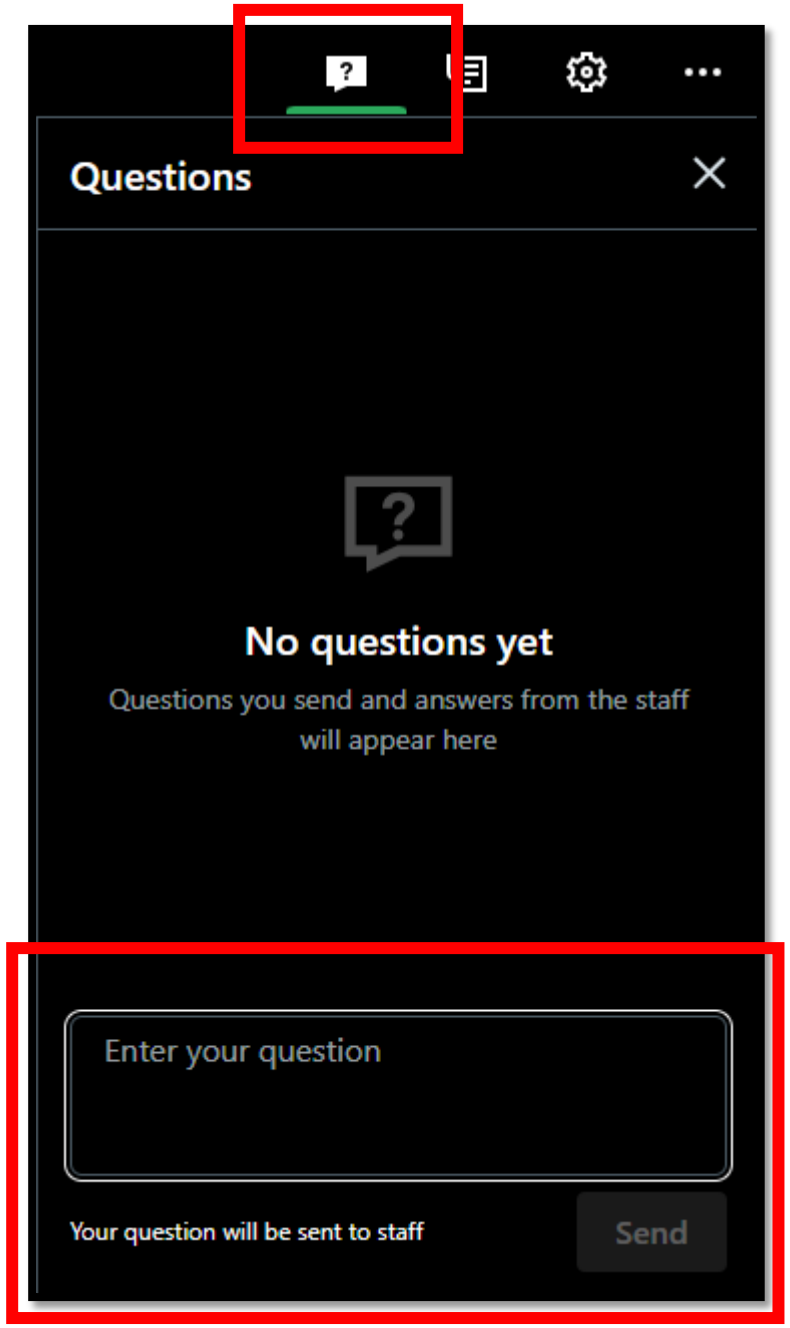
Learning Objectives

At the end of this webinar, you will be able to:

- Understand the meaning conveyed by each TWSI type and how people with vision disabilities may interact with them
- Consider the need for TWSIs in different transportation settings and determine what type of TWSI application is most suitable

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



Today's presenters

Sarah O'Brien
swobrien@hsrc.unc.edu
University of North Carolina
Highway Safety Research Center

Alan Scott
ascott@accessforblind.org
Accessible Design for the Blind

Lee Rodegerdts
lrodegerdts@kittelson.com
Kittelson and Associates, Inc.

Lukas Franck
lukasfranck@gmail.com
consultant

TRB Webinar

DATE 09/11/2024

Tactile Wayfinding – Improving Access for People with Vision Disabilities

THE UNIVERSITY OF NORTH CAROLINA HIGHWAY SAFETY RESEARCH CENTER

Accessible Design for the Blind

KITTELSON & ASSOCIATES

Background Context

Sarah O’Brien,
UNC Highway Safety Research Center

Who are we talking about?

- People who are totally blind or who have low vision-- "People with vision disabilities" (PVD)
- Estimates from 2022 National Health Interview Survey:
  - 340,000 American Adults age 18 and older are totally blind
  - 3.89 million adults have a lot of trouble seeing, even when wearing glasses
  - 50.18 million reported experiencing some degree of vision loss

Who are we talking about?

- The large majority have some vision
- The large majority become vision disabled after the age of 60
- The large majority have some degree of age-related hearing loss

Macular degeneration

Diabetic Retinopathy

Retinitis pigmentosa

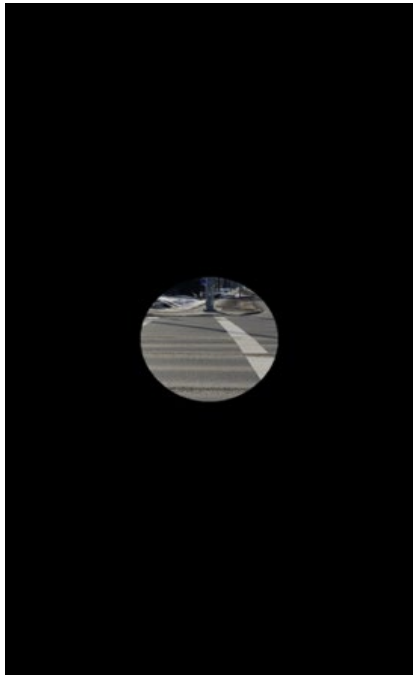


Photo credits: ADB Staff

People with low vision may have:

- Loss of visual acuity (sharpness of vision)
- Loss of visual field
- Difficulty seeing at night
- Sensitive to glare
- Reduced contrast sensitivity

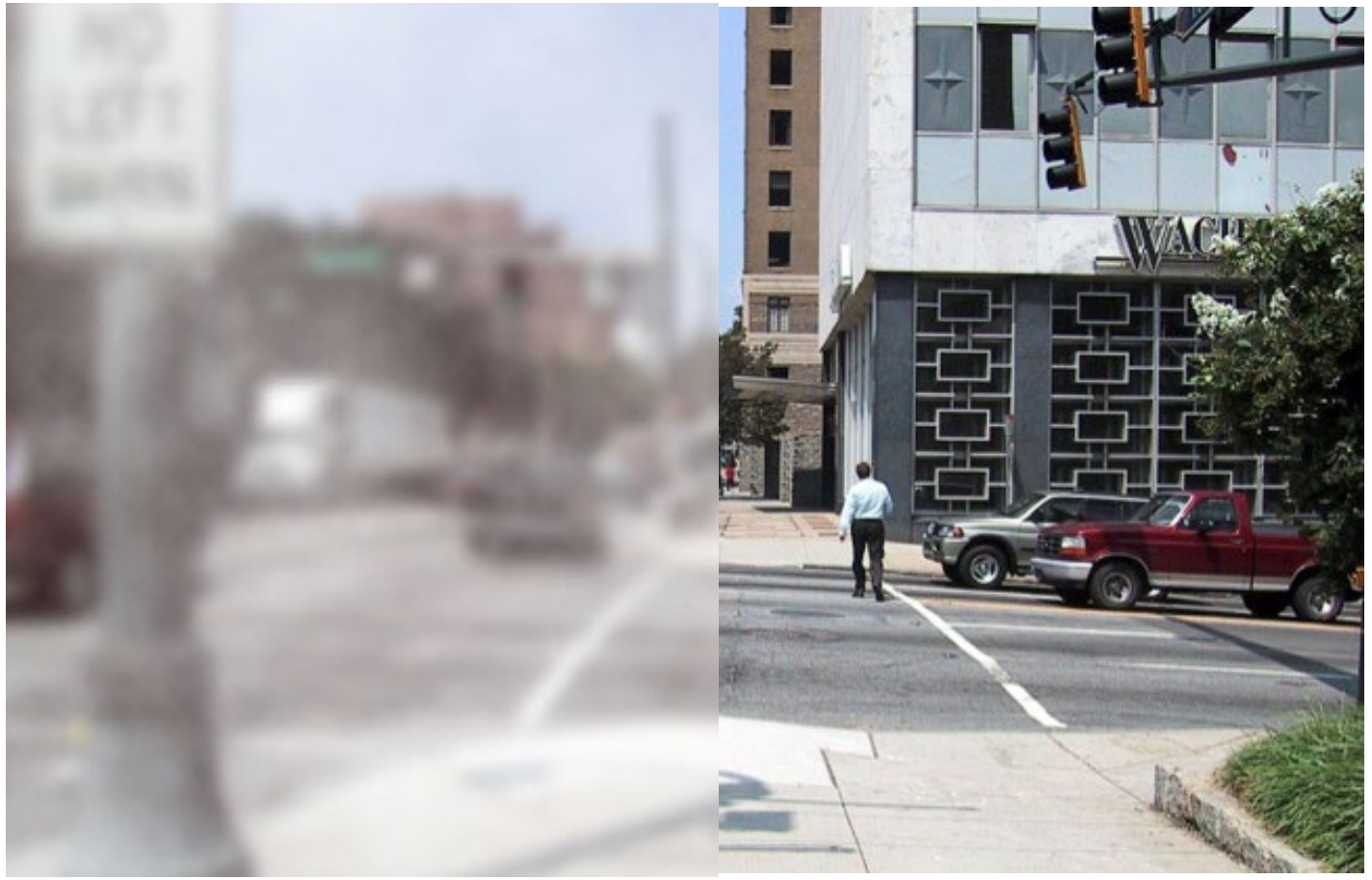


Photo credit: ADB Staff

Tools for travel

- Many PVDs use no obvious tool!
- Long white cane—scans the environment approximately where the next foot will fall
- Dog guide—handler gives directions; dog provides safety; only 5-10% of PVD
- Low vision aids—monocular; primarily for spot checking, especially signs
- Apps—helpful to some PVD; never a substitute for providing accessible information

Photo credit: Jen Graham

Photo credit: Beezy Bentzen

Photo credit: Jen Graham

Photo credit: Jen Graham

Techniques for travel

- Listening—most important technique
- Vehicle sounds to determine onset of walk interval at signalized crossing—surge of through traffic in near lane
- Vehicle sounds to determine direction (align to cross)—primarily traffic parallel to crosswalk
- Vehicle sounds to detect traffic gaps and yielding vehicles

Many PVDs have never been taught techniques for maximizing use of their low vision, or taught to use any special techniques

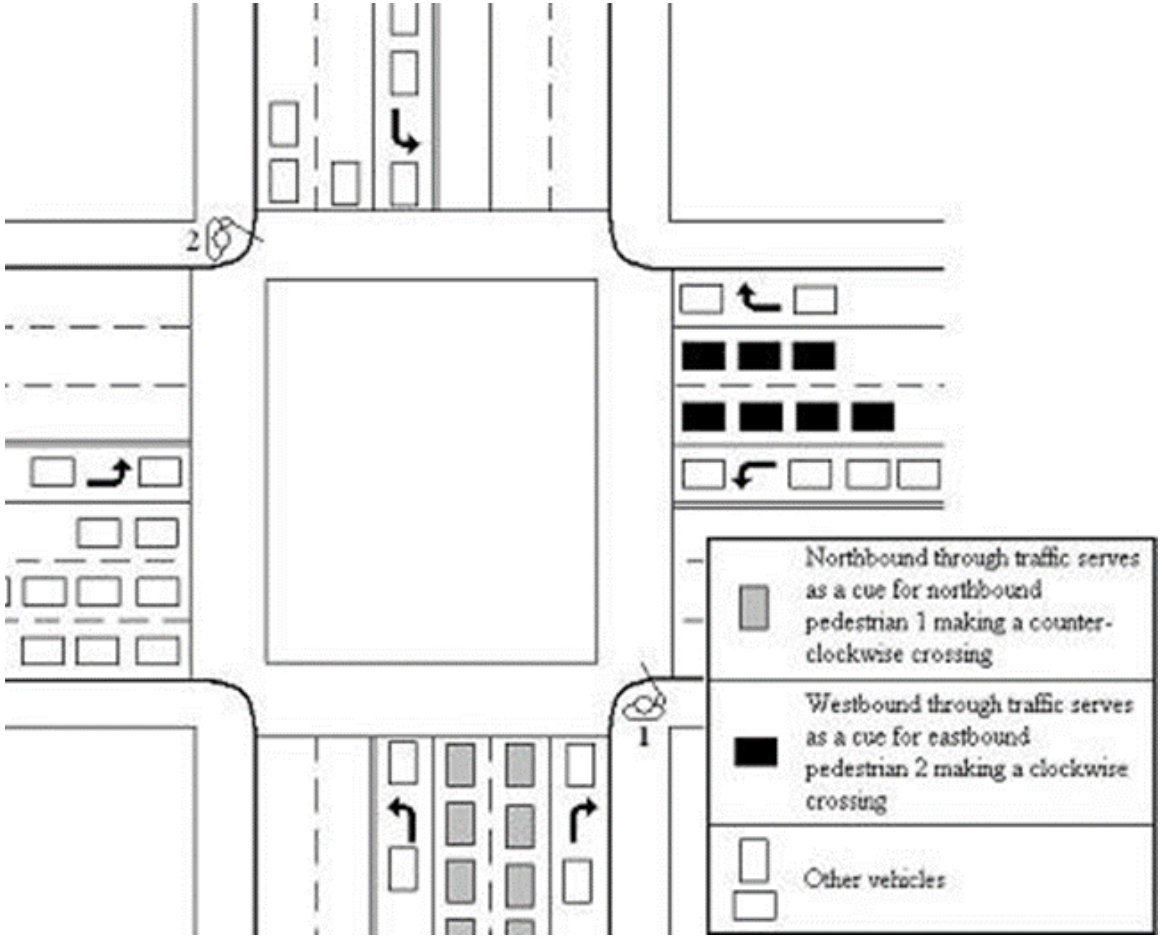


Photo credit: Janet Barlow-SOMA 2016 presentation

Wayfinding Challenges

Recognizing when a street has been reached

Photo Credit: Sean Bennett, Fig. 1. Representative intersection of sidewalk and road, including a diagonal curb ramp Download Scientific Figure on ResearchGate (researchgate.net)

Finding non-corner crossings

Photo credit: www.pedbikeimages.org / Toole Design Group

Aligning to cross where cues are absent or misleading

Photo credit: ADB Staff

Avoiding separated bike lanes at sidewalk level

Photo credit: Toole Design

Finding Transit Facilities

- Guidance to faregates, ticket machines, platforms, elevators/escalators
- Bus transfer areas
- Locating bus stops, floating transit islands

Tactile Walking Surface Indicator (TWSI)

Generic term for 3 types of walking surfaces to aid wayfinding for pedestrians with vision disabilities:

- Detectable warning surface (DWS)
  - aka: truncated domes, or domes
- Tactile direction indicator (TDI)
  - aka: raised bars, guiding bars, or directional bars
- Tactile warning delineator (TWD)
  - aka: trapezoidal delineator, or trapezoid

Photo Credit: Beezy Bentzen

Photo Credit: John Robert McPherson, CC0,via Wikimedia Commons

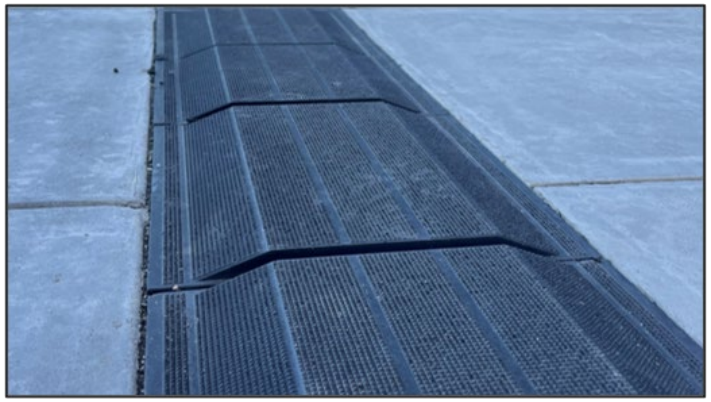


Photo Credit: Linda Myers

Detectable Warning Surface

What should pedestrians who are vision disabled think when they encounter truncated dome DWS?

I should stop and figure out whether I'm at a street or transit platform and prepare to either cross the street or board the vehicle.

If I'm at a street, I should explore for cues to help me align in the direction of the crosswalk.

The domes should NOT be used as a cue for aligning to cross.

Tactile Direction Indicator (TDI) – Bars

What should pedestrians who are vision disabled think when they encounter TDI bars?

- It depends on environmental context and width of the surface!
  - If 12 in. (4 bars): follow the bars parallel
  - If 24 in.: follow the bars perpendicular

If the bars are running in parallel and extending some distance, then this is a surface I can follow. I can follow it on either side if there is room. I should not encounter obstacles if I am following along while walking beside it.

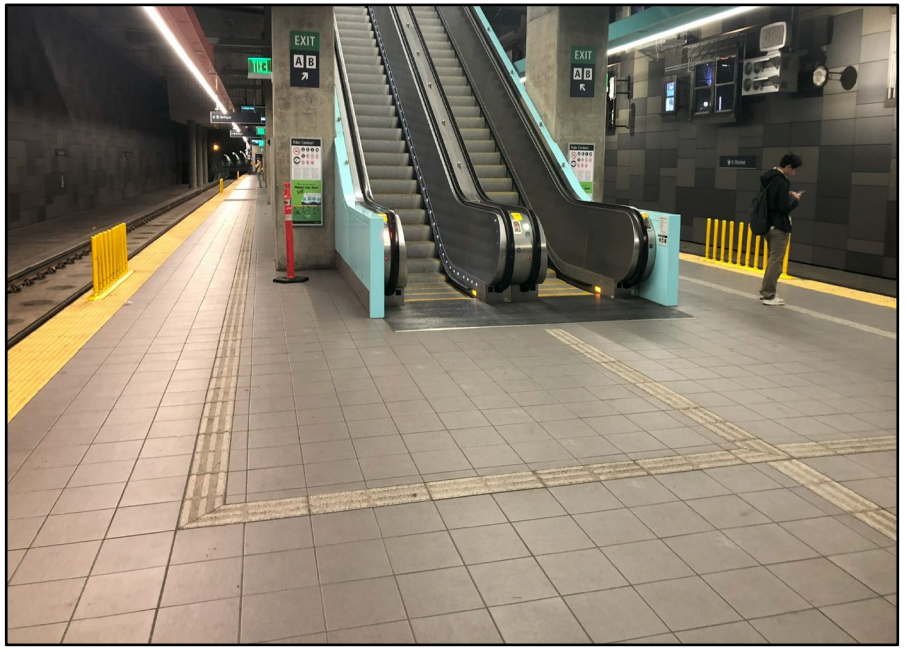


Photo Credit: ADB Staff

TDI – Sidewalk Alert Bars & Transit Door Location Bars

- Bars oriented perpendicular to direction of travel to cross street or board
- Extend at least 3 ft from DWS or curb at platform edge
- 24 in. wide surface

TDI bars running across a sidewalk, or across a transit platform indicate the location of a crossing or a transit stop. I can turn to use the bars running perpendicular under my feet to align to cross or board.

Photo Credit: ADB Staff

Photo Credit: Sarah O'Brien

Tactile Direction Indicators – Alignment Bars

- 2 ft. x 2 ft. square of bars
- Orient bars perpendicular to the direction of travel across crosswalk

If a "patch" of raised bars is located near a street crossing, and near the end of or just behind a DWS, I can use it to establish an accurate alignment with the crosswalk.

Photo Credit: ADB Staff

Photo Credit: Steve Graham

Tactile Warning Delineator (TWD)

What should pedestrians who are vision disabled think when they encounter a trapezoidal TWD?

I should not cross this surface because there is danger of a crash with a bicycle or other hazard on the other side.

Photo credits: Linda Myers

What is PROWAG?

The *Accessibility Guidelines for Facilities in the Public Right-of-Way* (PROWAG) are accessibility guidelines for implementing the Americans with Disabilities Act (ADA) with regard to: sidewalks, crosswalks, pedestrian signals, and other public pedestrian facilities, to ensure they are equally accessible to and usable by all pedestrians.

- No specification for use of TDI raised bar surfaces in the US
- No specification for use of TWD raised trapezoidal surface in the US

Evaluating TWSIs: TCRP B-46 Research Findings

Alan Scott,
Accessible Design for the Blind

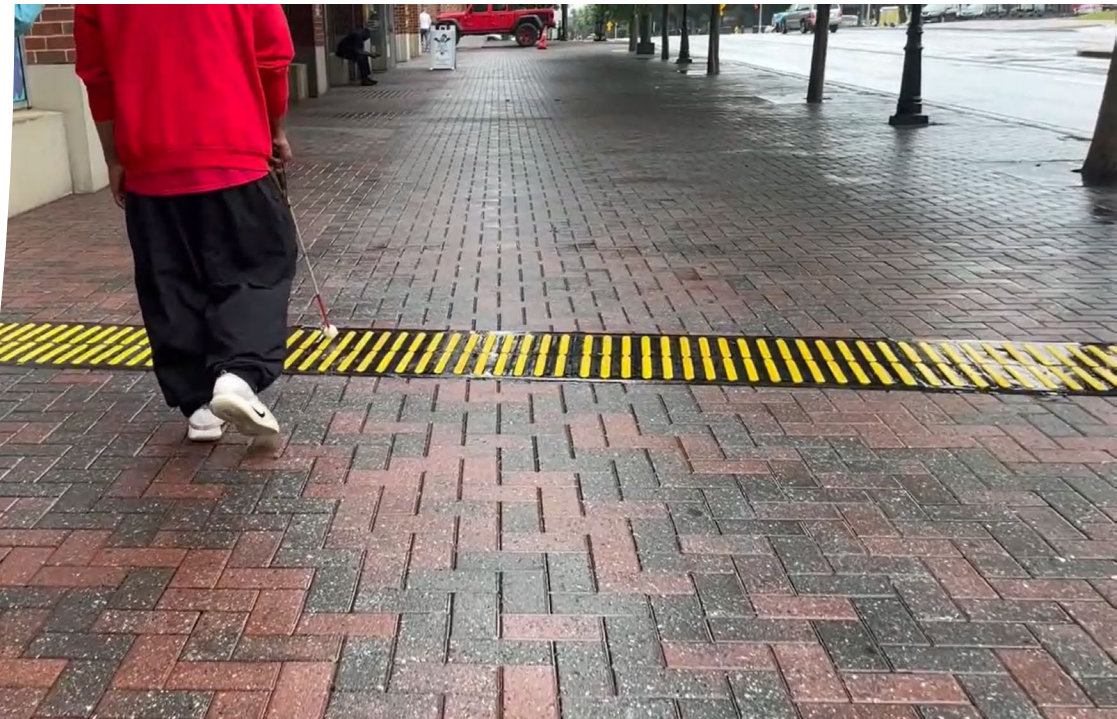


Photo Credits: Sarah Worth O'Brien

Human Factors Research

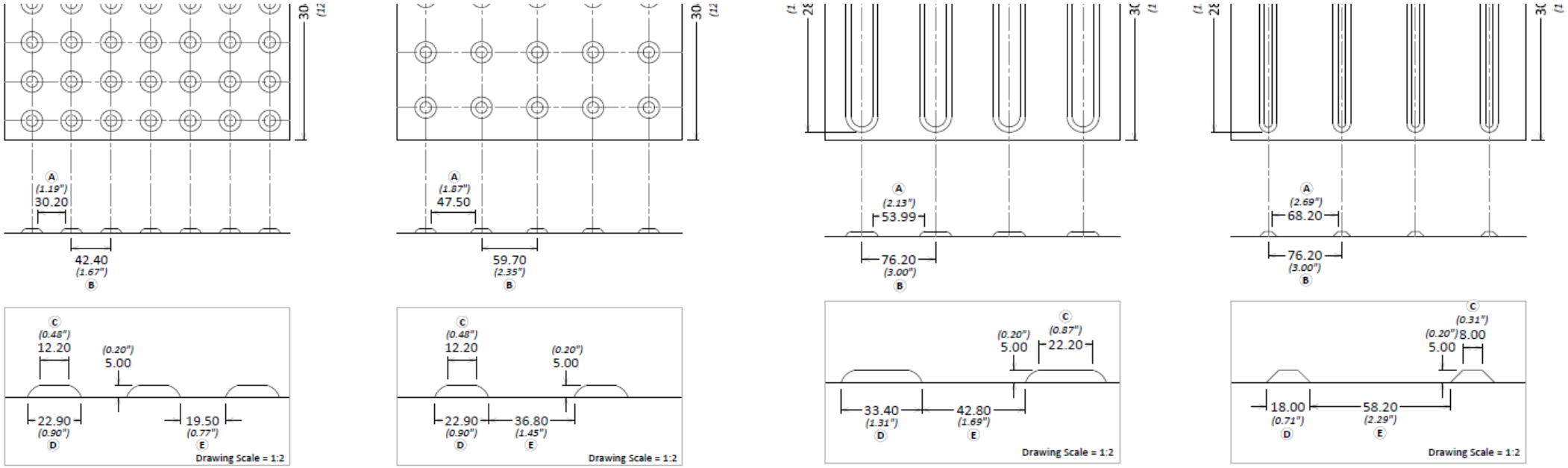
The guidance provided is informed by *empirical human factors experiments* conducted with participants with disabilities.

Funding for projects has come from the National Eye Institute; National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR); San Francisco Public Works; Federal Highway Administration; Transit Cooperative Research Program

Photo Credits: ADB Staff, S. Graham, & S. Worth O'Brien

Experiment 1 – Detecting and Identifying

- Determine detectability of DWS (domes) and TDI (bars) when approached from various angles
- Determine relative identifiability of various DWS and TDI



TDI Path Questions

- How reliably can a 12-inch-wide, four-bar TDI path be followed?
- How should path intersections be designed?

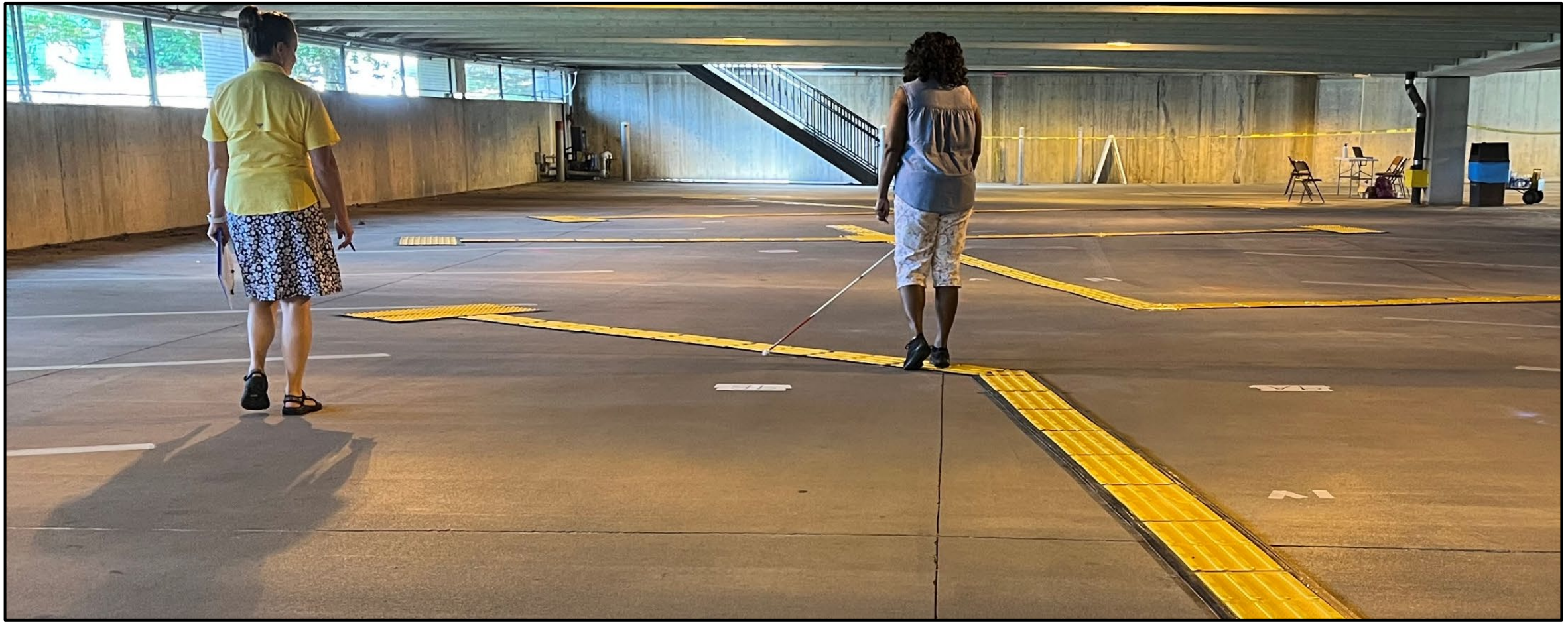
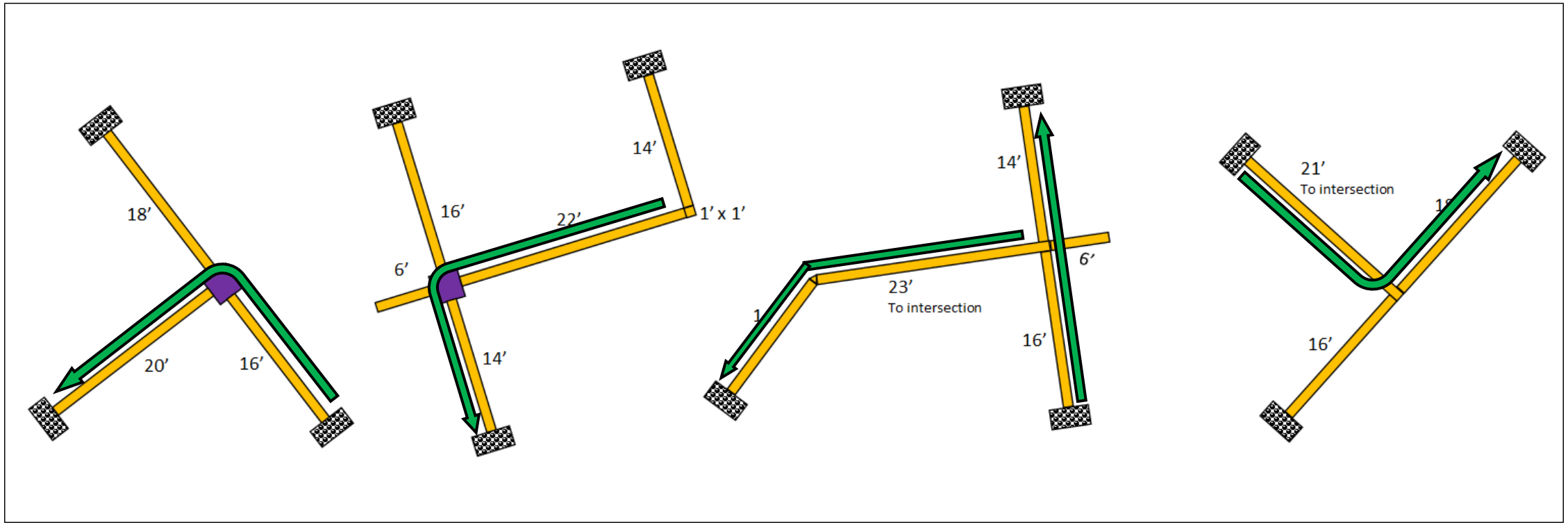


Photo Credit: Sarah Worth O'Brien

The Research

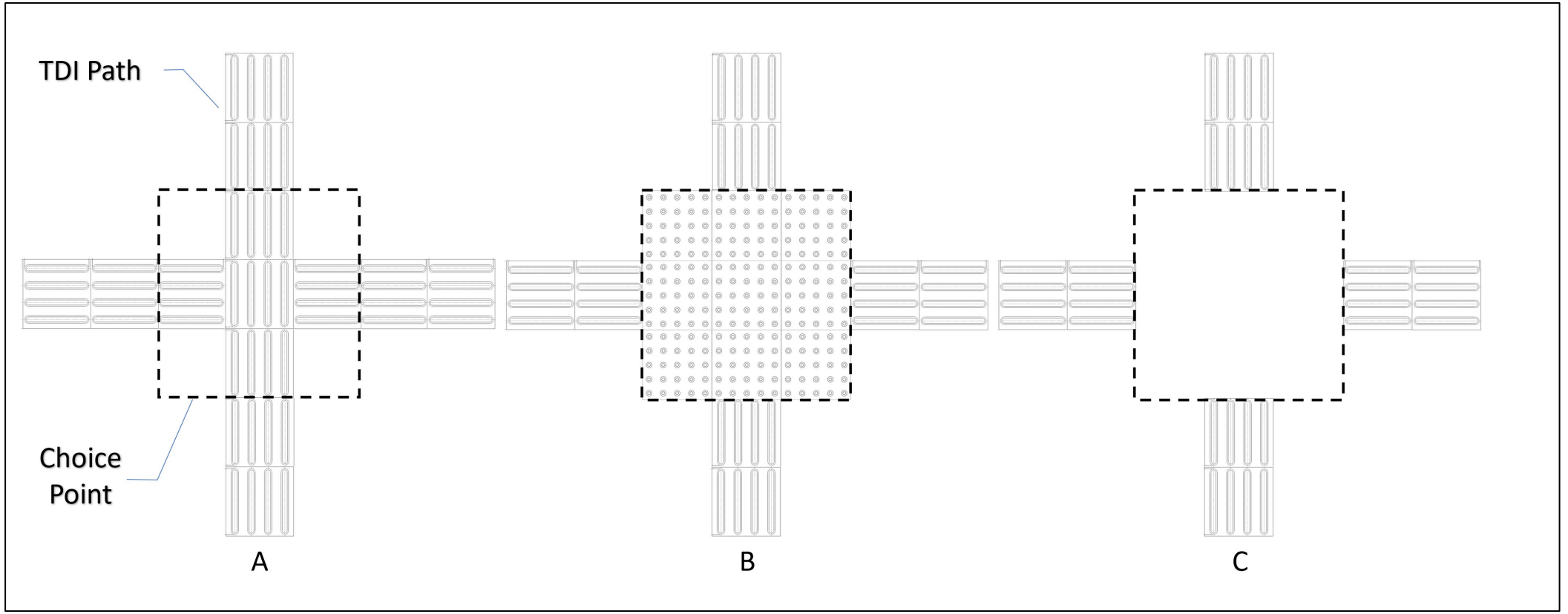
Test participants' ability to follow paths going straight and making non-intersection turns, and their ability to navigate through path intersections along a provided route.

- Green arrows show example trial paths/tasks.
- Participants did a total of 56 trials



The Research

- Determine whether choice point indicators (CPI) improve path-following through intersecting paths; test 2 CPI types



The Primary Findings

- Participants had no difficulty following the 12” wide, 4-bar TDI paths when straight.
- Route following through path intersections was more successful when there was a CPI.
- Participants were highly and equally successful navigating path intersections when either of the CPI options were present.

Photo Credit: Sarah Worth O-Brien

Path Junctions: Recommendation

- Need to indicate where paths cross

- Equally effective indicators at path node
  - 3-ft square of DWS
  - 3-ft square blank space

Recommend the blank space:
- Keeps DWS meaning intact
- Less to maintain

Photo Credits: Sarah O'Brien

Primary Purpose of Field Study

- Validate findings of previous research while testing arrangements of TWSIs as a system in a mix of challenging real-world environments.

All photo and video credits pertaining to this research project go to Alan Scott or Sarah Worth O'Brien

Setting: Uptown / City Center, Charlotte, NC

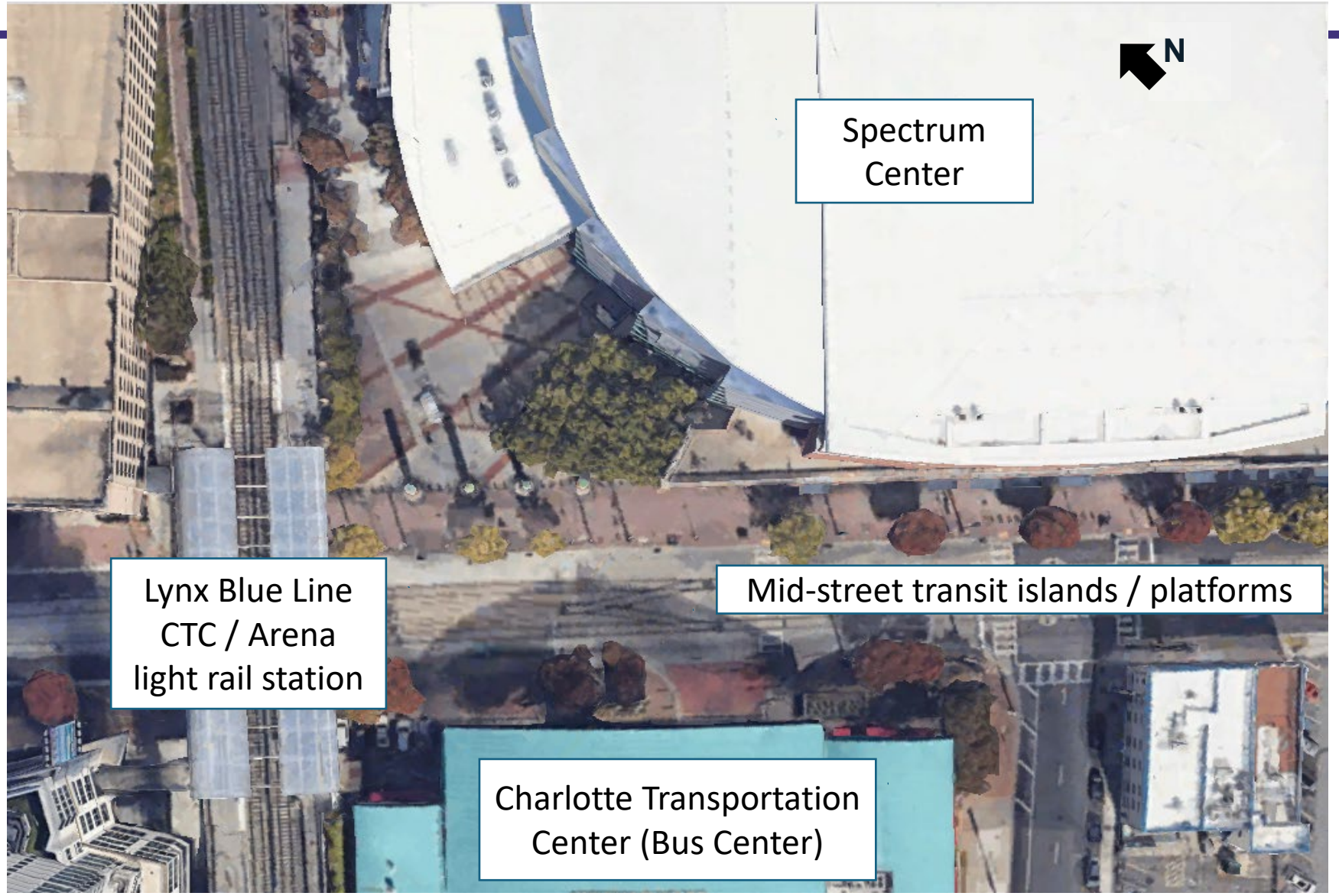


Photo Credit: Google Maps

Experimental Tasks and Route Details:

Task 1: Epicentre to CTC/Arena Lynx Northside Boarding Location

Experimental Tasks and Route Details:
Task 1: TWSI Treatments

Experimental Tasks and Route Details:
Task 2: CTC/Arena Lynx Station Rail Crossing

Experimental Tasks and Route Details:
Task 2: TWSI Treatments

Experimental Tasks and Route Details:
Task 2: TWSI Treatments

Experimental Tasks and Route Details:

Task 3: Complete Rail Crossing and Locate CTC/Arena Lynx Southside Boarding Location

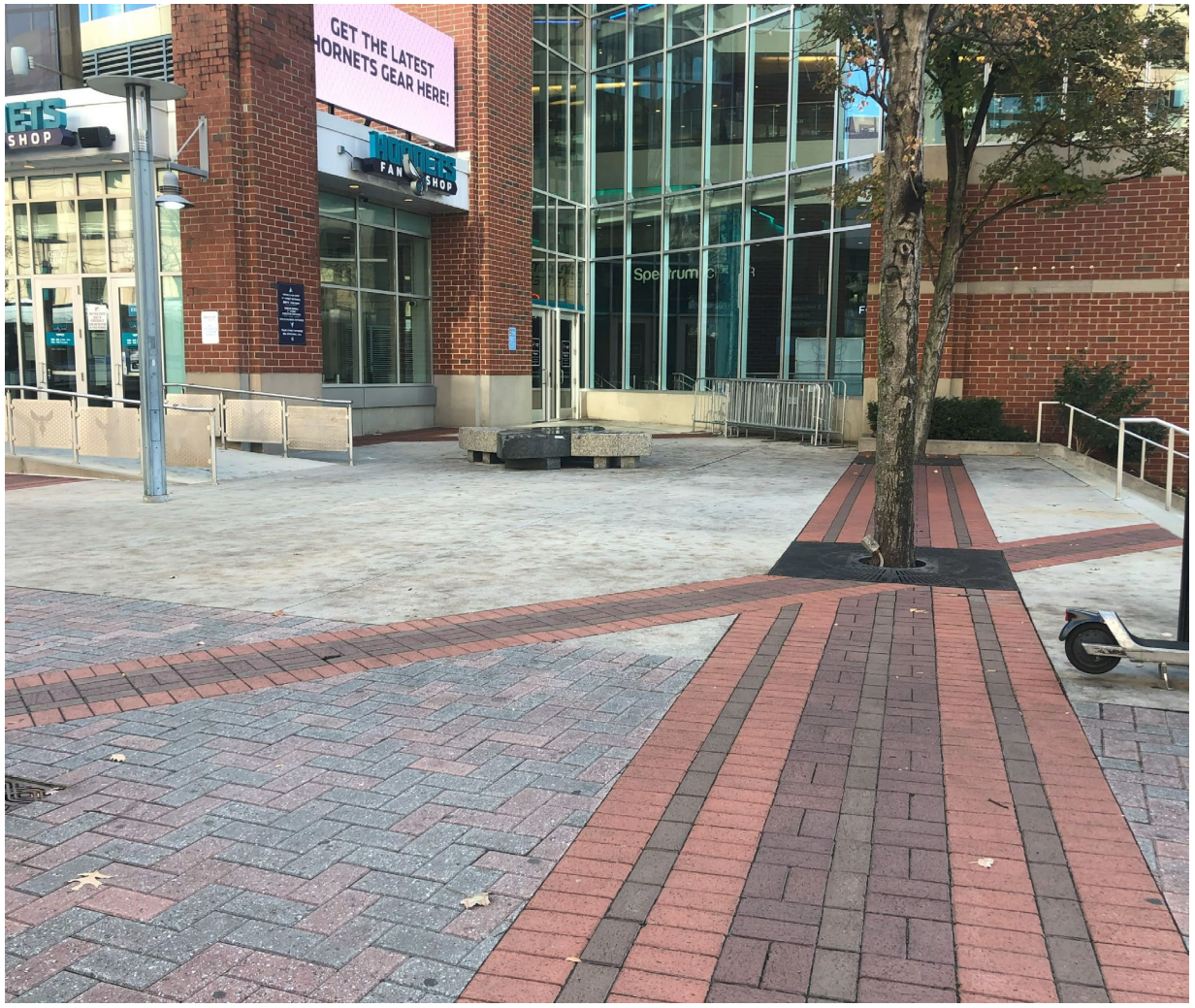
Experimental Tasks and Route Details:
Task 3: TWSI Treatments

Experimental Tasks and Route Details:
Task 4: CTC/Arena Lynx Station to Hornets Fan Store

Experimental Tasks and Route Details:
Task 4: TWSI Treatments

Experimental Tasks and Route Details:

Task 5: Hornets Fan Store to Spectrum Center Main Entrance



Experimental Tasks and Route Details:
Task 5: TWSI Treatments

Experimental Tasks and Route Details:

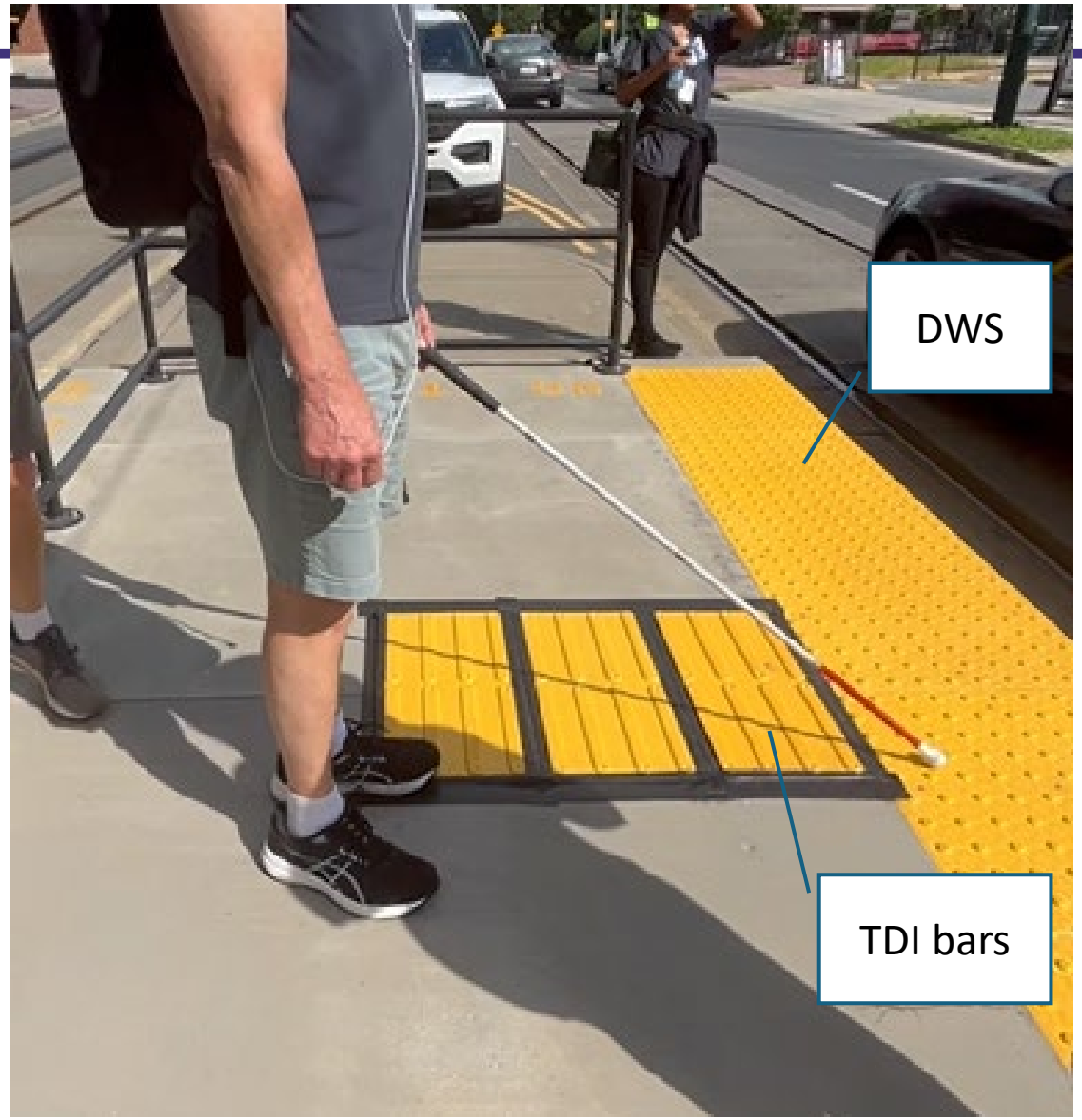
Task 6: E. Trade St. to Midblock Crossing Location (Access to Gold Line Streetcar Platform)

Experimental Tasks and Route Details:
Task 6: TWSI Treatments

Experimental Tasks and Route Details:

Task 7: Cross to Gold Line Gold Line Streetcar Platform and Find Boarding Location

Experimental Tasks and Route Details:
Task 7: TWSI Treatments



Experimental Tasks and Route Details:
Task 8: TWSI Treatments

Experimental Tasks and Route Details:

Task 9: Enter Charlotte Transportation Center and Find Bus Bay U Boarding Location

Experimental Tasks and Route Details:
Task 9: TWSI Treatments

Procedure

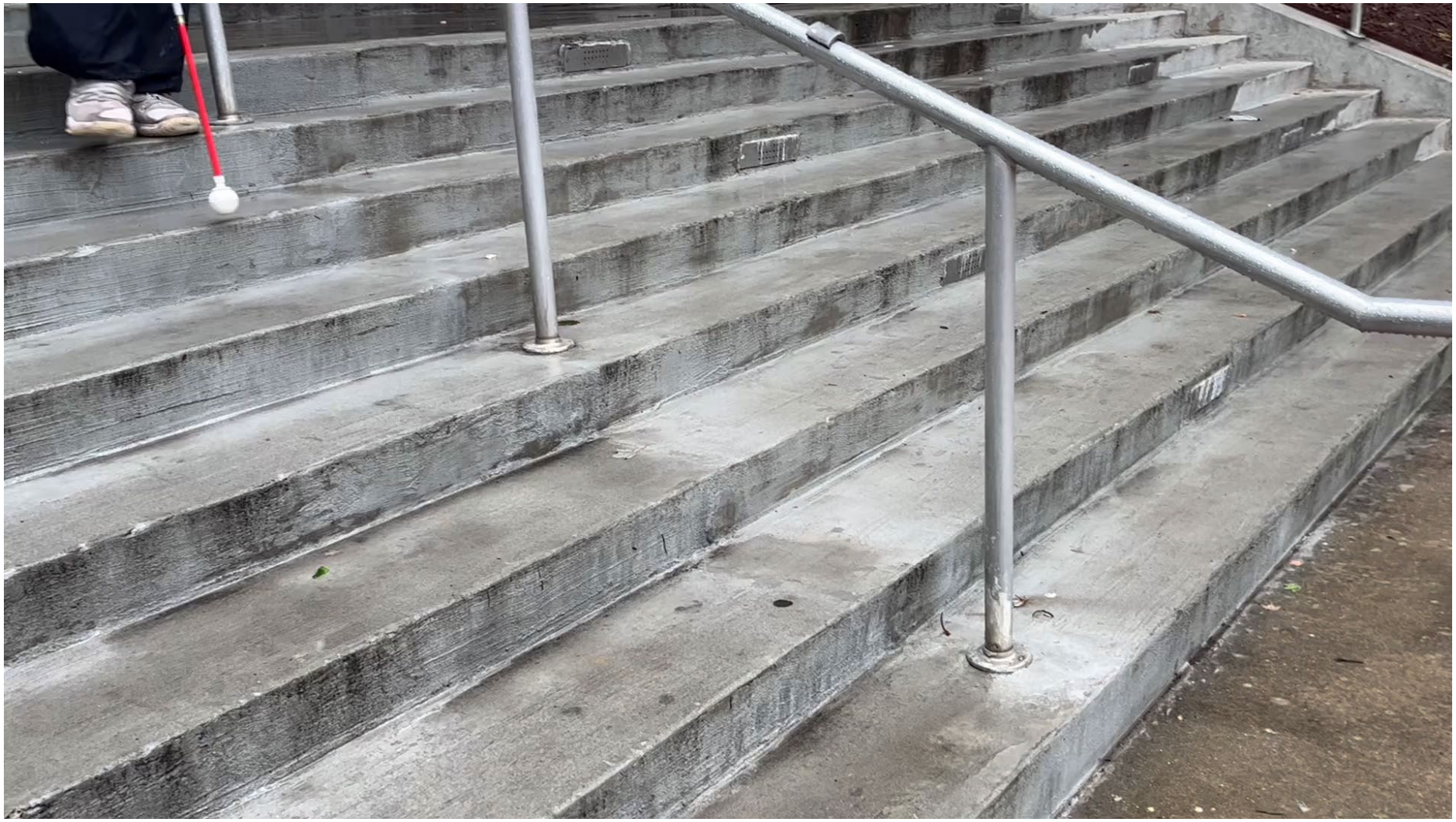
- Familiarization:
  - Participants were given many tasks to encourage the use of 3 TWSI types; TDIs arranged for distinct tasks/purposes.
  - Participants had approx. 40 min. to familiarize, train, attempt, and practice all tasks.
  - Most participants had little to no previous experience with TDIs or TWDs
  - Participants had a range of experience with the environments and underlying tasks (e.g., light rail transit stations, mid-street transit platforms, street crossings).
- Travel test route, following COMS instructions
- Debrief with semi-structured interviews

Video – Using Transit Door Location Bar

Video – Using Sidewalk Alert Bar

Video – Using alignment square

Video – Following TDI path; identifying and turning at a path intersection



Key Takeaways

- The experimental installations of TWSIs appear to have very well-supported completion of numerous ecologically valid tasks in real-world environments.
- These findings replicate and validate earlier findings regarding:
  - The effectiveness of TDI to indicate the presence of difficult-to-locate crossings
  - The effectiveness of TDI as an alignment cue
  - The effectiveness of a blank space at TDI path intersections to support effective path following
- Transit door location bar TDIs work better when they extend the width of a walkway.

Photo : Beezy Bentzen

Guide Overview & TWSI Applications

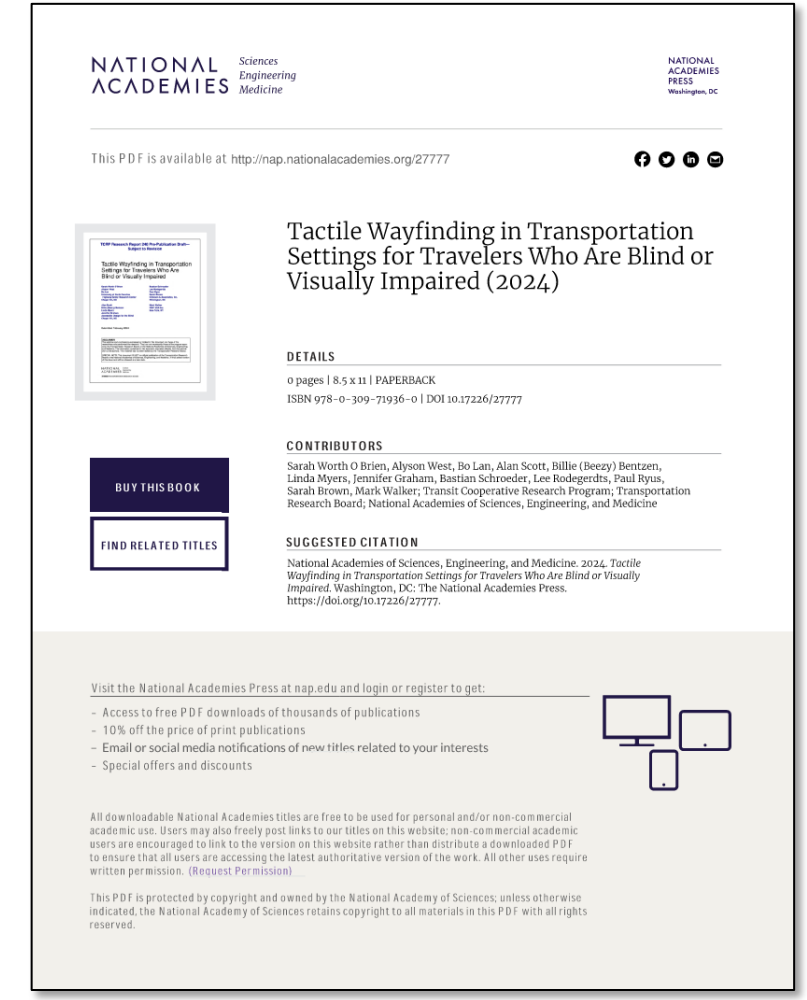
Lee Rodegerdts, PE
Kittelson and Associates, Inc.

Photo : Paul Ryus

Pre-publication Document Available

https://nap.nationalacademies.org/catalog/27777/tactile-wayfinding-in-transportation-settings-for-travelers-who-are-blind-or-visually-impaired

- Vol 1 – conduct of research
- Vol 2 – guide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Tactile Wayfinding in Transportation Settings for Travelers Who Are Blind or Visually Impaired (2024)

DETAILS

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Sarah Worth O Brien, Alyson West, Bo Lan, Alan Scott, Billie (Beezy) Bentzen, Linda Myers, Jennifer Graham, Bastian Schroeder, Lee Rodegerdts, Paul Ryus, Sarah Brown, Mark Walker; Transit Cooperative Research Program; Transportation Research Board; National Academies of Sciences, Engineering, and Medicine

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Structure of Guide

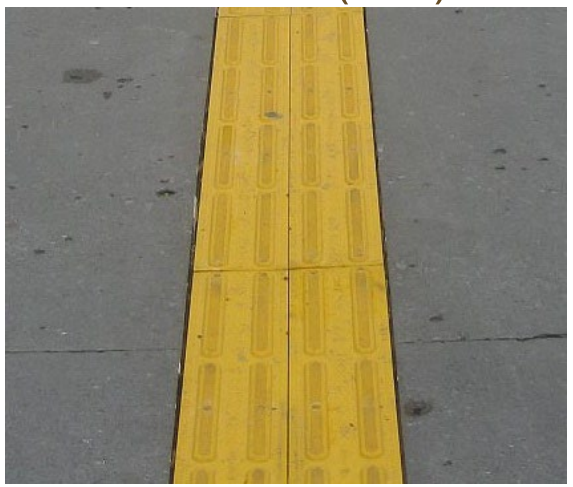
Chapter	Title
Chapter 1	Introduction
Chapter 2	Background
Chapter 3	Transit Facility and Other Plaza-Type Applications
Chapter 4	Crossing Applications
Chapter 5	Implementation
Chapter 6	Post-Implementation Activities
References	

Chapter 1: Introduction

- Introduces tactile walking surface indicators (TWSIs)
- Summarizes development of the guidelines
- Summarizes the outline of the guide

Detectable Warning Surface (DWS)

Tactile Direction Indicator (TDI)



Tactile Warning Delineator (TWD)

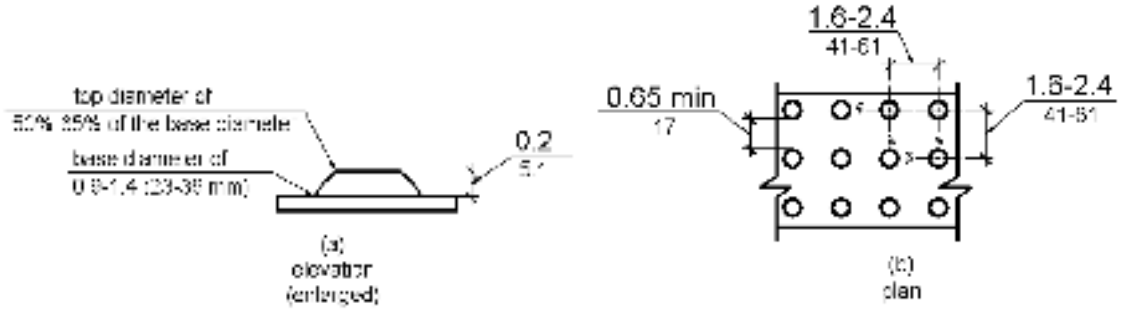
TCRP Research Report 248, Figure 2

Chapter 2: Background

- Designed for readers new to topic of tactile wayfinding
- Describes typical techniques and cues used for wayfinding by people who are blind or have low vision
- Describes need for tactile wayfinding
- Introduces types of TWSIs
- Brief history of tactile wayfinding in the U.S. and internationally
- Summary of current U.S. practice in applying TWSIs in public right-of-way and transit settings

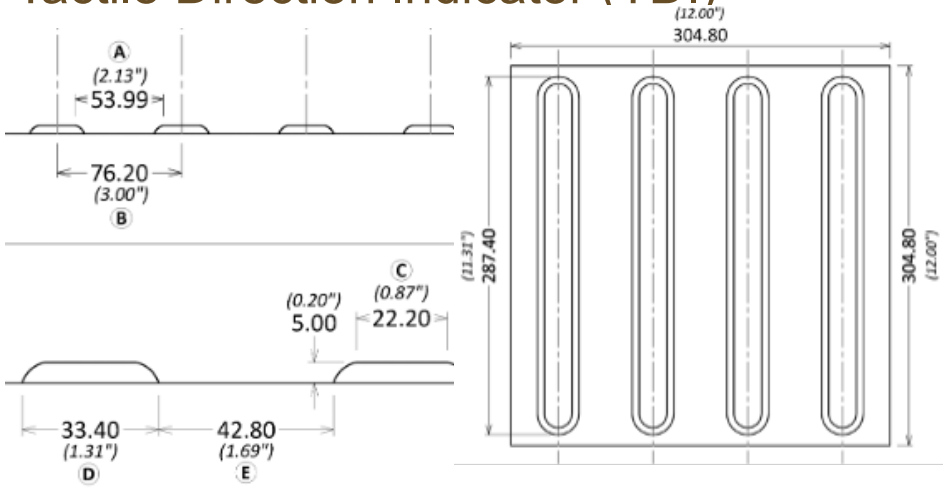
Specifications for TWSIs

Detectable Warning Surface (DWS)



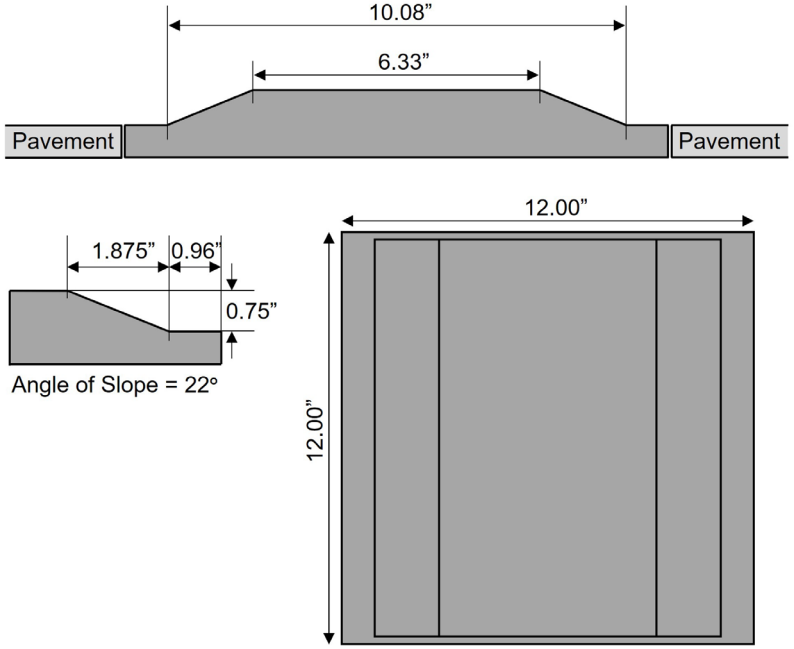
TCRP Research Report 248, Figure 5

Tactile Direction Indicator (TDI)



TCRP Research Report 248, Figure 7

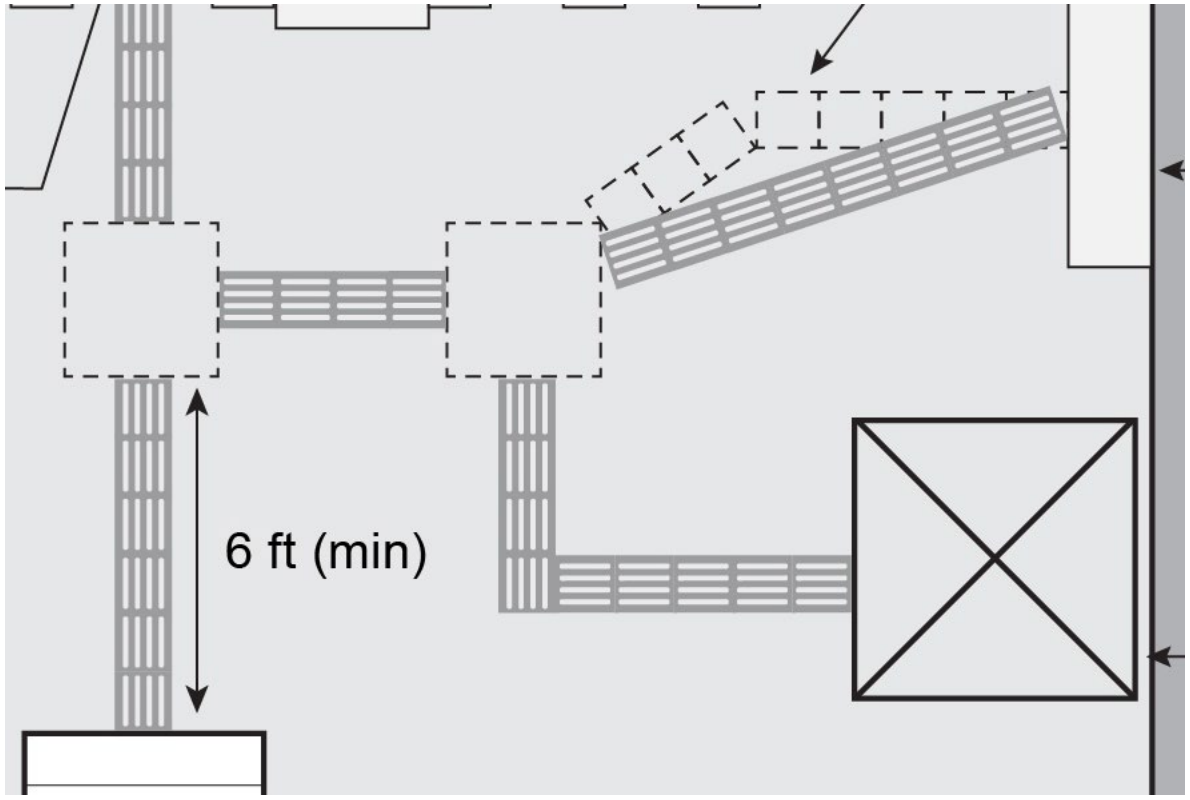
Tactile Warning Delineator (TWD)



TCRP Research Report 248, Figure 9

TDI Use: Guide Bars

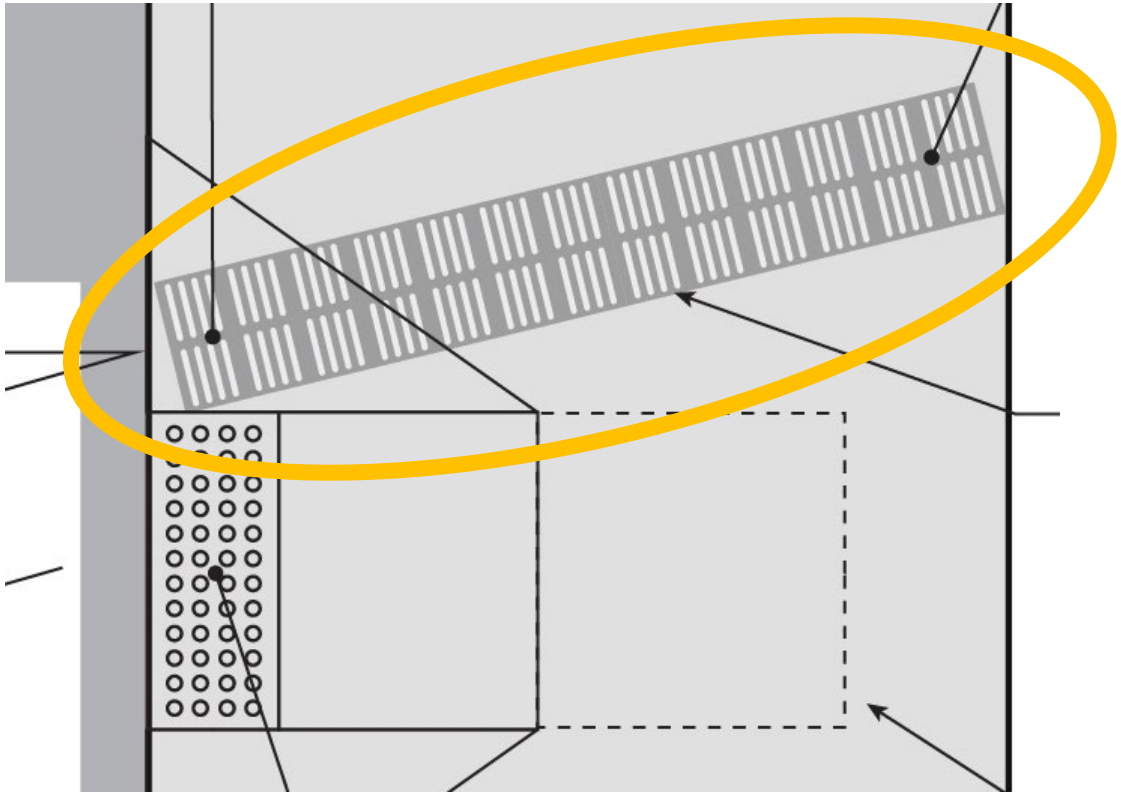
- 12-in.-wide (0.3 m) TDI defining an unobstructed path of travel in the direction of the bars. The bars are oriented in the direction of travel, and the pedestrian is expected to follow them.



Portion of TCRP Research Report 248, Figure 15

TDI Use: Sidewalk Alert Bars

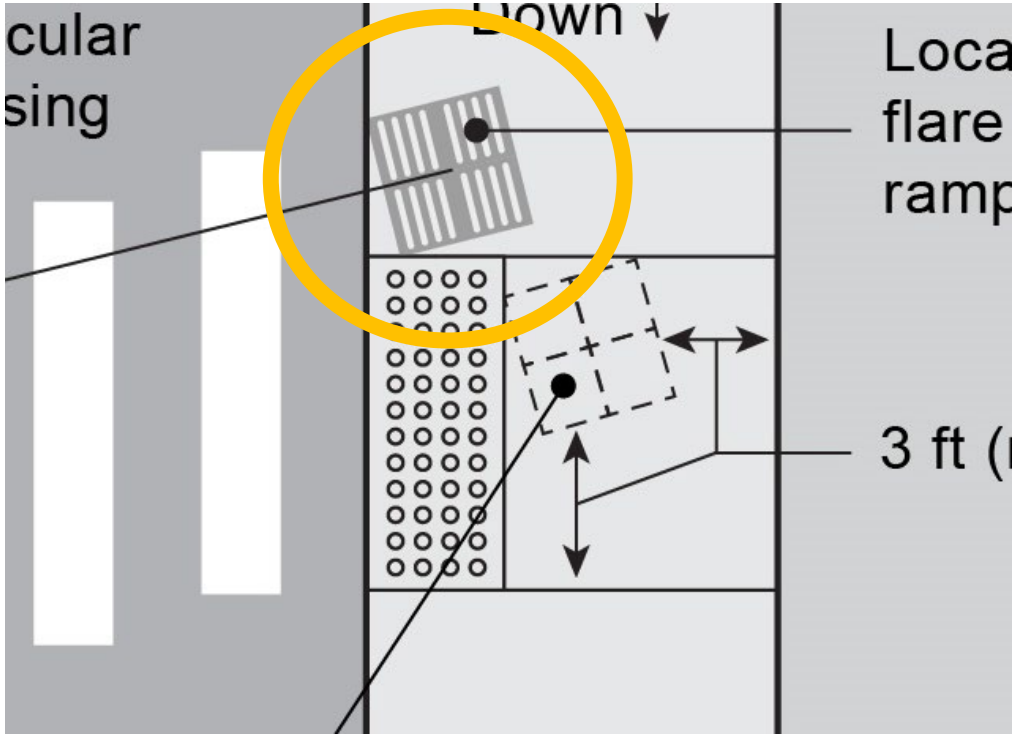
- A 24-in.-wide (0.6 m) TDI across the width of a sidewalk or walkway to indicate the location of a non-corner crossing or transit stop, and to provide a reliable cue for aligning to cross or to board. The raised bars are oriented perpendicular to the direction of travel across a crosswalk or onto a transit vehicle so they provide an accurate cue for aligning to cross or board.



Portion of TCRP Research Report 248, Figure 28

TDI Use: Alignment Bars

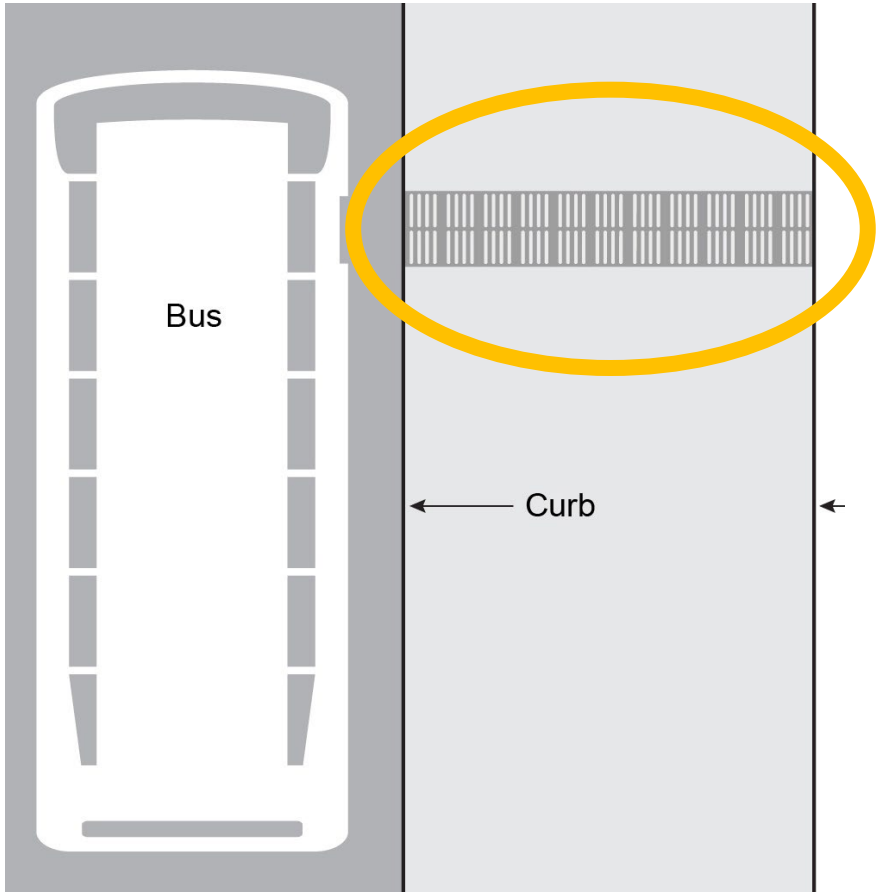
- A 24-in.-by-24-in. (0.6 x 0.6 m) square of TDI that provides an accurate alignment cue for crossing a street where other tactile or audible cues are absent or misleading. The raised bars are oriented perpendicular to the direction of travel across the associated crosswalk.



Portion of TCRP Research Report 248, Figure 36

TDI Use: Transit Door Location Bars

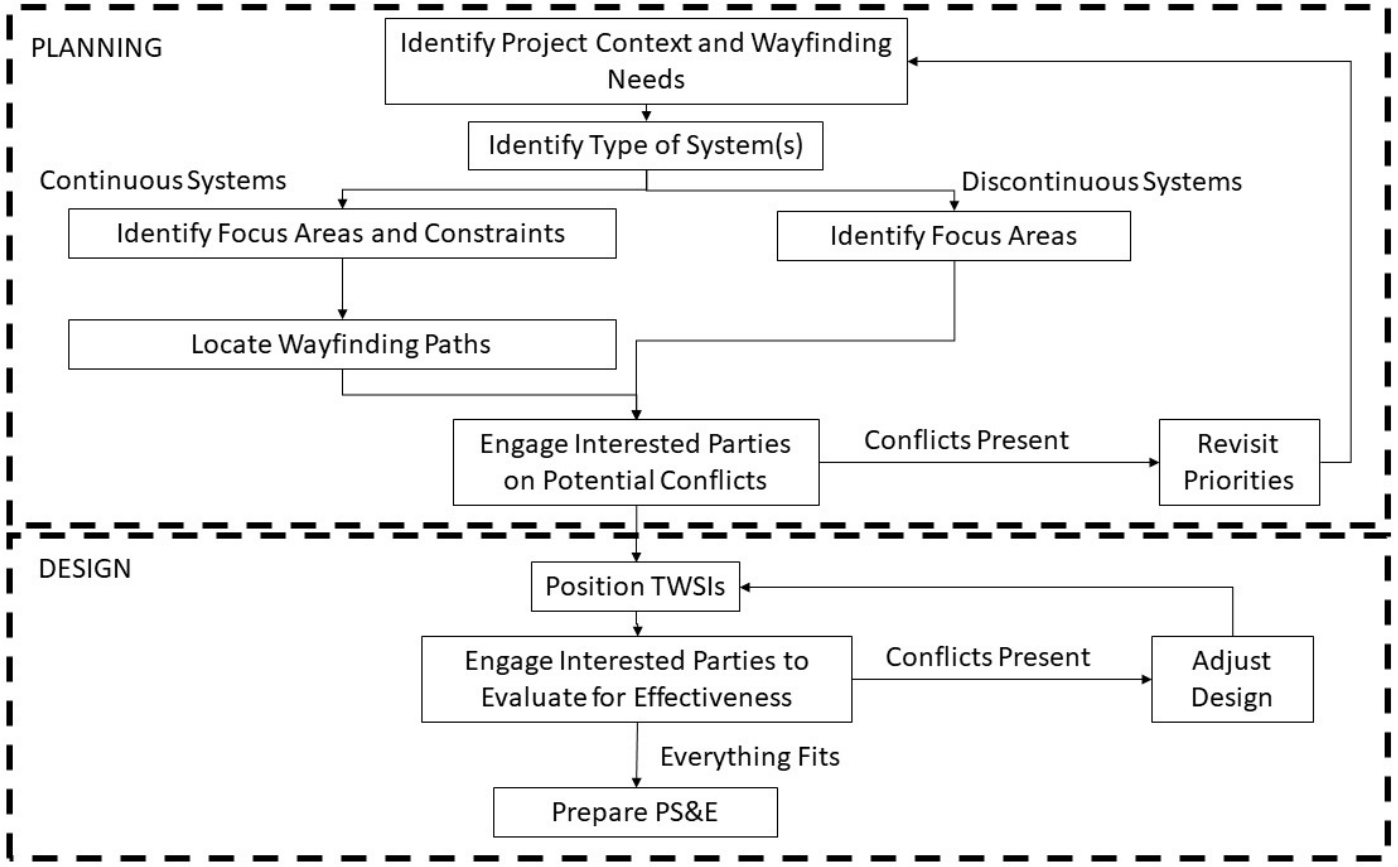
- A 24 in.-by 36-in. (0.6 x 0.9 m) rectangle of TDI, with the 24-in. (0.6-m) side parallel to the curb or platform edge, to indicate where transit boarding doors open. The raised bars are oriented perpendicular to the direction of travel onto a transit vehicle. At boarding areas on a platform raised above standard curb height, the TDI surface will be flush with the DWS at the platform edge or curb.



Portion of TCRP Research Report 248, Figure 24

Chapter 3: Transit Station and Other Plaza-Type Applications

- Introduction
- Planning process



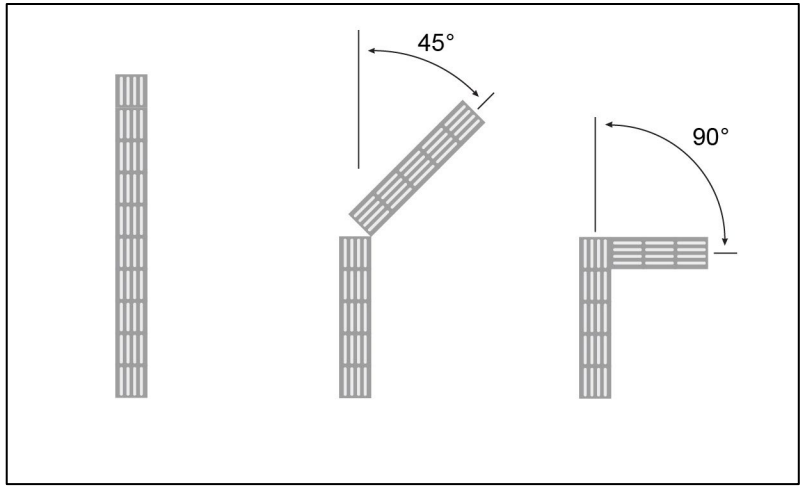
TCRP Research Report 248, Figure 15

Transit Design Applications

- DWS (domes) placed first
  - Mark edges of transit platform if above standard curb height
  - For marking hazardous locations in open-space applications, DWS are always installed in pairs
- TDIs (raised bars) can be used as follows
  - Guide bars: 12-inch-wide along a path
  - Sidewalk alert bars: 24-inch-wide across a path
  - Transit door location bars: 24-inch-by-36-inch (or longer) rectangle to mark typical door locations

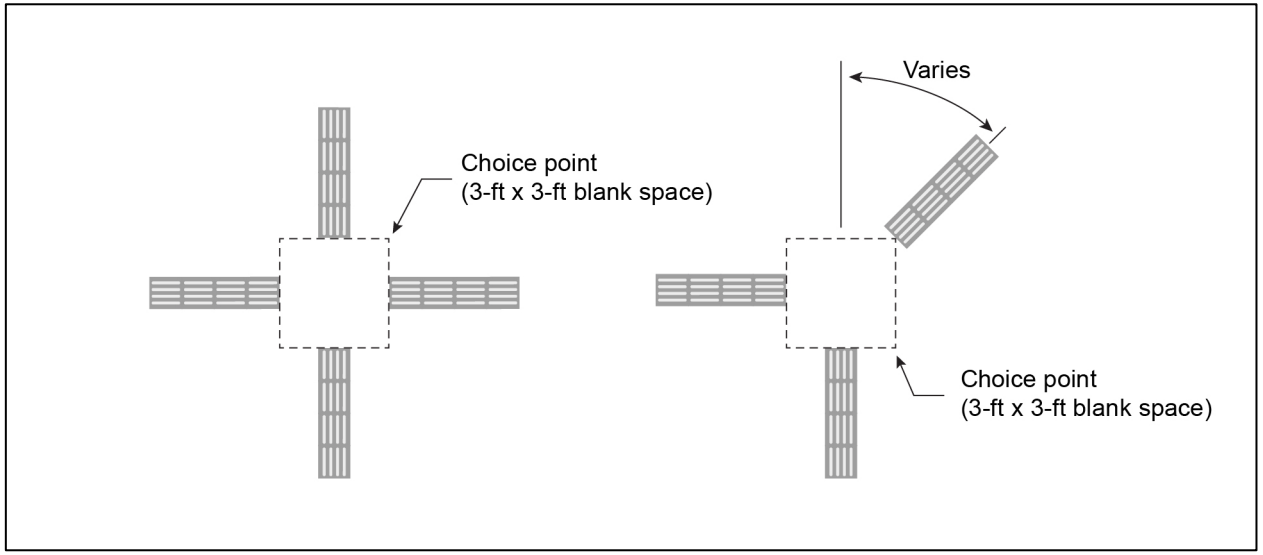
Wayfinding in Continuous Systems

Segments and Angle Points



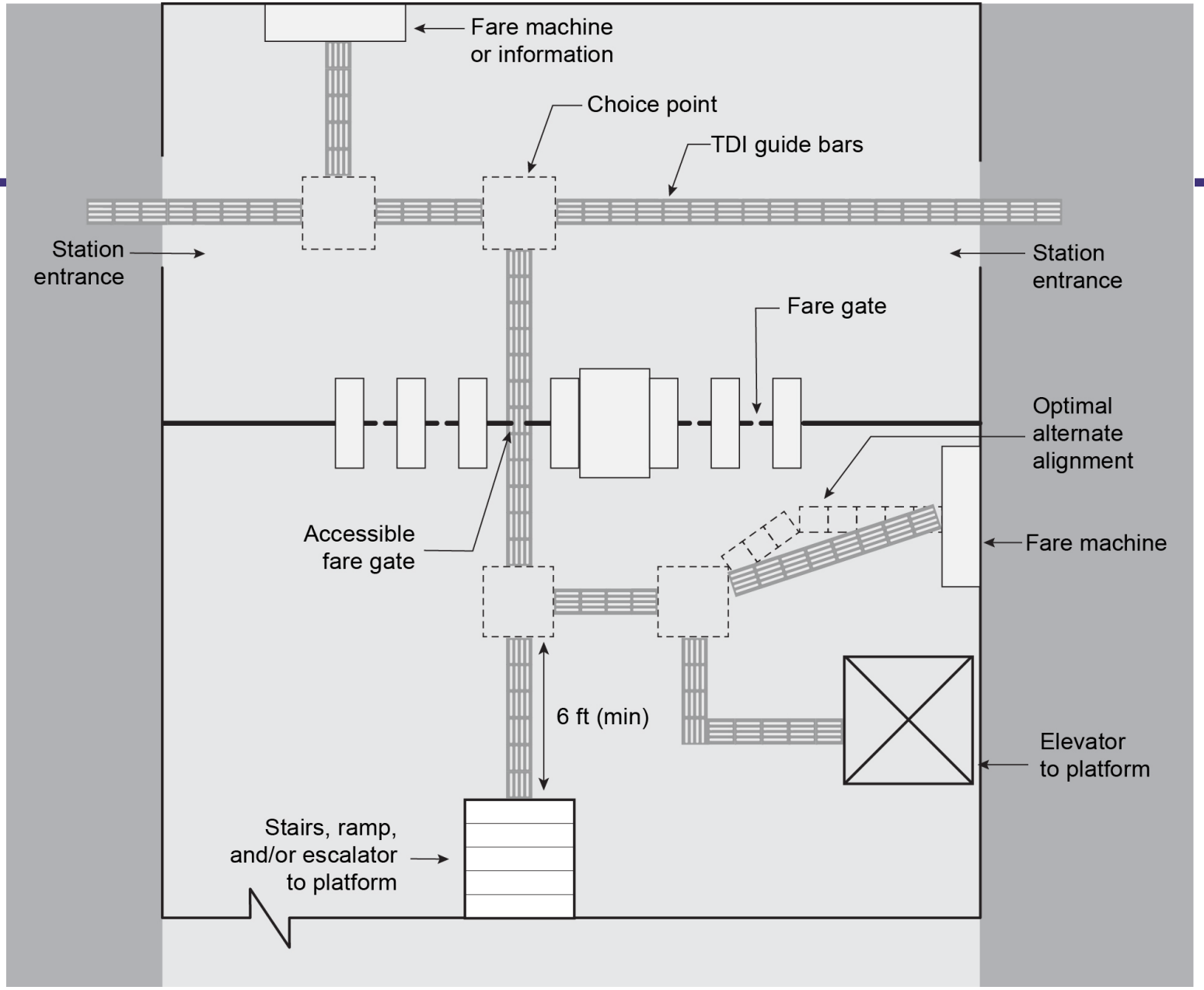
TCRP Research Report 248, Figure 16

Choice Points



TCRP Research Report 248, Figure 17

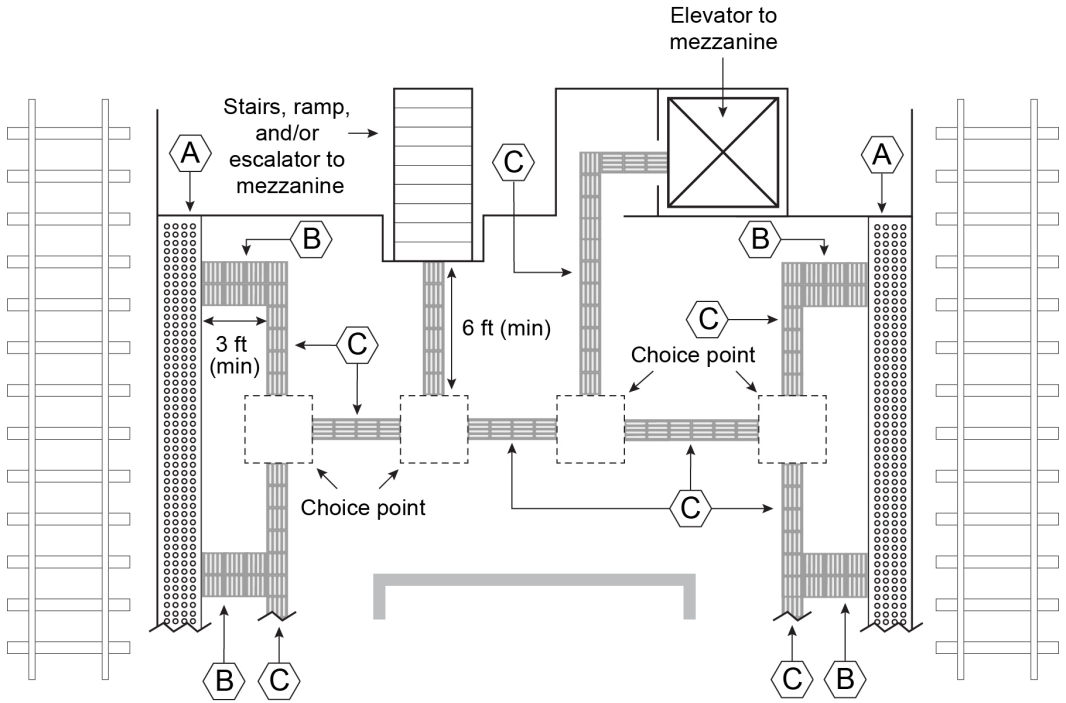
Transit Station Mezzanine



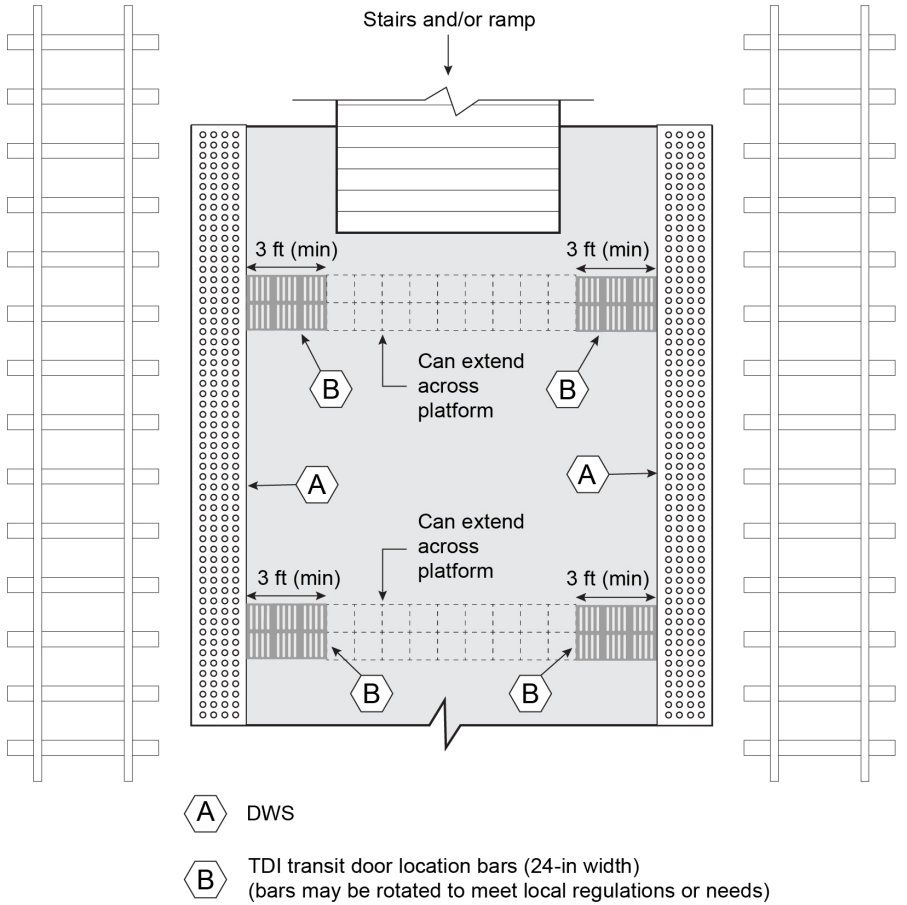
TCRP Research Report 248, Figure 18

Wide vs. Narrow Center Transit Platform

- Also figures for side platform

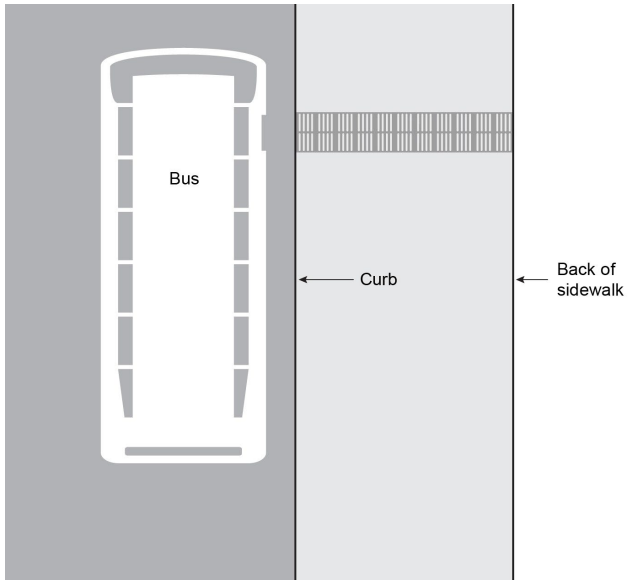


TCRP Research Report 248, Figure 19

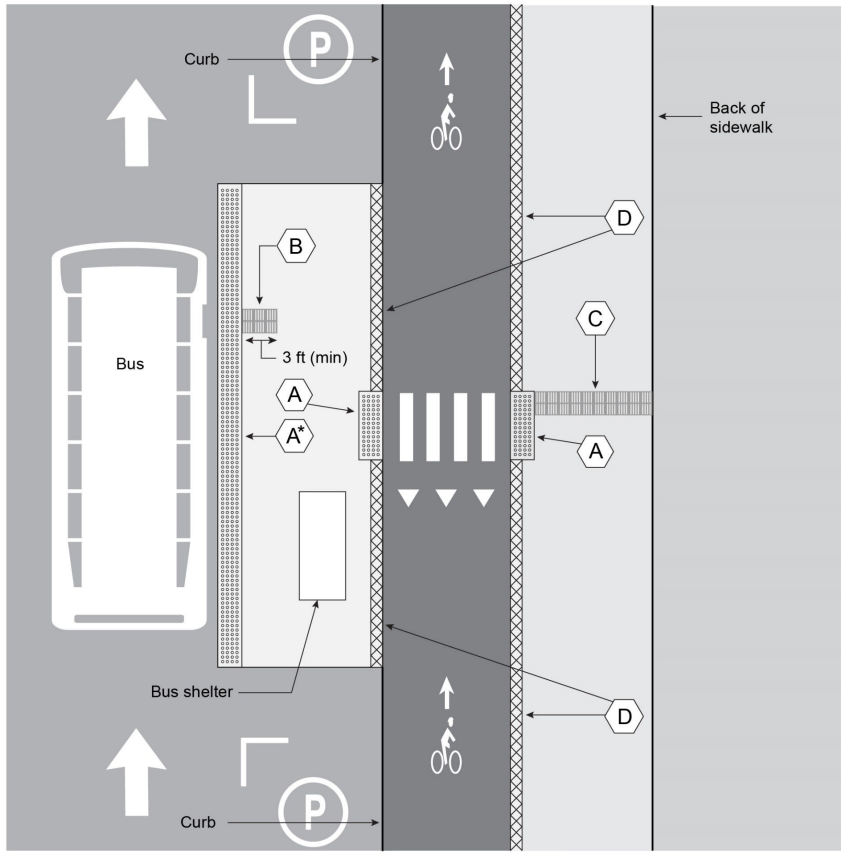


TCRP Research Report 248, Figure 20

Bus Stops, Bus Boarding Islands, and Transit Center



TCRP Research Report 248, Figure 23



*DWS required if platform is raised above standard curb height — see PROWAG

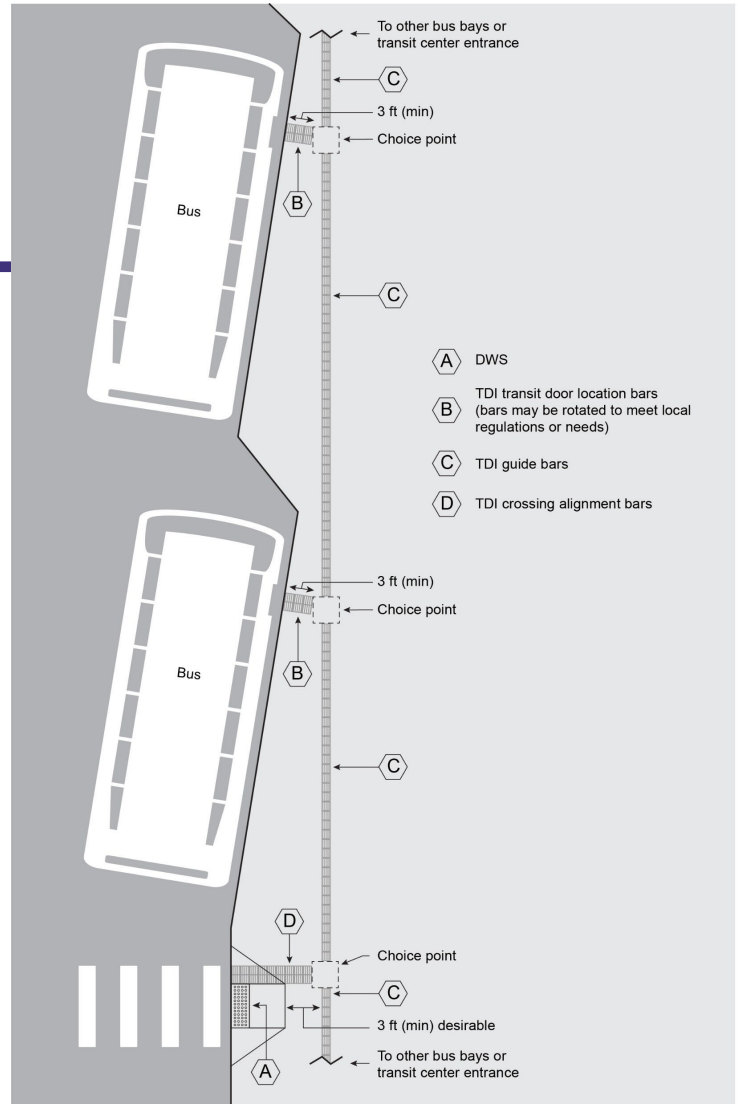
A DWS

B TDI transit door location bars (bars may be rotated to meet local regulations or needs)

C TDI sidewalk alert bars

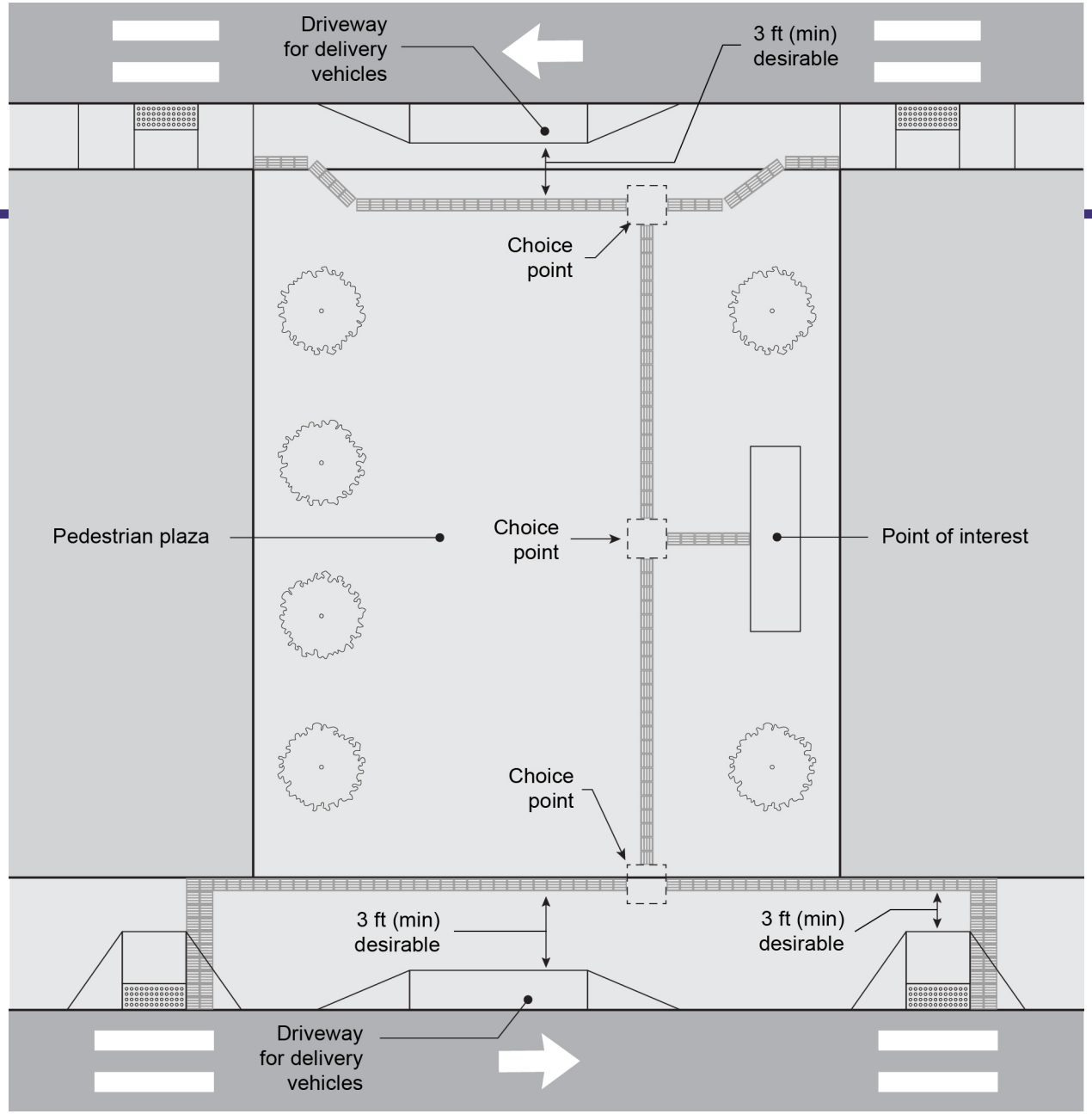
D TWD if bicycle lane is abutting and at same grade as pedestrian facility

TCRP Research Report 248, Figure 25



TCRP Research Report 248, Figure 24

Pedestrian Plaza



TCRP Research Report 248, Figure 26

Chapter 4: Crossing Applications

- TWSIs can help people who are blind or have low vision identify the following items:
  - Location where a street intersects the pedestrian path
  - Boundary between pedestrian path and the path of motor vehicles, bicyclists, or trains
  - Alignment of the street crossing
  - Changes in alignment for the pedestrian path
  - Transitions between shared-use paths and separated bicyclist and pedestrian paths
- **Use good geometry to do most of the work; TWSIs should be a supplement, not a primary measure**

Crossing Design Applications

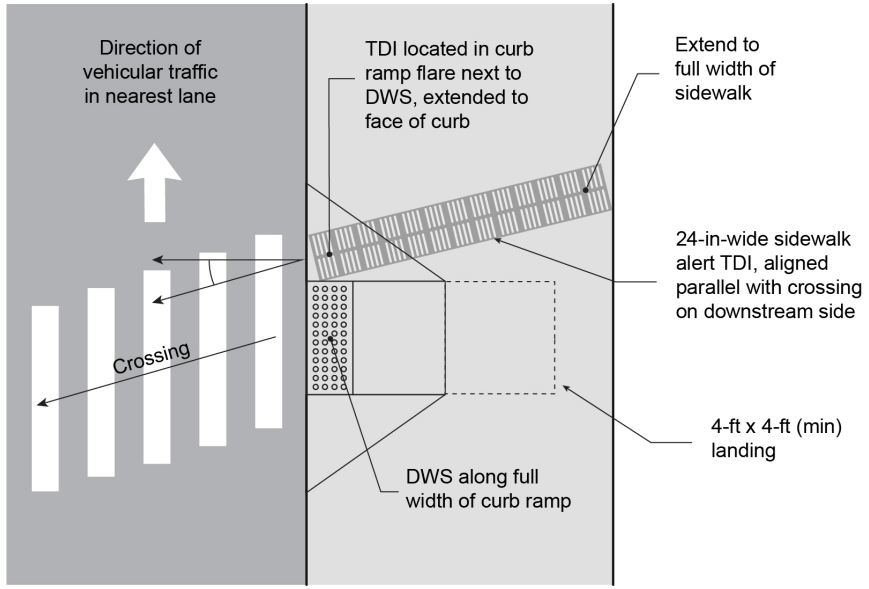
- DWS (domes) placed first
  - DWS are always installed in pairs
- TWDs (trapezoids) placed next
  - Mark boundary of pedestrian path next to bicycle path at same grade
- TDIs (raised bars) can be used as follows
  - Guide bars: 12-inch-wide along a path
  - Sidewalk alert bars: 24-inch-wide across a path
  - Alignment bars: 24-inch-by-24-inch square to mark alignment with crossing

Principles for Installing TDIs (Raised Bars)

- At all TDI installations, consider avoiding the expected path of travel for people using mobility aids
- Corners: Install beside or behind DWS (domes) on side away from center of intersection
- Midblock/roundabout: Install on downstream side of DWS
- TDIs may be beside the DWS or behind it
- TDIs may extend across the flare of a curb ramp
  - Choice of materials may affect how the TDI bends over the grade break

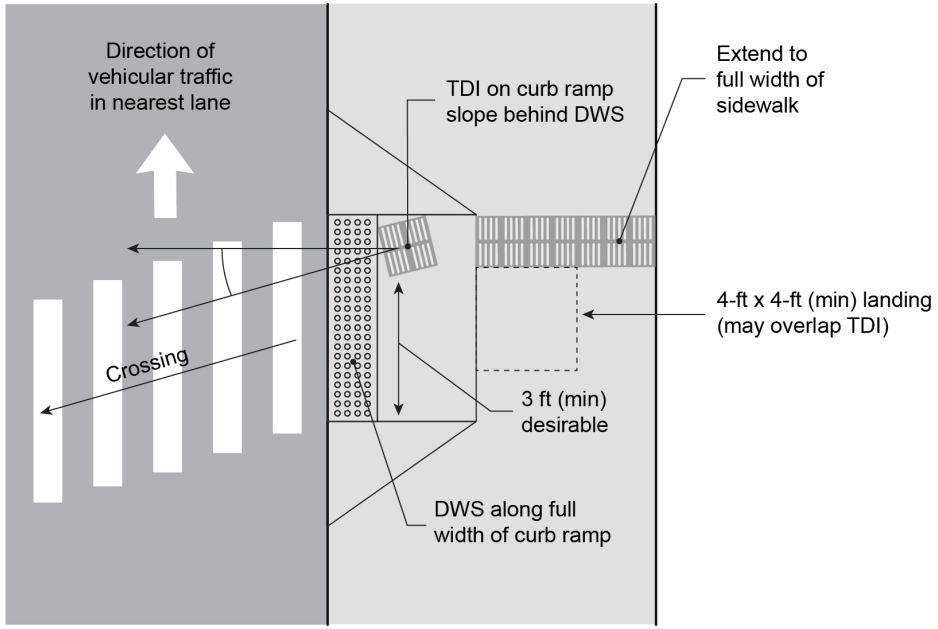
Typical Midblock Crossings or Crossings at Roundabouts

Narrow Curb Ramp with Flares



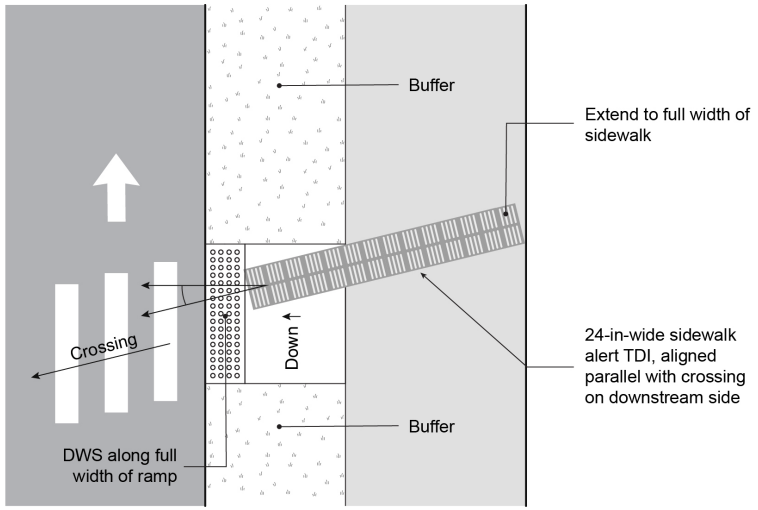
TCRP Research Report 248, Figure 28

Wide Curb Ramp with Flares



TCRP Research Report 248, Figure 27

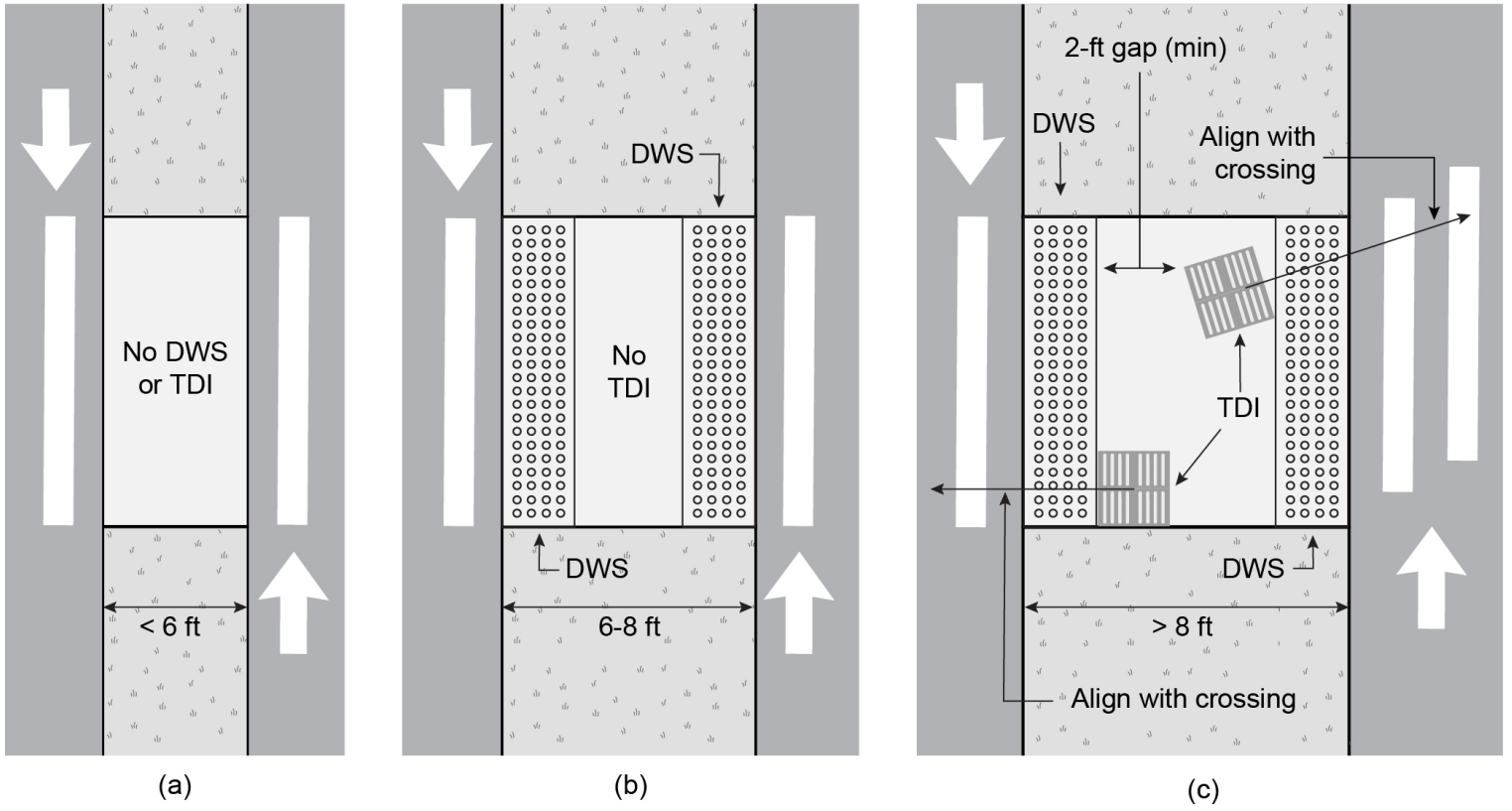
Curb Ramp with Returned Curb



TCRP Research Report 248, Figure 29

Median Islands (Traffic in Opposite Directions)

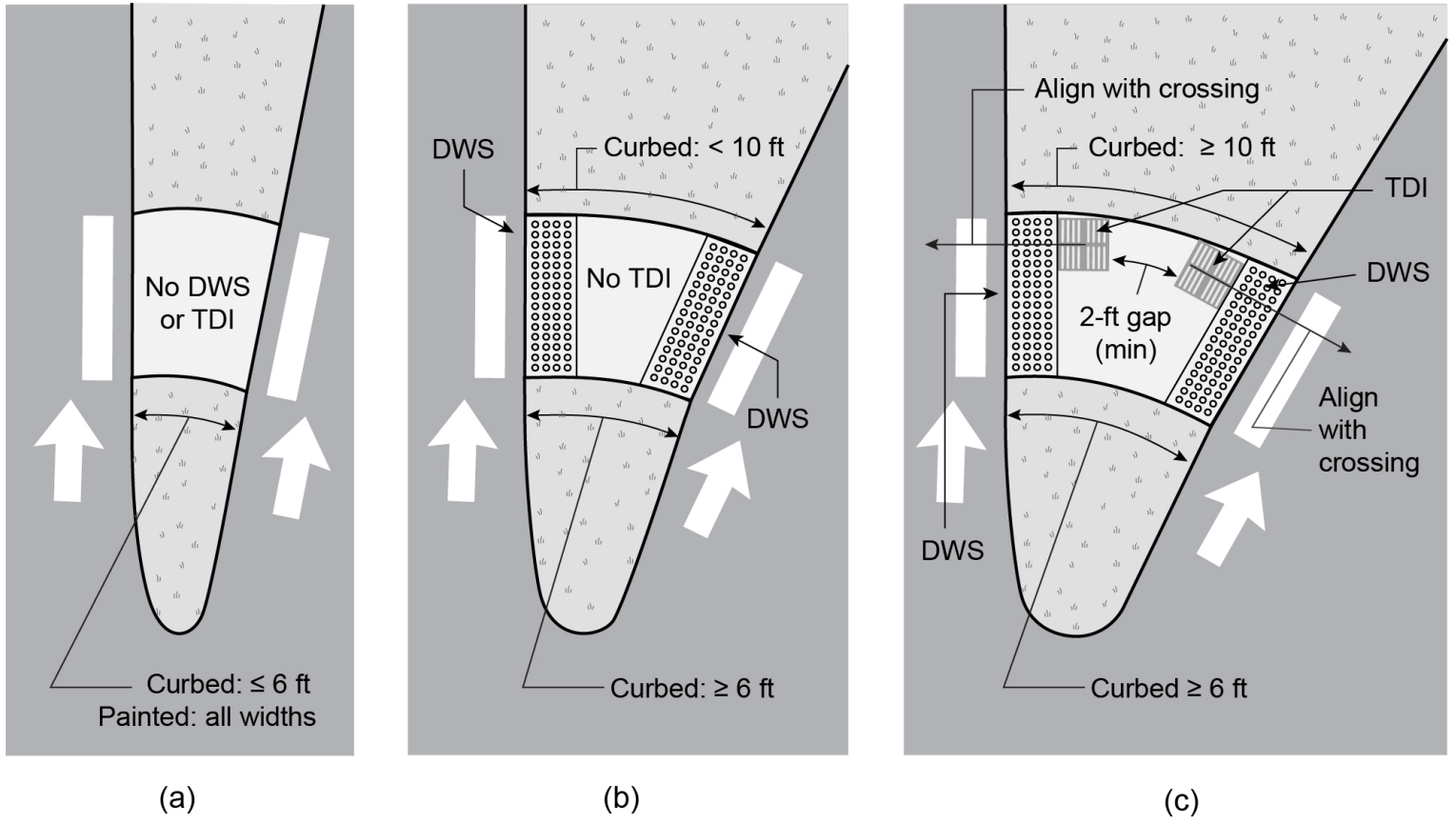
- Install on the downstream side of the DWS
- If using TDI, leave 2-ft gap between DWS and TDI
  - Requires at least 8 ft width



TCRP Research Report 248, Figure 30

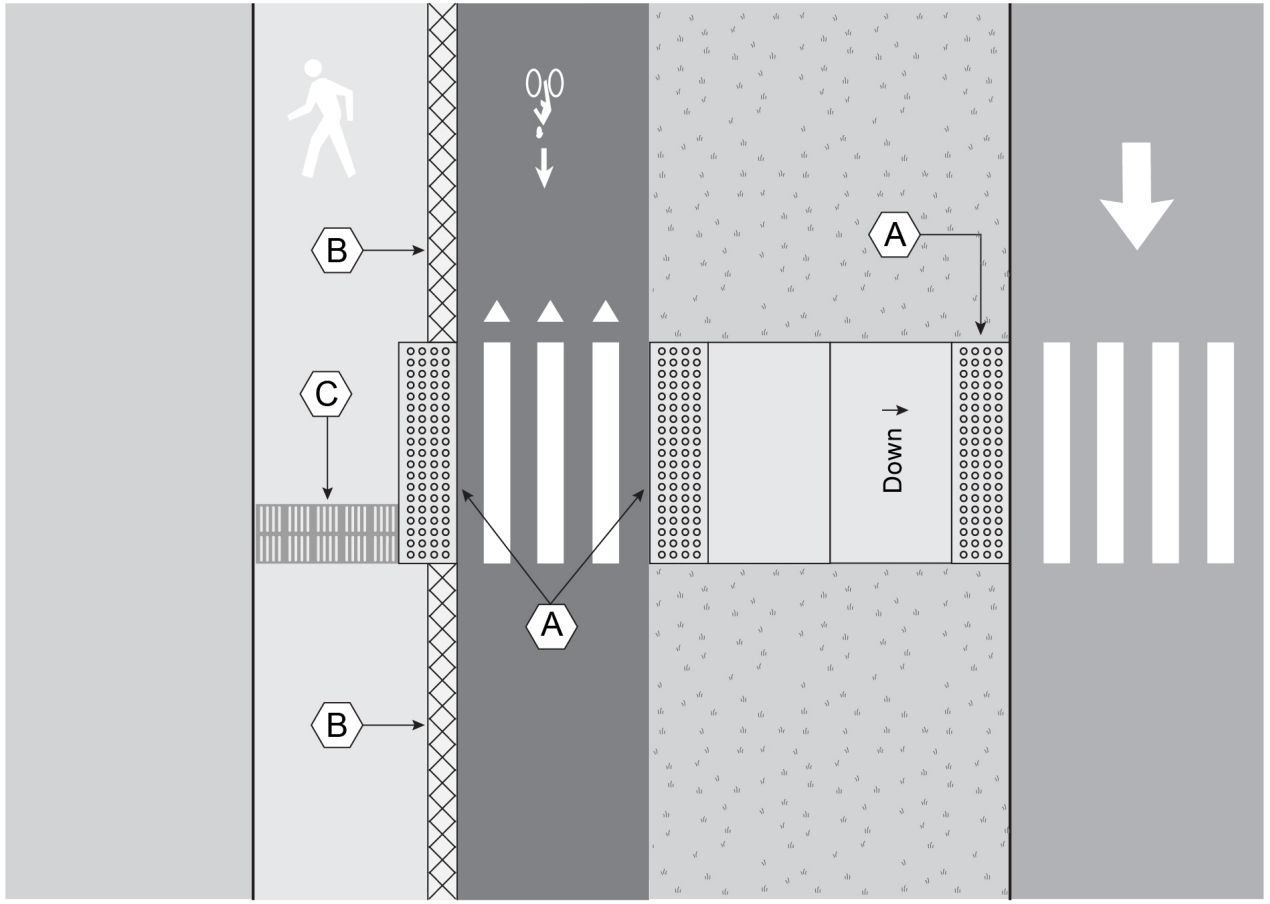
Channelized Turn Islands (Traffic in Same Direction)

- Install on downstream side of DWS
- Leave 2-ft gap between TDI alignment squares
  - Requires at least 10 ft width on downstream side



TCRP Research Report 248, Figure 31

Crossing Median-Separated Bicycle Facility



A DWS

B TWD

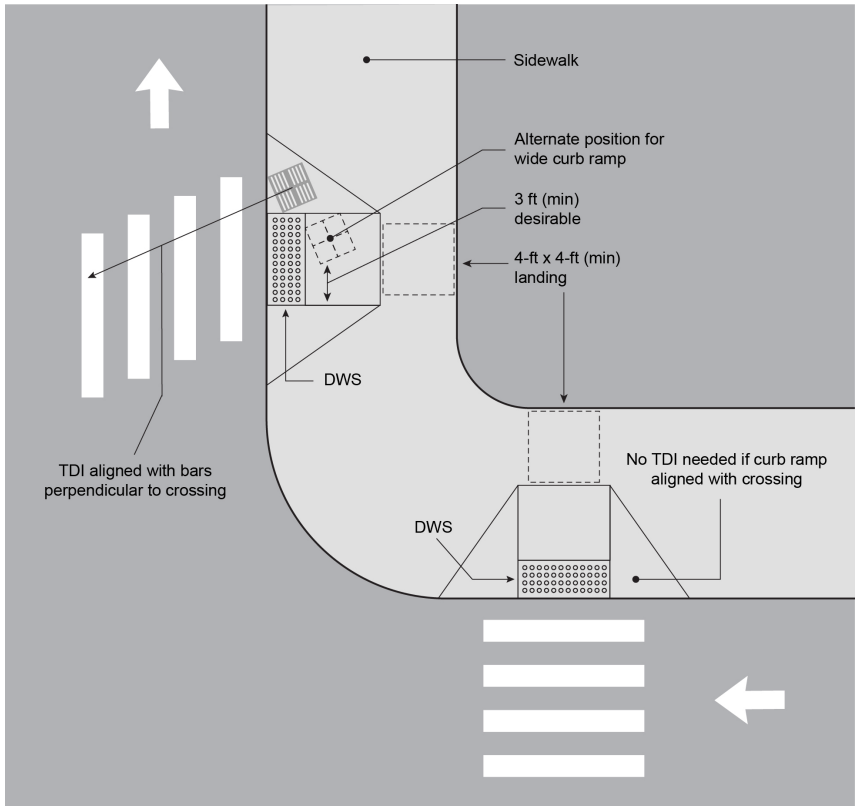
C TDI sidewalk alert bars

TCRP Research Report 248, Figure 33

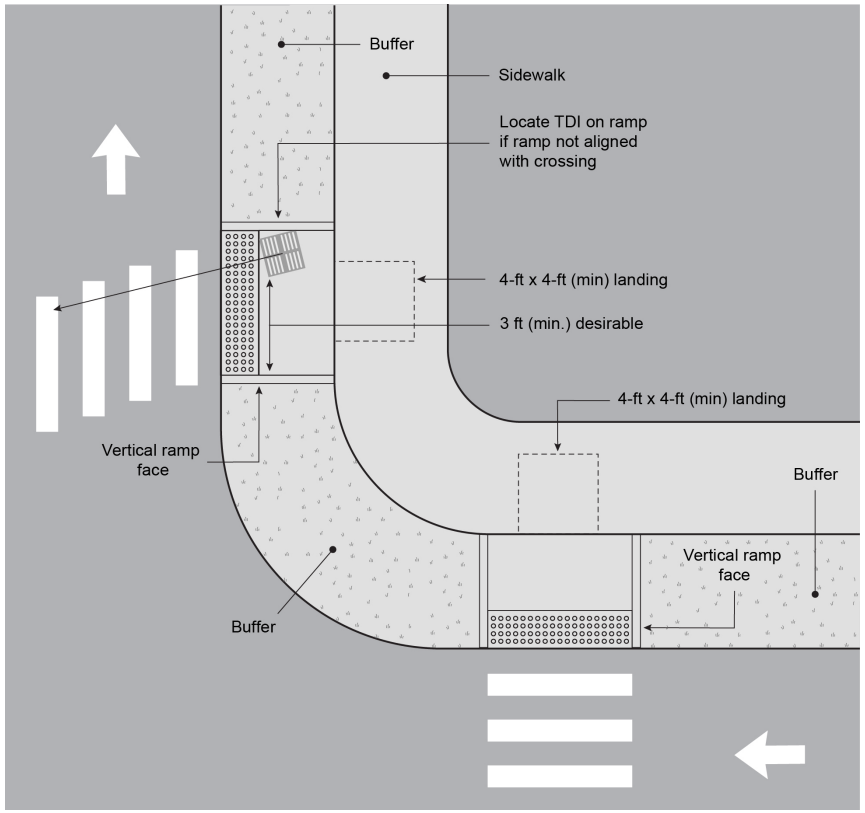
Photo credits: Linda Myers

Corner Applications: Perpendicular Curb Ramps with Flares or Returned Curbs

- Locate TDIs on side away from center of intersection



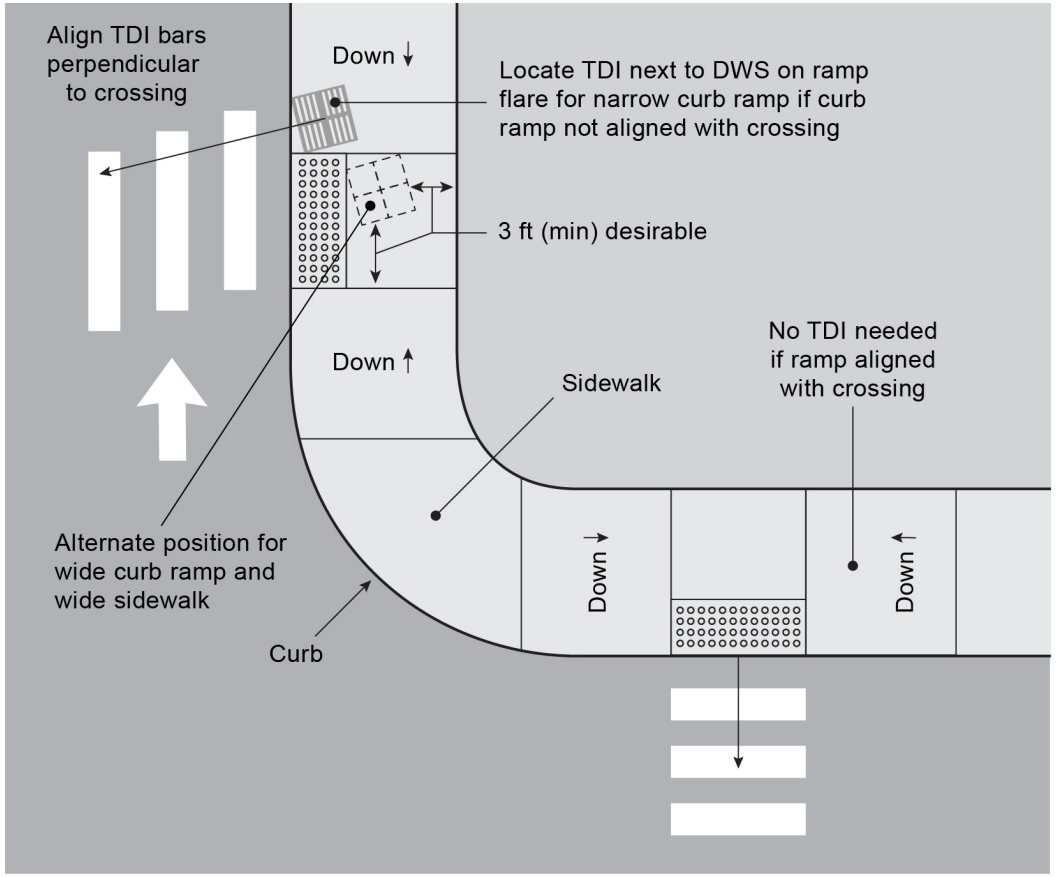
TCRP Research Report 248, Figure 34



TCRP Research Report 248, Figure 35

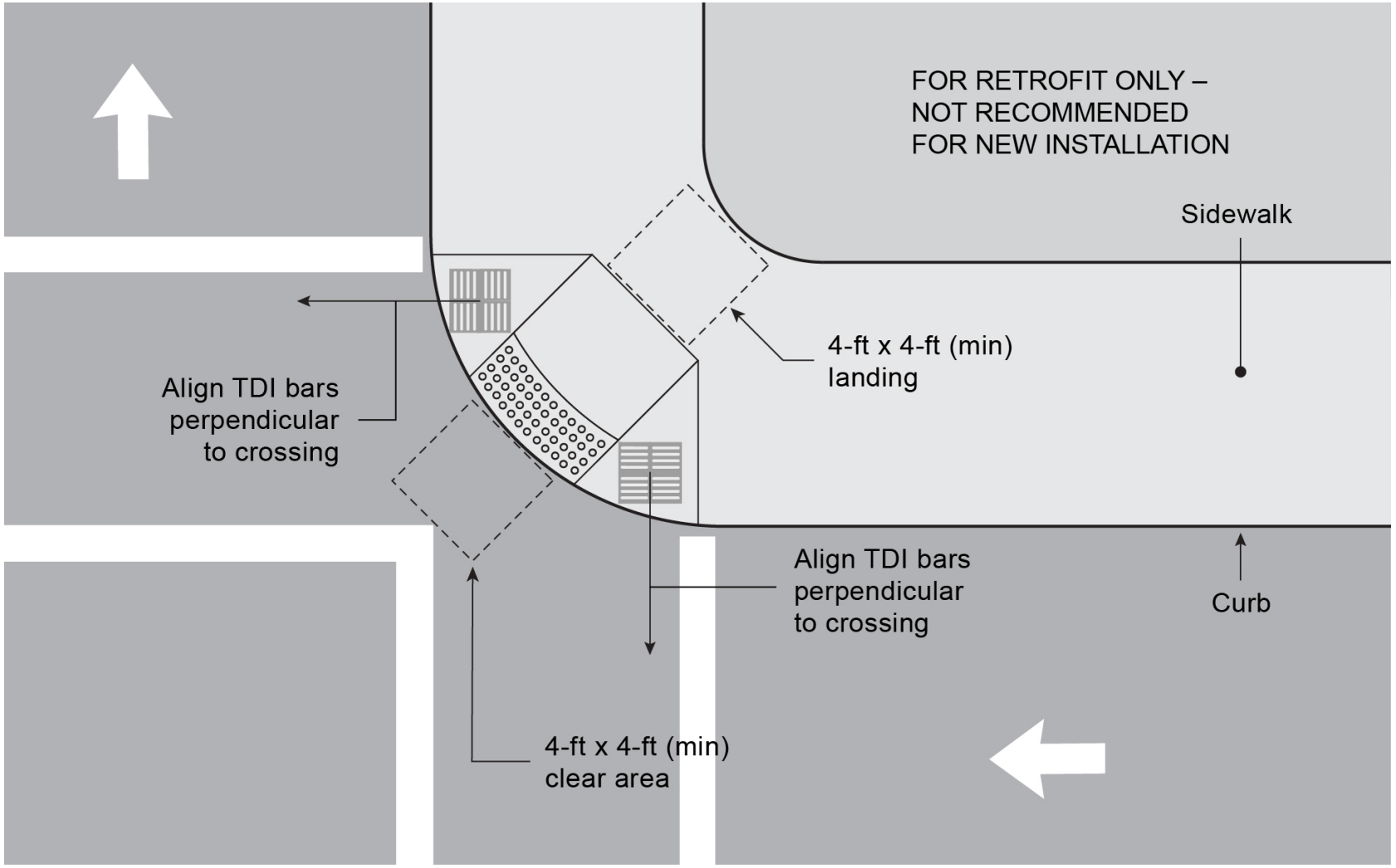
Corner Applications: Parallel Curb Ramps

- TDIs not required if ramp aligned with crossing



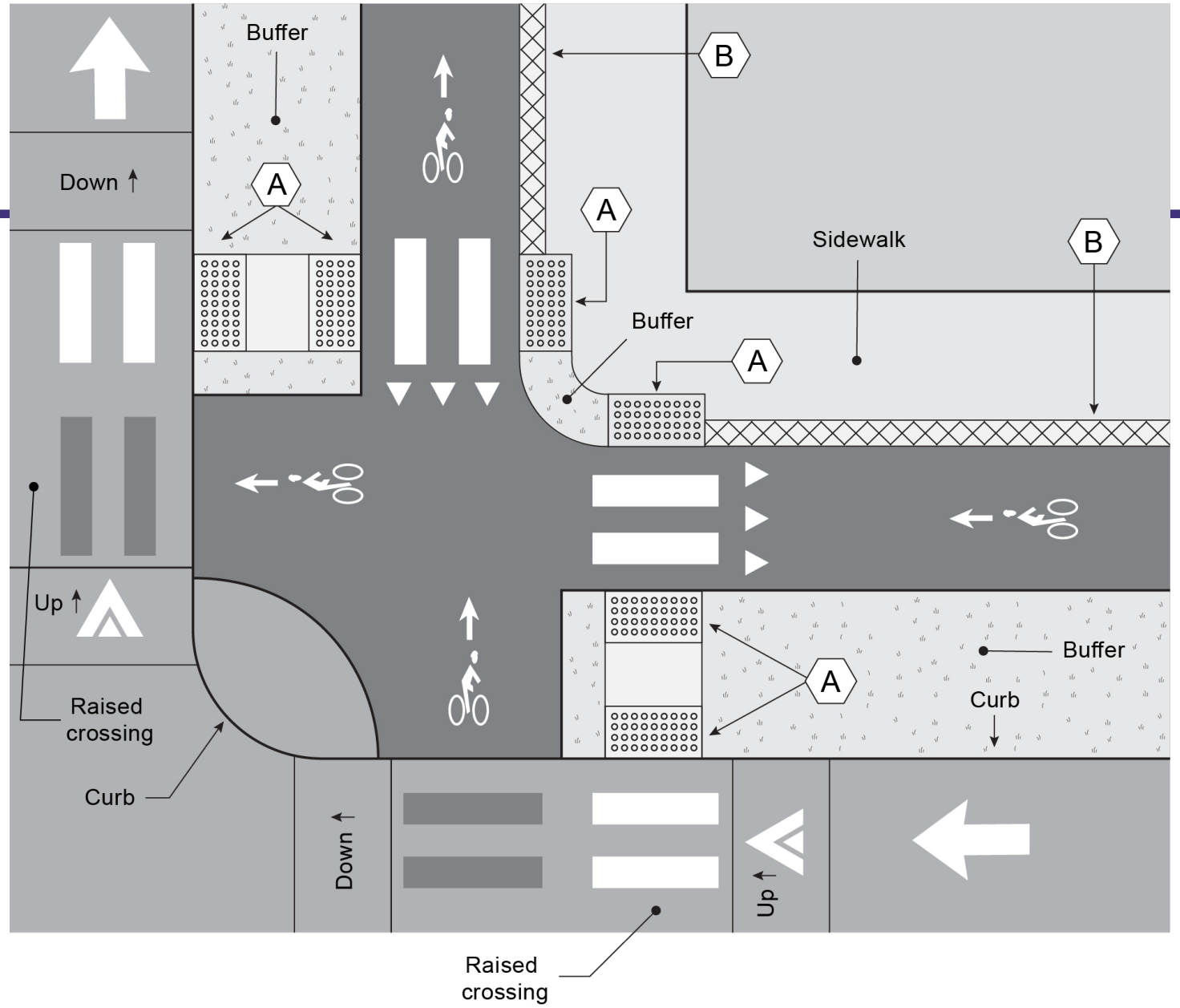
TCRP Research Report 248, Figure 38

Corner Applications: Single Curb Ramp Serving Two Crossings (RETROFIT ONLY)



TCRP Research Report 248, Figure 38

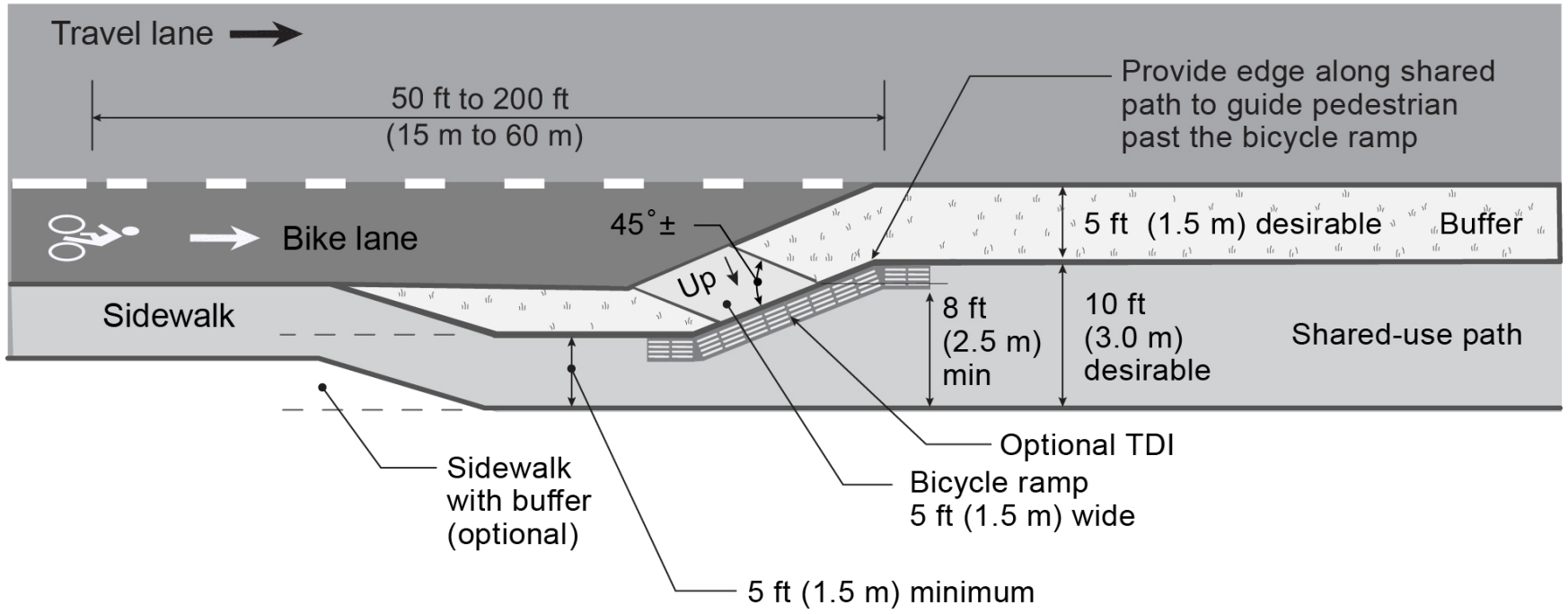
Separated Bike-Ped Facilities



TCRP Research Report 248, Figure 39

Bicycle Ramp Applications

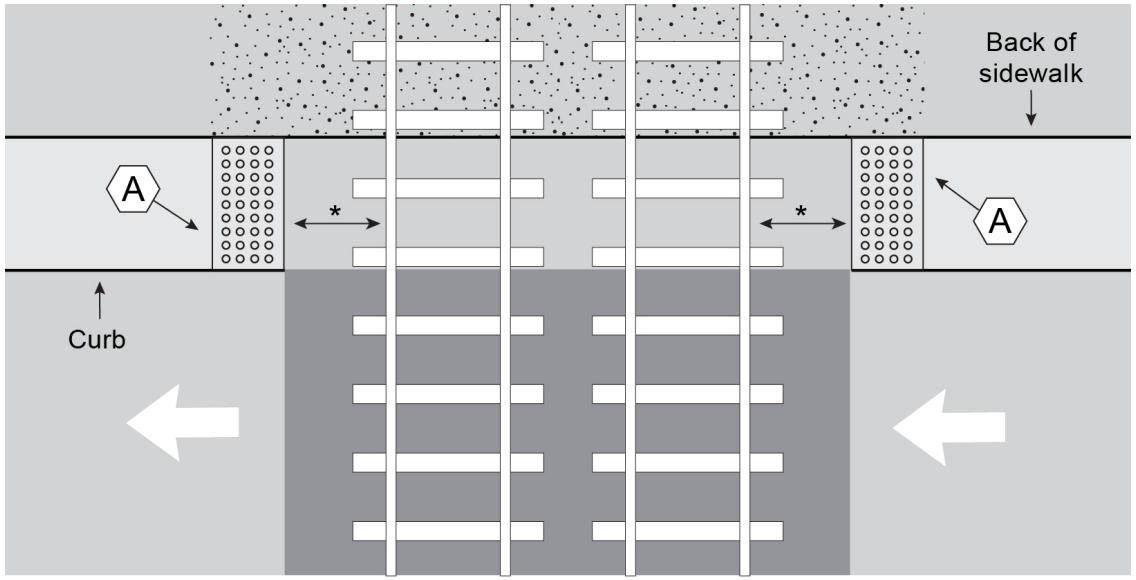
- Used to transition between on-street bicycle lane and shared-use path



TCRP Research Report 248, Figure 40

At-Grade Rail Crossing Applications

No offset in sidewalk alignment

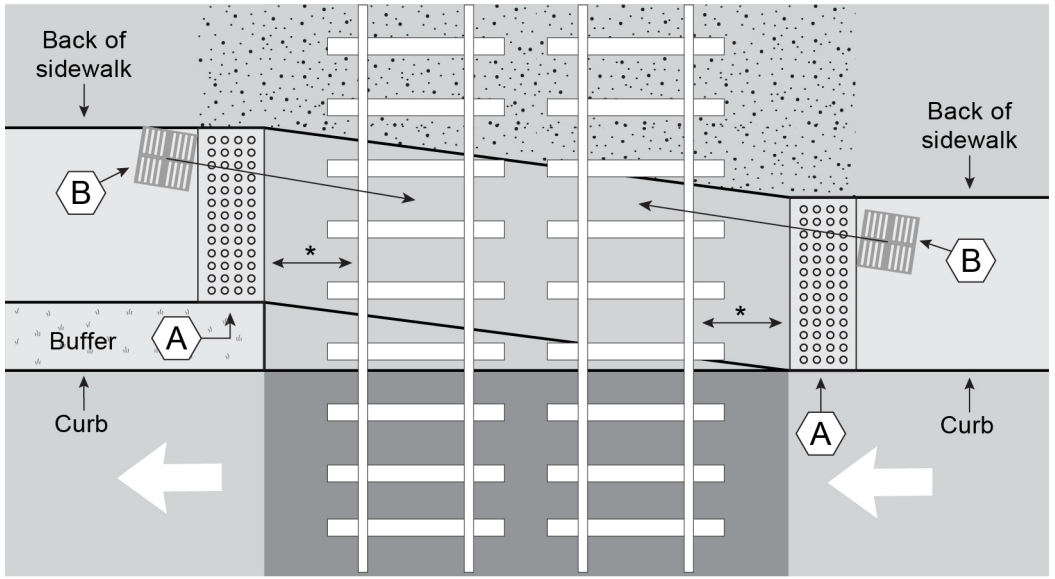


A DWS

*See PROWAG for dimensions

TCRP Research Report 248, Figure 41

Offset in sidewalk alignment



A DWS

B TDI crossing alignmnent square

*See PROWAG for dimensions

TCRP Research Report 248, Figure 42

Chapter 5: Implementation

- Selecting TWSI materials
  - Maximizing durability and detectability
  - Minimize future maintenance
- Guidance for Orientation and Mobility (O&M) Professionals
  - Training potential users
  - Discussion of basic principles using terminology familiar to O&M professionals
    - **“Domes”, “Raised Bars”, and “Trapezoid**”
  - Discussion of locations where different kinds of TWSIs might be found
  - Cane technique for detecting TWSIs
  - Strategies for using TWSIs

Chapter 6: Post-Implementation Activities

- Assessing effectiveness of tactile wayfinding system after installation
- System design to minimize future maintenance
- Routine maintenance activities
- Maintaining wayfinding during utility and construction work
- Brief case studies on four U.S. agencies
  - Bay Area Rapid Transit (BART), San Francisco Bay Area, California
  - Los Angeles Metro Rail, Los Angeles County, California
  - City of San Francisco, California
  - City of Seattle, Washington

Questions & Discussion

Thank you!

THE UNIVERSITY OF NORTH CAROLINA HIGHWAY SAFETY RESEARCH CENTER

Accessible Design for the Blind

KITTELSON & ASSOCIATES

Today's presenters

Sarah O'Brien
swobrien@hsrc.unc.edu
THE UNIVERSITY OF NORTH CAROLINA HIGHWAY SAFETY RESEARCH CENTER

Alan Scott
ascott@accessforblind.org
Accessible Design for the Blind

Lee Rodegerdts
lrodegerdts@kittelson.com
KITTELSON & ASSOCIATES

Lukas Franck
lukasfranck@gmail.com
consultant

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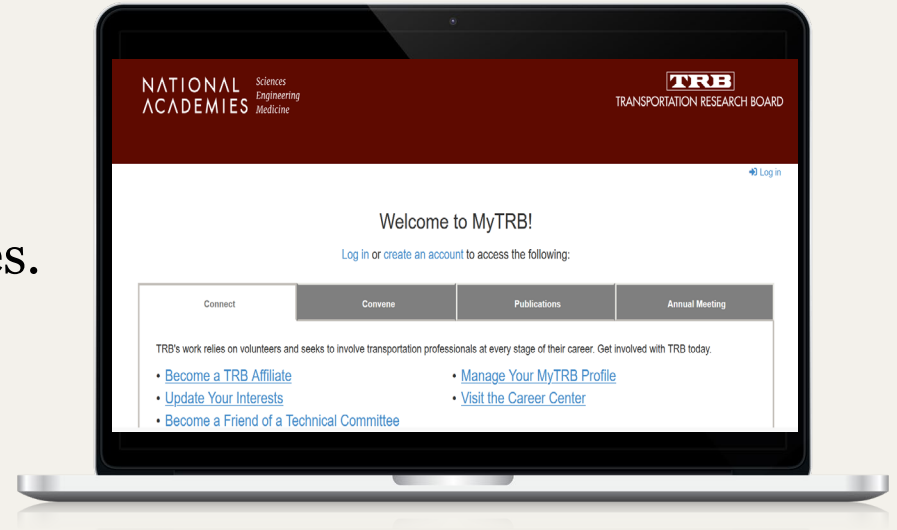

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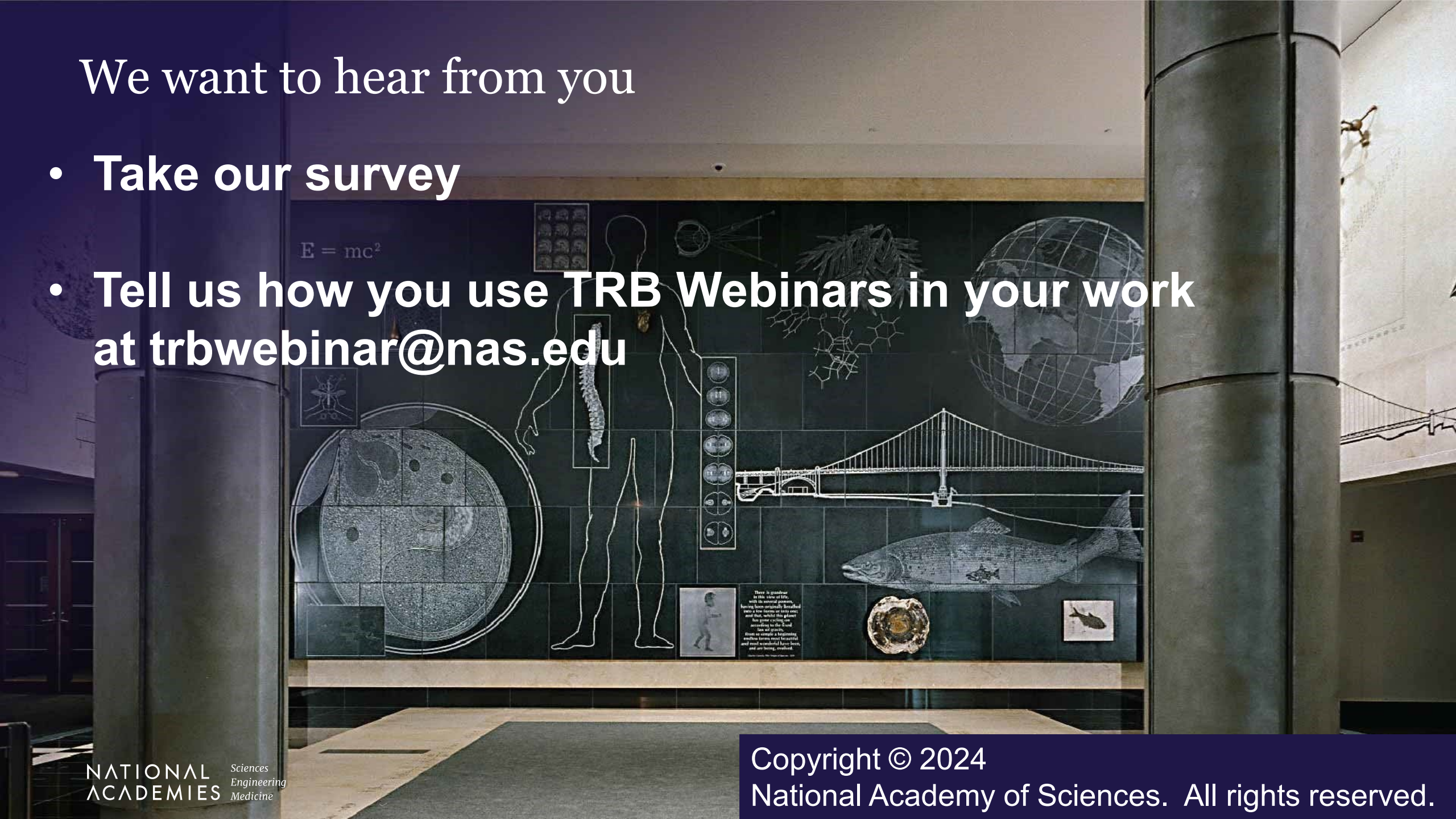

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