Designing Accessible Pedestrian Facilities

Module 1
Introduction – Pedestrians and the Pedestrian Environment
Introductions

• Name
• Title or Affiliation
• What do you want to learn from this course?
Instructor(s) Information

- Scott Lewendon
- Landscape Architect
- NYSDOT
  - Regional Landscape Architect
  - Bicycle and Pedestrian Safety Program Manager
- Consultant to U. S. Access Board for Training Materials
- APBP Member and Instructor of FHWA/APBP Course
- CHA Transportation Division
- JSLewendon@verizon.net
Course Agenda

• Module 1 – Introduction; Pedestrians and the Pedestrian Environment
• Module 2 – Legal Issues and Requirements
• Module 3 – Pedestrian Corridors
• Module 4 – Driveways and Curb Ramps
• Module 5 – Crossings and Intersections (except signals)
• Module 6 – Pedestrian Signs and Signals
• Module 7 – Temporary Facilities and Construction Site Safety
Course Objectives

• Learn about pedestrians with disabilities:
  – The range of pedestrians with disabilities
  – How people with disabilities use pedestrian facilities
  – How restrictive designs affect mobility and safety
Course Objectives

- Learn to recognize accessibility barriers and how to address issues through design:
  - Understanding of the needs of disabled pedestrians
  - Accessibility guidelines and requirements
  - Availability of design resources
Course Objectives

• At the completion of this workshop, participants will learn:
  – How to enhance pedestrian:
    • Mobility
    • Independence
    • Safety
Why is ADA Needed?

People with disabilities represent a significant segment of population.
Why is ADA Needed?

- 20 percent (54 million) of the U.S. population over the age of 15 has a disability (2000 Census)
- 17 million Americans have serious hearing disabilities (2000 Census)
- 10 - 12 million Americans have vision disabilities
- 70 percent will eventually have a temporary or permanent disability that makes climbing stairs impossible (National Council on Disabilities)
Pedestrians and the Pedestrian Environment

Issues we will cover:
• Characteristics of Pedestrians
• Pedestrian Environment
• Movement Barriers
• Information Barriers
Characteristics of Pedestrians

Young children have:
• Limited peripheral vision
• Difficulty judging speed and distance
• Difficulty localizing direction of sound
• Inability to understand complex crossings
• Difficulty stopping an action once started
Characteristics of Pedestrians

People who are elderly may have:

- Limited mobility
- Limited cognitive and sensory abilities
- High expectations of respect
Characteristics of Pedestrians

• The number of people with multiple disabilities will increase with the aging population
• Most of us will have a permanent or temporary disability in our lifetime.
• Important to design for people’s life span
Characteristics of Pedestrians

Factors that affect ability to negotiate sidewalks or trails?

- Hearing
- Vision
- Concentration ability
- Endurance
- Flexibility/agility/balance
- Strength
Pedestrian Characteristics

Assistive technologies and adaptations:
• Manual wheelchairs
• Powered wheelchairs or scooters
• Walkers
• Canes and crutches for balance and support
• Prostheses...
Pedestrian Characteristics

Assistive technologies and adaptations:
• White cane for use by pedestrians who are blind
• Guide dogs and service dogs
• Sighted guide
• Hearing aids
• Small handheld telescopes and binoculars
Powered wheelchair and service dog
Cane for balance and support
White cane
Woman who is blind with service dog
Not all disabilities are readily apparent. Question – What are some disabilities that may not be apparent to the casual observer?
Responsibility of design and planning community

• While some pedestrians use adaptive devices and personal technologies, such as a white cane or wheelchair, these devices have limitations
• The design and planning community are responsible for understanding the users for whom it designs and how public facilities need to perform for these users
Primary Subjects of Our Design

• Mobility Impaired
  – People in wheelchairs
  – People with ambulatory assistance devices

• Visually impaired
  – Blind
  – Poor vision

• Elderly

• People with injuries or illness
Characteristics of People in Wheelchairs
Characteristics of People in Wheelchairs

- Stability and control affected by surfaces with cross slopes and steep grades
- Loss of control on compound slopes
- Require more space to turn around (esp. motorized wheelchairs)
- Reach limitations
  - Minimum low side reach of 9 inches
  - Maximum high side reach of 54 inches
Wheelchair Types
Excessive Cross Slope

UPHILL TRAVEL
- Progress Impacted
- Unequal forces (pushing)
  on wheels
- Sideways slide on ice
Instability on Compound Slopes
Visually Impaired and Blind
Characteristics of Visually Impaired and Blind

• Need to assimilate information for navigation through non-visual sources
  – Auditory
  – Touch
• Assistance Devices
  – Canes
  – Guide Dogs
• Rely on warning cues and wayfinding information
Visually Impaired with Canes

- Cane techniques - touch and diagonal
- Forward path of travel
  - Building shoreline
  - Change in “feel”
- Intersection crossing
  - Perpendicular edge
  - Listen for changes in traffic direction
Visually Impaired with Guide Dogs

- Use the curb as an edge
- Most direct path of travel across an intersection
Seeing through the eyes of the visually impaired....
Elderly
Elderly

- Difficulty in negotiating steep grades and cross slopes
- Decreased stability - icy or uneven surfaces potentially hazardous
- Slower walking speed and reduced endurance
- Inability to react quickly to dangerous situations
- Many use walkers and canes
- Need frequent rest areas
People With Walkers and Canes
Require Longer Crossing Time

Require Smoother Surface
People With Injuries and Illness

- Decreased mobility from muscle ailments (MS)
- Spinal cord injuries
- Crutches and canes need greater width for gait
The Pedestrian Environment

The pedestrian environment includes sidewalks, trails, crosswalks, parks, paved shoulders, etc.
The Pedestrian Environment

The Principle of Universal Design:
The walking environment should be usable by all
Movement Barriers

Definition:
• Anything that restricts an individual's ability to physically move or progress along or within an environment.
Question

What are some examples of movement barriers?
Movement Barriers

- Difficult terrain -- steep grades and cross slopes, soft surfaces, uneven surfaces
- Long slopes
- Obstacles in pathway -- lampposts, benches, newspaper boxes
- Insufficient time to cross the street
- Too narrow facilities
- No ramps
- Lack of sidewalk
- Detectable warnings!
- Skewed ramps
Movement barriers: obstacles on sidewalks
Movement barrier: steep slope
Movement barrier: lack of curb ramp
Video: Movement Barriers

• This video depicts movement barriers encountered by people who use wheelchairs, crutches and walkers.
• Video: “Accessible Sidewalks – Design Issues for Pedestrians with Disabilities” Parts 1 and 2
  - US Access Board
Information Barriers

Definition:
• Anything that restricts the individual’s ability to use the information contained within the street, sidewalk and trail environment.
Question

What are examples of information barriers?

• Think of possible examples of where you work, the neighborhood you live in, and the places you shop
Information Barriers

• People with visual disabilities rely on sounds and textures
  – No tactile information indicating boundaries
  – Continuous traffic stream
  – No crossing information in accessible formats (audible and vibrotactile)
  – Can’t find pedestrian push buttons
  – Indirect routes
Information Barriers

People with visual disabilities benefit from:

- Information in reliable and standardized tactile and audible formats
- Direct routes with defined edges
- High color contrast on signs, signals, street markings, and curb ramps
Information Barriers

People with hearing disabilities:
• Rely on their vision
• Benefit from good sight lines for assessing street crossing conditions
Information Barriers

• People with cognitive disabilities:
  – Have limited processing and decision-making skills

• People with cognitive disabilities benefit from:
  – Straightforward, direct environments
  – Uncomplicated street crossings
  – Easy to understand symbols
Examples of Cognitive Information Barriers

• Short sight lines or inability to judge traffic distance and speed
• Complex traffic patterns, right turn on red, and unusual signal operation, free-flow movements
• Non-standard locations for pedestrian features (push buttons, crosswalks)
• Poor crosswalk and curb ramp alignment
• Unlit or dimly lit path of travel
Information barriers: complex intersections, unusual motor vehicle turning movements
Examples of Information Barriers

- Other barriers for visually impaired pedestrians
  - Intersection too noisy to distinguish the directional and surging sounds of traffic
  - Traffic flow too intermittent
  - Surge of traffic too far away
  - Bicycles and quieter cars
  - Obstacles not detectable by cane
  - Signs and signals only in visual format
Information barrier: depressed corner, no detectable grade, all same surface texture
Pedestrians who are blind cannot identify this barrier or navigate around it.
Sign provides no information to pedestrians who are blind
This pedestrian signal does not provide information to pedestrians who are blind.
Video: Information Barriers

• This video depicts barriers encountered by people with low vision and who are blind.
• Video: “Accessible Sidewalks – Design Issues for Pedestrians with Disabilities” Parts 3 and 4
  - US Access Board
Pedestrian Facilities
Issues to Solve

• People should not have to adapt to the environment. The environment must be usable to the full spectrum of users.
• Users should be able to travel independently
• In general, streets and other public facilities must be designed for all users – pedestrian facilities should not be an afterthought
Pedestrian Facilities
Issues to Solve

• Issues to solve due to pedestrian facilities being considered as an afterthought:
  – Lack of a continuous pedestrian network
  – Not well designed for people with disabilities, young children, and elderly
  – Unsafe or perceived unsafe highway environment
  – Land use and development patterns that discourage walking
  – Lack of pedestrian interface with transit
Question

• What are examples of designs that may facilitate smooth flow of traffic but affect pedestrians and compromise pedestrian safety?
Answers

• wide curb radii (longer pedestrian exposure to traffic)
• wide lanes
• multiple lanes
• right turn on red
• high speeds
• right slip lanes
Summary

• Why we should design for all pedestrians
• Pedestrian Characteristics
  – Children/Elderly
  – Pedestrians in wheelchairs
  – Visually impaired
  – Other disabilities
• Pedestrian Environment
  – Mobility Barriers
  – Communication Barriers
Designing Pedestrian Facilities for Accessibility

Module 2
Legal Issues and Requirements
What Will Be Covered

• Legal Background
• Relevant Titles of the ADA
• ADA Title II - State and Local Government Services
• ADA Accessibility Guidelines
• ADA Accessibility Standards
• Enforcement
Legal Background

Architectural Barriers Act (1968)
• Required buildings and facilities designed, constructed, altered, or leased with Federal funds to comply with Accessible Design Standards (ANSI A117.1; UFAS After 1982)

Rehabilitation Act (1973)
• Section 504 - Prohibited discrimination with Federal funds in any program, service, or activity of Federal aid recipients
• Established the U. S. Access Board
• Required curb ramps on Federally assisted construction
Legal Background

Americans with Disabilities Act (1990)
• Civil Rights law that prohibits discrimination against people with disabilities in all aspects of life (regardless of funding source)
• Equal participation and opportunity into mainstream society is goal

ADA (Title II and III) Amended – July 23, 2010
• Published in the Federal Register on September 15, 2010
• Effective March, 2011
• Adopted the 2010 Standards for Accessible Design
Five Titles of ADA

I. Employment
II. State & Local Government Services
III. Public Accommodations and Commercial Facilities (Public and common use areas of privately-owned facilities)
IV. Telecommunications
V. Miscellaneous, includes requirements for the U.S. Access Board to develop design guidelines
Title I - Employment

Basic Requirements:

• Employers must make *reasonable accommodation* to provide for the needs of a qualified applicant/employee with a disability

• Employers must provide accommodations specific to individual use when needed to perform their job
Title II - State and Local Government Services

- Title II is the primary section that affects the built environment in the public right-of-way

- Title II requirements are based on Section 504 of the Rehabilitation Act (1973)
Title III - Private Entities Operating Public Facilities

Basic Requirements:

• Must meet both Title III and Title II
• Must provide readily achievable barrier removal in places of public accommodation
• Requirements for Title II entities are more stringent than Title III entities in some areas
• No requirement for evaluation and transition plan
Title IV - Telecommunications

Basic Requirement:

- Requires telephone companies to provide telecommunications relay services for hearing-impaired and speech-impaired individuals
Basic Requirements:

- Directs the U.S. Access Board to develop design guidelines for accessibility standards - Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- ADAAG was adopted by the Departments of Justice and Transportation as ADA standards for accessible design
Title II - State and Local Government Services

Basic Requirements:
• Must ensure that individuals with disabilities are not excluded from programs, services, and activities (pedestrian facilities are an example of a program)
Title II - State and Local Government Services

Basic Requirements:

• **New construction and altered facilities** must be designed and constructed to be accessible to and usable by people with disabilities

• **Existing facilities, policies and programs** must be evaluated for discrimination and a plan for modification put in place (Transition Plan)
Title II - New Construction

New Construction – 28 CFR 35.151*

- Any facility altered or constructed after January 26, 1992 must comply with ADA Accessibility Guidelines (ADAAG) or Uniform Federal Accessibility Standards (UFAS)
- Can depart from these standards if equivalent or higher access is provided (equivalent facilitation – ADAAG 2.2)

*Note: CFR = Code of Federal Regulation
Title II - New Construction

New Construction – 28 CFR 35.151

- New construction expected to provide highest level of accessibility
- Free from architectural barriers
- Free from communication barriers
- Cost of providing accessible features is minimal in new construction
Title II - Alterations

Alterations – 28 CFR 35.151

- Altered portions of facilities must meet new construction guidelines to maximum extent feasible
- When one requirement is technically infeasible, other design specifications must still be met
- Document, document, document when not able to meet specific design requirements
Title II - Alterations

Alterations – 28 CFR 35.151
• DOJ and court decisions consider roadway resurfacing an alteration (1993)
• Roadway resurfacing triggers requirement for curb ramp installations

(Kinney v. Yerusalim, 813 F. Supp. 547 F.D. PA 1993)
Title II - Self Evaluation
(Prerequisite for Transition Plan)

Self Evaluation – 28 CFR 35.105

• Public entities:
  – Shall examine accessibility of its current programs, services, and activities
  – Shall maintain records of self-evaluation activities for three years:
    • Who was consulted
    • What was examined
    • What problems were identified
    • What changes are to be made
Title II - Transition Plan

- Every program or inaccessible facility identified in the self evaluation needing structural modifications for accessibility must be in the transition Plan
  - Specifies the steps for achieving accessibility
  - Solicit input from interested parties
  - Copy of plan available for public inspection
Title II - Transition Plan

• Transition plan requirement is a carry over from Section 504 Rehabilitation Act (1973)
  – Transition plan was to be complete by July 1992
  – Modifications complete by Jan. 1995

• 49 CFR, part 27.11, requires Federal-aid recipients to evaluate policies and practices and schedule modifications
  – Must establish a periodic review and update the evaluation process
Existing Facilities 28 CFR 35.150

• Program access:
  – Pedestrian facilities are a program
  – Allows relocating a public program or providing alternative access to gain access to a service rather than altering a facility
  – Structural changes are required if program cannot be modified
Title II - Existing Facilities

Alterations to facilities on Transition Plan must meet minimum design standards:

• Unless it is “technically infeasible”
• Technical infeasibility refers only to structural conditions
Title II - Existing Facilities

Requires public entities to make programs accessible in all cases unless:

- Improvement fundamentally alters the nature of the program (for example, a historic building tour or a rugged hiking trail in back woods)
- Improvement creates undue financial and administrative burden
Title II - Existing Facilities

Undue Burden:
• Based on all resources available for a program
• Claims must be proven and accompanied by a written statement of reasons and signed by the head of the public entity
• What constitutes undue burden will often be decided in courts
Title II - Existing Facilities

Undue Burden:
• Exceptions should be rare
• Entities must make good faith effort to provide accessibility
• If full accessibility is not feasible, document what steps were taken
• Applies only to existing facilities, not new or planned construction
Title II - Existing Facilities

Barden vs. Sacramento case (settlement in 2004):
• Provides significant insight into what constitutes an undue burden
• Court ruled that public entities must address accessibility barriers to and along sidewalks
• Settlement requires city to spend 20% of its entire transportation budget to make the public right-of-way accessible (for 30 years)
Arbor Hill, Albany, NY

- Ramp at 12% to 15%
- Two Span Bridge 8.3% - No Landings
- 75’ Switchback – No Landings
Arbor Hill, Albany, NY
Arbor Hill, Albany, NY
Arbor Hill, Albany, NY
Title II - Existing Facilities

Summary

• Goal for structural modifications and program access is a level of usability that balances:
  – User needs
  – Constraints of existing conditions
  – Available resources
Title II - Maintaining Accessibility

Maintaining Accessibility 28 CFR 35.133

• State and local governments must maintain the accessible features of facilities in operable working conditions (for example, curb ramps, sidewalk breaks, buckled bricks)

• Poorly maintained facilities are not accessible or safe
Title II - Maintaining Accessibility

Maintenance Examples
- Sidewalks blocked by street furniture
- Broken Elevator
- Snow on sidewalk and curb ramp
- Clogged drains
- Trimming trees and landscaping
ADA Accessibility Guidelines (ADAAG)

- **Guidelines** serve as the basis for enforceable standards
- Serves as basis for *enforceable design standards* issued by other agencies under Title II and Title III entities
- **Standards** are minimum requirements to be used as building blocks
- **Best practices** often go beyond the ADAAG
- **Evolving** document updated periodically
ADA Accessibility Guidelines (ADAAG)

• ADAAG first developed by Access Board in 1994
  – Developed for buildings and facilities
  – Did not specifically apply to public ROW’s

• Revised – July 23, 2004
  – Better conformance with IBC
  – Includes UFAS

• Guidelines are not mandatory until the enforcing authorities (DOJ or DOT) use it to update their ADA standards
2004 ADAAG

- Chapter 1: Application and Administration
- Chapter 2: Scoping Requirements
- Chapter 3: Building Blocks
- Chapter 4: Accessible Routes
- Chapter 5: General Site and Building Elements
- Chapter 6: Plumbing Elements and Facilities
- Chapter 7: Communication Elements and Features
- Chapter 8: Special Rooms, Spaces and Elements
- Chapter 9: Built-In Elements
- Chapter 10: Recreation Facilities
ADA Accessibility Guidelines (ADAAG)

- Entities are required by DOJ Title II regulations to provide accessibility even if ADAAG does not cover specific design issue (for the right-of-way).
- State and local standards must meet or exceed ADAAG standards.
- Title II entities can use either ADAAG or UFAS.
ADA Accessibility Guidelines (ADAAG)

- ADAAG is the foundation for best practices
- Best practices should be considered for safer and more usable facilities in the public right-of-way
  - Pedestrian environment is more hazardous than the building environment
  - Interactions with motorists
  - Pedestrians travel faster outdoors
Public Rights-of-Way Accessible Advisory Committee (PROWAAC)

- Drafted Public Rights-of-Way Accessibility Guidelines (PROWAG) - July 17, 2002
- Received public comments and revised PROWAG - 2005
- “Notice of Proposed Rulemaking” anticipated?
- FHWA Memorandum (January 23, 2006) – Draft PROWAG are “recommended best practices” for accessible design within ROW’s
What resource should I use for the design of public rights-of-way???

1. Draft PROWAG, 2005 – Best practice and soon to be standard
2. ADAAG, 2004 – Standard and the law
3. MUTCD – Standard for signals and construction
4. Common sense (engineering judgment) based on your knowledge of the characteristics of users

When in doubt about conformance – document, document and document
Recommended Practices Guidance

- Designing Sidewalks & Trails for Access Part II (FHWA) (http://www.fhwa.dot.gov/environment/sidewalk2/)
- Guide for the Planning, Design, and Operation of Pedestrian Facilities (AASHTO)
Federal Regulatory Standards

- Manual on Uniform Traffic Control Devices (MUTCD) (FHWA)
- Policy on Geometric Design of Highways and Streets (Green Book) (AASHTO) is the standard for the National Highway System (NHS) and a guide for other roadways
ADA Enforcement Agency?

- There is no agency that actively reviews the actions of public or private entities and enforces ADA compliance on a national level (no permitting process)
- DOJ receives complaints and negotiates settlement or litigates
- Project Civic Access – DOJ initiative
- Key Bridge Foundation – Mediation
- DOJ Program to monitor ADA civil litigation
Designing Accessible Pedestrian Facilities

Module 3:
Accessible Pedestrian Design:
Pedestrian Corridors and Accessible Routes
Accessible Pedestrian Design

The rest of this course will cover most of the design guidelines contained in:

• ADAAG
• PROWAG
• Recommendations from the Public Rights-of-Way Access Advisory Committee
What Will Be Covered in Module 3

• Types of Pedestrian Facilities
• Sidewalk Corridor
  – The Zone System
  – Grades
  – Cross-slope
  – Surfaces
  – Obstructions and Objects
Pedestrian Corridor Design Concepts

• Walking is the root of all travel
• Every public right-of-way needs to accommodate pedestrian travel
• Every pedestrian corridor within a public ROW requires an accessible route
• Accessible routes require:
  – Adequate space
  – Gentle slopes
  – Sufficient surface
Types of Pedestrian Facilities
Shared Use Paths

- Pedestrians are a key user group
- Always address pedestrian needs during planning and design
- FHWA recommends Outdoor Developed Areas design criteria
Paved Shoulders

• Typically used on rural highways and roadways (and some suburban roadways)

• Minimum width for to accommodate pedestrians: 4 ft (1.2 m)

• Most standard sections require 6% cross slope
Pedestrians can get by without sidewalks on low-volume and low-speed streets
Shoulders serve pedestrians in rural areas
At a certain point, sidewalks are needed
“Goat trail” indicates sidewalks are needed
A sidewalk on one side only is often inadequate
Guidelines for New Sidewalk Installation

USDOT Policy Statement:
• Accommodate pedestrians in new construction and reconstruction unless
  – Pedestrians are prohibited by law
  – Sparsity of population or other factors indicating absence of need
  – Cost would be excessively disproportionate to need or probable use (e.g., greater than 20% of total project)
Sidewalk Corridor - The Zone System

• The sidewalk corridor extends from the edge of roadway to the edge of right-of-way
  – Curb zone
  – Furniture zone
  – Pedestrian zone
  – Frontage zone
Curb Zone

- **furniture zone**
- **curb zone**
- **pedestrian zone**
- **total width**
Curb Zone

- 6 inches (150 mm) immediately adjacent to the roadway
- Integral to drainage – prevents water from collecting on the sidewalk
- Discourages motorists from driving onto the sidewalk
- Valuable cue for vision impaired
Mountable curbs are not acceptable solution in urban areas
Furniture Zone

- furniture zone
- curb zone
- pedestrian zone
- total width
Planting Strip

Furniture Zone

Planter Strip
Furniture Zone

- Between the curb and pedestrian zones
- Buffers pedestrians from the roadway
- Keeps pedestrian zone free of obstacles
- Provides space for utilities, fire hydrants, trees, grass, signs, driveway aprons, bus shelters, garbage cans, benches, vending machines, and other sidewalk amenities
- Can be used for outdoor dining
- Facilitates well designed curb ramps
Furniture Zone

All these things go here!
Furniture Zone Width

- 4 to 6 feet (1.2 to 1.8 m) recommended
- 2 ft. (0.6 m) min.
Furniture Zone Width

• 3 ft. (0.9 m) recommended next to parallel parking so car doors can be opened without obstructing pedestrian zone
Furniture Zone Width

- 4 ft. (1.2 m) recommended next to diagonal parking to prevent overhang into pedestrian zone (greater for back-in parking)
Furniture Zone Width

- 4 ft. (1.2 m) min. for trees
Furniture Zone Width

- 6 ft. (1.8 m) min. for snow storage
- Bottom line: Make it as big as needed for what goes in it
Carefully arranged street furniture leaves sidewalk clear
Randomly arranged street furniture clutters sidewalk
Poorly chosen and placed trees clutter sidewalk
Planting strip provides pleasant, uncluttered sidewalk
Wide planting strips makes it easy to meet ADA
Furniture zone can be used for outdoor dining
Delineating sidewalk café maintains clear sidewalk
Furniture zone can be used for bus pads & shelters
What facilities in the furniture zone need to be accessible?

- Bus stops
- Public facilities
  - Sitting areas
  - Sidewalk dining
  - Vending machines
- Obstructions
- Accessible routes to handicap parking
Pedestrian Zone
(Accessible Route)
Pedestrian Zone

- Positioned between the frontage zone and furniture zone
- Specifically reserved for pedestrian travel
- The “accessible route”
- Free of obstacles, protruding objects, and vertical obstructions
- Width should vary based on pedestrian volume
Pedestrian Zone Width

• Minimum standard for the “accessible route”
  – 3 feet (0.9m) \{ADAAG 4.2.1 and 4.3.3\}
  – 5x5 ft. (1.5 m) passing area every 200 ft. (60 m)
    \{ADAAG 4.2.3 and 4.3.4\}

• Proposed public rights-of-way draft increases the minimum to 4 feet (1.2 m)

The “minimum” is Never enough
Accessible Route Widths

- Minimum required: 3 feet
- Minimum for travel: 4 feet
- Preferred for Travel: 5 feet
- Preferred for turning: 5 feet

Sidewalk Widths
5 feet (1.5 m) necessary for two people to walk comfortably side by side (or to pass each other)
3 feet (0.9 m) for one wheelchair user
4 ft. (1.2 m) for user with guide dog, sighted guide, or one person assisting another
3.5 feet (1.1 m) for a person using crutches
5 ft. (1.5 m) for a turning wheelchair
5 ft. (1.5 m) for a wheelchair user and walking companion; 6 ft (1.8 m) for two wheelchair users
Families need more width too
AASHTO recommends an extra 2’ buffer, so a 4’ nominal sidewalk requires a 6’ total width.

6’ recommended for curbside sidewalk (least desirable) – measured from back of curb.
Narrow curbside sidewalk provides no buffer
A sidewalk should be as wide as needed to serve anticipated pedestrian use.
Sidewalks in high-use areas are extra wide
Shy distance applies to pedestrians, who will shy away from a vertical face; extra width is needed.
On existing narrow sidewalks, short wide areas can be retrofitted to provide periodic passing spaces that are at least 5 ft. x 5 ft. (1.5 m x 1.5 m)
Frontage Zone

pedestrian zone

frontage zone
Frontage Zone

- Located between the pedestrian zone and the property line (primarily in commercial areas)
- Minimum width 1 ft. (0.3 m); 2.5 ft. (0.8 m pref.)
- Allow up to 5 feet (1.5 m) for doors
- Not necessary adjacent to open space
- People with vision impairment often travel in this space using sound from adjacent buildings for orientation
- Must be kept free of overhanging and protruding obstacles that are barriers
The Zone System - Summary
The Zone System - Summary

Street Parking
Curb Zone
Furniture Zone
Pedestrian Zone
Frontage Zone

Photo credit: Michael Ronkin
Summary of Basic Accessible Route Requirements

• Grade: 5% or 8.3% (1:12) max.
• Cross-slope 2% max.
• Smooth Surface
• Width – 3’ (0.9 m) minimum clear of any obstructions
  – Best practice - 4’ (1.2 m) minimum

"elbow room" 3 ft*
People with mobility impairments must exert significantly more energy on slopes than those without.
Grades

- Downhill travel can be as difficult as uphill for wheelchair, walker, cane, crutch, and prosthetic users or anyone with difficulty bending their legs.
Running Grades

- 5% maximum grade

- Sidewalks adjacent to an existing roadway may follow the running grade of the roadway (technically infeasible)
Grades

Away from roadways, facilities with grades greater than 5 percent must be treated as a ramp as outlined in ADAAG:

• (8.3% max. for max. rise of 2.5 feet (0.75 m) with 5’ x 5’ (1.5 m x 1.5 m) level landings between segments
• At 8.3% grade, 2.5’ rise = 30’ (0.9 m) long
Level landing for stopping, resting, turning
Reducing the Impact of Steep or Long Grades (Best Practice)

- Limit the distance and magnitude of the grade as much as possible
- Provide periodic landings – in this case, flat areas for driveways double as resting areas
Reducing the Impact of Steep or Long Grades

Provide rest areas with accessible benches, include space for wheelchair users.
Reducing the Impact of Steep or Long Grades

Wide sidewalks allow wheelchair users to travel in a zigzag pattern, reducing the grade’s impact.
Reducing the Impact of Steep or Long Grades (Best Practice)

• Provide signs that indicate:
  – grade and length
  – alternative routes with lesser grades

• Provide handrails where possible
  – A “handrail” for use along a grade can have large openings, unlike a pedestrian rail on a bridge or retaining wall
Running Grades

• In difficult situations and steep terrain, the ADA expects designers to make reasonable decisions
• Use innovative solutions where appropriate
• The next few slides illustrate a few examples
Steep Grades
It’s OK to build stairs where there is a reasonable alternate route – the stairway on the left provides a shortcut from a parking lot to the street; full access is provided with a ramp, which is longer in order to meet the 5% grade requirement.
Asheville, NC – During a mall reconstruction project, the developer was required to add a sidewalk to this street with 10% (plus) grades.
• City standards specify a 5’ planting strip which would mean huge retaining walls & tree removal
• A long 10% grade is very hard on disabled users
City staff & the developer’s engineer improvised a solution to take the sidewalk away from the roadway and use 8.3% ramps with landings...
And a huge switchback at the bottom of the hill……
Stairs included for those who don’t need the ramp....
Ugly and expensive, but it was cheaper than the alternative, makes it much easier on wheelchair users, and provides a large setback for all pedestrians.
Cross Slopes

- Level would be best for wheelchair users
- Some slope needed for drainage
- ADAAG specifies 1:48 (about 2%)
- So for sidewalks, when we say “level” or “flat” we mean generally mean 2%

2% cross slope max.
Steep Cross Slopes

Lateral balance is more difficult for all pedestrians
Steep Cross Slopes

- Pedestrians must work against gravity
  - Wheelchair users must make significant efforts just to travel straight
  - Crutch, walker, and prosthesis users may be forced to walk sideways
Steep Cross Slopes

Surfaces more slippery when wet, icy, or snowy
Steep cross slopes can pull wheelchair users into street
Cross Slope Challenges

Sometimes building elevations make it difficult to create a proper cross slope

• On the left, the elevation change is done in the sidewalk, resulting in excessive cross-slope
• On the right, the cross-slope is acceptable, but a step hinders wheelchair user access to buildings
Cross Slope Challenges

Acceptable solution: Raise the curb – but curbs higher than 8” (200 mm) create parking concerns
- Parallel parking – doors cannot be opened
- Diagonal Parking – overhang is impossible
Cross Slope Challenges

Here the curb is stepped to allow diagonal on-street parking & sidewalks with good cross-slope
Cross Slope Challenges

Retrofit a building entrance using a ramped sidewalk – may need handrails
Sidewalk ramp up to building doorways
Sidewalk split to ramp down to building doorways
Cross Slope Challenges

Best solution: Create a level area of preferably 6 feet (1.8 m) – 4’ (1.2 m) min. – in the center of the sidewalk and make up elevation change at edges.
Elevation change occurs in the furniture zone
Surfaces

- Use a firm, stable and slip resistant surface such as concrete or asphalt (ADAAG requirement)
- Surfaces should be smooth, free of rough textures, openings and gaps
Surfaces Should Be Free of Joints

Exception:
Expansion and contraction joints are allowed but must not create a level change of more than $\frac{1}{4}$ inch (6.5mm)
For a smooth surface concrete is best – Include a broom finish to increase slip resistance
Rough Texture Surfaces

Bricks, cobblestones, and textured pavement can cause:
• Tripping hazards
• Confusion to people who are blind in detecting tactile cues
• Painful vibrations to people with brittle bones or spinal cord injuries using wheelchairs
• Maintenance difficulties
Rough Texture Surfaces

Some users are excluded from using the following because they are inaccessible:

• Beveled bricks, tiles, and pavers
• Materials with deep wide grouting
• Concrete with exposed aggregate
For a smooth surface, well-installed, well-maintained bricks are OK, but not great
For a smooth & flat surface, paving stones can work, but grout line should be narrow or flush.
For a smooth surface, granite works marginally well, but smaller gaps should be used.
For a smooth surface, pavers with beveled edges don’t work as they make it rough for wheelchairs
For a smooth surface, pavers with beveled edges are undesirable as they make it rough for wheelchairs.
For a smooth surface unmaintained bricks don't work
Pavers provide a smoother path through a rough cobblestone plaza, concrete would be better.
Solutions for Decorative Surfaces

Creative alternatives

• Concrete sidewalks with brick trim
• Colored asphalt or concrete
Good Design: Concrete in the pedestrian zone, textured surface in furniture zone
Visual Contrast of Surfaces

Sidewalk surfaces should be as visually uniform as possible

• People with low vision may mistake visual contrast in the pathway with changes in grades
Visual Contrast of Surfaces

Clearly definable sidewalk edges provide navigation cue for people with low vision
Visual Contrast of Surfaces

People with low vision can benefit from visual contrasts at transitions (sidewalk to ramp to street)
Visual Contrast of Surfaces

Good design: use visual and textural contrast at transition from the pedestrian zone to the furnishing zone.
Visual and Tactile Contrast

Detectable warning/truncated domes
- Can be detected by cane and underfoot
- Standard cue for the boundary between the sidewalk and roadway (more in next module)
Surface Maintenance

Surfaces should be designed so that water and ice do not collect on them.
Establish a regular snow removal/salt or sanding program for sidewalks.
Utility covers can be made less slippery with a thin layer of concrete.
Changes in Level

Changes in level are vertical elevation differences between adjacent surfaces.
Changes in Level

- Can be tripping hazards
- Can be inaccessible to wheelchair users
Changes in Level
Up to 1/4 inch

Changes in level up to 1/4 inch (6 mm) may remain vertical (ADAAG 4.5.2)
Changes in level between 1/4 inch (6 mm) and to 1/2 inch (13 mm) are permitted but must be beveled – bevel cannot be steeper than 1:2.
Changes in level greater than 1/2 inch (13 mm) must be treated like a ramp (maximum grade 8.3% or 1:12) \{ADAAG 4.5.2\}
Changes in Level

• Prevent changes in level with good initial design
• Remove changes in level with an active maintenance program
• Changes in level are often caused by:
  – Tree roots
  – Heaving and settling due to frost
  – Brick surfaces buckling
  – Uneven transitions settling between adjacent streets, gutters, and curb ramps
Change in level caused by tree roots
Narrowing this wide sidewalk at this tree location allows the tree to get more water, reducing root growth and the potential impact on the sidewalk.
Minimizing Changes in Level

Temporary repair allows passage by some pedestrians with disabilities, but probably doesn’t meet ADAAG standards.
Minimizing Changes in Level

Temporary repair again doesn’t meet standards but is better than leaving it as is.
Openings, Gaps, and Grates

Canes and wheels can be caught in cracks, holes, grates, and gaps
Openings, Gaps, and Grates

Grate openings shall be perpendicular to direction of travel (ADAAG)
Openings shall be no greater than a 1/2 inch (13 mm) wide (ADAAG)
Solution: Existing Open Grates

Wire mesh screen will eliminate hazards from open gaps.
Solution: Existing Open Grates

Straps welded to existing grate make it a bit safer, especially for bicyclists, but small wheelchair casters can still be caught.
Tree Grates

- Tree grates should be placed in the furnishing zone, outside the pedestrian zone
- Large openings like these do not meet standards
- Tree grates expand the pedestrian zone for some users
This tree grate has properly sized openings.
Obstacles in Pedestrian Zone

Eliminate objects or provide a pathway around
Removable Objects

Eliminate removable obstacles, such as mailboxes, newspaper stands, tree branches, or hedges – even power poles can be removed.
Free speech laws give news companies the right to put boxes in the right-of-way, but cities can and should control their location.
Cities can pass ordinances to control this as well
Sidewalk widened around pole
Sidewalk widened around pole
Sidewalk wraps around large tree
Note that a longer taper would be easier to use.
Sidewalk widened around planned mailboxes
Clearances and Obstructions
Protruding Objects
Protruding Objects and Vertical Clearance

Objects that protrude into the accessible route must be:

- Relocated so they don’t protrude
- Moved above 80 inches over the sidewalk
- Protected by a barrier or curb
Branches should be trimmed up to a height of 80 in.
Protruding Objects

Signs within height of 27 to 80 inches must not protrude into pedestrian path of travel
Edge Protection

Edge protection is needed if there is a drop off, a slope steeper than 1:3, or other potential hazard next to the accessible route.
A physical barrier such as a wall, shrubbery, railing or fence is preferred.
Summary

- Zone System
- Grades and Slopes
- Surface Materials
- Changes in Level
- Grates/Surface Conditions
- Obstacles/Protruding Objects
- Edge Conditions
Designing Pedestrian Facilities for Accessibility Training

Module 4: Accessible Pedestrian Design: Driveways and Curb Ramps
What Will Be Covered in Module 4

• Driveways
  – Problems with existing driveways
  – Design solutions

• Curb ramps
  – Standards
  – Detectable warnings
  – Types of curb ramps
DRIVEWAYS
Driveway Crossing Concepts

- Driveways encroach into pedestrian right of way
- Should not compromise safety, comfort, and access of pedestrians
- Designed so both pedestrians and motorists can use them effectively
Poor design: These driveways send the wrong message to drivers and pedestrians
Poor design: This alley design tells drivers they have priority – rough surface may be inaccessible
Good design: This driveway tells drivers that they are crossing the pedestrian area.
If driveways are not done right, sidewalks won’t be used (most common reason given by wheelchair users using the street)
Driveway Crossings

At old, non-compliant driveway aprons, user encounters:
• Rapid change of grade at driveway flare - results in one wheel off the ground compromising balance and stability
• Steep cross slope
Cross-slope on an old-style sloped driveway is often 5 or 6 times higher than the 2% maximum.
Inaccessible residential driveway
Accessible residential driveway, but not efficient
Driveway Crossing Design Objectives

• Maintain a level accessible route
• Design guidance for accessible route (ADAAG)
  – Cross slope = 2% (1:48) maximum
  – Width = 3 feet (0.9 m) – 4 feet recommended
  – Changes in level = flush preferred
Access Management

- Locate parking lots to side or rear of buildings
- Limit and consolidate vehicle access points
- Use designs that slow turning motorists (small curb radii and flares, steeper aprons)
Driveways from Hell
Design Solutions for Sidewalks at Driveways

• The following driveway designs are options for meeting ADA standards

• Several factors must be considered when choosing the appropriate option:
  – Sidewalk width
  – Planter strip width
  – Sidewalk and planter strip cross-slope
Best Solution – Planter strip allows flat, uninterrupted sidewalk
Best Solution – Planter strip allows flat, uninterrupted sidewalk

Elevation change is made within the planter strip, allowing level (2%) sidewalk at driveway
Best Solution – Planter strip allows flat, uninterrupted sidewalk

OPTION H
TYPICAL SEPARATED SIDEWALK DRIVEWAY
(Use Options M or N below if slope requirements shown in Section A-A and General note 2 can’t be met)

K = Planter strip width as shown on plans

Standard Drawing from Oregon
Good example of this preferred design
Bad design – Constant steep slope across planter strip and sidewalk
Acceptable variation for narrow planter strips – Apron encroaches on sidewalk

Option 1
Driveway encroaches into sidewalk

W = Width of driveway as exists behind sidewalk

Standard Drawing from Oregon
Good Solution – Level accessible route at back of wide sidewalk

- ADAAG specifies 3 ft. (0.9 m) min. level area
- May increase to 4 ft.
- Wider is better
Good Solution – Level accessible route at back of wide sidewalk

Standard Drawing from Oregon
Driveway example with level area in wide sidewalk
This older driveway was built with 6’ level area...
...but this newer driveway just down the street was built in an inaccessible manner
Acceptable Variation –
Driveway with mountable curb

Revert to vertical curbs before and after the driveway to discourage cars parking on sidewalk
Good solution for narrow sidewalks – Wrap sidewalk around driveway apron

• **Width of level area**
  - 3 ft. min. (ADAAG)
  - 4 ft. preferred minimum
  - **Best to use full sidewalk width**

• **Difficult for pedestrians with visual impairments to follow travel path**

• **Longer tapers are easier to use**
Good solution for narrow sidewalks – Wrap sidewalk around driveway apron

Use reversing curves for alternate transition (As Directed)

Lip
0 mm norm.
(20 mm max).

Normal sidewalk width (1.2 m min.)

1.0 m norm.

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Standard Drawing from Oregon
Wrapping sidewalk around driveway apron creates de facto planter strip design
Good solution for narrow sidewalks – Wrap sidewalk around driveway apron

Landscaping can be added by increasing the length of the setback area or the sidewalk taper
Landscaping adds a nice touch.
Note that a longer taper would be easier to use.
Acceptable solution for narrow sidewalks – Fully lowered sidewalk

• Possible problems:
  – Drainage
  – Users must negotiate two ramps
  – Peds who are blind may veer into street
  – Allows drivers to turn at higher speeds

• Up to 1 inch (25 mm) lip may be used to reduce drainage problem and direct pedestrians who are blind – lip is a problem for bicyclists
Variation for narrow sidewalks – Partially lowered level area

OPTION M
PARTIALLY LOWERED SIDEWALK

See General Note 4

$g = 8.33\% \text{ max.} (\text{See note 7})$

$W$

$W$

$8.33\% \text{ max.} (\text{See note 7})$

Sidewalk

Landing $(L) 1.2 \text{ m norm.} \quad \text{Use max. width feasible} \quad \text{See Gen. Note 1}$

$0.8 \text{ m min.}$

$L$

$1.2\% \text{ max.}$

$Sf \text{ vert.}$

$Sf \text{ vert.}$

$\theta^o$

$\theta^o$

$\theta^o$

$\theta^o$

$\theta^o$

$Lip$

$Lip$

$0 \text{ mm norm.}$

$0 \text{ mm norm.}$

$(20 \text{ mm max.})$

$c = o - Lip - K(\text{Apron grade} - 0.02)$

$b = c/g$

$* \text{ May be lengthened to obtain flatter slopes on hills.}$

Standard Drawing from Oregon
Slope down at 1:12

2% cross-slope

Apron, may be any acceptable grade

Slope up at 1:12
Comparison of two narrow sidewalk options for different disabilities

- People with mobility impairments stay at grade
- Could be problematic for pedestrians who are blind

- People with mobility impairments must go up and down
- Straight path for peds who are blind

Designing Sidewalks and Trails for Access, FHWA, 2001
CURB RAMPS
Curb Ramps

• First required by the Rehabilitation Act of 1973, Section 504
• Title II of the ADA specifically require curb ramps for existing facilities, as well as for all new construction
Curb Ramps

• Installations at:
  – Transition from on-street parking
  – Loading zones
  – Bus stops
  – Mid-block crossings
  – Roundabouts
  – Shared-use paths
  –Sidewalks

• At intersections, two ramps per corner preferred
Curb ramps have many benefits

- Wheelchair access
- Strollers
- Delivery carts
- Rolling luggage and business cases
- Shopping carts
A few curb ramp drawbacks

- Curbs form a reliable cue for detecting the boundary between the sidewalk and street.
- Curb ramps create an information barrier for people with visual disabilities.
- Detectable warnings are required to indicate location of the street.
Curb Ramps
(Sidewalk/Street Transitions)

Concepts/Design Objectives (order of importance)
1. Perpendicular Approach to grade change
2. Directionality (continuous straight line)
3. Smooth Vertical Transitions (slopes) - No Warped Surfaces
Perpendicular Attack

- Difficult turn on ramp
- One caster off ground
- Greater than 90°
Directionality
Directionality
No Warped Surfaces

One wheel off the surface
Skewed ramp leaves one caster off the ground
Skewed ramp leaves one wheel off the ground
Curb Ramp Types
(In order of desirability)

1. Perpendicular Ramp (Curb Ramp)
2. Combination Ramps (Assemblies)
3. Parallel Ramp (Transition Ramp)
4. Diagonal Ramp (Shared Curb Ramp)
5. Blended Transitions
6. Corner Parallel Ramp (Shared Flush Landings)
7. Built Up Ramps
Perpendicular Curb Ramp - Application

• Wide ROW
• Small curb radii
• Few obstructions
• Rating Preferred (A)
Perpendicular Ramp (Curb Ramp)

Detectable Warning

Bottom Landing
Chasing the Standard Pitch

Sidewalk Pitch ¼” per foot

Handicapped Drop Curb/Ramp

Scale: N.T.S.

Expansion joint (where adjacent to concrete pavement / curb)

CONCRETE RAMP
(1 on 12 max.)

4,000 P.O.I.

FLARED SIDES
(1 on 12 max.)

Concrete drop curb (4’ long)
(Flush with road - no reveal)

8 feet
Ramp Length

Example: ramp length = 6”/(8.3%-2%) = 7’ 11”
Higher curb or flatter ramp grade = longer ramp
Length of sides must be equal to avoid warping
Future standards may limit ramp length to 15’
Perpendicular Ramp

Shared Landing
Perpendicular Ramp
Curb Ramp

Advantages:
• Allows best “attack”
• Good directionality
• Assists with orienting visually impaired

Disadvantage:
• Requires small curb radius
• Requires wide sidewalk (12’)

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UCONN
Combination Curb Ramp - Application

- ROW not wide enough for perpendicular ramps
- More than enough ROW for parallel ramps
- Small or large curb radii
- Rating – Less desirable (B+)
Combination Curb Ramps

- Uses parallel ramps to lower the elevation of the landing
- Perpendicular ramps connect the landing and the street
Combination Ramp (Assemblies)

Detectable Warning
Combination Curb Ramps

Advantages
- Can be aligned with the crossing direction (like a perpendicular ramp)
- Landings can easily be provided
- Can be useful where the sidewalk has a steep grade or high curbs
- Useful in situations where unusual geometry makes it difficult to use other ramp types
Parallel Curb Ramp

Detectable Warning
15’ maximum
Parallel Curb Ramp - Application

- Narrow ROW
- Curb radii not an issue
- Corner obstructions
- Midblock crossings
- Rating – Less desirable (B-)

Parallel Ramp
(Transition Ramp)

Advantages:
Requires minimum R.O.W.

Disadvantages:
• Not continuous. requires people in wheelchairs to turn
• Drainage?
Combination Curb Ramps

Disadvantages
• Require more space than a parallel curb ramp
• More extensive work needed for retrofits
• Like parallel ramps, users continuing on sidewalks must negotiate ramp grades
Diagonal Curb Ramp - Application

- Moderately wide ROW
- Large curb radii
- Numerous obstructions
- Rating – Least desirable (C)
Why are diagonal curb ramps the most desirable choice for many municipalities?

LOW COST!!!
Diagonal Ramp (Shared Curb Ramp)
Diagonal ramp disadvantage: Pedestrians are directed toward the center of the intersection, creating a variety of problems.
Wheelchair users are forced out of the crosswalk
Wheelchair users are forced out of the crosswalk
These diagonal ramps require out-of-direction travel; two ramps per corner would be feasible & preferable.
Diagonal Curb Ramp Markings

- This marking pattern ensures that the pedestrian is in the crosswalk at all times
- However, the 4’ X 4’ bottom landing requirement still applies
Diagonal Ramp (Shared Curb Ramp)
Diagonal Ramp (Shared Curb Ramp)

Use on corners that are cluttered
Diagonal Ramp (Shared Curb Ramp)

Use on acute angle of skewed intersection
Diagonal Ramp (Shared Curb Ramp)

Advantages:
• Works where street corner is cluttered
• Low cost

Disadvantages:
• Non-directional
• May force people in wheelchairs into traffic
• Confusing for visually impaired
Corner Parallel Ramp - Application

- Insufficient ROW
- Large Curb Radii
- Few Obstructions
- Rating – Least desirable (D)
Corner Parallel Ramp
(Shared Flush Landing)
Blended Transition - Application

• Narrow ROW
• Small Curb Radii
• Few Obstructions
• Rating – Least desirable (D)
**Blended Transitions**  
*(Depressed Blended Corners)*

- An expanded diagonal curb ramp that extends around the entire corner
- The level of the sidewalk, through an almost undetectable change in slope is lowered to meet the street grade
Blended Transition
Disadvantages of Blended Transitions

• Trucks may encroach onto the sidewalk when turning, putting pedestrians at risk (use bollard)
• May give children and people with cognitive impairments an unsafe illusion that the sidewalk and the street are a unified pedestrian space
• Guide animals may not distinguish the boundary
• Motorists may encroach on the sidewalk, enabling them to turn at high speeds
Alternatives to Blended Transitions

Combination Ramp

Lower entire sidewalk at corner by 3 inches to allow a combination of perpendicular and parallel ramps.
Alternatives to Blended Transitions
Built-up Curb Ramps - Application

- Where all others fail
- Drainage is not an issue
- Unmovable obstructions
- Temporary fix
- Rating – Undesirable (D-)
Built-up Curb Ramps

- Built-up curb ramps project from the curb into the street
- Are used more often in parking lots than for public sidewalks
- If used, should be protected by a parking lane
Built up curb ramp
Disadvantages of Built-up Curb Ramps

• Users are more exposed to cars in the roadway
• No clear boundary exists between the ramp and the street
• Adequate drainage is difficult to achieve
• Edges can be hazardous
• Might interfere with bicycle travel
• Requires more maintenance, especially if driven over by cars making parking maneuvers
Partially Built-up Curb Ramps

- This alternative can allow perpendicular ramps on narrower sidewalks
- If restricted to the width of the gutter, this allows clean-looking design and won’t fill with water
Ramp Alignment with Crosswalk

• Aligning ramps with crosswalks helps users orient themselves to cross the street

• However, it is more important to keep ramps perpendicular to the curb
Surfaces – Ramps should be smooth, texture makes them hard to climb

Poor design  Better design
Ramp Surfaces

Gratings, access covers, and similar surfaces should not be located on curb ramps, transition ramps, landings, or adjacent gutter pans.
Changes in level at adjacent ramp components

Transition points between curb ramp, landing, gutter, and street shall be flush (ADAAG)
Lip renders ramp unusable by many users
These changes in level make the ramps unusable.
A lip combined with steep grade in the street can catch anti-tip wheels.
Ramp Standards Summary

2% max
7.1% preferred
8.3% max
5% max

10% max
not part of the
“accessible route”
Ramp Grade

- Maximum grade – 8.3% (ADAAG 4.8.2)
- Recommended maximum grade to allow for construction tolerance – 7.1%
- Least slope possible is preferred
Ramp Cross Slope

• Cross slope should follow street slope
• Ramp cross slope shall not exceed 2.0 percent (1:48) – Zero is best
• Many people with mobility impairments have difficulty negotiating a grade and cross slope simultaneously
• Since the grade of the ramp will be significant, the cross slope should be minimized
Gutter Slope
(Parallel to the curb and the roadway)

• Becomes a cross slope for pedestrians
• Slope should not exceed 2% (1:48) at the curb ramp
• Some slope is needed for drainage
Gutter Counter Slope
(Slope opposite the ramp grade)

- Becomes a running grade for pedestrians
- Slope should not exceed 5% (1:20) at the curb ramp (ADAAG 4.7.2)
- 2% maximum for diagonal ramps
Abrupt changes of grade are difficult to use and can cause wheelchairs to flip over backward or forward.
Counter Slope Solutions

Mill Roadway Surface

Level area at landing
Ramp Width

• ADAAG minimum width is 36 inches (0.9 m)
• Does not provide enough width for walker or crutch users or for a person assisting another
• Recommended minimum width is 48” (1.2 m)
• Wider ramps may be desirable in areas with high pedestrian traffic
Landing Dimension and Slope

• Landing should be the width of the ramp and a minimum of 36” deep (ADAAG) - 48” Best Practice
• 60 x 60 inches allows wheelchair users to turn more easily
• Landing slope: 2.0% (1:48) max. in any direction
• Landings may overlap or serve multiple ramps
Bottom Landing at Diagonal Ramp

Bottom of ramp must have 48 x 48 inch level (2% max) clear space outside of vehicle travel lanes (ADAAG 4.7.10)
Not enough maneuvering space at base of ramp
Flares

- Not part of the accessible route
- Flares should be used on all curbside sidewalks
- Flare slope: 10% (1:10) max. (ADAAG)
- If landing is less than 48”, flare slope 8.33% (1:12) max. (ADAAG) (Alterations Only)
Curbed Ramps

• Flares are not necessary where furniture zone is landscaped – curbs are sufficient (ADAAG).
• Curbs help guide users down the ramp, so protecting the sides of curb ramps with planting, signs, or street furniture can allow curbs to be used to help promote wayfinding
Flares not needed in landscaped areas
Using curbs allows for nice landscaped areas
Detectable Warnings

A detectable warning at the bottom of curb ramps alerts pedestrians with visual impairments about the sidewalk/street transition.
Detectable Warnings History

• First required in 1991 by ADAAG (full ramp)
• Requirement was temporarily suspended (except at transit platforms)
• Suspension ended July 26, 2001
• FHWA memo on May 6, 2002 clarified that detectable warnings are a required standard
• 2004 ADAAG silent on need for DW’s
• FHWA clarifies requirement for DW’s in 9-12-06 Memo
• **Truncated domes** are the only acceptable DW
Detectable Warnings – Disclaimer

Since detectable warnings are a relatively new requirement, this module and other modules of this course contain numerous photos of ramps without detectable warnings. Some of these photos show “good” examples of curb ramp design. Under current requirements, these photos would also need detectable warnings in order to be fully ADA-compliant.
Detectable Warning (DW) Concepts and Objectives

- DW’s inform pedestrians with visual disabilities to stop at potential hazards
- Can be “felt” by cane and under foot
- Provide some directional information to visually impaired
- Can be an issue with people in wheelchairs
Detectable Warning (DW) Scoping

• Detectable Warnings are required:
  – Whenever a walkway crosses a vehicular way, excluding unsignalized driveway crossings:
    • At curb ramps, medians, and islands
    • At railroad crossings
  – On commercial Driveways that perform like streets (Best Practice)
  – Shared use
  – On transit platforms
  – At reflecting pools, which have no curb or rim protruding above the walkway surface
Detectable Warnings

Detectable warnings are especially needed at raised crosswalks and depressed corners.
Truncated Dome Details

Due to their unique design, truncated domes are detectable by cane and under foot.
This unique design is the only acceptable detectable warning
During the suspension period, other treatments were tested but were not sufficiently detectable or had other problems.
This is not an adequate detectable warning
(in addition, the gaps and bumps are a problem)
Detectable Warning Details

• DetectableWarnings should have contrasting color (ADAAG)

• In this picture, what are two possible problems for people with disabilities?
Detectable Warning Placement

- Truncated domes should be placed across all curb ramps 6-8 inches (150 to 200 mm) from the face of the curb
- Domes not needed on flares
- Domes aligned perpendicular to curb or slope break
Detectable Warning Placement and Alignment

- A 24” (600 mm) deep band of DW is required
- Align domes with direction of pedestrian travel (perpendicular to curb or slope break)
Proper placement of truncated domes
Improper placement of truncated domes
Proper placement of truncated domes on a depressed blended transition
Detectable Warnings at Raised Intersections
Detectable Warnings at Railroad Crossings

Outside the “dynamic envelope” and pedestrian gate (best practice)
Detectable warnings should **not** be used at unsignalized driveways.
Truncated domes should **not** be placed on flares
Truncated domes are not necessary for the full length of the ramp
Detectable Warning Types (Tiles)
Detectable Warning Types
(Embossed Concrete)
Detectable Warning Types (Bricks)
Detectable Warning Types
(Metal)
This square area is the level landing that serves both ramps.

Planter strip & small radius make it easy to place 2 ramps per corner lined up with sidewalks, obstacle-free, and with landings.
The Cheap Way Out!
Curb Extensions

Instead of built-up ramps, use curb extensions with perpendicular ramps at locations with on street parking (more on curb extensions in Module 5 – Crossings and Intersections)
Curb extensions with perpendicular ramps
Dealing with Corner Radius

FIGURE 1B
TYPICAL MINOR COMMERCIAL DRIVEWAY OUTLINE

Driveway Width
W = 24 ft
7.32 m

R₂ = 34.0 ft (10.36 m)

D₂

C₂

Y₂
32.0 ft
9.75 m

R₁ = 34.0 ft (10.36 m)

D₁

C₁

Y₁
32.0 ft
9.75 m

X₁ = 22.5 ft
(6.86 m)

X₂ = 22.5 ft
(6.86 m)

Refer to Table 2 for design values for corner angles other than 90 degrees
Refer to Chapter 4.1.1 for description of design features

1:200

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NO! DIFFICULT TURN ON RAMP

YES! LEVEL AREA AT BASE OF RAMP ALLOWS TURN

GREATER THAN 90°
Parallel-type ramp is a possible solution to this non-compliant ramp.
Large Corner Radius
Level landing
Slope Break
Detectable Warning
(Less than 5 feet length)

Slope Break
Drainage at Curb Ramps

• Drainage is difficult because gutter grade should not exceed 2%
• To prevent standing water at the base of ramps:
  – Place inlets upstream of ramps
  – Widen the gutter pan and flatten at the ramp
  – The gutter pan counter slope must be flatter than the running slope of the ramp; a steeper gutter cross slope can resume outside the ramp
Drainage at Curb Ramps

Add inlets upstream of ramps
Inlet upstream of ramp
In the picture at left, the gutter counter slope is very steep, resulting in water on the ramp. On the right, the gutter is much flatter than the ramp.
Widened gutter pan flattened to 2% at ramp
Designer Threats

- Unfamiliar with existing conditions
- CAD “cut and pasting”
- Relying on field personnel to adjust to field conditions
Conflicting Dimensions and “Rubber Stamping”

Expansion joint (where adjacent to concrete pavement / curb)

Sidewalk Pitch ¼” per foot

Concrete drop curb (4' long) (Flush with road - no reveal)

Handicapped Drop Curb/Ramp

Scale: N.T.S.
Quality Control of Grades, Cross-slopes and Widths

- Detailed engineering:
  - Large scale (1”=5’ is good)
  - All elevations, dimensions and curve data shown
  - Portland, Oregon uses this method
Quality Control of Grades, Cross-slopes and Widths

Reliance on contractors and inspectors

- Tight construction tolerances are needed
- Inspections: actual measuring (not visual)
- Train carpenters, concrete finishers, and inspectors – some jurisdictions have certifications.
## Scoping for Ramp Types

<table>
<thead>
<tr>
<th>Available ROW</th>
<th>Ramp Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3 feet</td>
<td>None</td>
<td>Pedestrians will need to use roadway</td>
</tr>
<tr>
<td>4 to 6 feet</td>
<td>Parallel</td>
<td></td>
</tr>
<tr>
<td>6 to 12 feet</td>
<td>Combination Diagonal</td>
<td>Perpendicular ramps w/curb extensions</td>
</tr>
<tr>
<td>&gt; 12 feet</td>
<td>Perpendicular</td>
<td></td>
</tr>
</tbody>
</table>

**Ramp Type Options:**
- Perpendicular
- Combination Diagonal
- Parallel
- None
Designing Pedestrian Facilities for Accessibility Training

Module 5
Accessible Pedestrian Design: Crossings and Intersections
What will be covered in module 5

- **Crossings**
  - General Principles
  - Crosswalks
  - Medians
  - Curb Extensions
  - Overcrossings and Undercrossings

- **Intersections**
  - General geometric issues
  - Crosswalk and ramp placement
  - Roundabouts
Crossings – General Principles

1. Pedestrians need opportunities to cross the street safely
2. Pedestrians will cross where it’s most convenient
3. Pedestrians need to be able to determine the right time to cross
4. Drivers need to understand pedestrians intent
5. Speed matters
Principle # 1 – Pedestrians need opportunities to cross the street safely
A movement barrier is anything that restricts an individual’s ability to physically move along or within the sidewalk or crosswalk.

What are some movement barriers at crosswalks or other street crossings?
Principle # 2 – Pedestrians will cross where it’s most convenient

Disabled users often don’t have this option, making it even more critical to provide convenient and safe “official” crossing locations
Principle # 3 – Pedestrians need to be able to determine the right time to cross
Information Barriers at Crosswalks

Information barriers restrict a pedestrian’s ability to use information contained within the sidewalk or crosswalk environment.

What are some information barriers at crosswalks or other street crossings?
Principle # 4 – Drivers need to understand pedestrians’ intent
Principle # 5 – Speed Matters

High speeds equate to greater reaction time and stopping distance
Principle # 5 – Speed Matters

- High speeds equate to greater chance of serious injury & death
- The elderly have even higher chances of injury and death

Pedestrians’ chances of death if hit by a motor vehicle

SOURCE: *Killing Speed and Saving Lives*, UK Department of Transportation
Good Design Makes Use of These Principles

What are some design Objectives for accessible crossings?
Design Objectives for Crossings

• Remove Movement Barriers:
  – Shorten crossing
  – Slow traffic
  – Increase crossing cycles
  – Surface improvements

• Remove Communication Barriers
  – Improve visibility for drivers
  – Highly visible markings
Crosswalks
What is a Crosswalk?

• Sect. 14-297 - (2) "Crosswalk" means that portion of a highway ordinarily included within the prolongation or connection of the lateral lines of sidewalks at intersections, or any portion of a highway distinctly indicated, by lines or other markings on the surface, as a crossing for pedestrians, except such prolonged or connecting lines from an alley across a street;
Is This a Crosswalk?
Is This a Crosswalk?
Crosswalk Design Details

• Crosswalks are part of the accessible route; normal ADAAG provisions apply:
  – Cross slope (e.g., road grade) – 2% (1:48) maximum (ADAAG)
  – Running grade (roadway crown or super-elevation) – 5% maximum (ADAAG)
  – Width – 10 feet (3 m) recommended, 6 feet (1.8 m) min. (MUTCD)
Inaccessible Crosswalk: Exaggerated crown exceeds 5% and even 8.3% slope
Inaccessible Crosswalk:
Crosswalk exceeds 2% cross-slope
Inaccessible Crosswalk: Crosswalk is rough and probably exceeds 2% cross-slope
Crosswalk Markings

• There are numerous opinions and theories about whether to mark or not mark crosswalks in general, but this information is beyond the scope of this accessibility training.

• The following study provides more information:
  – “Safety Effects of Marked vs Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines”
    Available at http://www.walkinginfo.org/rd/devices.htm
Crosswalk Markings

• Are used to define the pedestrian path of travel and alert drivers
• Provide useful information for people with visual disabilities
• Should be of a slip resistant material
• Designed in accordance with the Manual of Uniform Traffic Control Devices (MUTCD)
• Marking pattern needs to be visible to the driver
Crosswalk marking patterns from the MUTCD
Crosswalk Markings

• Although the MUTCD provides for design options, research and observation indicate that the continental and ladder designs are the most visible to drivers.

• These “longitudinal” markings also improve guidance for pedestrians with low vision and cognitive impairments.
Visibility of various crosswalk marking patterns
Longitudinal markings are more visible to drivers.
Driver perspective: what the driver sees
Continental or Ladder Crosswalk Markings Standards

• MUTCD longitudinal crosswalk markings:
  – White longitudinal (to traffic flow) lines
  – Lines 12” to 24” (300 to 600 mm) wide and spaced 12” to 60” (300 to 1500 mm) apart
• Markings should avoid wheel paths, and spacing should not exceed 2.5 times the line width.
• While continental markings provide more guidance to pedestrians with low vision than 2 simple lines, ladder markings (longitudinal plus transverse markings) are even better
Ladder markings stand out
“Staggered Continental” markings spaced to avoid wheel paths provide high visibility and low maintenance.
“Staggered Continental” markings effectively improve visibility at a distance
Leaving a gap in continental or ladder markings allows a smooth area for wheelchair passage.
Midblock Crossings

• Provide mid-block crossings where blocks are long or where there is pedestrian demand
• Use Accessible Pedestrian Signals (APS) for universal access [more detail in Module 6]
Textured crosswalks

- Textured crosswalks are not recommended because they can cause difficulty for pedestrians who are disabled
- Textures are aesthetically pleasing and are used to:
  - Distinguish pedestrian and vehicle space
  - Make crossings more visible in theory, but...
What the pedestrian sees – good visibility for most; not much help to those with low vision
What the driver sees
Although not recommended due to their effect on disabled users, if used, textured crosswalks should be outlined with white lines.
Creative Solutions to Decorative Crosswalks
Crosswalk Sight Distance

• Provide good sight lines between pedestrians and motorists
• Children and people who use wheelchairs have reduced sight distance
• Improve sight distance:
  – Install curb extensions
  – Trim vegetation
  – Avoid visual clutter
Crossing Distance

• Minimize crossing distance
• Factors affecting crossing distance:
  – Number of lanes
  – Lane width
  – Curb radii
  – Medians/islands
  – Curb extensions
  – Parking lanes
  – Bike lanes
  – Transit lanes

Photo credit: Dan Burden
Crossing Distance

Long Crossing Distance:
• Makes crossing difficult for pedestrians who walk slowly
• Increases exposure time for pedestrians
• Makes it hard for pedestrians who are blind to stay in the crosswalk
• Increases motorist delay (at signals)
Illumination is essential for all crossings

- 60% of ped crashes occur at night
- Lighting improves safety and visibility for all users
- If you mark a crosswalk – light it
- Unmarked crosswalks at intersections can be improved by lighting as well
At mid-block crosswalks, lights should be placed at the crossing location.
This intersection is well lit; both the crosswalks and the pedestrian are visible.
Other tools to make crosswalks more apparent to drivers
In-street pedestrian crossing signs

At right: New MUTCD signs R1-6 and R1-6a
In-roadway lights at crosswalks

Lights are activated by either passive detection or pushbuttons (MUTCD Chapter 4L)
Overhead Pedestrian Crossing Signs
Multiple Threat Crash

First car stops for pedestrian, but too close, masking visibility for driver in 2nd lane
Multiple Threat Crash

Problem: Car 1 stops to let pedestrian cross; car 1 blocks sight lines, and car 2 hits pedestrian at high speed.
Solution: place advance stop or yield line, so car 1 stops further back; resulting in better sight lines.
New signs R1-5 and R1-5a in the 2003 MUTCD
Example of advanced yield line (this yield line design is new in Section 3B.16 of the MUTCD)
Example of advanced stop line
Advanced yield line combined with ITS ped crossing sign – significant increase in yield rates
Crossing Islands and Medians

Breaks into two easier crossings of one-way streets
Continuous raised medians help some pedestrians cross at any location along a street.
A median break at designated crossing points allows use by people with mobility impairments.
At marked crosswalks, crossing islands can create the effect of a continuous median.
Cut-through Medians or Islands

Design guidance:
• At intersections, extend the nose of the median into the crosswalk
• Median should be at least 6’ (1.8 m) wide
• Make cut-through as wide as possible – min. 5’
• Align the ends of the cut with the crosswalk
• Provide a 2’ (0.6 m) strip of detectable warnings at both ends of cut-through
Median option: place staggered cut-through so pedestrians face oncoming traffic in 2\textsuperscript{nd} half
Ramped Medians

Design guidance:
• Provide two curb ramps at least 3 feet (0.9 m) wide (5 feet recommended)
• Provide a level landing at least 5 feet x 5 feet between the ramps
• Landing does not need to be the full height of the median – 3” is sufficient
• 2’ wide detectable warning at base
Detectable Warnings at Medians and Islands

• 24 inches (0.6 m) of detectable warnings required at both openings
• If median is wide enough, 24 inches (0.6 m) of non-textured pavement should be placed in the center
Overcrossings and Undercrossings

Concerns at grade separations:
• Lack of access – pedestrians with low vision cannot easily find structures; pedestrians with limited mobility cannot easily climb ramps
• Longer route is inconvenient
• Limited connectivity
• Security
• Cost
Pedestrians prefer to cross at grade instead of above or below grade
Overcrossings work best if roadway is lowered
They are very expensive to build correctly
Much of the expense is due to ADA requirements: To rise 20 feet at 5% or 8.3% (with landings), ramps must be 300’ long or more; creating serious difficulties for users with disabilities.
Undercrossings work best if roadway is elevated
Undercrossings require generous dimensions to be attractive: security is main issue

Users must see light at the end of the tunnel
Undercrossings must not be narrow and dark
Undercrossings work best if roadway is elevated and structures are open and airy or well-lit.
Elevators for grade separations or other purposes

Elevators and lifts should remain unlocked and operable during operating hours.
Intersections – General Principles

• Smaller is better
• Keep it simple
• Design for slow speeds
• Maintain good visibility
• If complex, break it up with islands
Keep it Tight – Small Corner Radii

Radius affects:
- Intersection geometry
- Crossing distance
- Crosswalk placement
- Ramp placement
- Vehicle turning speeds
Effect of large radius on crosswalk and ramp placement

Hard for users to figure out where to cross; hard for designers to place ramps & crosswalks
Large radius causes drivers to drive fast…
... endangering pedestrians
Large vehicles must be considered
Skewed intersections

Skews increase crossing distance & vehicle speeds
Long crosswalk at skewed intersection
Skew increases crosswalk length, decreases visibility
Right angle shortens crosswalk, improves visibility
Old curb line

Crossing distance reduced
“Sea of Asphalt” recaptured
Curb Extensions

- Reduce crossing distance
- Improve visibility for both pedestrians & drivers
- Signal pedestrians’ intent to cross
- Act as traffic calming
- Create room for ramps and street furniture
Curb extensions reduce crossing distance and improve visibility
Curb extensions reduce crossing distance and improve visibility: before
Curb extensions reduce crossing distance and improve visibility: after
Curb extensions help pedestrians tell drivers they want to cross & increase driver yielding
Curb extensions help slow traffic: before
Curb extensions help slow traffic: after
But what’s wrong with this picture?
Curb extensions create room for street furniture and trees, allowing obstacle-free sidewalks.
Where sidewalks are narrow, curb extensions allow ramps to be easily installed
At this “curb retraction”, the sidewalk is too narrow for a ramp, so it is placed in odd location
This person using a wheelchair must leave the crosswalk to access the ramp
Curb extension with perpendicular ramp solves narrow sidewalk problem
Crosswalks, ramps & sidewalks should line up so pedestrians can travel in a straight line at curb extensions.
Crosswalk Placement

Crosswalk placement is a delicate balance of several goals that sometimes compete:

• Short crosswalk length
• Minimal crosswalk setback allows:
  – Less out-of-direction travel
  – Good sight lines between peds and motorists
• Ramp placement
  – Two ramps preferred whenever possible
  – Must meet ramp standards
Small corner radius allows two ramps, short crosswalks, and direct travel paths
When larger radii are used for trucks, undefined areas make crosswalk placement more difficult.
Placing ramps outside of radius shortens crosswalk and allows ramp alignment with crosswalk, but setback increases dramatically.
Using a single ramp reduces crosswalk setback, but increases crosswalk length.
Balancing the various goals works best (but crosswalk length and setback are always greater with large radii than small radii)
Crosswalk placement – pedestrians know best
Islands reduce crossing distance & separate conflicts but increase need for cues for non-visual travel
Islands break up complex intersections; without island, pedestrians would cross 6+ lanes at once.
Channelized right or left turn slip lanes

• Crossing issues for pedestrians who are blind:
  – Right turning traffic masks the sounds of stop and go traffic flows at intersection
  – Even with well placed crosswalks, pedestrians may have a hard time finding and using them
  – Drivers often fail to yield to pedestrians waiting to cross who don’t make eye contact

• Signalization of slip lane improves access for pedestrians who are blind
Right-turn slip lane: Design for pedestrians

Old Way

- Wide Angle
- High speed, low visibility of pedestrians, head turner

New proposal

- Tighter angle
- Slower vehicle speeds, good visibility of pedestrians

55 to 60 degree angle between vehicle flows.
Right-Turn Slip Lane - Details

- 50 to 60 degree angle between vehicle flows.
- 25’ to 40’ radius depending on design vehicle
- One car length back
- Long radius followed by short
- 150’ to 275’ radius
- Bicycle lane

Cut-through median & island for peds
Cut Through Corner Islands

- If slip lanes are used, always use raised island
- Provide at least 5 feet (1.5 m) of clear space in all directions
- Provide a 2 foot (0.6 m) strip of detectable warnings at either side
- Align cut-through with crosswalks
Ramped Corner Islands

- Provide a level landing at least 5 feet x 5 feet (1.5 m) Provide curb ramps at least 4 feet (1.2 m) wide
- Provide a 2 foot (0.6 m) strip of detectable warnings at the end of all curb ramps

Based on Designing Sidewalks and Trails for Access, FHWA, 2001
Additional Intersection Crossing Concerns

• Right turns on red can be problematic for pedestrians
• Avoid restrictions for pedestrians to cross on only one leg of an intersection
  – Where crosswalks are closed, a solid barrier and accessible information about the restricted crossing pattern must be provided for pedestrians with visual impairments
Traffic-calming techniques such as curb extensions help slow traffic.
Modern Roundabouts

- A different intersection concept
- Vehicles can enter at same time: they’re separated in space
A modern roundabout is not a large rotary
(New England)
A modern roundabout is not Dupont Circle (DC)
A modern roundabout is not Place de l’Etoile (Paris)
A modern roundabout is a specific type of intersection control
Roundabouts

Design principles that distinguish roundabouts from other circular intersections:

- Entering vehicle yield to traffic in circle
- Counterclockwise circulation
- Deflection to slow traffic
- Entering speeds should always be lower than exiting speeds
Roundabouts Essential Components for Pedestrian Safety

- Slow speed entry
- Splitter island
- Truck apron
- Lots of deflection for slow speeds throughout
- Slow speed exit
- Crosswalk 1 car length back
- Separated sidewalk to direct peds to crosswalks
To make roundabouts work for pedestrians, the following are needed:

- Slow speeds – lots of deflection
- Simple, single lane, throughout
- Well-defined crossings
- Splitter islands
- Ramps and cut-throughs for ADA compliance – including detectable warnings
Key elements for pedestrians:
Constrained entry to slow drivers
Key elements for pedestrians: Truck apron narrows roadway and helps create deflection
Key elements for pedestrians: Deflection at exit to slow drivers
Key elements for pedestrians:
Well defined crossings and splitter islands
Roundabout crossings:

• Pedestrians look for gaps in traffic in one direction at a time, in exit & entry lanes

• Pedestrians with visual impairments have difficulty:
  – Finding crosswalks
  – Distinguishing exiting from circling vehicles to find gaps
People figure it out – most pedestrians can easily look for a gap, then cross one leg at a time
But pedestrians with visual disabilities cannot easily perceive gaps in exiting traffic.
Multi-lane roundabouts are more challenging for pedestrians, especially those with disabilities.
Multi-lane = less deflection, higher speed
Multi-lane = less deflection, higher speed. At high-volume multi-lane roundabouts, gaps are infrequent and pedestrians with visual disabilities often cannot determine when it is safe to cross.
Well-designed roundabouts can enhance pedestrian safety, but access is an issue for some
Recommendations for improving access to roundabouts

- Include an audible or tactile cue to indicate crossing location
- Provide appropriate sight distances between pedestrians and motorists
- Include setback sidewalks at the roundabout to guide users to the crosswalks
Recommendations for improving access to roundabouts

• Rumble strips along exiting vehicle path to audibly warn pedestrians with visual impairments
• Accessible Pedestrian Signals with locator tone
  – Passive pedestrian detectors at signals or other technology could be used to stop traffic only when pedestrians are in the roadway
Signalized pedestrian crossing
Signals at Roundabouts

• The ADA draft public rights-of-way guidelines included a requirement for signals at all roundabouts.

• It is likely that some form of a signalization requirement will be included in the final version, so designers should keep this in mind.
Passive pedestrian detection:

- Microwave sensor detects pedestrians in crosswalk – could be used at roundabouts to extend time for slower pedestrians or allow traffic to start earlier when crosswalk is clear
Designing Pedestrian Facilities for Accessibility

Module 6
Accessible Pedestrian Design: Pedestrian Signs and Signals
Pedestrian Signs and Signals

Pedestrians require information that is specifically directed to them because their needs, viewpoints, travel speeds, and other characteristics that are different from motorists.
Pedestrian Signs and Signals

• Most pedestrians use visual cues to obtain information about traveling safely; for example:
  – Intersection configuration
  – Traffic signals
  – Street signs
  – Informational or tourist signs
How do pedestrians with visual impairments gather information and travel independently?
Pedestrian Signs

Redundant information:
• Increases the likelihood that all users, including people with visual and cognitive impairments, will make informed, safe traveling decisions
• Multiple formats help pedestrians gather information using multiple senses
Pedestrian Signs

• Format and location standards should be established statewide (locally at minimum)
  – A consistent format with high legibility helps people with both low vision and cognitive impairments to utilize the information
  – Consistent placement enables these users to locate the sign

• Sign specifications are provided in July 23, 2004 ADAAG and ABA accessibility guidelines, section 703
Pedestrian Street Sign

- Braille and raised print
- Consistent location and format is necessary
These signs do not provide information in an accessible format
Pedestrian Signs - Developing Technology

- Remote Audible Infrared Signage is an option to provide wayfinding information for pedestrians who are blind or visually impaired.
- Verbal messages transmitted from buses, kiosks, or other signs received by persons with visual disabilities when they point receiver in direction of transmitter.
- Other types of GIS and GPS systems are being developed.
Pedestrians with visual impairments can receive “sign” information via a receiver – but this requires all non-visual travelers to carry one
Example of a user “reading” pedestrian sign or signal information
Examples of non-typical traffic and traffic control that affect pedestrians

Physical Environment:
- Right turn on red
- Wide streets
- Free flow turn lanes
- Large corner radii
- Skewed intersection layout
- Actuated traffic signals, turn lanes and arrows
- Diagonal curb ramps
Examples of non-typical traffic and traffic control that affect pedestrians

Other activity:
• Quieter cars
• Low traffic volumes
• Aggressive drivers
  - Many of the items described in the previous slide allow or encourage aggressive driving (large curb radii, free-flow turn lanes, right turn on red, etc.)
Pedestrian Signals

Pedestrians signals can be fixed-time or actuated
• Fixed time signals include a pedestrian phase in each cycle
• Actuated signals may require the pedestrian to take action – to push a button to call the pedestrian phase
Problems related to pedestrian signals

- Knowing if a pushbutton is there
- Locating the pushbutton
- Accessing the pushbutton
- Pushing the pushbutton, particularly for those with limited hand function
- Knowing which street the pushbutton controls
- Seeing the pedestrian signal indications
- Knowing when the walk interval begins
Pushbutton Locations

- Is the pushbutton easy to use?
- Is location conveniently near the crosswalk?

2003 MUTCD guidance, section 4E.08:
“When pedestrian actuation is used, pedestrian pushbutton detectors should be capable of easy activation and conveniently located near each end of the crosswalks.”
What makes these pushbuttons inaccessible?
Pushbuttons “should be capable of easy activation” (MUTCD)
Find the pushbutton
What would make it easier?

- Pushbutton in line with crosswalk line
- Pushbutton located 10 feet maximum from the face of the curb
- Pushbutton located in an unobstructed area
- A locator tone
Accessible Pedestrian Signals – Pushbutton Location Guidance

2003 MUTCD Section 4E.09:

• Adjacent to a level all-weather surface… and where there is an all-weather surface, wheelchair accessible route to the ramp

• Within 5 feet (1.5m) of the crosswalk extended

• Within 10 feet (3m) of the edge of the curb, shoulder, or pavement; and

• Parallel to the crosswalk to be used
Accessible Pedestrian Signals – Pushbutton Location Guidance

2003 MUTCD Section 4E.09:
• Pushbuttons should be separated by at least 10 feet (3 m) (If two APS pushbuttons are on the same pole, WALK indication for the two streets can be confused – another solution is to use a speech message which includes the street name to provide the WALK indication)
Pushbuttons should be accessible and usable by everyone
Adjacent to all-weather surface, within 10 feet of edge of the curb
Within 5 feet of the crosswalk extended
Parallel to crosswalk
This pushbutton has been relocated to be parallel to the crosswalk
Height of 42 Inches in order to be accessible to all (MUTCD section 4E.08; ADAAG 4.2)
Pushbutton Size

Person with limited hand function cannot push this button
• Size – at least 2 inches in diameter
• Provide audible and visual confirmation of button press

(These are currently not required, but are best practice recommendations)
Recommendations for Pushbuttons

- Actuation force requirement of no more than 3.5 lbs – operable with closed fist
- Visual contrast of at least 70%

(These are currently not required, but are best practice recommendations)
Passive Pedestrian Detection

• Passive detection technologies such as microwave or infrared systems may solve some problems with pushbuttons

HOWEVER…

• Pedestrians may not always be within the detection area when waiting to cross and crossing, and may not be reliably detected

• Pedestrians may not realize that they have been detected
Determining When to Cross

Three methods are typically used to determine when to cross:

• Visible pedestrian signal head
• Listening to traffic
• Accessible pedestrian signals
Find the pedestrian signal head
What would make it easier?

- Signal mounted between 7 and 10 feet above surface (MUTCD Section 4E.05)
- Pedestrian signal head within the crosswalk lines
- Lack of visual clutter and glare near the pedestrian signal head
- Additional signal head on median at very long crosswalks
This pedestrian signal head is easy to see
Revisiting the WALK, flashing DON’T WALK and steady DON’T WALK system:
• 50% of Americans don’t understand the signal system.
• Is there a better system?
Problem with current system: Pedestrians not sure if they can start during flashing don’t walk
Problem with current system: Pedestrians not sure how much time is left during flashing don’t walk
Pedestrian count-down signal shows promise; it lets pedestrians know how much time is left ...
Pedestrian Countdown Signal Research Results

- Pedestrians understand how it works
- More pedestrians start to cross during clearance phase, but...
- Fewer pedestrians start to cross late in clearance phase
- Almost no pedestrians left in crosswalk in steady don’t walk phase
Determining When to Cross

Non-Visually by Listening to Traffic IF:

- Traffic movement is predictable
- There is a surge of cars starting and traveling parallel to crosswalk
Determining When to Cross

Accessible Pedestrian Signals (APS) Indicate WALK interval by providing:
• Unique tone
• Speech message
• Vibrating surface
Accessible Pedestrian Signals (APS)

- All pedestrians benefit from receiving information in multiple formats, especially persons with visual and cognitive disabilities, as well as children.
- Audible, tactile, and vibrotactile information can be provided as part of the APS.
- APS increase the efficiency of pedestrian timing.
- APS make pedestrian actuated devices accessible and usable by all pedestrians.
APS Use by Blind Pedestrians

- APS information is combined with listening skills and other mobility skills
- Travelers who are blind hear the APS, then must listen for turning cars or cars that are running the light
- The sound of parallel cars is used to maintain alignment while crossing
Accessible Pedestrian Signals (APS)

- Intersection complexity has created a demand for APS by pedestrians who are blind
- New types of APS have become available in the U.S. in recent years
Types of Accessible Pedestrian Signals

Accessible pedestrian signals provide information in a variety of formats, including audible, broadcast, tactile, and receiver-based:

- Pedhead mounted audible signals
- Pedestrian pushbutton integrated signals
- Combination systems with pedhead speaker and locator tone at pushbutton
- Transmitted message signals
- Vibrotactile
Pedhead Mounted APS

• Most common type of APS in the US to date
• Sound comes from a speaker mounted on or in the pedestrian signal head
• Typically a buzz, tone, or bird call is used to alert pedestrians to the WALK interval:
  – Common practice is “cuckoo” for north/south crossings and “chirp” for east/west crossings (confusion has been reported)
• Typical US installations include no locator tone
Pedhead Mounted APS

North/South

East/West

(Click each photo to play tones)
Pedhead Mounted APS

The use of a loud volume intended to provide guidance across the street, has not been successful:

- Sound bounces and echoes
- Far side sound is masked by near side signal
- Loud volume of APS masks traffic sounds
Pushbutton Integrated APS

• Speaker and a vibrating surface or arrow located at the pedestrian button
• Includes locator tone to identify that a button should be pushed to call the pedestrian phase
• Walk interval may be indicated by:
  – Same tone as the locator tone at a faster repetition rate,
  – Speech message, or
  – Other tones including bird calls
What is a Pushbutton Locator Tone?

- Repeating sound that informs approaching pedestrians that there is a pushbutton and enables pedestrians to locate the pushbutton

Draft Guidelines for Accessible Public Rights-of-Way (2005) recommends that all pushbuttons be required to have integrated locator tones to indicate that pedestrian activation is necessary and to identify the location of push button
Pushbutton Locator Tone

• Sound comes from the pushbutton location
• Sound less than 0.15 seconds in duration
• 1 tone per second
• Loud enough to be heard within 10 to 12 feet
• Sound volume should respond to ambient noise levels
• During solid and flashing don’t walk intervals
Pushbutton Integrated APS: Locator Tone

(Click photo to play tone)
Pushbutton Integrated APS: Locator Tone

(Click photo to play tone)
Pushbutton Integrated APS: Locator Tone
Pushbutton Integrated APS: Locator tone followed by walk tone

(Click each photo to play tones)
Pushbutton Integrated APS: Locator tone followed by speech walk indication
Pushbutton Integrated APS: Speech walk indication alone

(Click each photo to play tones)
Combination APS

Combines features of pedhead mounted and pushbutton mounted APS

• Typically WALK indication comes from speaker mounted on pedhead – speaker may be aimed down at pedestrian waiting location or across street

• Locator tone is from separate speaker usually mounted near pushbutton, but can be mounted higher
Combination devices

- Pushbutton-integrated device with locator tone and tactile arrow
- Overhead speaker for WALK indication
Receiver-Based APS

• Message transmitted by infrared or LED technology from pedhead to a personal individual receiver
• Person who is blind or visually impaired points receiver at pedhead to receive message
• These devices may also give other types of information, including information about name of streets or shape of intersection
• Issue: requires users to carry a receiver
Receiver-Based APS
Vibrotactile Alone: APS

Problems:
• Must be located very precisely at the departure curb to be useable
• Pedestrian may not know it is there (no locator tone)
• Vibrotactile feature location varies on various manufacturers’ buttons
• Pedestrian has to have hand on the button (a problem in crowded areas)
APS Recommendations

Public Rights-of-Way Access Advisory Committee (PROWAAC) recommended:

• That transmitted message APS with personal receiver should only be used in combination with audible indication

• That vibrotactile WALK indication should only be used in combination with audible indication
APS Recommendations

PROWAAC recommended that APS:

• Identify specific crosswalk and identify start of WALK phase with audible and vibrotactile indication

• WALK indication and locator tone sound at a quiet volume, only audible within 10 to 12 feet of the pushbutton, except when optional ‘audible beaconing’ is used
APS Recommendations

• MUTCD and PROWAAC recommend:
  – Pushbutton Locator tone
  – Signal volume adjust to between 2 to 5 dB over ambient noise level, audible within 6 to 12 feet of the pushbutton, or the building line (whichever is closer)
  – Tactile arrow aligned with crosswalk
Tactile arrow

- Points toward crossing controlled by pushbutton;
- Arrow should be aligned with direction of travel on crosswalk
- Arrow may be on the pushbutton or on the device above the pushbutton
- Arrow is the part that vibrates during the walk interval
Accessible Pedestrian Signal Features

APS may have additional features:
• Vibrating surface
• Pushbutton message
• Tactile map
• Audible beaconing
• Pushbutton activation of additional features
Vibrating Surface

• Vibrating surface communicates information to pedestrians with both hearing and visual impairments, or when traffic sounds mask the APS audible component
• The vibrotactile component vibrates during the WALK interval
• May be part of the actual pushbutton or on the pushbutton housing
Pushbutton Message

- Pushbutton message to provide intersection information
- Plays when pushbutton is pressed for 1 second or more
Tactile Map of Crosswalk

Symbols:
- Down curb ramp
- Two-way bike facility
- 2 lanes of cars from left
- Median/island
- Rail line
- 2 lanes of cars from right
- Up curb ramp
APS Features:
Audible Beaconing

- Sound from the opposite side of the street is used to provide directional guidance during street crossing; is needed at a minority of crosswalks.
- Can be provided only when a pedestrian holds the pushbutton in for a longer period of time.
APS Features:
Pushbutton Activation of Options

A 1-second hold of pushbutton may be used to activate:
• Message
• Audible beaconing feature
• Longer crossing time
Installing Accessible Pedestrian Signals
PROWAAC Recommendations for APS Installation

APS should be installed at all new signals when any of the following exist:

- When the pedestrian walk phase is pedestrian activated (a button has to be pushed)
- Where there is a leading pedestrian interval (LPI)
- Where the traffic signal is pre-timed (fixed timed) and pedestrian information is provided
MUTCD Recommendations for APS Installation

2003 MUTCD - Conduct an engineering study, which should consider the following factors:

- Potential demand for accessible pedestrian signals
- A request for accessible pedestrian signals
- Traffic volumes during times when pedestrians might be present; including periods of low traffic volumes or high turn-on-red volumes
- The complexity of traffic signal phasing
- The complexity of intersection geometry
Choosing Audible Tones

• As we’ve seen, there are many audible tones available at this time
• The MUTCD has guidance on choosing tones
• Studies are underway to work toward standardization in the future
Collaboration

• Engineers and designers should work with pedestrians who are blind, and with orientation and mobility specialists, in making decisions about APS
• Need to understand what information is needed by pedestrians who have visual disabilities
• Audible and vibrotactile features can be easily and inexpensively integrated into ped signals
Pedestrian Crossing Time
MUTCD Recommendations

Pedestrian clearance interval (flashing don’t walk):
• 4 feet/sec walking speed
• “Where pedestrians who walk slower than normal or pedestrians who use wheelchairs routinely use a crosswalk, a walking speed of less than 4 feet/sec should be considered.”
Pedestrian Crossing Time
PROWAAC Recommendations

• For pedestrian signal phase timing, use 3.5 feet per second pedestrian walking speed
• Include the length of the crosswalk and one curb ramp for calculating crossing distance
Pedestrian Crossing Time

Pedestrian clearance interval extension:
- Can be provided when user holds down button
- Can be provided through Passive detection of pedestrians who are still in the crosswalk; while inducing minimal delay to other traffic.
In this example, a high number of slower pedestrians would have caused significant delay to traffic if a reduced crossing speed (3 ft/sec) was used every time a pedestrian pushed the button.
• The signal is timed for 4 ft/sec whenever a pedestrian pushes the button
• Microwave sensors aimed at the crosswalk are mounted on poles on each side of the street
• The sensor tracks pedestrians as they cross the street.
• If a slower pedestrian has not made it across the street, the sensor tells the controller to add four seconds to the crossing time.
• The sensor keeps tracking the pedestrian till he has finished crossing, adding more time if necessary.
At this location, the need to prolong the walk phase occurs in 20% of crossings, reducing unnecessary delay to drivers the other 80% of crossings.
Some simple ideas for improving signal operations for pedestrians
In areas with high pedestrian activity, pedestrians should get a signal at every cycle. Accessible pushbuttons should still be used.
Tell drivers they must to yield to peds when turning
Part time no turn on red
LPI = Lead Pedestrian Interval; gives peds a head start; it looks like a normal signal to drivers
LPI has a subtle difference:

• The pedestrian WALK comes on a few seconds prior to the vehicular green signal, allowing pedestrians to enter crosswalk before turning vehicles arrive there.
Designing Pedestrian Facilities for Accessibility Training

Module 7
Accessible Pedestrian Design: Temporary Facilities and Construction Site Safety
MUTCD Provisions

Section 6D.01:
The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a temporary traffic control zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.
MUTCD Provisions

Section 6D.02:
When existing pedestrian facilities are disrupted, closed, or relocated in a temporary traffic control zone, the temporary facilities shall be detectable and include accessibility features consistent with the features present in the existing pedestrian facility.
Construction Sites

- Construction sites must provide a continuous, safe, accessible path of travel
- Avoid displacing pedestrians
Temporary Construction

- An alternate route should be provided whenever the pedestrian access route is blocked
- Warning signs shall be provided when an alternate circulation path is provided or a barricade is constructed
- Temporary facilities in the public right-of-way must conform to the requirements for permanent facilities
Construction Site Dangers

- Access to curb ramps and accessible alternative routes not provided
- Pedestrians forced to take circuitous or dangerous alternative routes
Construction Site Dangers

Pedestrian zone reduced or blocked by materials or equipment
Construction Site Dangers

• Ineffective barriers (plastic tape) around the site
• Fails to provide detection around site
Barriers

• Accessible barricades should be provided when construction occurs in the public right-of-way

• Barriers defining the alternate route should:
  – Be a minimum of 36-42 inches in height and continuous with the ground surface
  – Extend around the entire perimeter of the construction site or entire length of the alternate circulation route
Provide effective accessible barriers

Solid and continuous, 36-42 inches high
Extend barrier around entire area of construction
Barriers

• This barrier does not provide adequate warning
• Sidewalk closed sign should be placed further back
Barricades for Cane Detection
Barricades for Cane Detection

- The previous slide image shows examples of methods to construct detectable barricades.
- Manufacturers are working on prefabricated detectable barricades.
- As seen in the next few slides, FHWA and others recently hosted a demonstration to test various delineation devices.
Examples of tested accessible barricades
Examples of tested accessible barricades
Curb Ramp Barricade for Cane Detection

Effective method of providing information at crosswalk closing
Design Solutions: Turn protruding blocks and make them visible
Design Solutions: Temporary ramps and boardwalks ensure smooth continuous surface
Repair Issues

• Repair utility work as soon as possible
• Hold companies accountable for timely repairs
Design Solutions: Provide smooth patching to utility work
Design Solutions: Provide temporary curb ramps where needed
Design Solutions: Provide temporary curb ramps where needed
Design Solutions

Provide crash resistant barriers when a temporary pedestrian route is in the roadway
COURSE EVALUATION