

Designing Streets for Pedestrian Access



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Instructor Information

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Course Objectives

In this workshop, we'll discuss:

- Diversity of people with disabilities
- Best practices:
 - Sidewalk design
 - Crossings and intersections
 - Ramps
 - Signals



Pedestrians and their Environment

Module Components:

- Pedestrian characteristics
- Assistive technologies & devices
- Movement & information barriers



Pedestrians and their Environment

Traditional transportation system assumes users:

- Are able-bodied
- Have good vision and hearing
- Understand traffic laws and safety issues

Many in the US are not served by these assumptions.



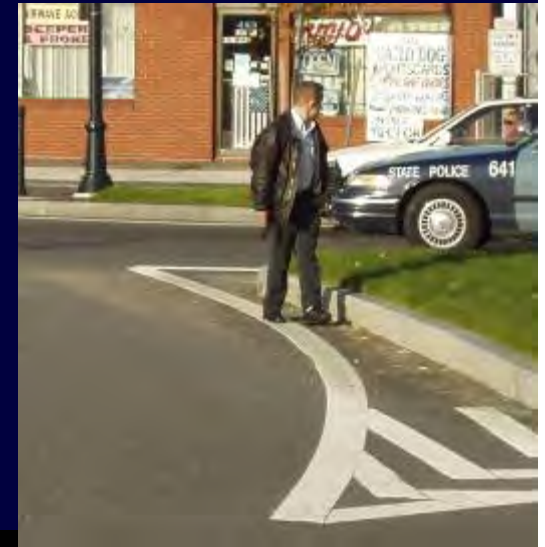
Pedestrian Characteristics

Disabilities occur:

- At birth
- Suddenly (accidents/disease)
- Slowly over time

Disabilities may be permanent or temporary

Disabilities may not be obvious or visible



Pedestrian Characteristics

The number of people with disabilities increases with age

Limitations include:

- Mobility
- Sensory
- Cognitive



Pedestrian Characteristics - Mobility

Mobility disabilities can affect:

- Agility
- Speed
- Endurance

Usability features include:

- Firm surfaces
- Adequate widths
- Unblocked travel
- Ramps to street
- Least-effort routes



Pedestrian Characteristics: Vision

Information sources

- Sound
- Texture
- Contrast

Usability features:

- Audible/vibrotactile signals
- Tactile indication of boundary
- Contrast in key elements
- Direct and in-line routes

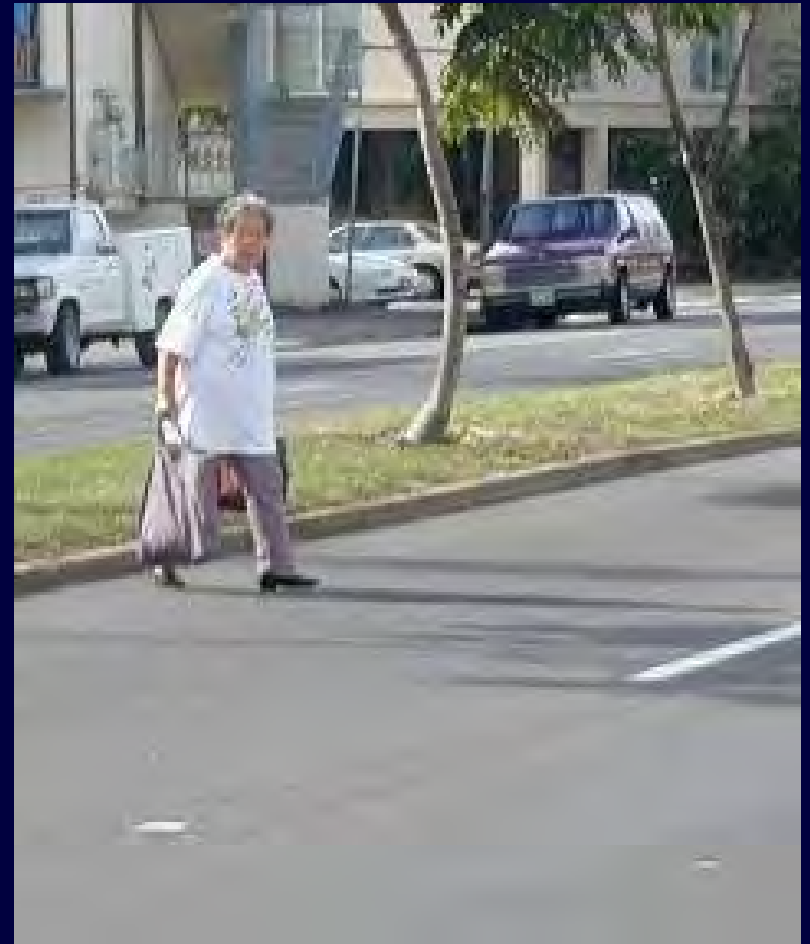


Pedestrian Characteristics: Hearing

Information source: Vision

Usability features:

- **Good sight lines at crossing**
- **Visual or vibrotactile signals & signs**



Pedestrian Characteristics: Cognitive

Differences in skills:

- Processing
- Decision-making

Usability features:

- Intuitive environment
- Uncomplicated crossings
- Easily understood symbols



Assistive Technologies & Devices

Fill the gap between an individual and the environment:

- Mobility
- Vision
- Hearing

The more accessible the environment, the greater the potential accommodation.



Assistive Technologies & Devices: Mobility

- Motorized scooters
- Manual wheelchairs
- Prosthesis
- Walker
- Cane
- Crutches



Assistive Technologies & Devices: Vision

- **Dog guides**
 - guide around obstacles
 - block path to obstructions
- **White cane**
 - detect obstacles
 - preview surface
- **Low vision aids**
 - may not use a cane or dog guide
 - may use a telescope or magnifier



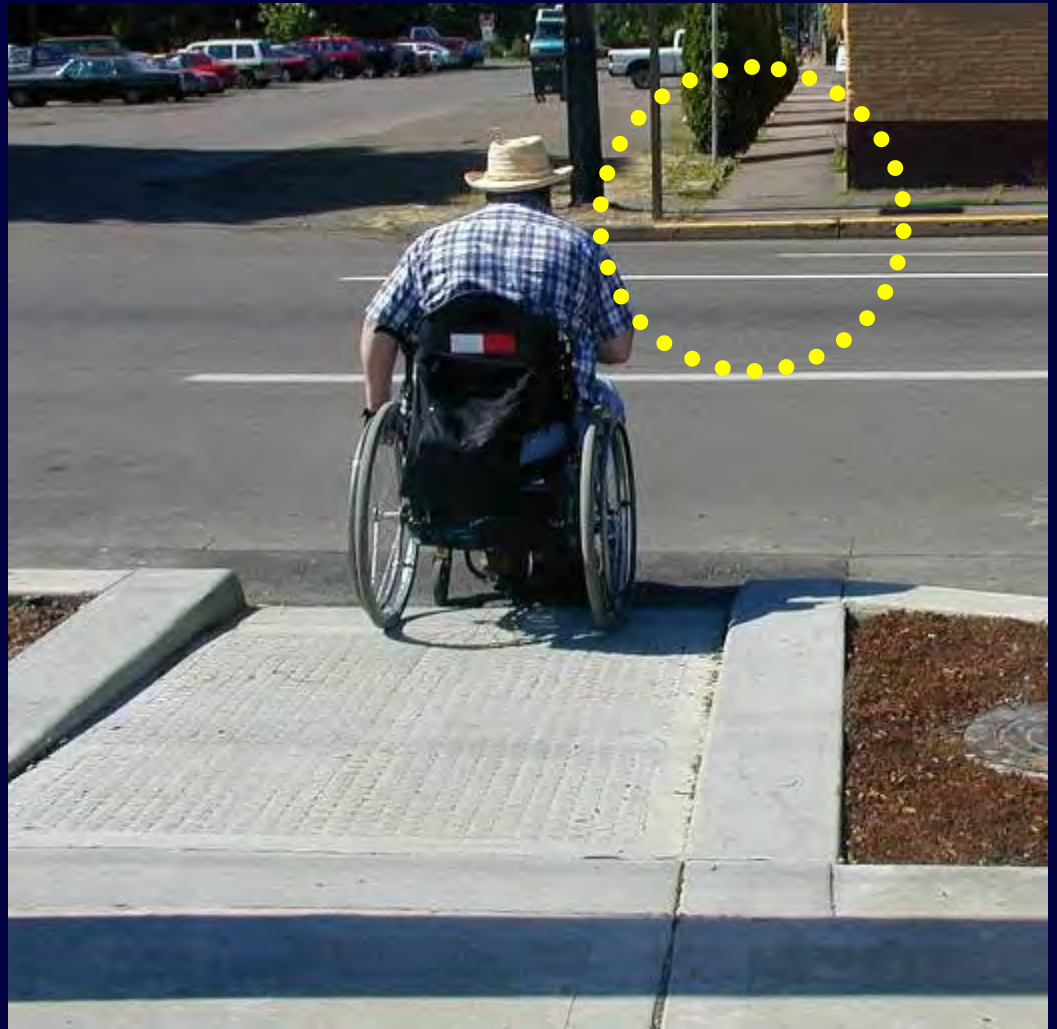
Assistive Technologies & Devices: Hearing

Hearing aids

- amplify sounds in the environment
- not usually directional

Movement Barriers

Restrict a person's ability to physically progress along a route or within an environment



Movement Barriers

What are some movement barriers?

- **Lack of sidewalks**
- **Missing ramps**
- **Steep grades/cross slopes**
- **Uneven surfaces**
- **Obstacles: lampposts, benches, newspaper boxes**
- **Narrow routes**
- **Insufficient time to cross street**

Information Barriers

Restrict a person's ability to use information contained in the environment



Information Barriers

What are some information barriers?

- **Undefined boundary between sidewalk and street**
- **Unlit or dimly lit path of travel**
- **Signs and signals in visual format only**
- **Obstacles not detectable by cane**
- **Distant push button locations**
- **Skewed crosswalks**
- **Complex traffic patterns, RTOR, free-flow vehicle movements**

Accessible Design Principles

- Design built environment for entire pedestrian spectrum
- Enable users to travel independently
- Integrate usability in planning and design



Questions?

Designing Streets for Pedestrian Access

Module 2: Sidewalk Design

What will be covered in Module 2

■ Sidewalk Design

- The Zone System
- Obstructions and Protruding Objects
- Running Slope
- Cross-slope
- Driveways
- Surfaces
- Openings, Gaps, and Grates

Types of Pedestrian Routes





Sidewalks = essential pedestrian facility



Pedestrians can get by without sidewalks on quiet streets



Shoulders serve pedestrians in rural areas



At a certain point, sidewalks are needed



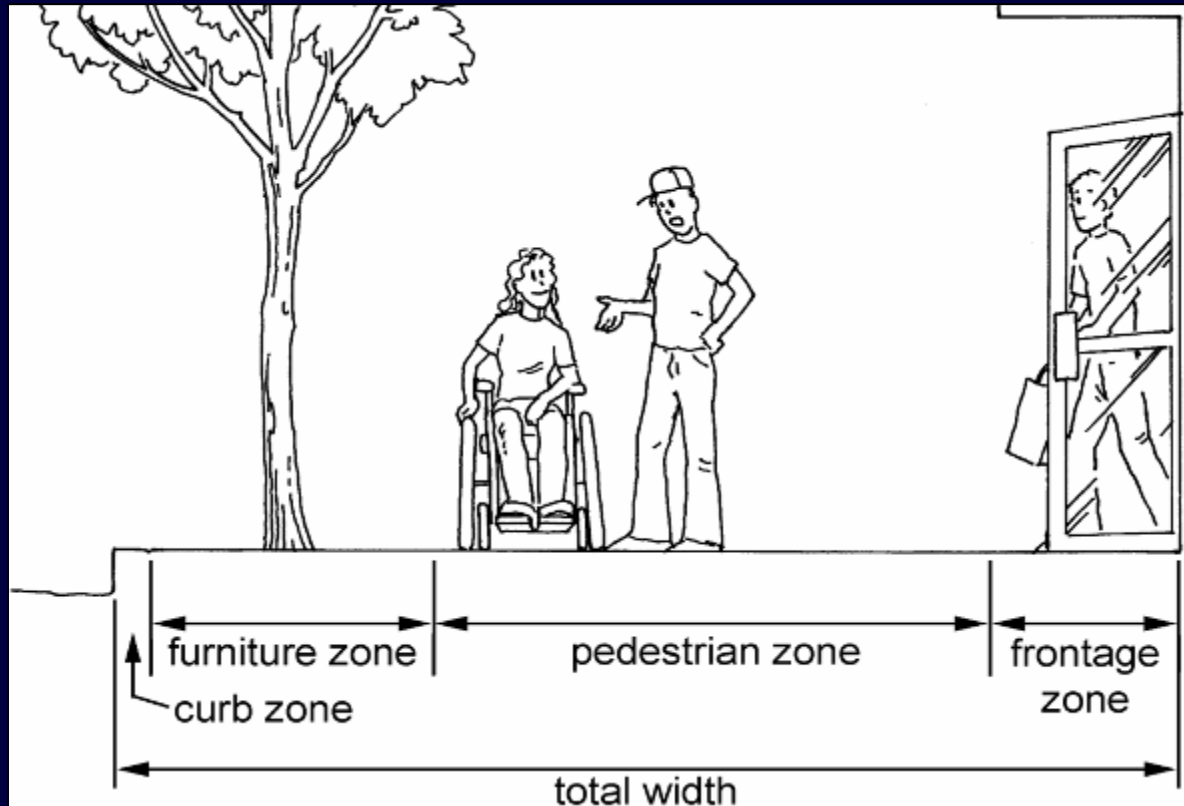
**Shoulders inappropriate in
suburban/urban areas**

‘Goat trail’ indicates need

Sidewalk Corridor / Zone System

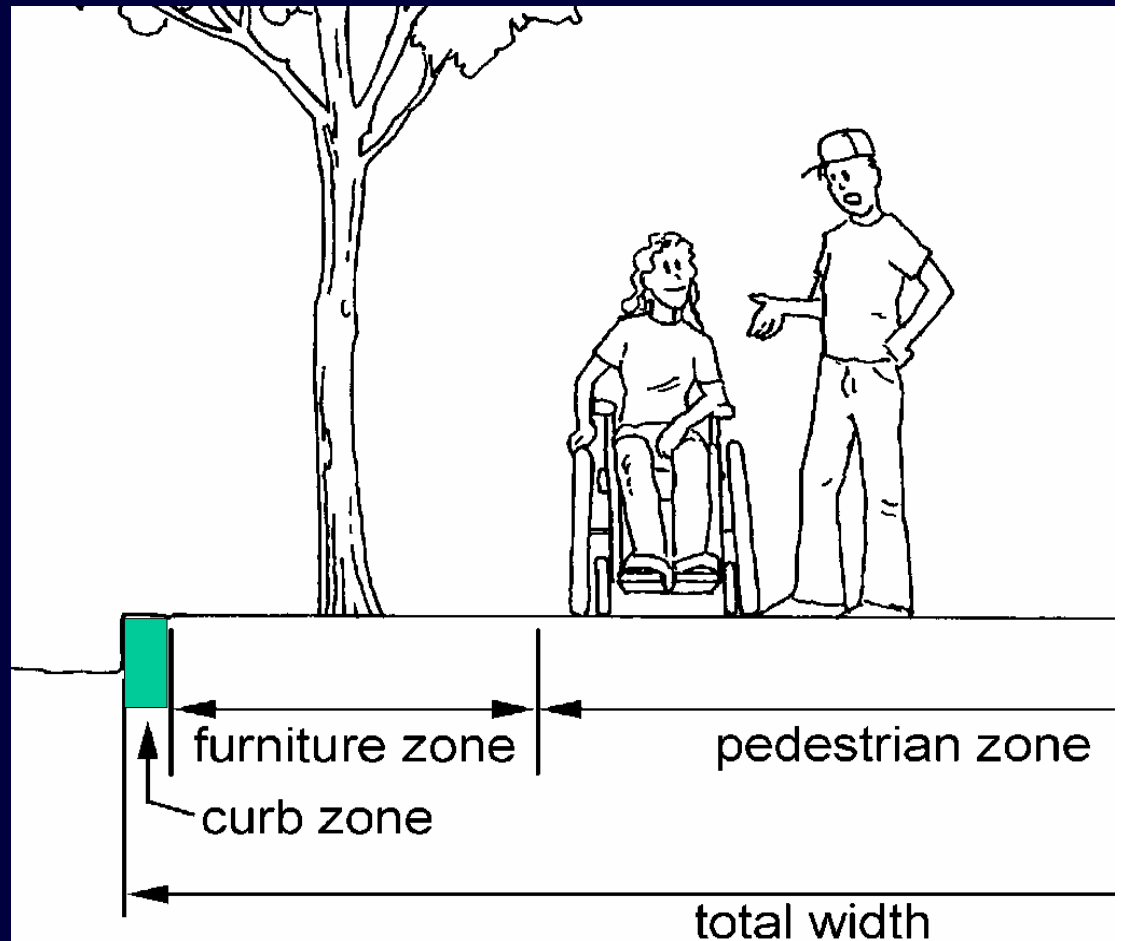
Sidewalk corridor extends from roadway to right-of-way line. Zone system makes it easier to provide accessible sidewalks:

- Curb zone
- Furniture zone
- Pedestrian zone
- Frontage zone



Curb Zone

- **Drainage:** keeps water off sidewalk
- **Keeps drivers from parking on sidewalk**
- **Valuable cue for vision impaired**





Why the curb zone matters:
Mountable curbs are inappropriate on local streets



**Why the curb zone matters:
It's where pedestrians transition from/to the street**



The curb zone matters:

Overlays result in low curb exposure, which encourages sidewalk parking



Curbless sidewalks are possible



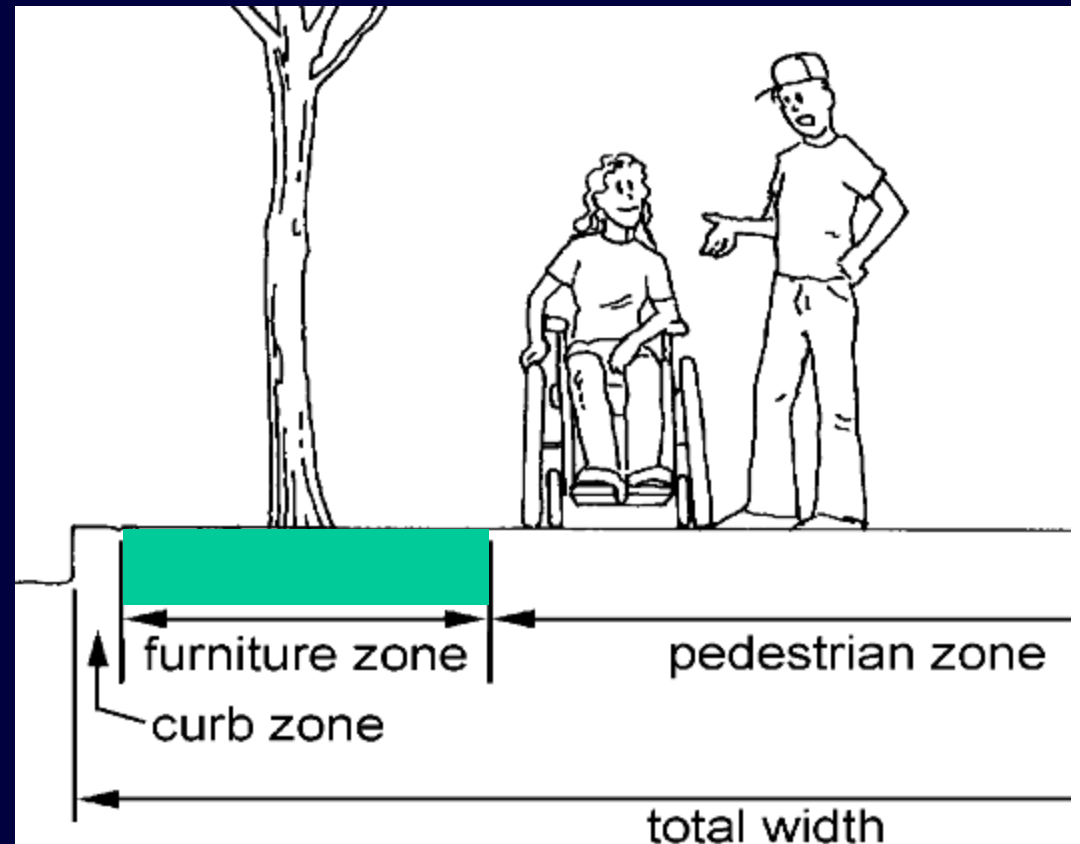
Curbs & drainage are the greatest sidewalk cost



This sidewalk cost little to install w/o curb

Furniture Zone

- Keeps pedestrian zone free of obstacles
 - Space for street furniture (signs, benches, trees, fire hydrants)
- Buffers pedestrians
- Easier to provide accessible ramps and driveways



Furniture Zone

All objects go here!



Collector Strip

Parking Strip

Government Grass

BOULEVARD

Buffer

Utility Strip

Landscape Strip

Dark Strip

Planting Strip

Lawn Extension

Idiot Strip

Boulevard Strip

Tree Lawn

Hell Strip

Furnishing Zone

Devil's Strip

Furniture Zone

Landscape Area

Buffer Zone

THE PARKING

Terrace

Grass Lawn

Verge

Planter Strip

Parkway

Kill Strip

Greenway

Snow Zone

Parkway Strip

Planting Strip

Furniture Zone

Or simply “buffer”

Planter Strip



Furniture zone can be used for bus pads & shelters



The furniture zone keeps the sidewalk clear



Sidewalk with furniture zone is pleasant to walk on

Furniture Zone Width

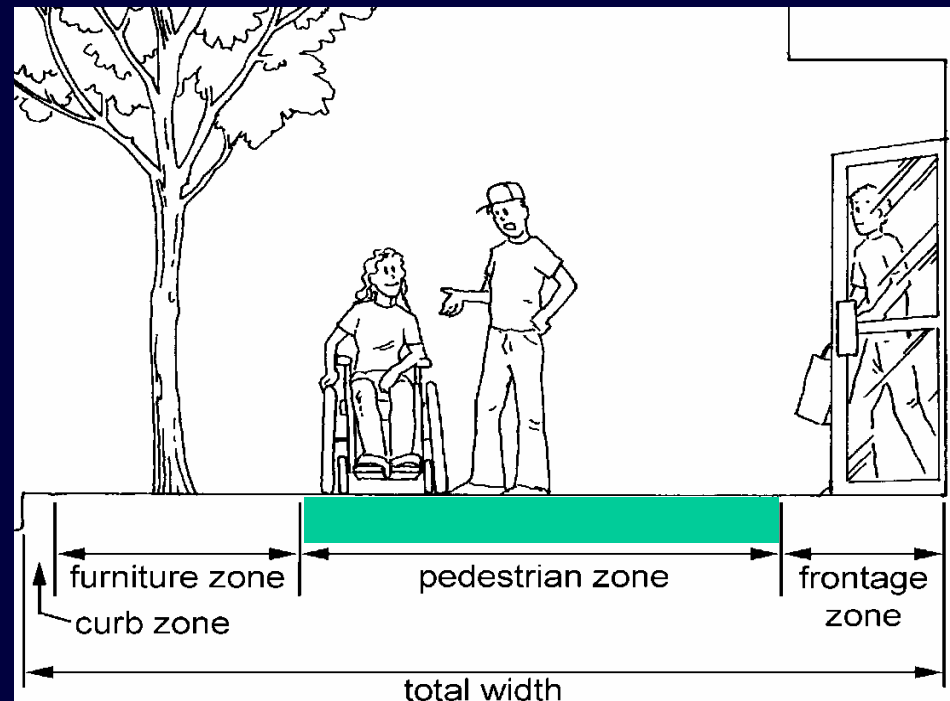
Depends on what goes in it:

- 0.6m min for signs and poles
- 1.2m min for trees
- 2m for snow storage
- 2.5m to provide perpendicular curb ramp



Pedestrian Zone

- Area reserved for pedestrian travel
- Includes “pedestrian access route” (PAR)
- Must be free of obstacles and protruding objects
 - Width varies based on pedestrian volume



Pedestrian Zone Width Minimums

- Consider 1.2m minimum pedestrian access route width on sidewalks





1m for one wheelchair user



**1.2m for a person
using crutches**



**1.2 m for user with dog
guide or sighted guide**



**1.5 m for turning a
wheelchair**



**1.5m for a wheelchair user and walking companion;
1.8m for two wheelchair users**

Practical Minimum “Sidewalk” Width



**1.5m for setback sidewalk:
two people can walk
comfortably side by side**



**1.8m for curbside sidewalk:
0.6m for poles and signs and
1.2m for ped access route**



A sidewalk should be as wide as needed to serve anticipated pedestrian use



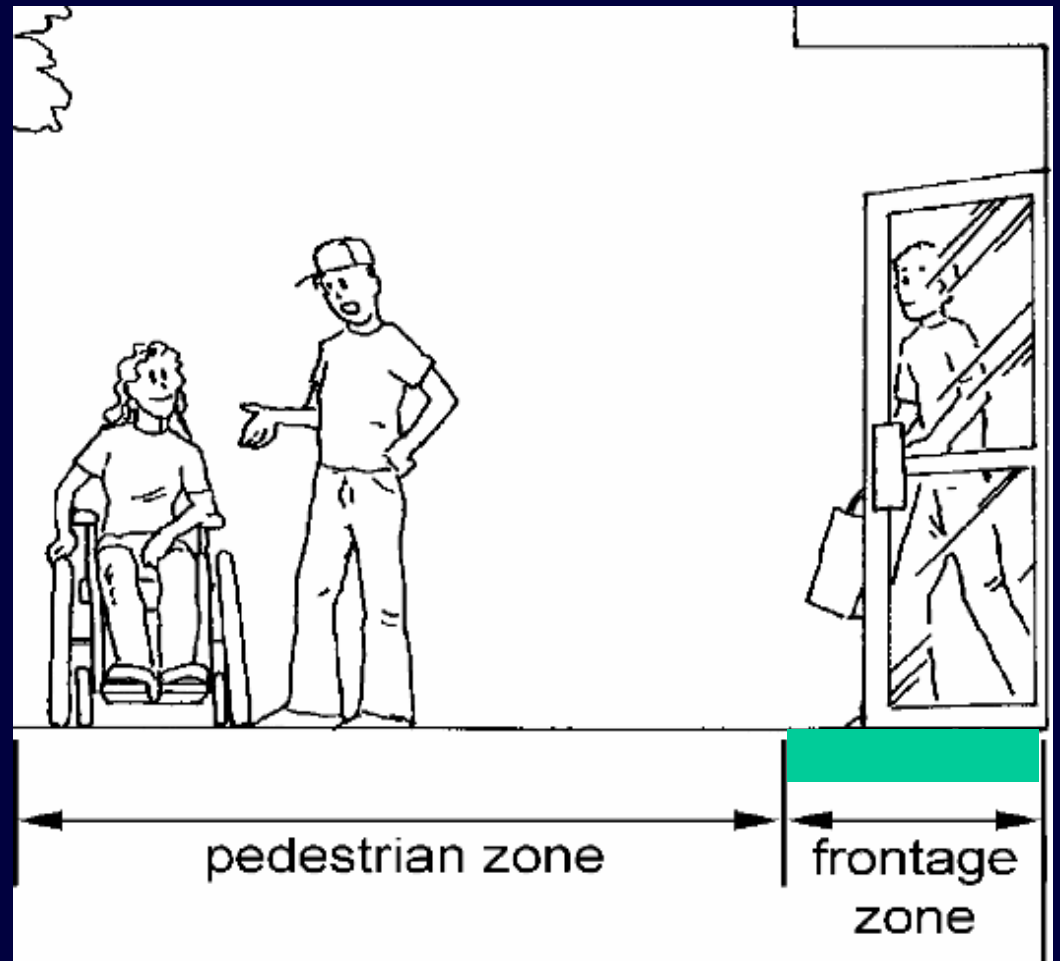
Nice wide sidewalk with many amenities

Unless...



Frontage Zone

- Room for doors, planter boxes, signs on buildings, etc.
- Free of overhanging/ protruding obstacles





Shy distance concept applies to pedestrians, who will shy away from a vertical face; extra width is needed

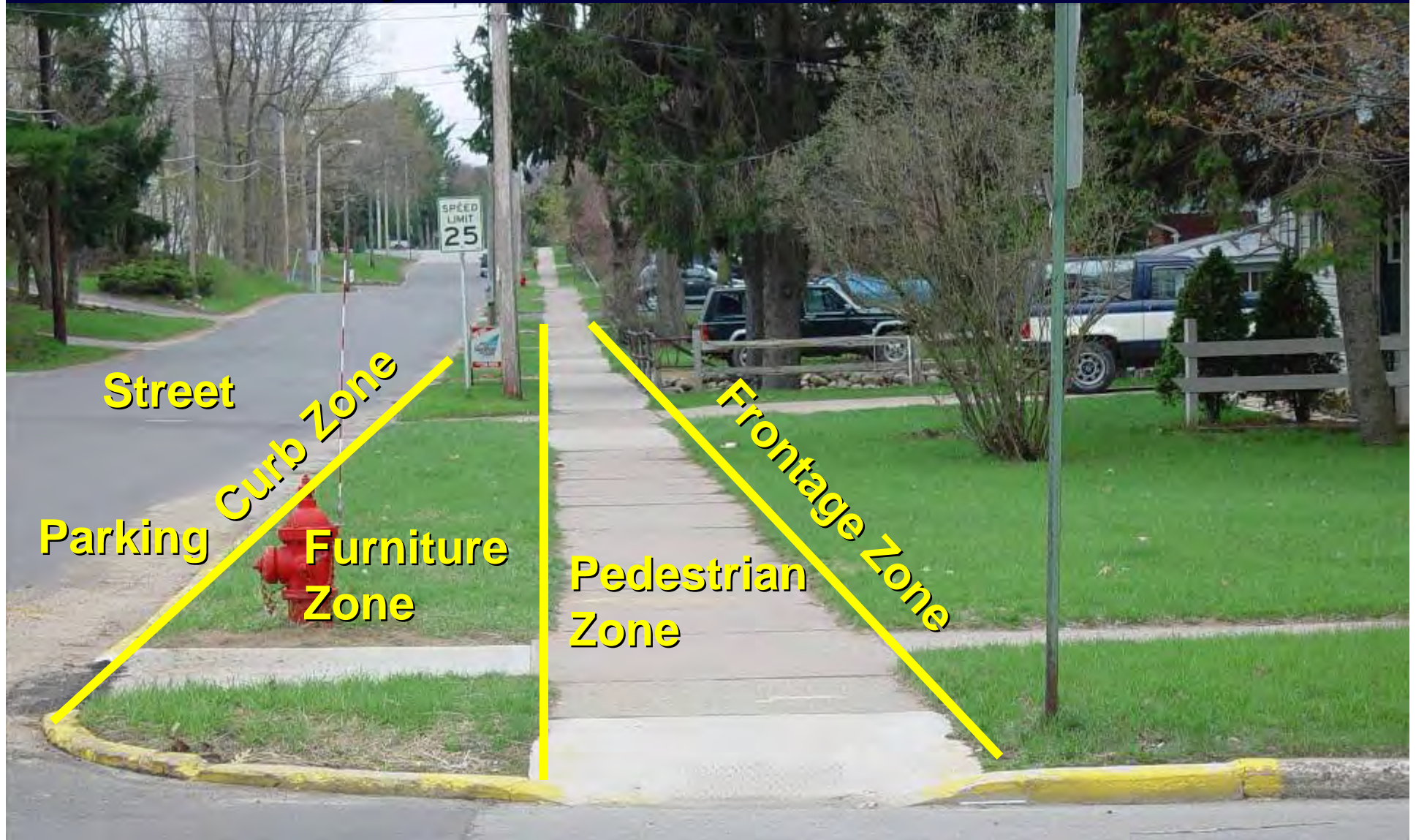


An interesting façade makes narrow sidewalks feel wider



**The type/placement of fence impacts pedestrian comfort:
The sidewalk on the left is wider, but feels constrained
because of high chain link fence**

Zone System Summary - Residential



Zone System Summary - Commercial





With zone system: organized street furniture provides clear pedestrian access route



W/o zone system: random street furniture clutters sidewalk and complicates wayfinding

Obstacles & Protruding Objects

Obstacles in Pedestrian Zone

3 ways to provide access:

- 1. Plan/design to limit objects in pedestrian zone**
- 2. Eliminate/move objects (Poles, utility boxes, signal cabinets)**
- 3. Provide access route around objects**



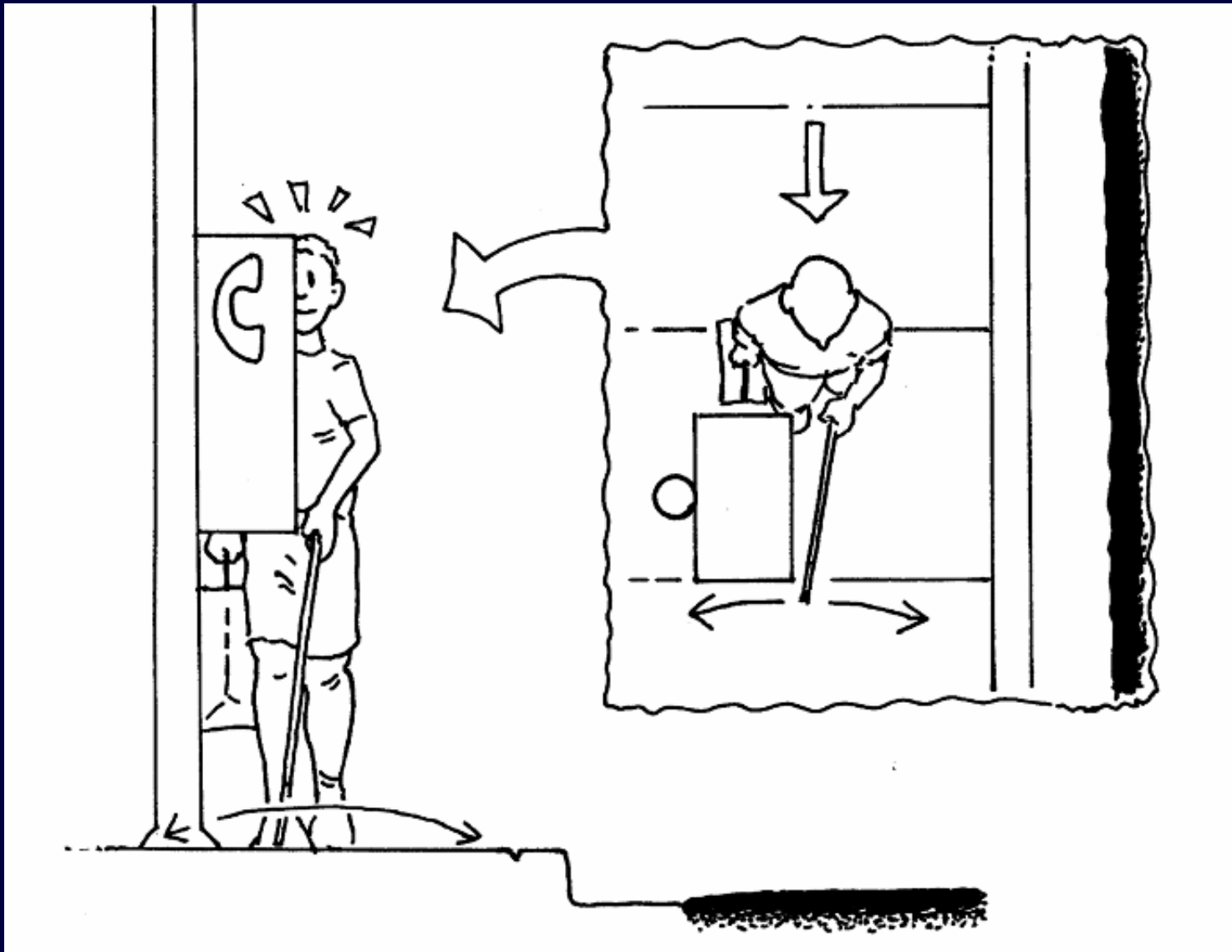


Sidewalk widened around pole

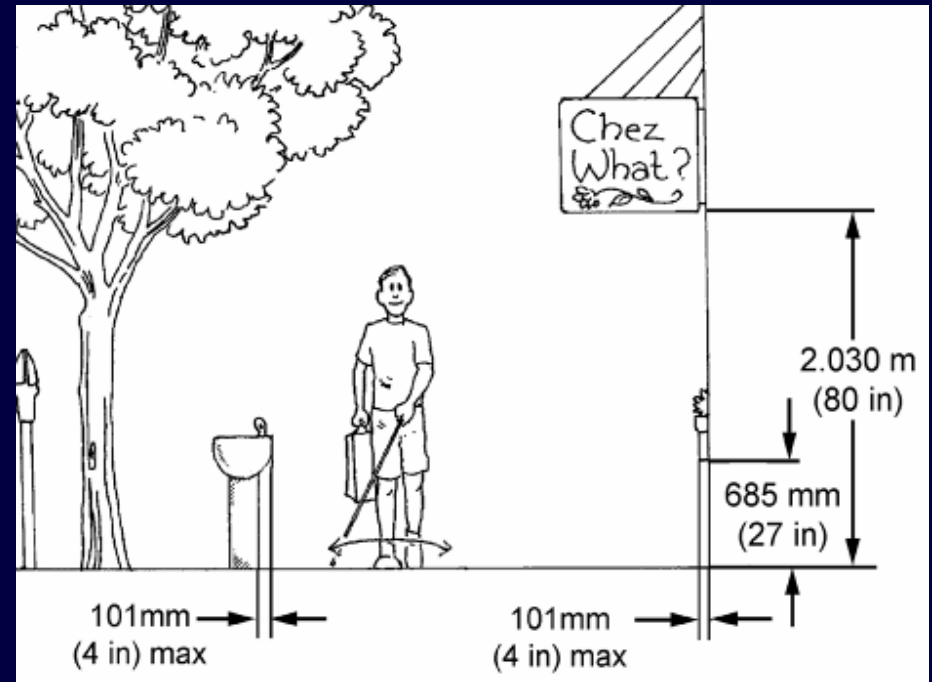
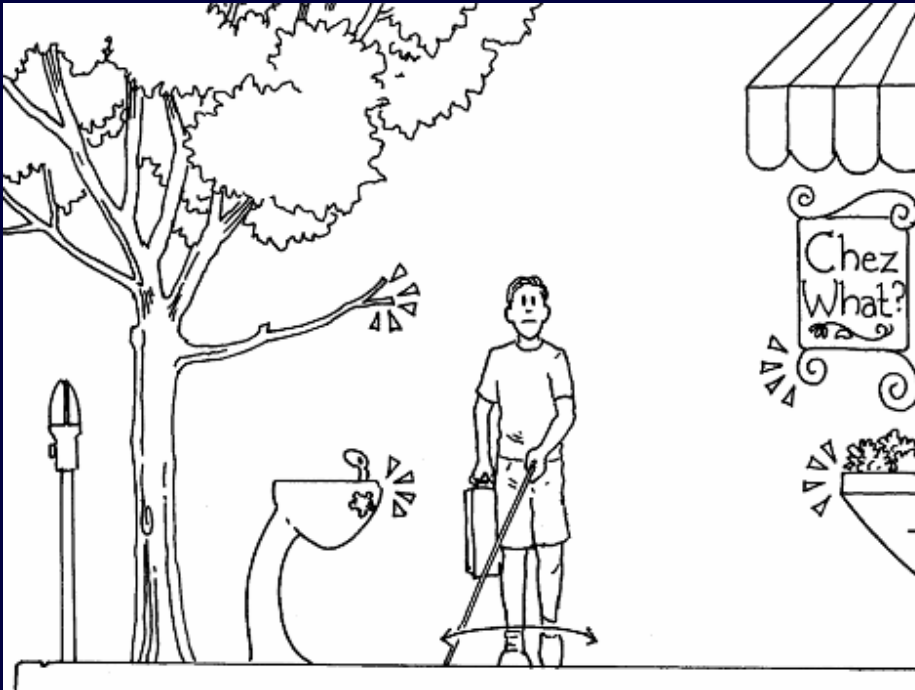


Use extension post for guy wire

Protruding Objects



Protruding Objects



- Objects between 0.6m - 2m above ground are not detectable by cane so must not protrude more than 10cm (*including objects in frontage zone*)
- Protruding objects may be protected by a barrier or curb that is detectable

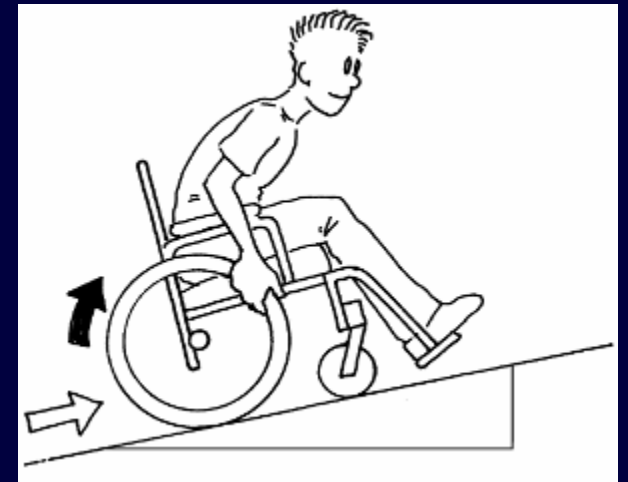
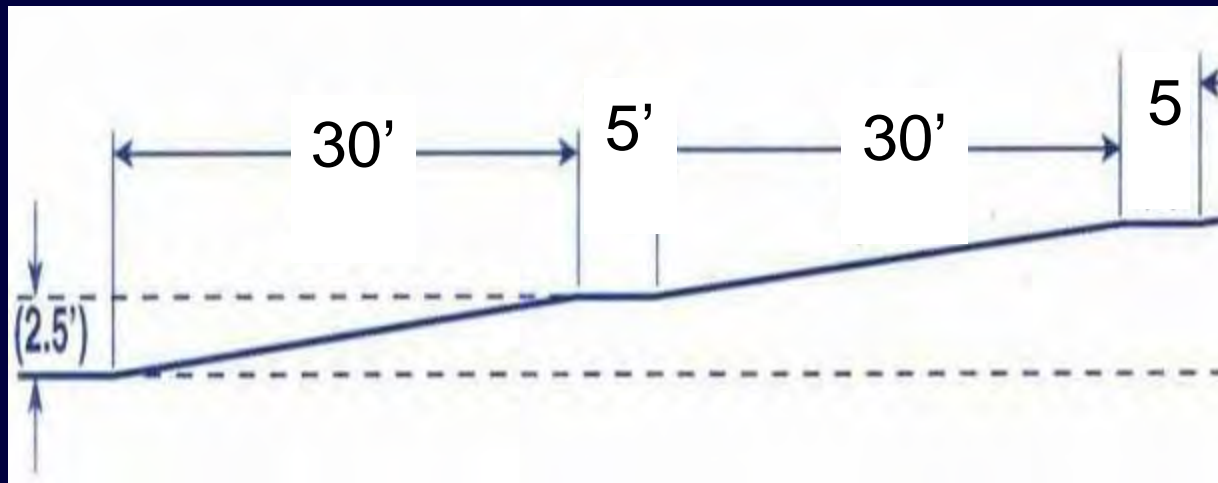


Signs within height of 0.6m - 2m must not protrude into pedestrian path of travel

Running Slope

Running Slope Guidelines

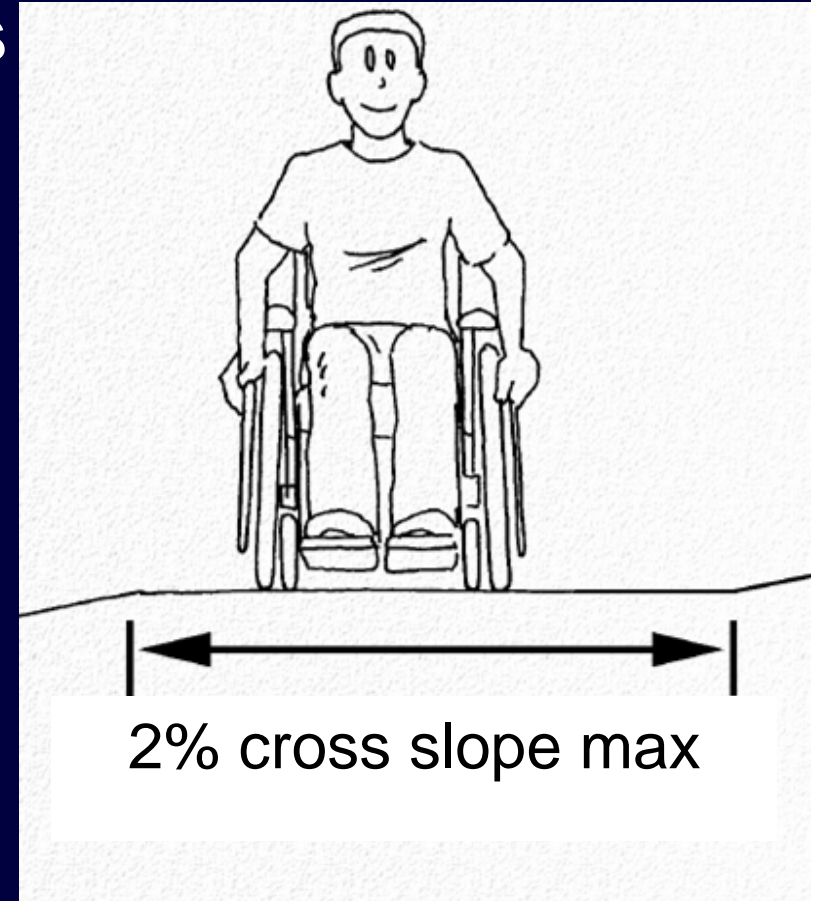
- Sidewalks may take grade of adjacent roadway
- Limit grade on artificially-created rises to 5% max
- Above 5%, alternate ramps and level landings



Cross Slope

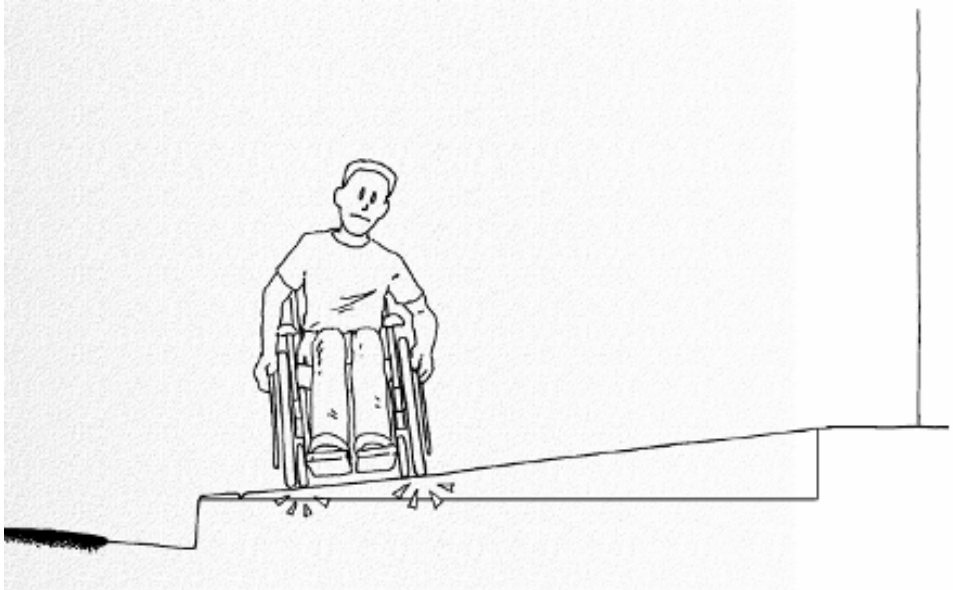
Cross Slope Guidelines

- 0% best for wheelchair users
- Some slope needed for drainage
- Max cross slope 2%
- “Level” means 2% max

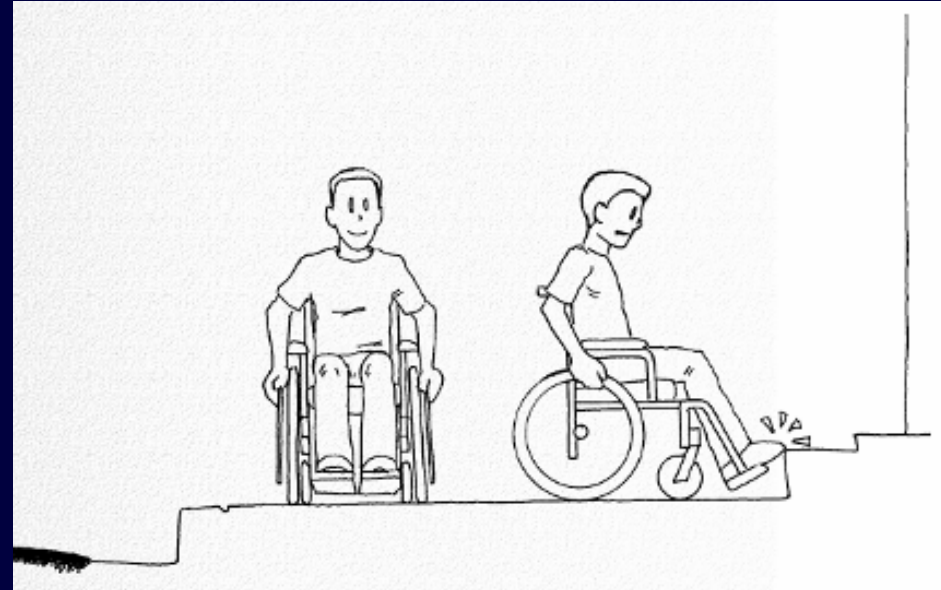


Cross Slope Retrofit Challenges

Building entrance elevations create problems:

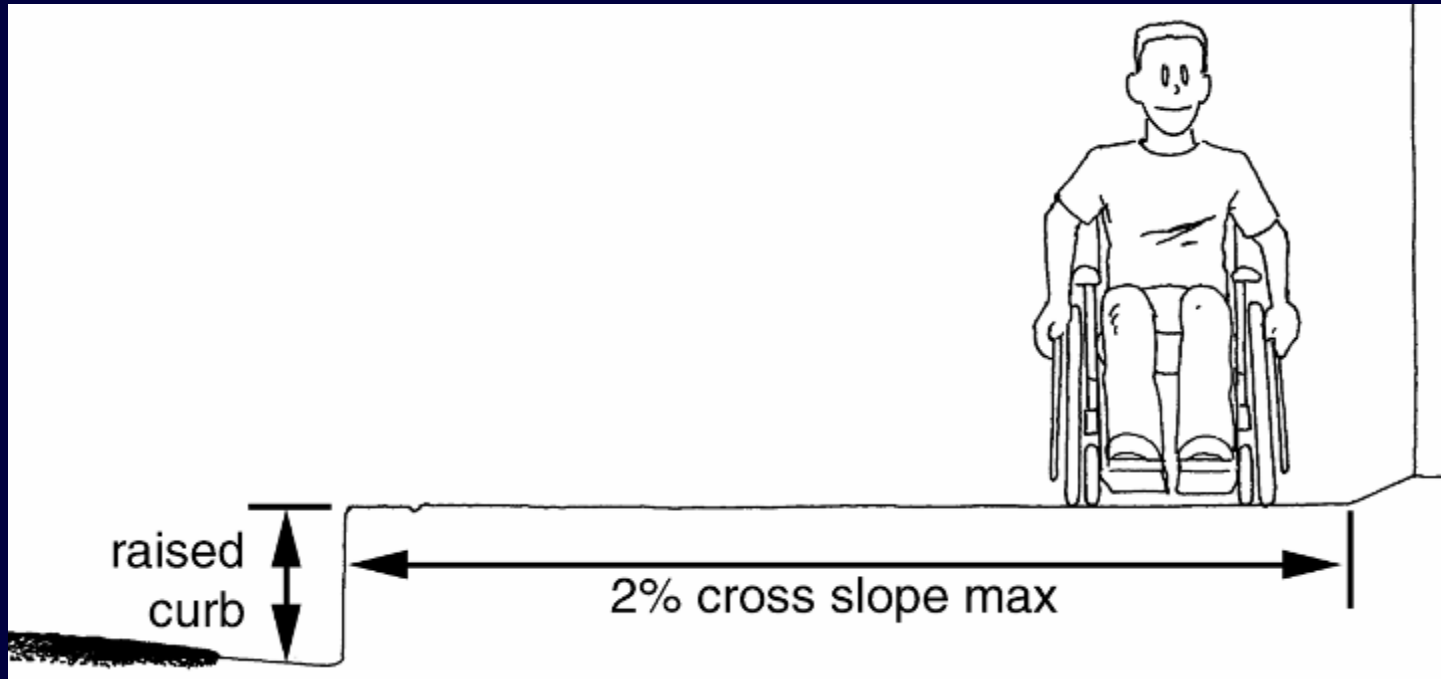


Elevation change is in sidewalk, resulting in excessive cross-slope



Acceptable cross-slope, but step hinders wheelchair users

Cross slope solutions



Raise curb; but curbs $> 20\text{cm}$ create parking issues:

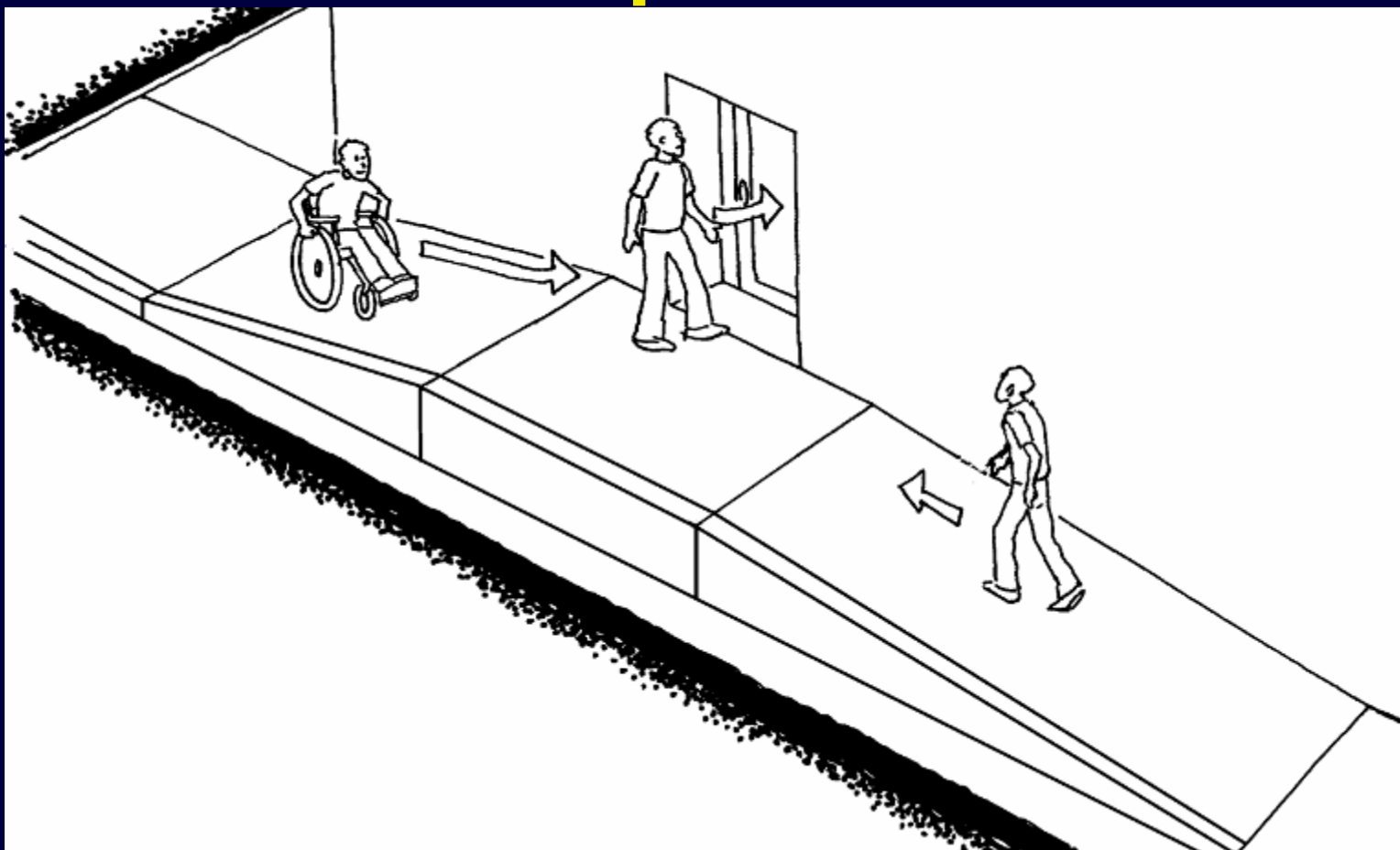
- **Parallel parking – doors cannot be opened**
- **Diagonal Parking – car overhang is impossible**

Cross slope solutions



**Stepped curb allows diagonal on-street parking
& sidewalks with good cross-slope**

Cross slope solutions

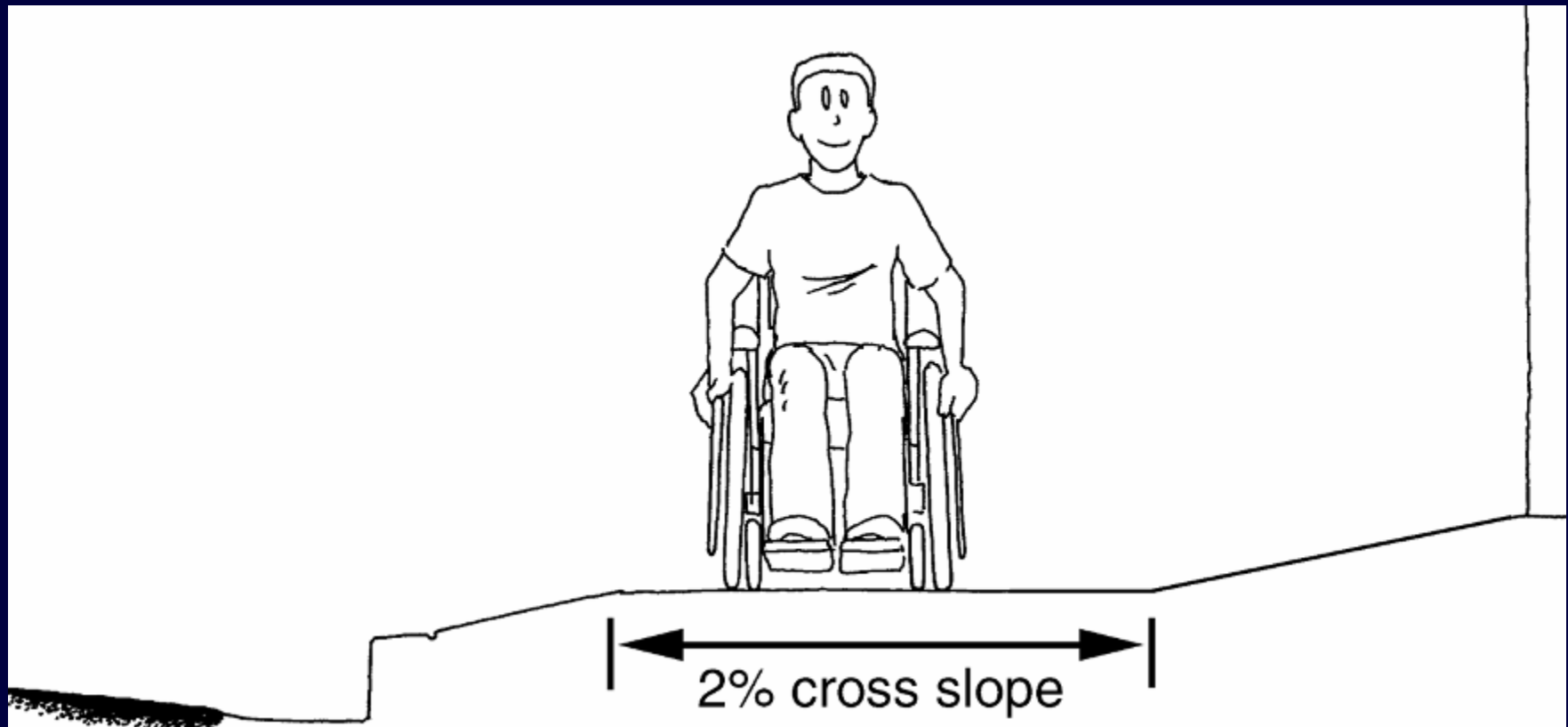


**Retrofit building entrance using
ramped sidewalk (may need handrails)**

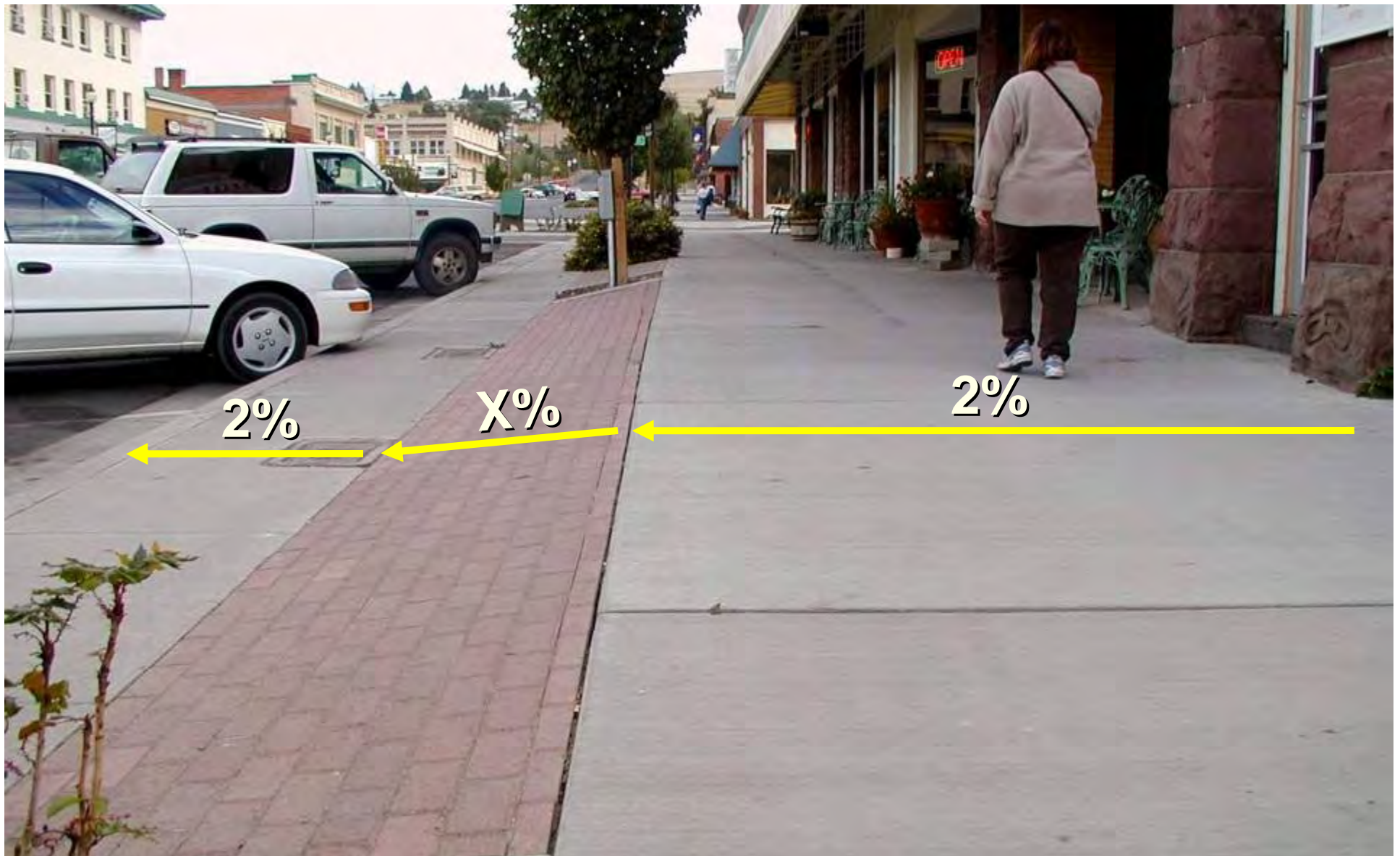


Sidewalk splits, ramps down to building doorways

Cross slope solutions



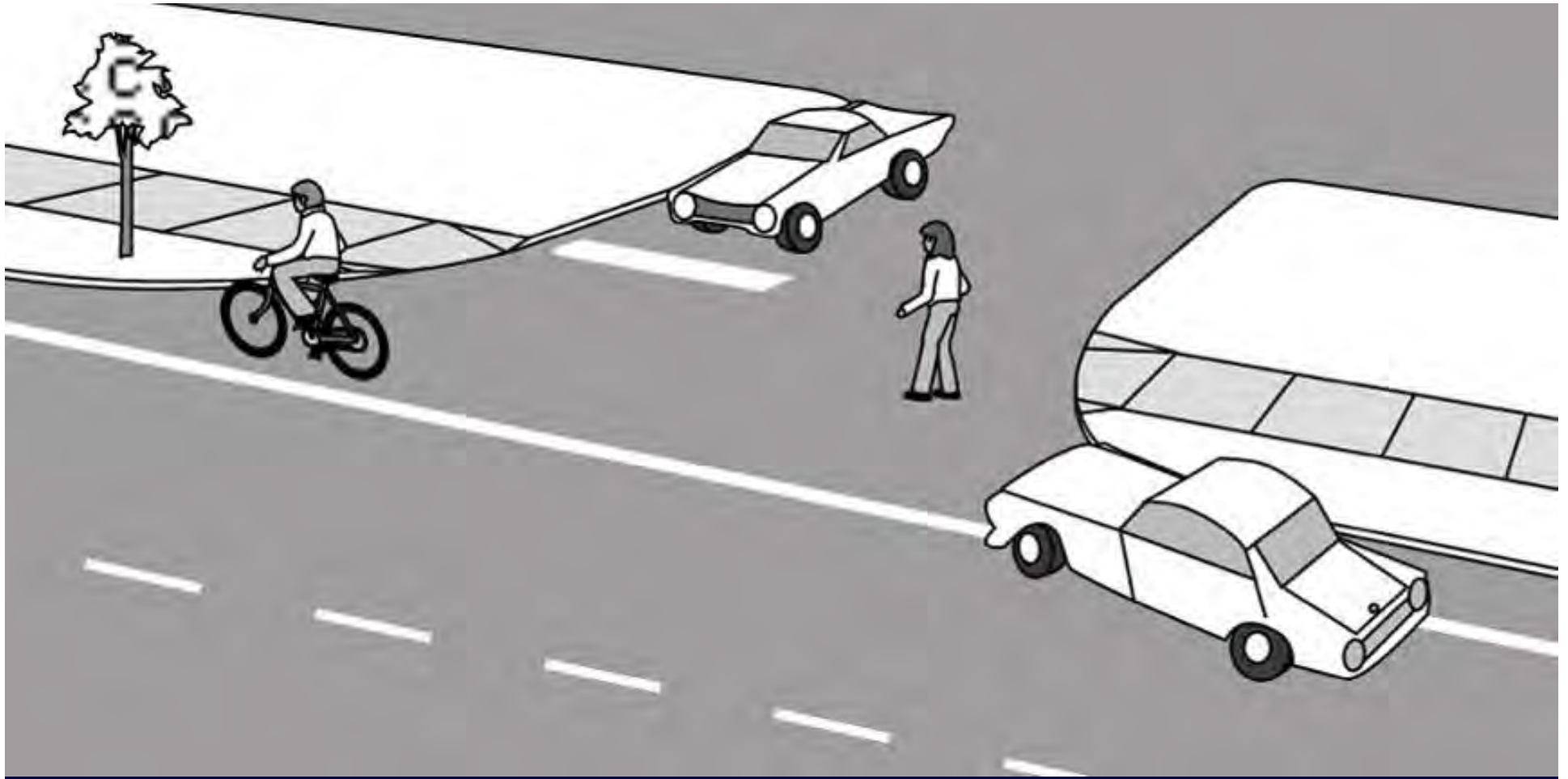
**Best: create level area (1.2m min) in sidewalk;
make up elevation change elsewhere**



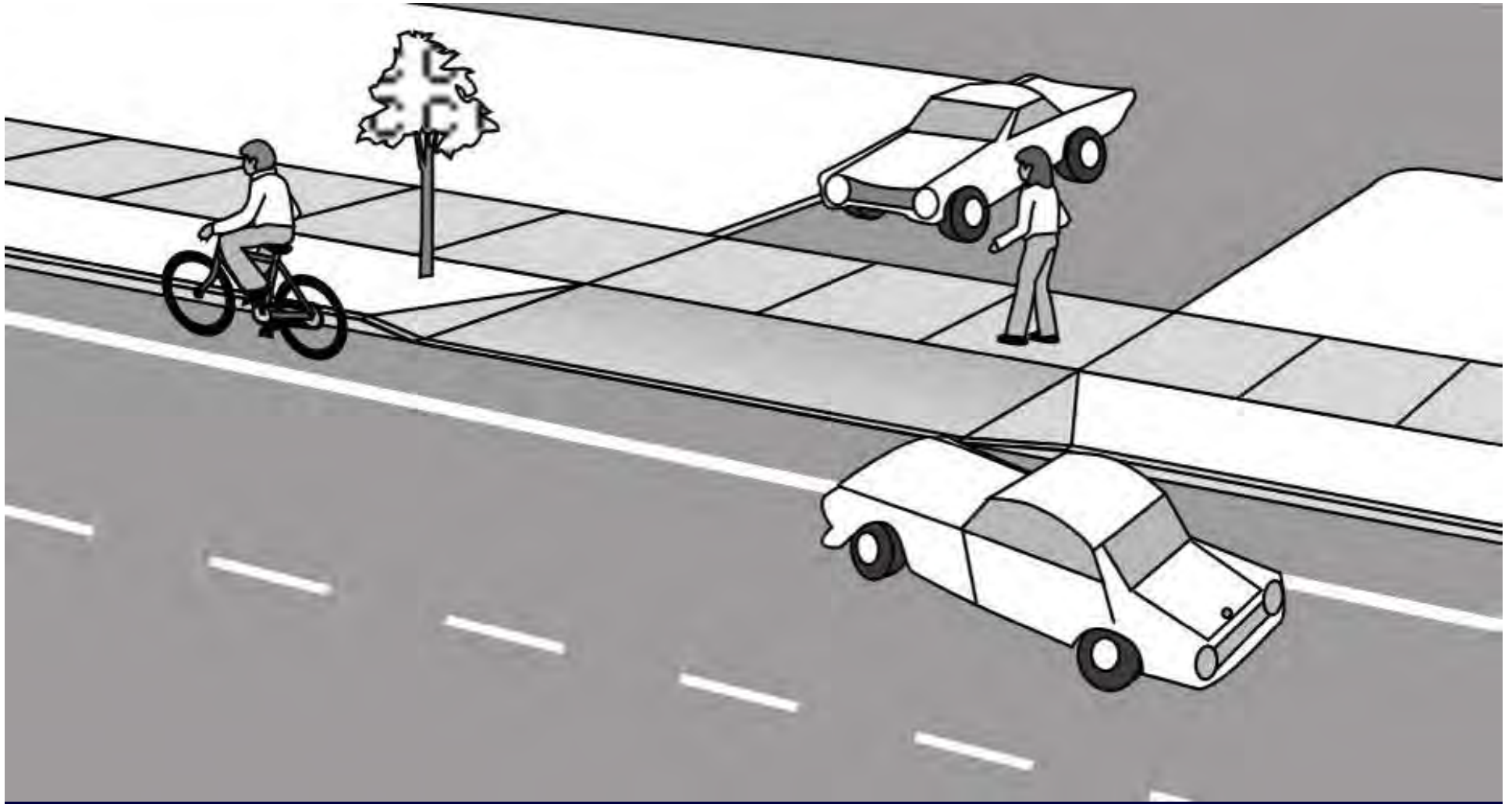
Elevation change occurs in furniture zone

Driveways

Driveways are the source of most conflicts with motor vehicles on sidewalks, and the greatest cross-slope challenge



Driveways built like intersections encourage high-speed turns



**Driveways built like driveways encourage
slow-speed turns**

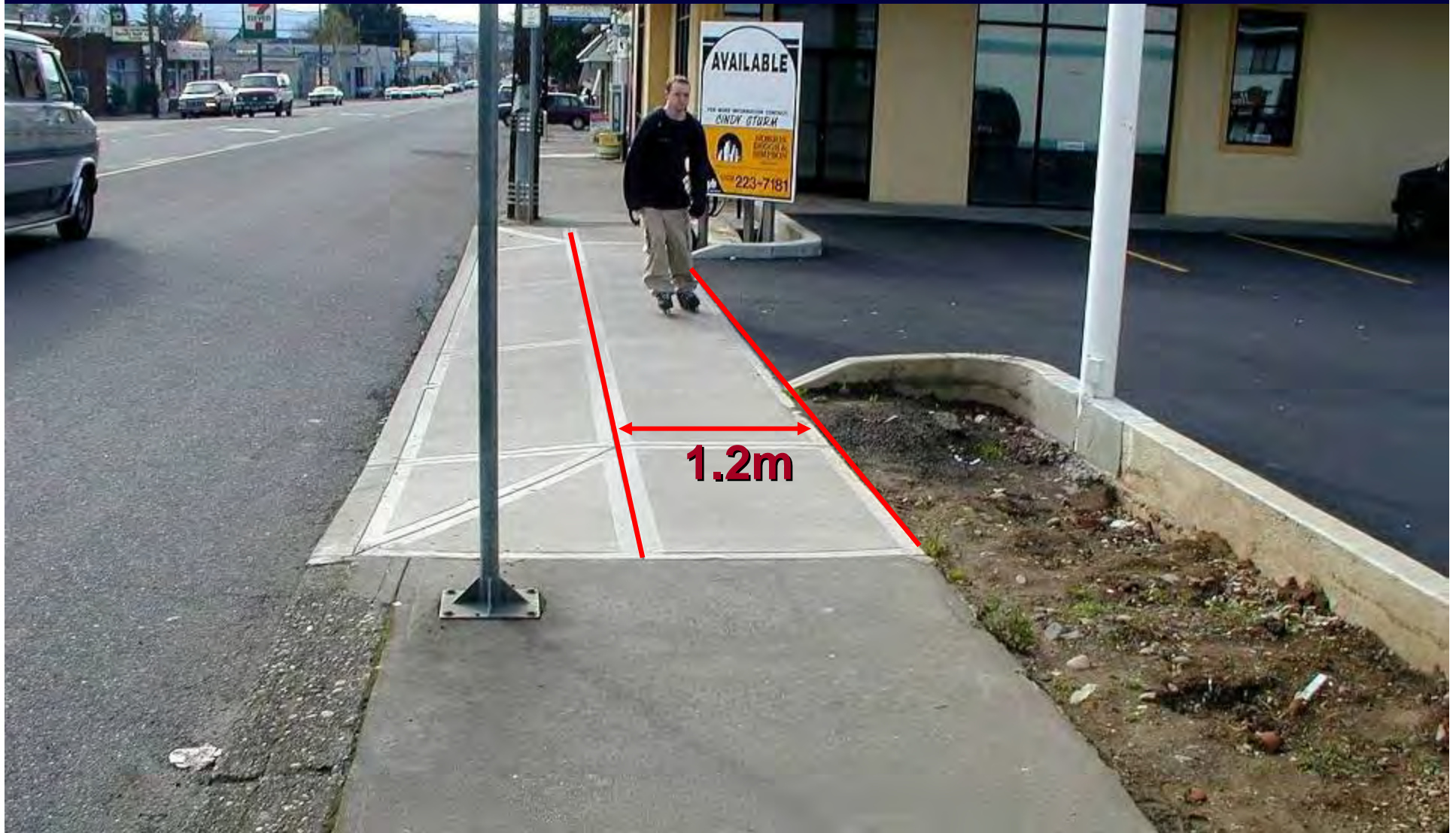


This driveway was built like an intersection



Driver exits at high speed, not looking at pedestrians

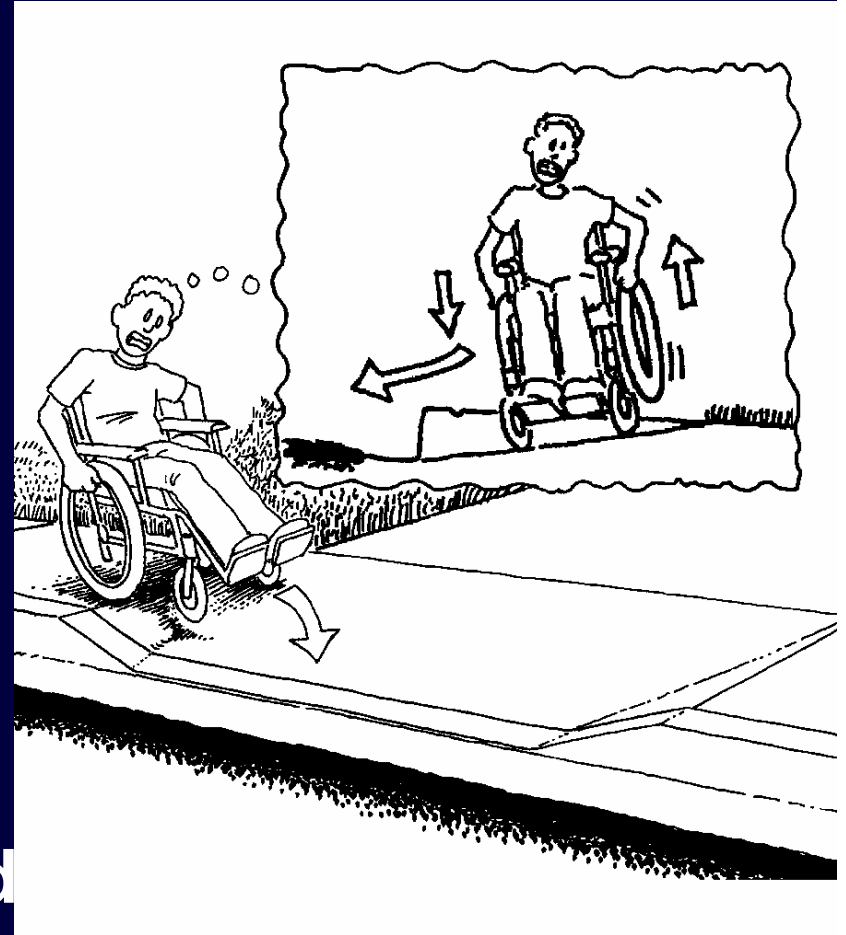
Accessible driveways



Driveways = significant barriers

At inaccessible driveways users encounter:

- Steep cross slope
 - Requires energy better put to forward travel
- Rapid grade change at driveway flare:
 - One wheel off the ground compromises balance and stability





Cross-slope at an inaccessible driveway is much greater than the 2% maximum, often even exceeding permissible ramp running slope



Inaccessible residential driveway



Driveways from hell
Out of compliance and far too many



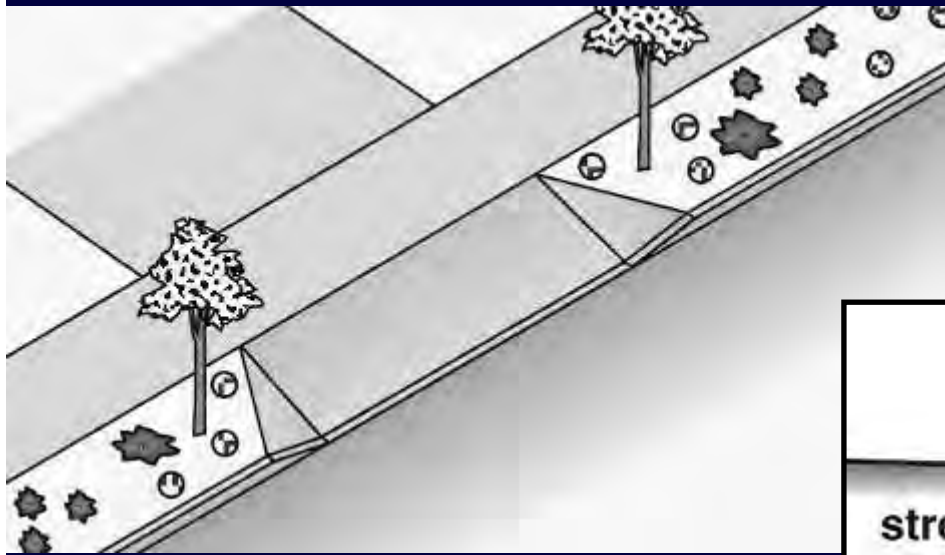
**If driveways aren't done right, sidewalks won't be used
*(one reason given by wheelchair users using the street)***

Design solutions for driveways

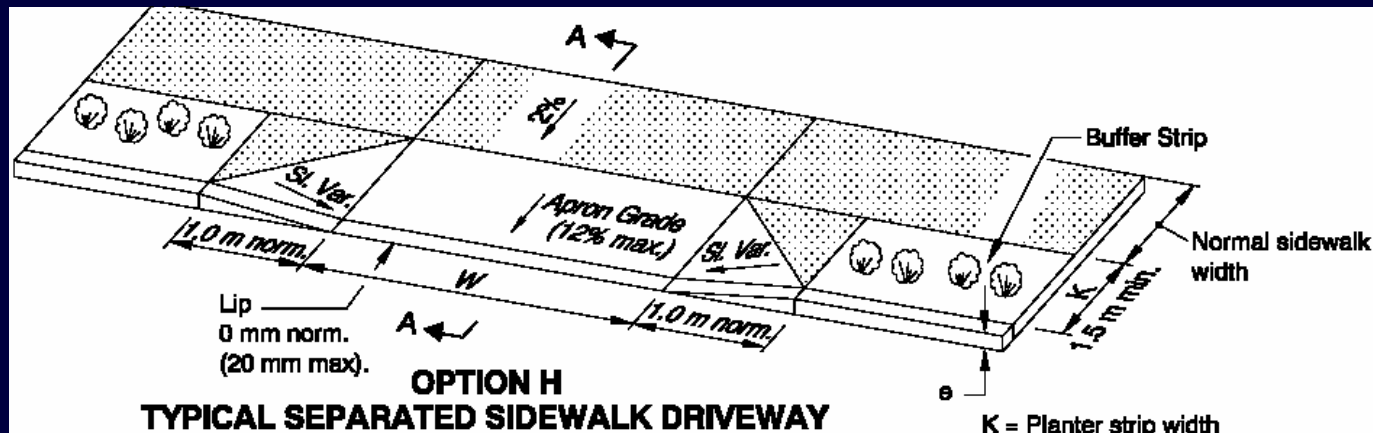
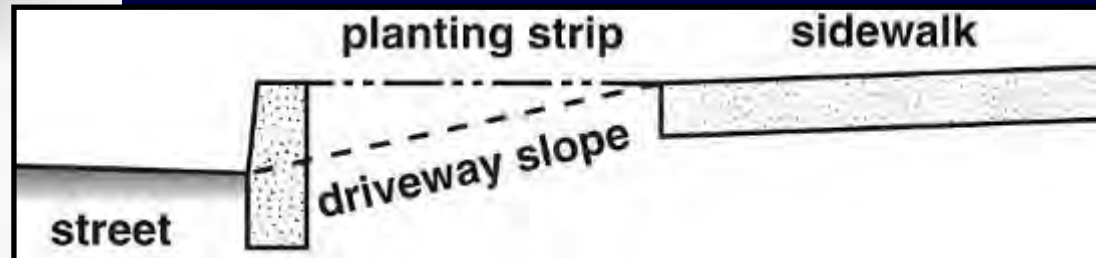
- Accessible driveway requires level pedestrian access route:
 - Cross slope: 2% maximum
 - Width: 1.2m minimum
- Factors to consider when choosing accessible driveway option:
 - Sidewalk width
 - Planter strip width
 - Curb height
 - Available right-of-way



Best Solution: Planter strip allows flat, uninterrupted sidewalk



Elevation change occurs in planter strip, sidewalk is level (2%) at driveway

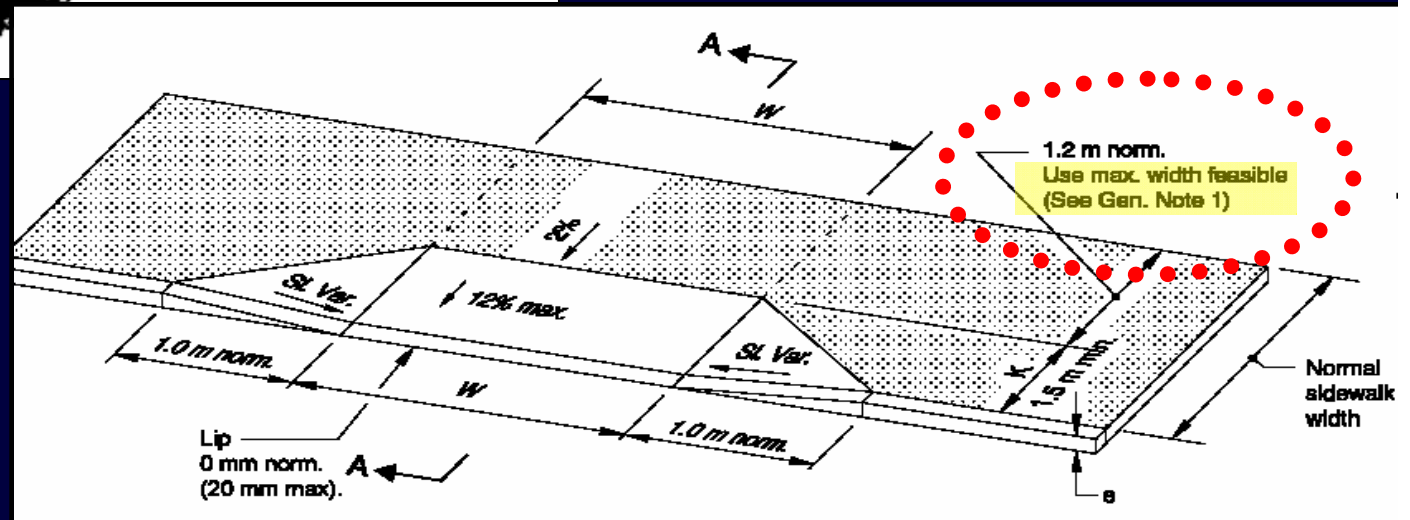
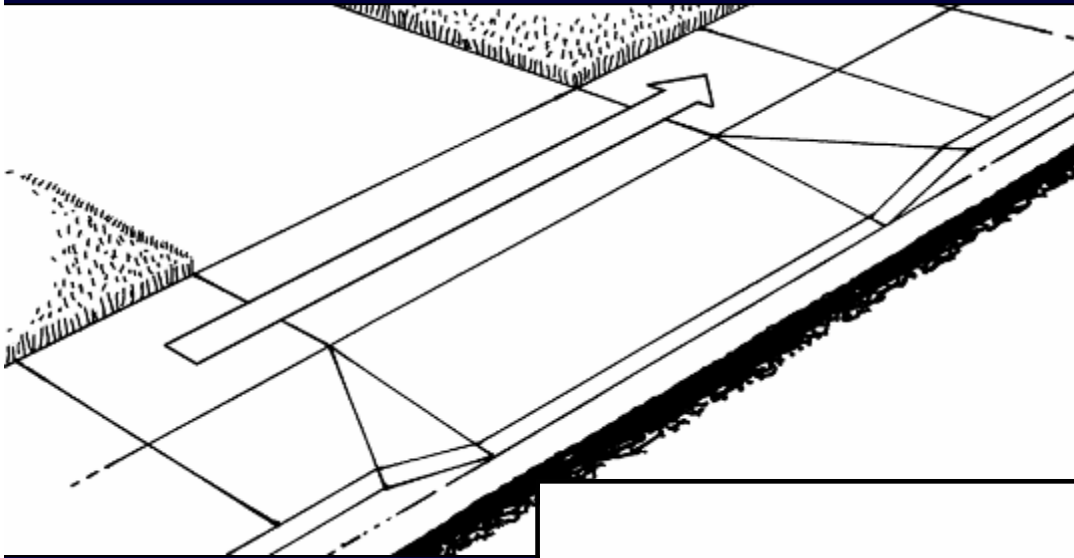


Oregon DOT Standard Drawing



Good example of preferred design

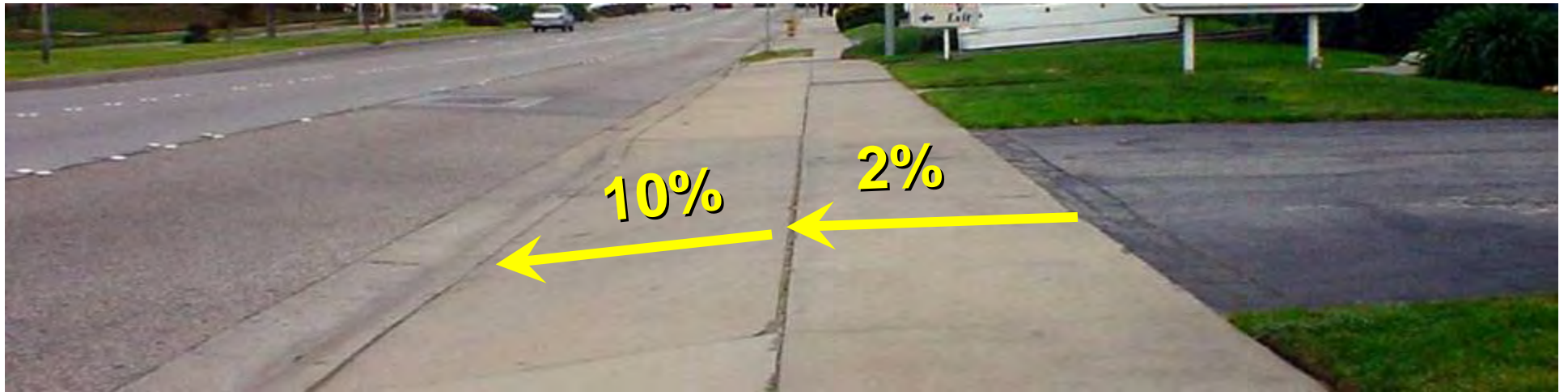
Good Solution for wide curbside sidewalk: Level pedestrian access route at back



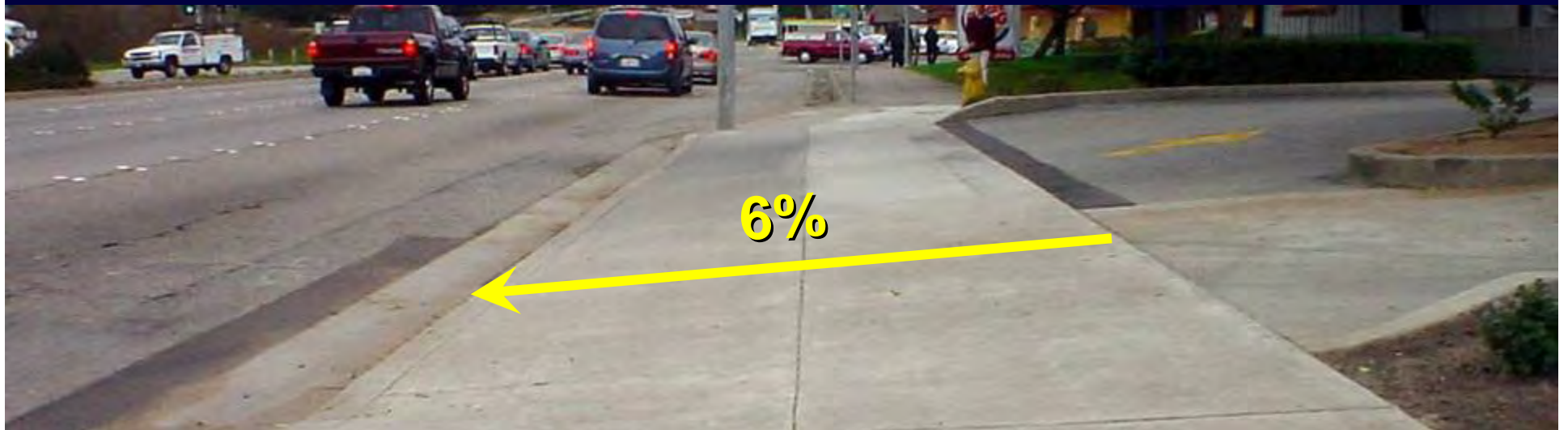
Oregon DOT Standard Drawing



Driveway with level area in wide sidewalk



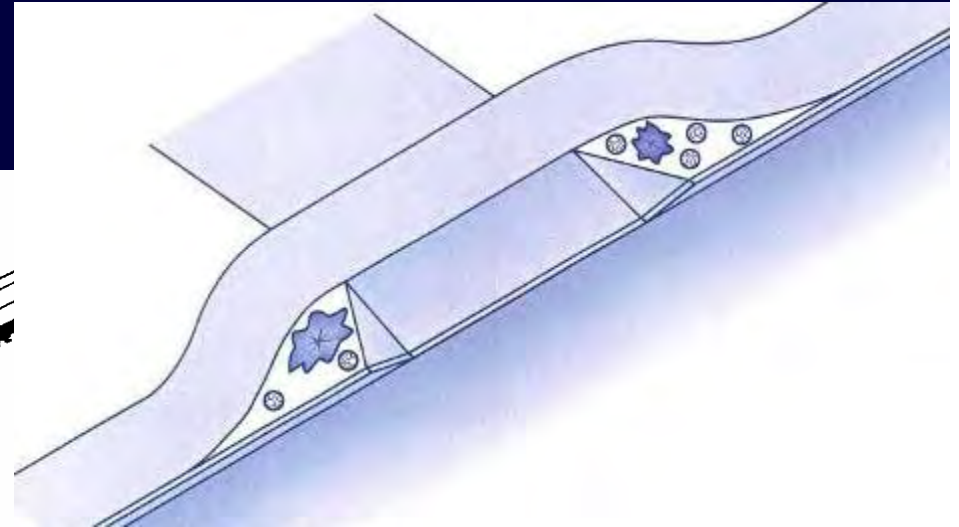
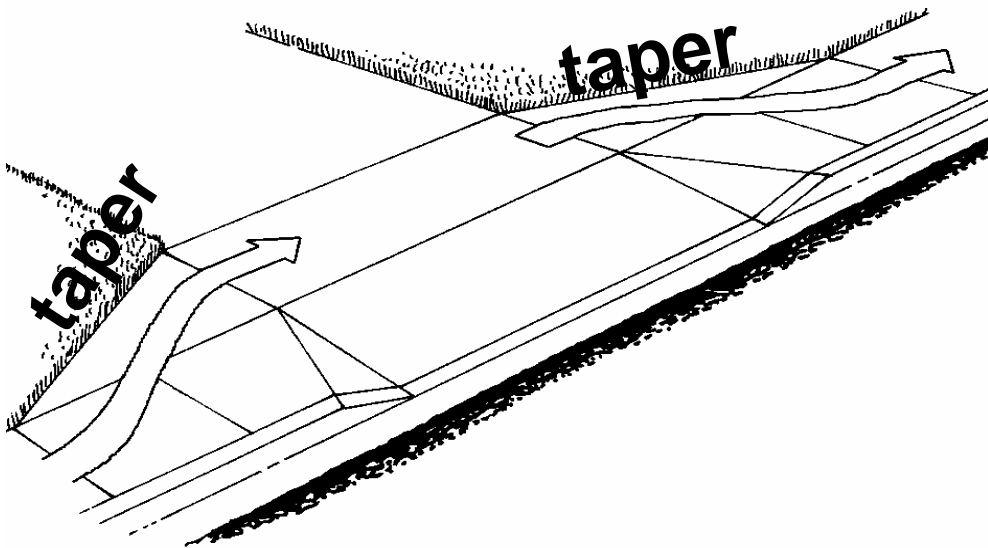
Older driveway was built with 1.8m level area...



... but not newer driveway just down the street

Good solution for narrow curbside sidewalks: Wrap sidewalk around apron

- Use full sidewalk width, or min ped access route (1.2m) (*may require r.o.w. or easement*)
- Longer tapers preferred

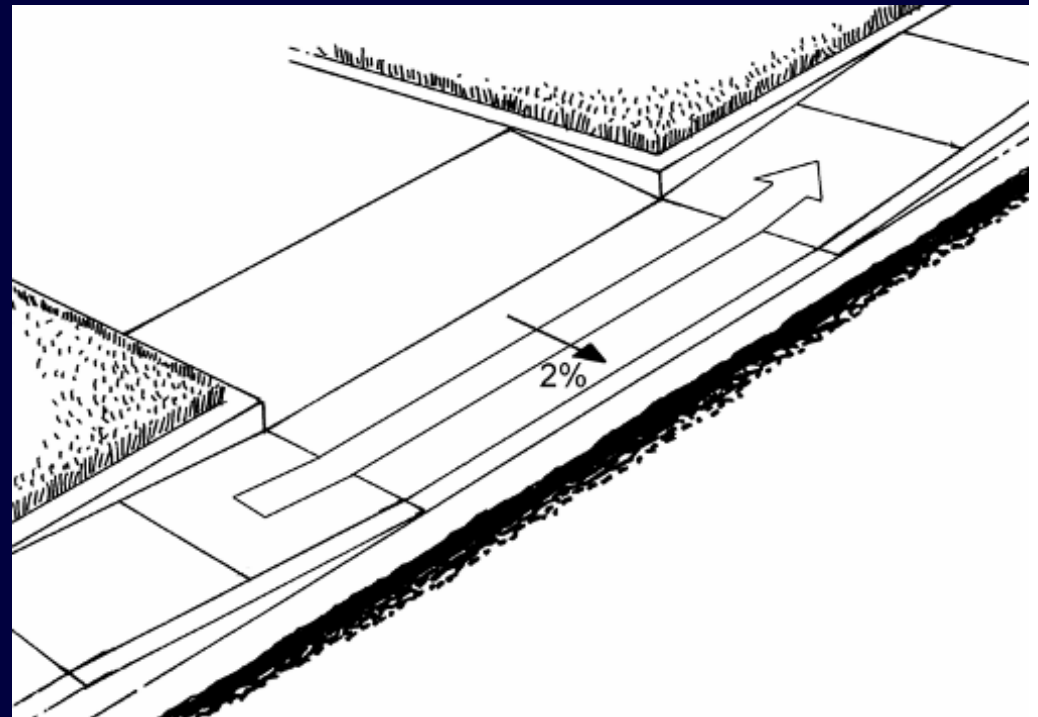


Add landscaping by
increasing setback
area or sidewalk taper

Acceptable solution for narrow sidewalks: Fully lowered sidewalk

Possible problems:

- Users must negotiate two ramps
- Allows drivers to turn at higher speeds
- Drainage:
 - Lip improves drainage and provides cue for blind pedestrians
 - Lip may be problem for cyclists





Fully lowered sidewalk at driveway

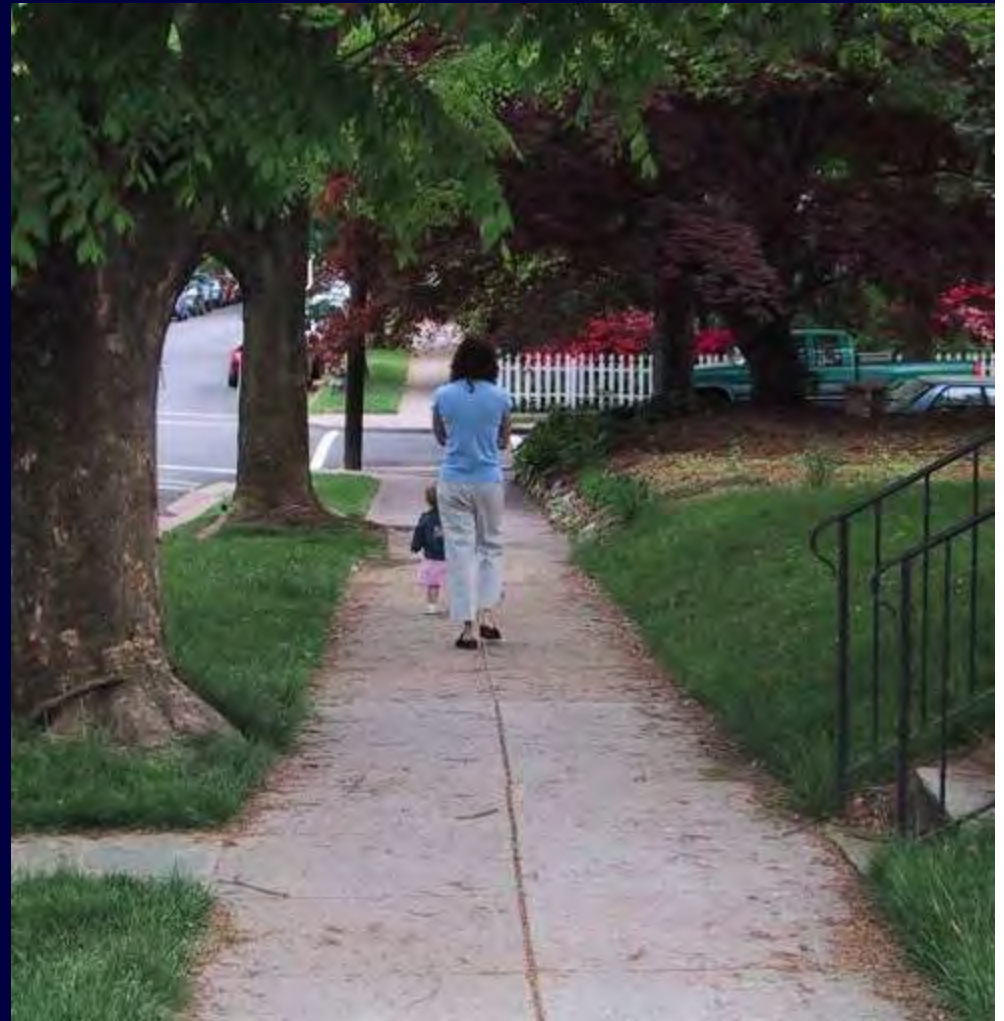


Surfaces

Sidewalk surfaces

Surface should be:

- Firm, stable, and slip-resistant
- Smooth – free of rough textures, large openings and gaps





Concrete: smooth, easy to make flat, offers least rolling resistance; broom finish adds traction



Concrete w/large exposed aggregate is too rough

Textured surfaces

Bricks, cobblestones, textured pavement create:

- **Increased rolling resistance**
- **Tripping hazards**
- **Maintenance hassles**
- **Painful vibrations to people with brittle bones or spinal cord injuries in wheelchairs**





Well-installed, well-maintained bricks work



Well-installed, well-maintained paving stones can work if grout line is narrow or flush



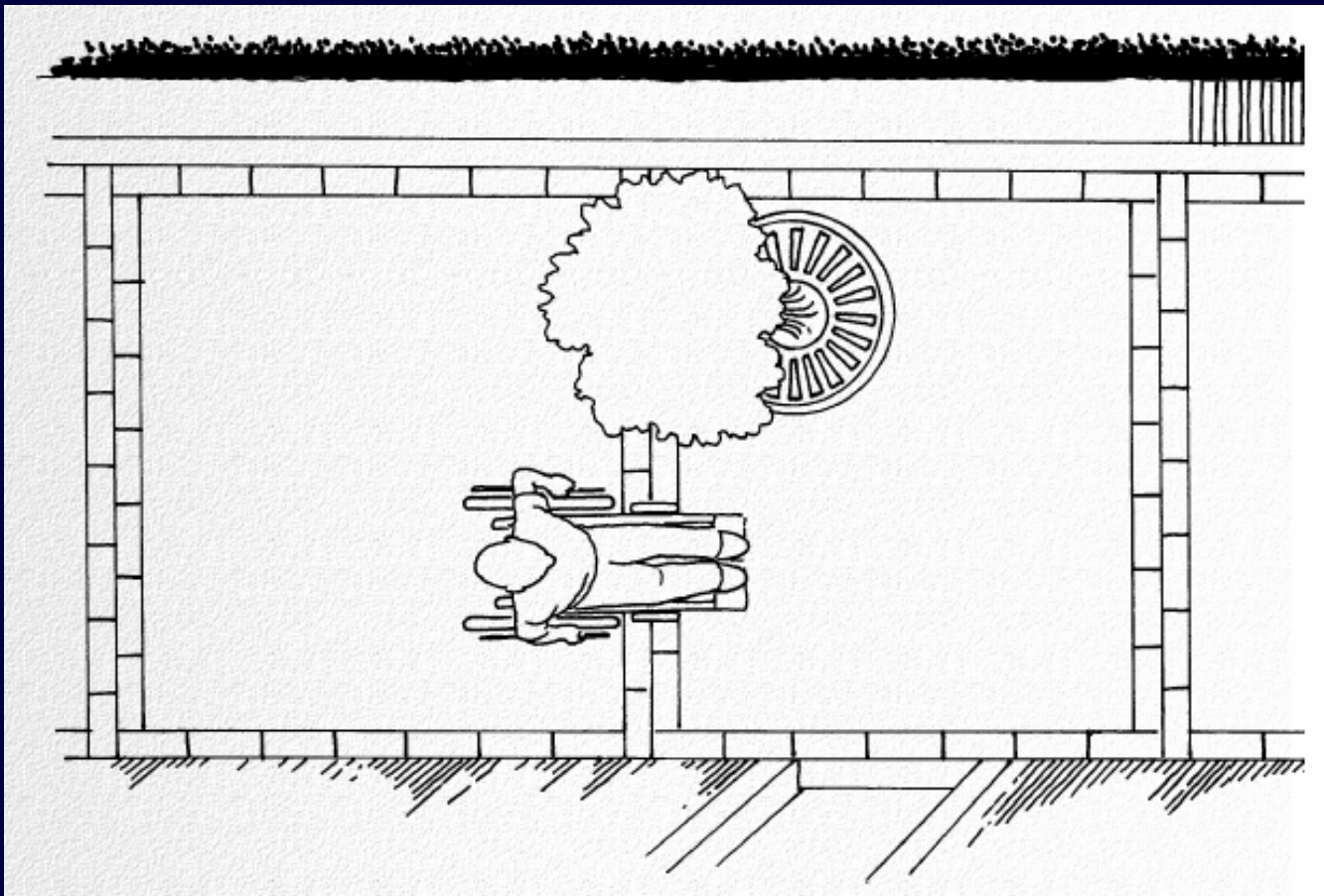
Well-installed, well-maintained flagstones work



Beveled or “pillowed” pavers don’t work: rough

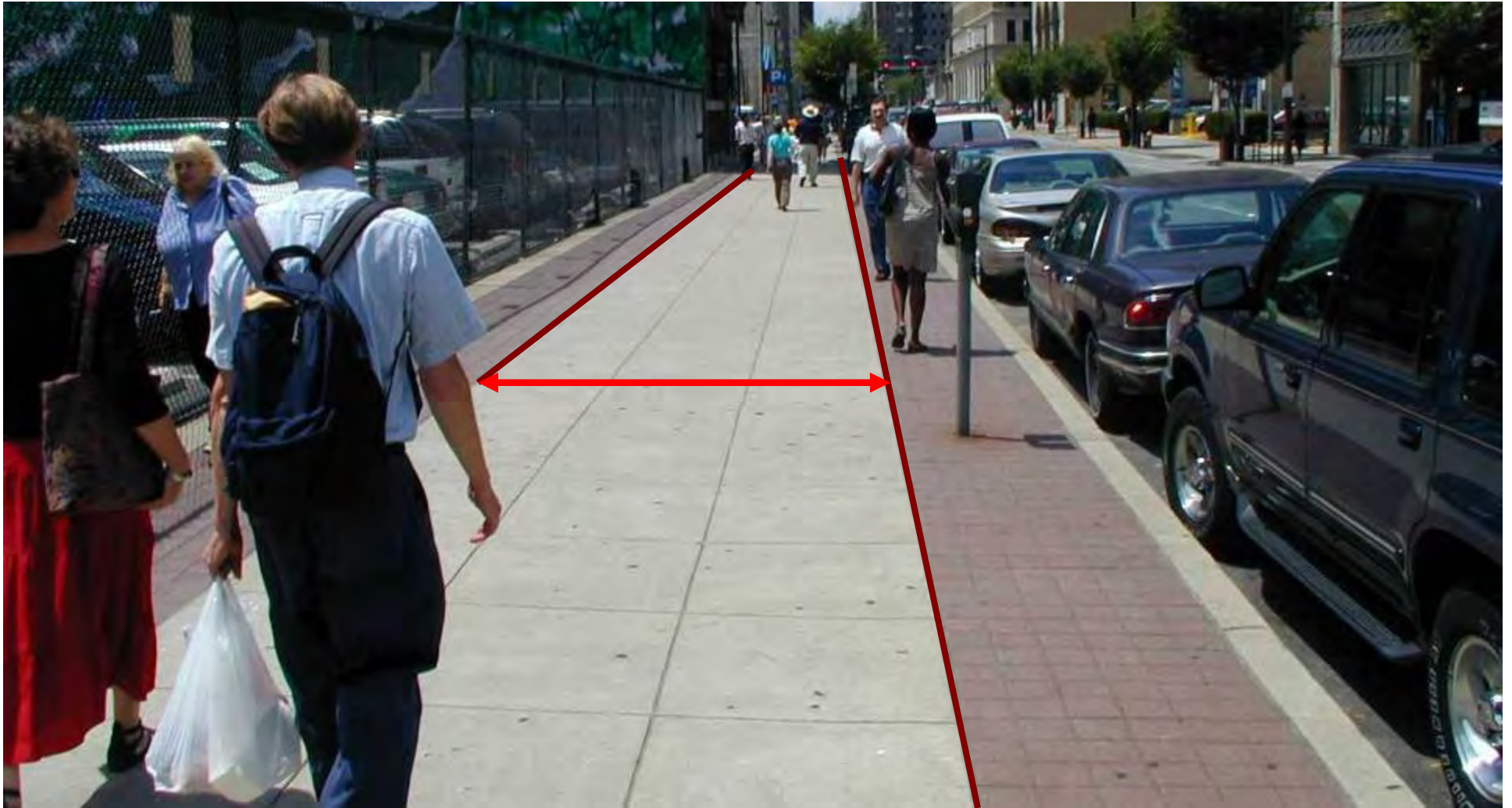
Solutions for decorative surfaces

- Concrete sidewalks with brick trim
- Colored asphalt or concrete





Concrete with smooth inlay



**Concrete in pedestrian zone,
textured surface in furniture and frontage zones**

Visual contrast of surfaces

**Well defined sidewalk
provides navigation
cue for people with
low vision**



Changes in level



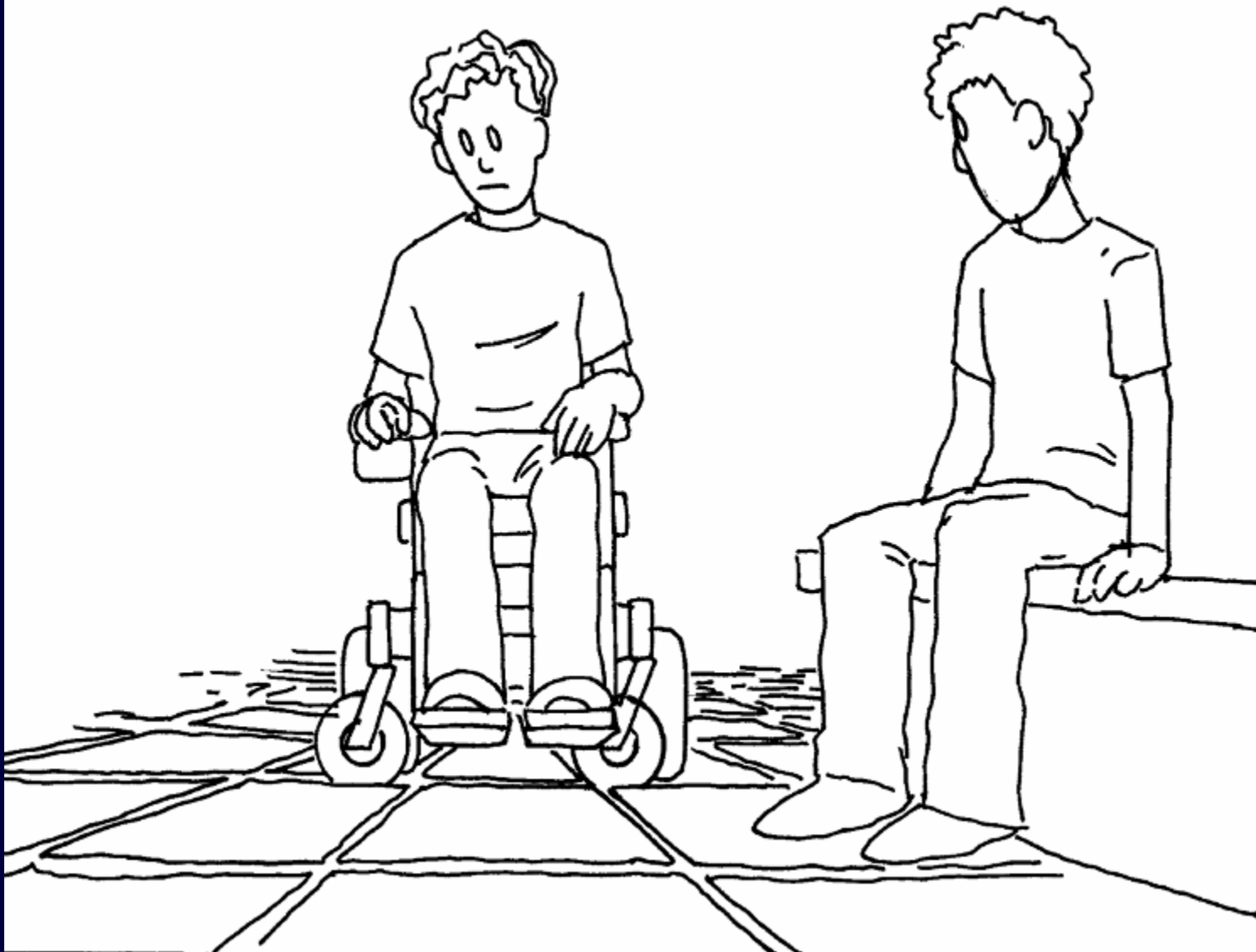
Elevation difference between adjacent surfaces

Changes in level

- Barrier to pedestrians with mobility impairments
- Tripping hazards
- Catapult users from their wheelchairs



Openings, Gaps and Grates



Canes and wheels can be caught in joints, cracks, holes, grates, and gaps



**Openings should be less than 2cm wide
and perpendicular to direction of travel**

Solutions to eliminate gaps



Wire mesh screen



Straps welded to existing grate

Tree grates

- Grates belong in furniture zone, away from ped access route
- Grates with small openings can expand the travel zone
- Slip resistance when wet is a concern if in the ped access route



Questions?

Designing Streets for Pedestrian Access

Module 3

Crossings and Intersections

What will be covered in module 3

- **General Principles**
- **Crossings (mostly midblock):**
 - Crosswalks
 - Medians
 - Over/undercrossings
- **Intersections:**
 - General geometric issues
 - Crosswalk/ramp placement
 - Curb extensions
 - Right turn lane islands
 - Roundabouts



Principle # 1 – Pedestrians must be able to cross the street safely



Principle # 2 – Pedestrians need to be able to determine where and when to cross



Principle # 3 – Peds must be visible to drivers; drivers must understand pedestrian intent



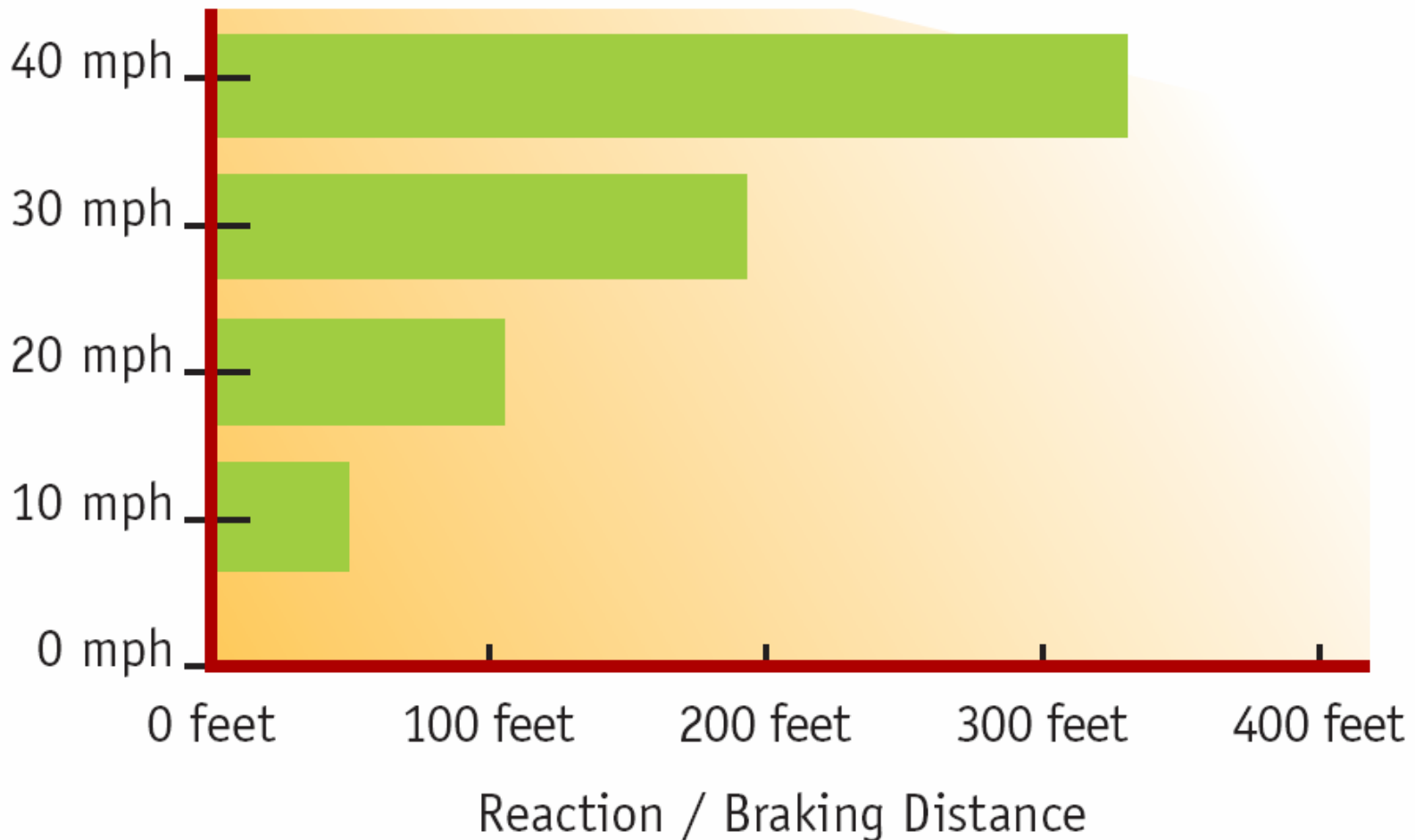
Principle # 4 – Minimize Crossing Distance

Long crossing distances:

- Increase exposure time
- Increase vehicle-pedestrian conflict
- Decrease ability of slower pedestrians to cross
- Make it hard for blind pedestrians to stay in crosswalk
- Increase vehicle delay



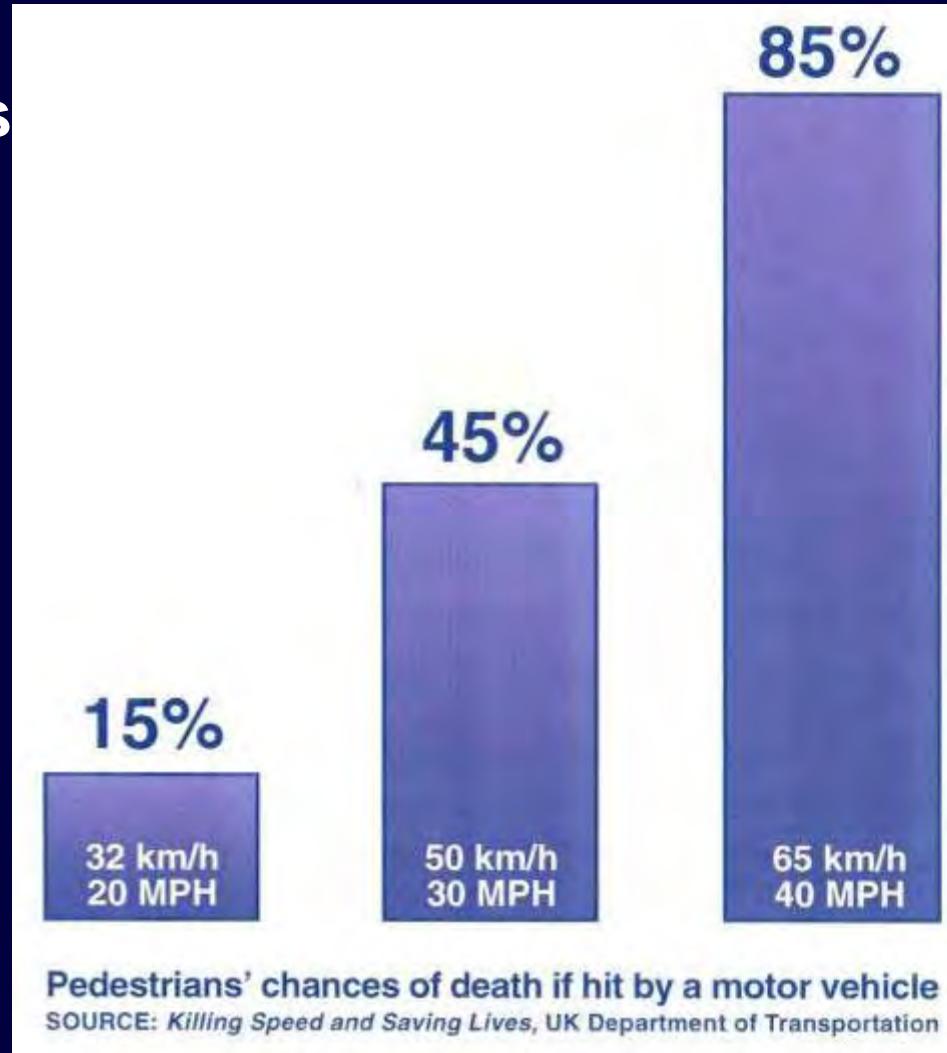
Principle # 5 – Speed Matters



High speeds equate to greater reaction 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



Crosswalks

Crosswalks

- Define where pedestrians should cross
 - Provide information for people with visual disabilities
- Alert drivers where to expect pedestrians
- Markings must be visible to drivers & pedestrians



Crosswalk Markings

- Should be slip resistant
- Should be designed according to MUTCD
- There are many opinions and theories about marked crosswalks, beyond the scope of this accessibility training; for best guidance:
 - “Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines”
 - Available at <http://www.walkinginfo.org/>



Transverse



“Continental” (longitudinal)



“Ladder” (longitudinal plus transverse)

Longitudinal markings are more visible to drivers



Transverse markings: what the pedestrian sees



Transverse markings: what the driver sees

Longitudinal (continental or ladder) crosswalks

- Continental markings provide more guidance to pedestrians with vision and cognitive impairments
- Ladder markings (longitudinal + transverse markings) are even better





Place longitudinal markings to avoid wheel paths to reduce maintenance



**Longitudinal markings
improve visibility at a distance**



Gap in continental or ladder markings allows a smooth area for wheelchair passage

Colored/Textured Crosswalks

- Colored crosswalks are more visible in theory by distinguishing pedestrian and vehicular space
- Textured crosswalks are not recommended because they create challenges for mobility-impaired pedestrians
 - When crossing the street, pedestrians want to move quickly



Colored/Textured Crosswalks – the reality



What the pedestrian sees – visible to many, but not very visible to those with low vision

Colored/Textured Crosswalks – the reality



What the driver sees



**If used, outline textured crosswalks with white lines;
Stamped asphalt products are usually fairly smooth**

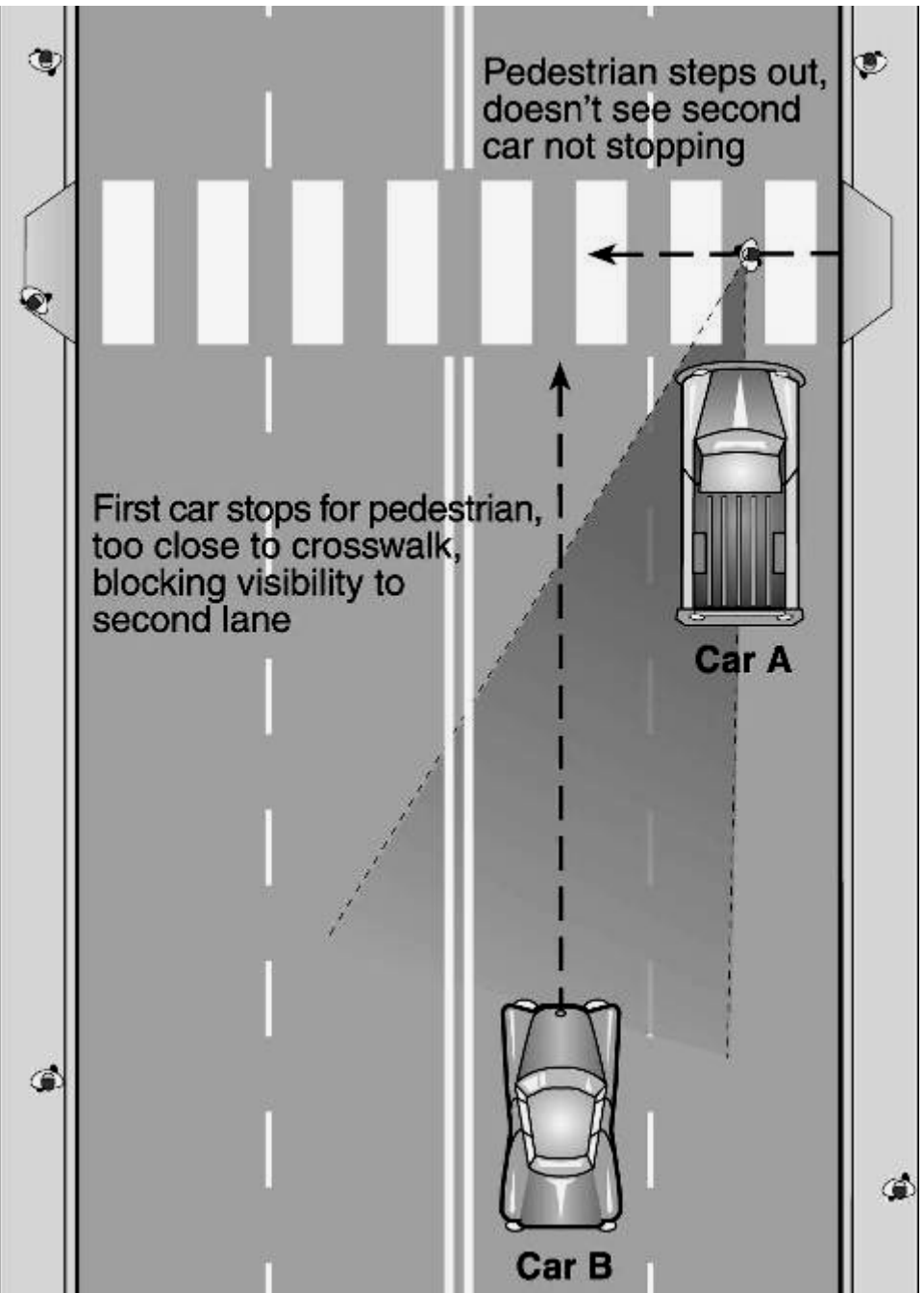


Ideal solution: smooth crosswalks, textured street

Multiple threat crash problem

1st car stops to let pedestrian cross

1st car masks 2nd car, which doesn't stop, hits pedestrian at high speed

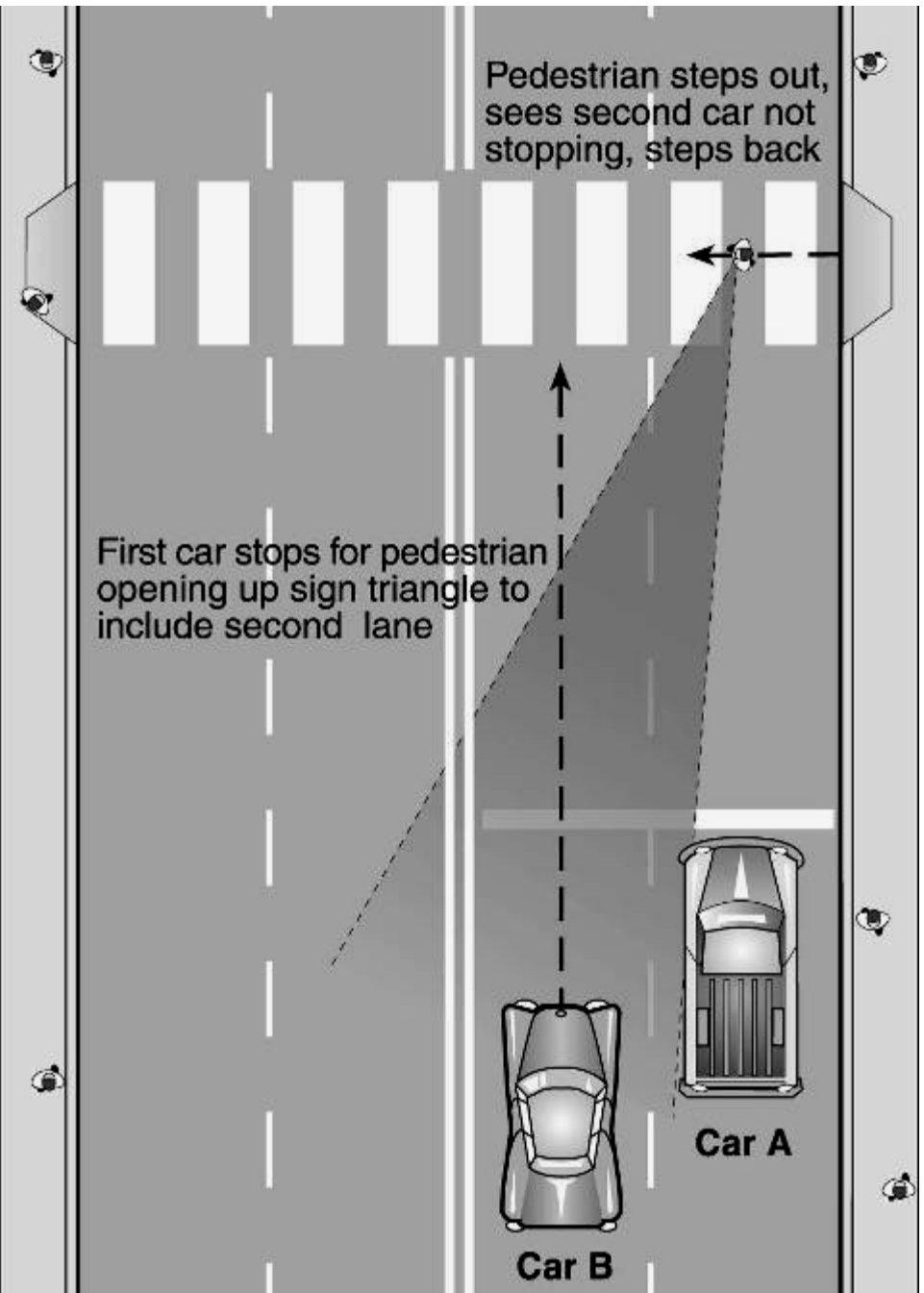


Multiple threat crash solution

Advance stop line

1st car stops further back

1st car no longer masks 2nd car, which can be seen by pedestrian



Crosswalks: geometric design

Crosswalks should be considered part of the pedestrian access route:

- Running grade (crown or super-elevation): 5% max
- Cross-slope:
 - At fully-controlled approaches (yield/stop sign/signal): 2% max
 - At approaches without control: least feasible, with 5% max
 - Midblock crossings: may equal street grade
- Smooth surface
- Width: 3 m min ensures ramps are in crosswalk



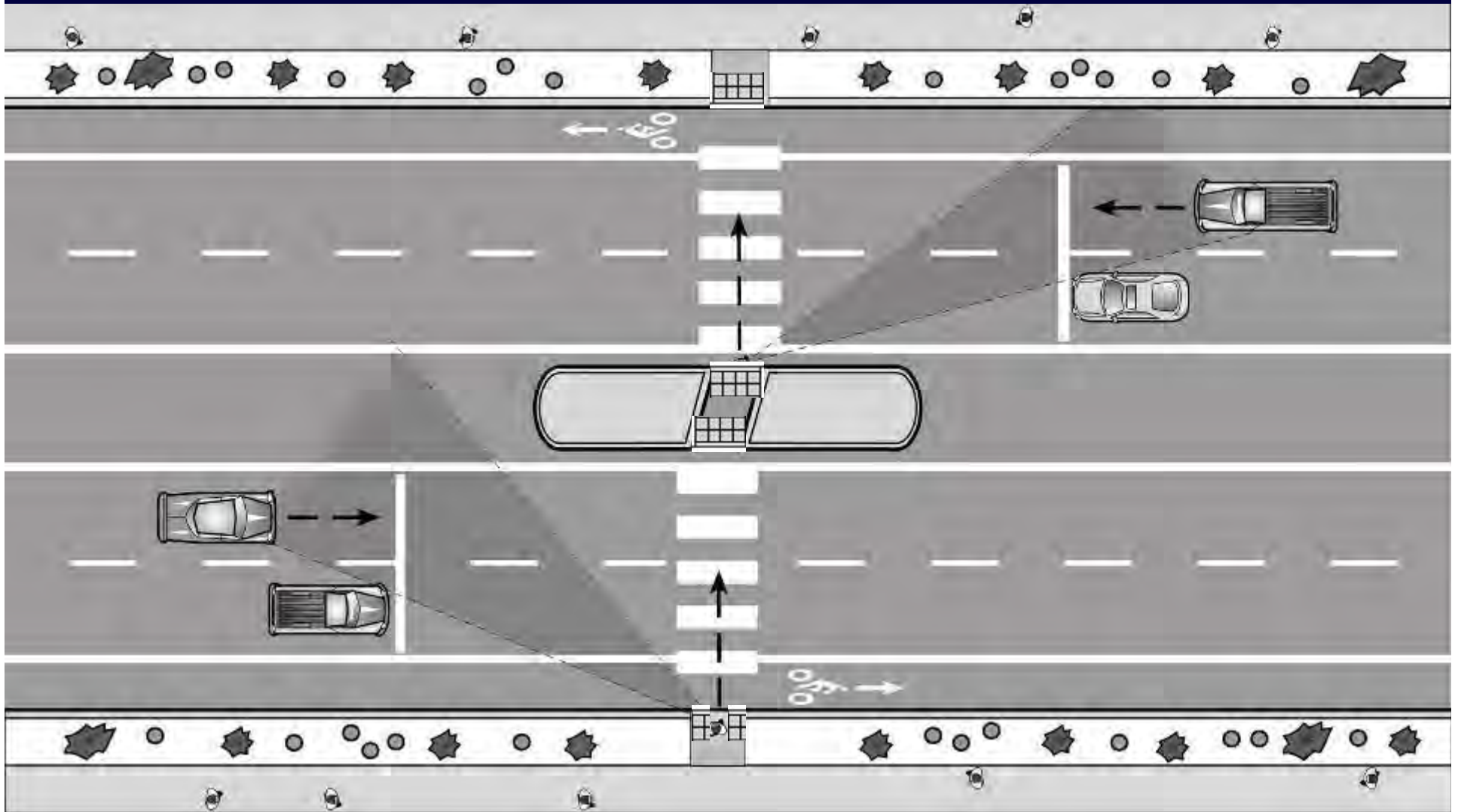
**Inaccessible crosswalk: Exaggerated crown exceeds 5%
and even 1:12 slope**



Inaccessible crosswalk: Exceeds 2% cross-slope

Crossing Islands and Medians

Crossing islands and medians break one long crossing into two simpler crossings





Stand-alone crossing island must be accessible

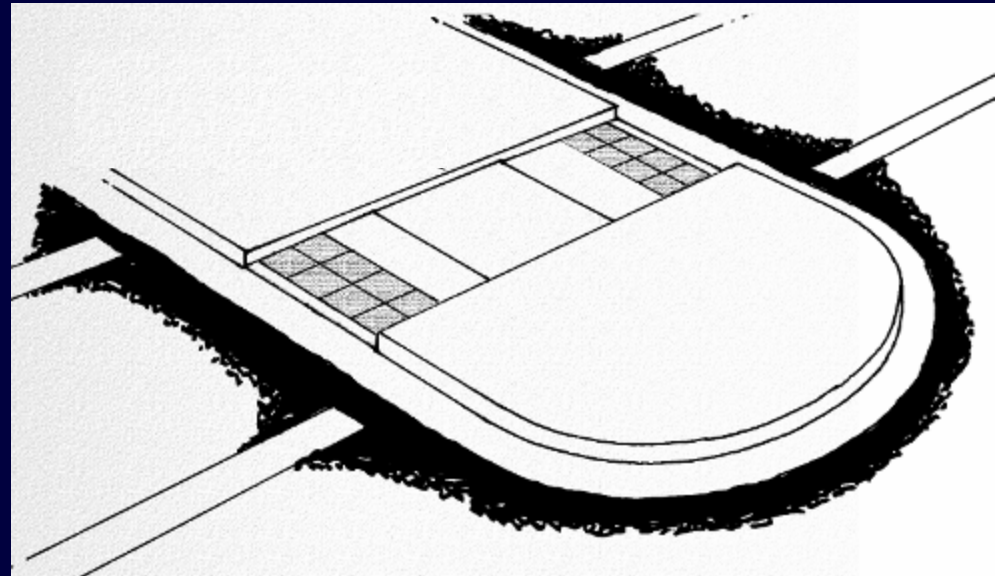
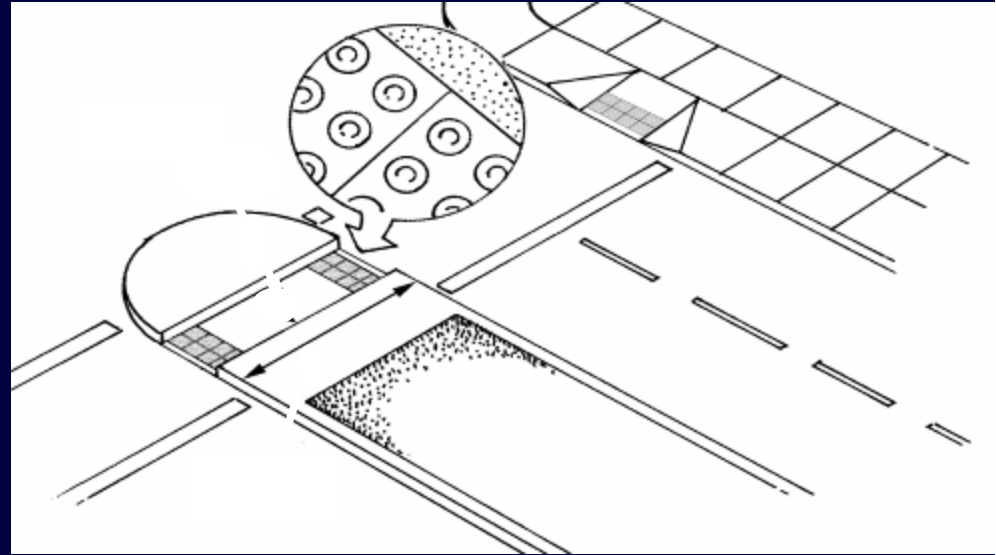
Medians & islands design

- Width: 1.8m min recommended
- Cut-through (or ramp): as wide as possible – min 1.5m
- Align the ends of the cut or ramp with crosswalk
- Stagger cut-through so pedestrians face oncoming traffic in 2nd half



Medians & islands details

- At intersections, extend median nose into crosswalk
- DW at both openings
 - Provide smooth pavement in center (if possible)
- If ramped, use landing between ramps
 - Landing need not be full median height



Island Design Details



- Cut-through preferred over ramps
- 2.4m or more preferred width – 1.5m minimum



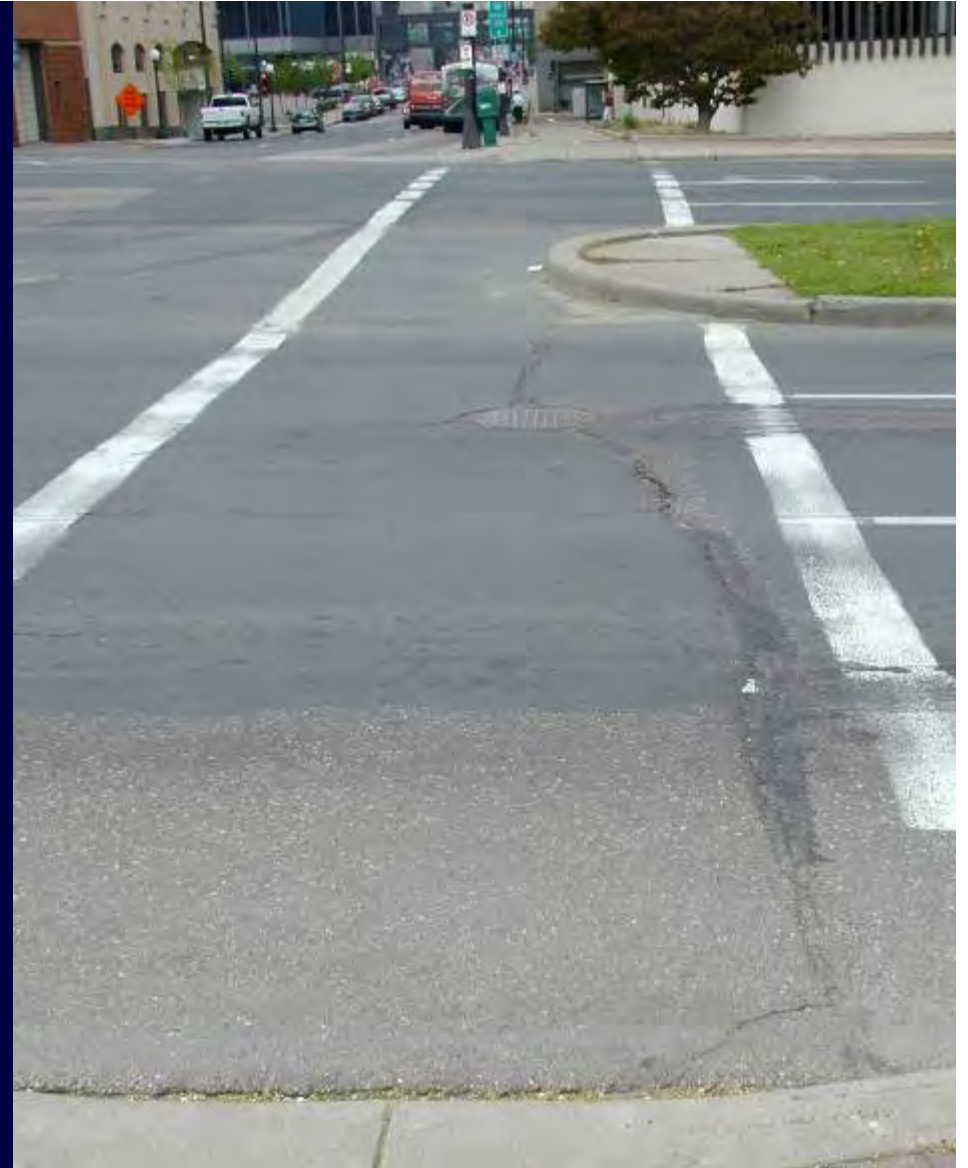
With ramps, provide at least 1m level area



NOT Okay



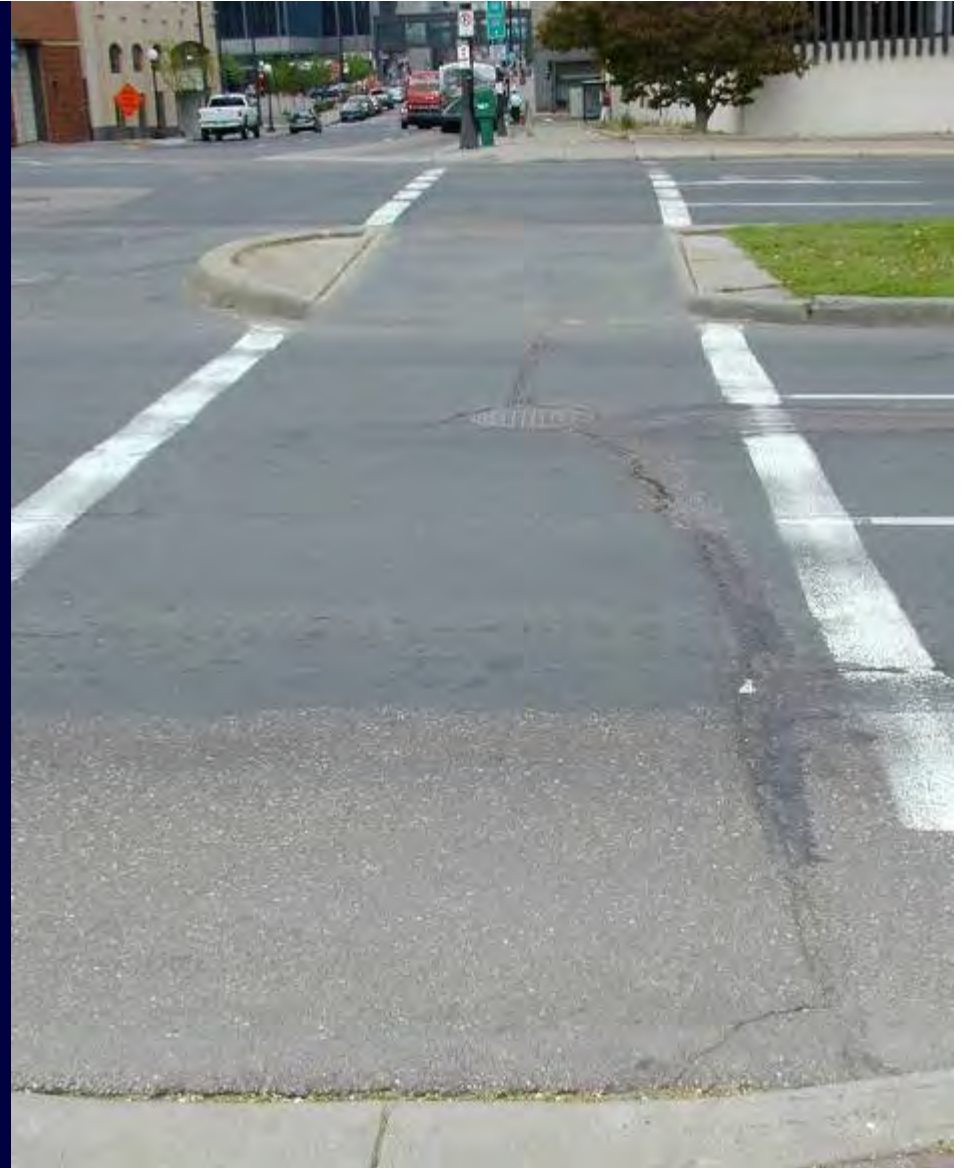
Not acceptable



Acceptable, not great

Best:

**Bullet nose protects
pedestrians from high-
speed left-turning cars**



Overcrossings & Undercrossings

Overcrossings & undercrossings concerns

- Longer route is inconvenient for everyone
- Ramps are difficult to climb for peds with limited mobility
- Structures are hard to find for peds with low vision
- Overcrossings are expensive
- Security concerns





Undercrossings work best if roadway is elevated and structures are open and airy or well-lit

Intersections

Intersections – general principles

- Smaller is better
- Keep it simple
- Design for slow speeds
- If complex, break it up with islands

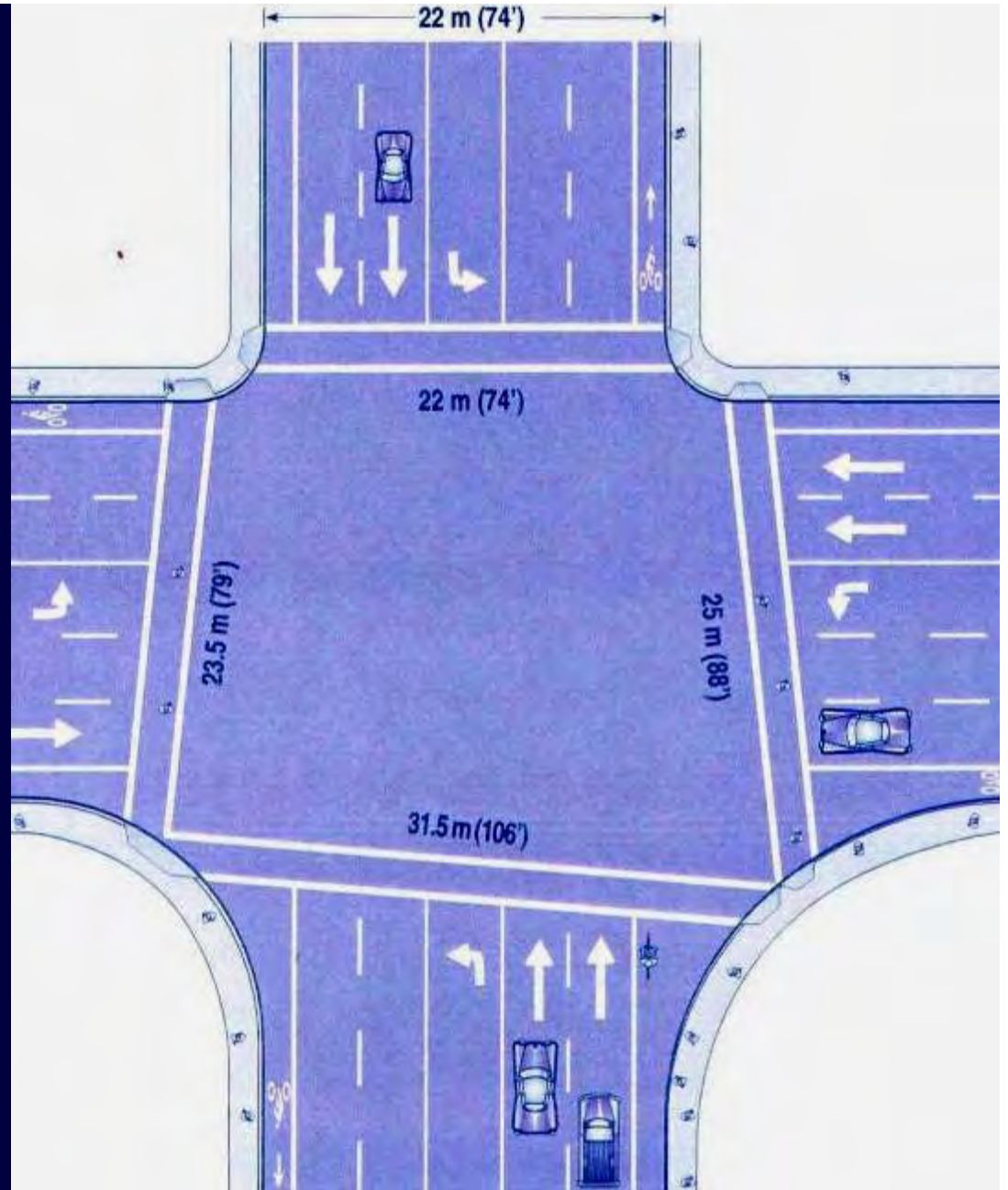


Small curb radii

- Make crosswalk and ramp placement easier
- Safer for pedestrians

Large curb radii

- Increase crossing distance
- Make crosswalk & ramp placement more difficult
- Allow drivers to make high speed turns





Large radius:

- **Hard for users to figure out where to cross**
- **Hard to place ramps and crosswalks conveniently**

Crosswalk and Ramp Placement

Crosswalk placement requires balancing several goals that sometimes compete:

1. Ramp placement:

- Ramps must be within crosswalk
- Two ramps preferred where possible

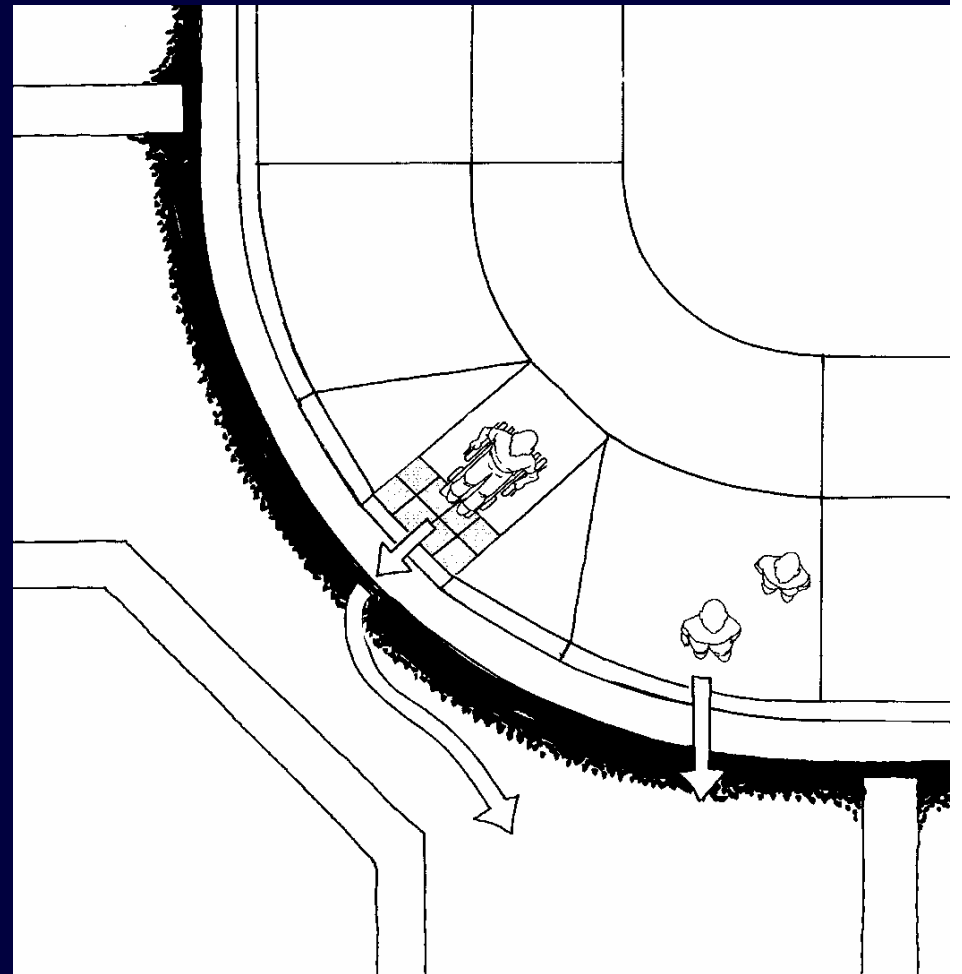
2. Short crosswalk length

3. Minimal crosswalk setback to:

- Reduce out-of-direction travel
- Provide good sight lines between peds and motorists

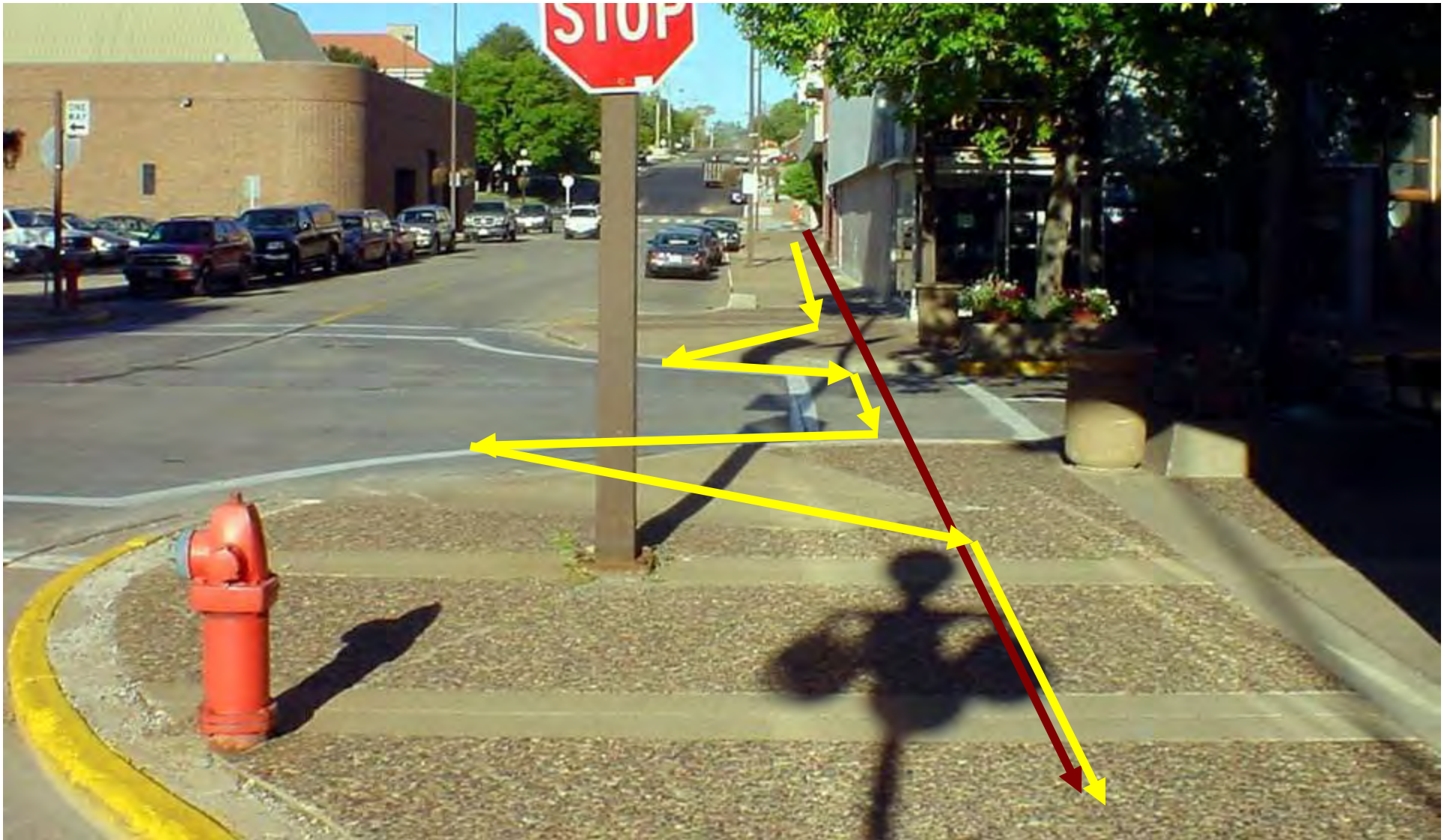
Single Diagonal/Apex Curb Ramp

- Two ramps preferred where possible
- If necessary, a single curb ramp at the apex of the corner can work
- Requires protected turning space at the toe

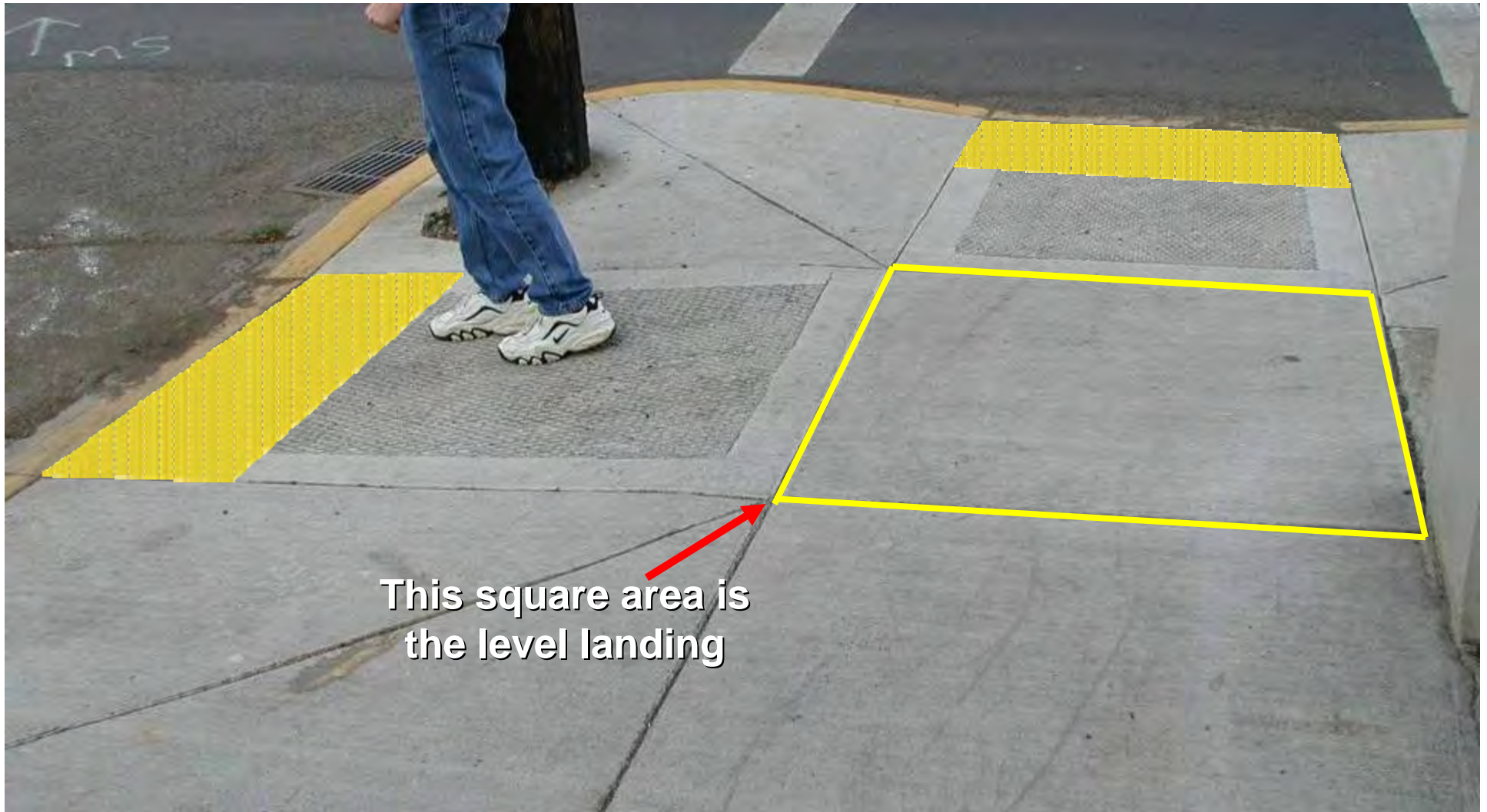


**Single diagonal ramp
forces wheelchair
users out of
crosswalk**





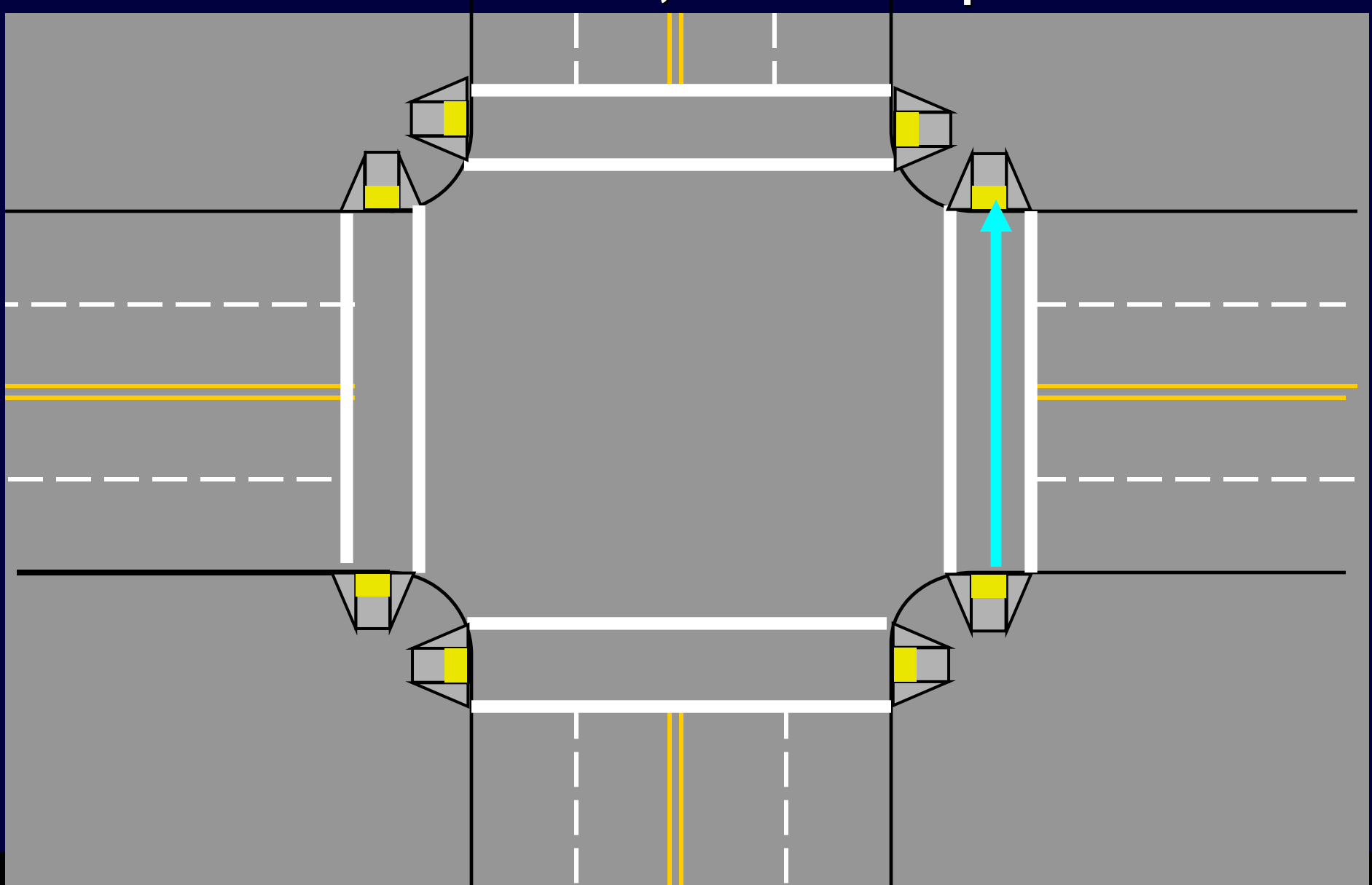
**Single diagonal ramps also force out-of-direction travel;
2 ramps per corner are feasible and preferable here**



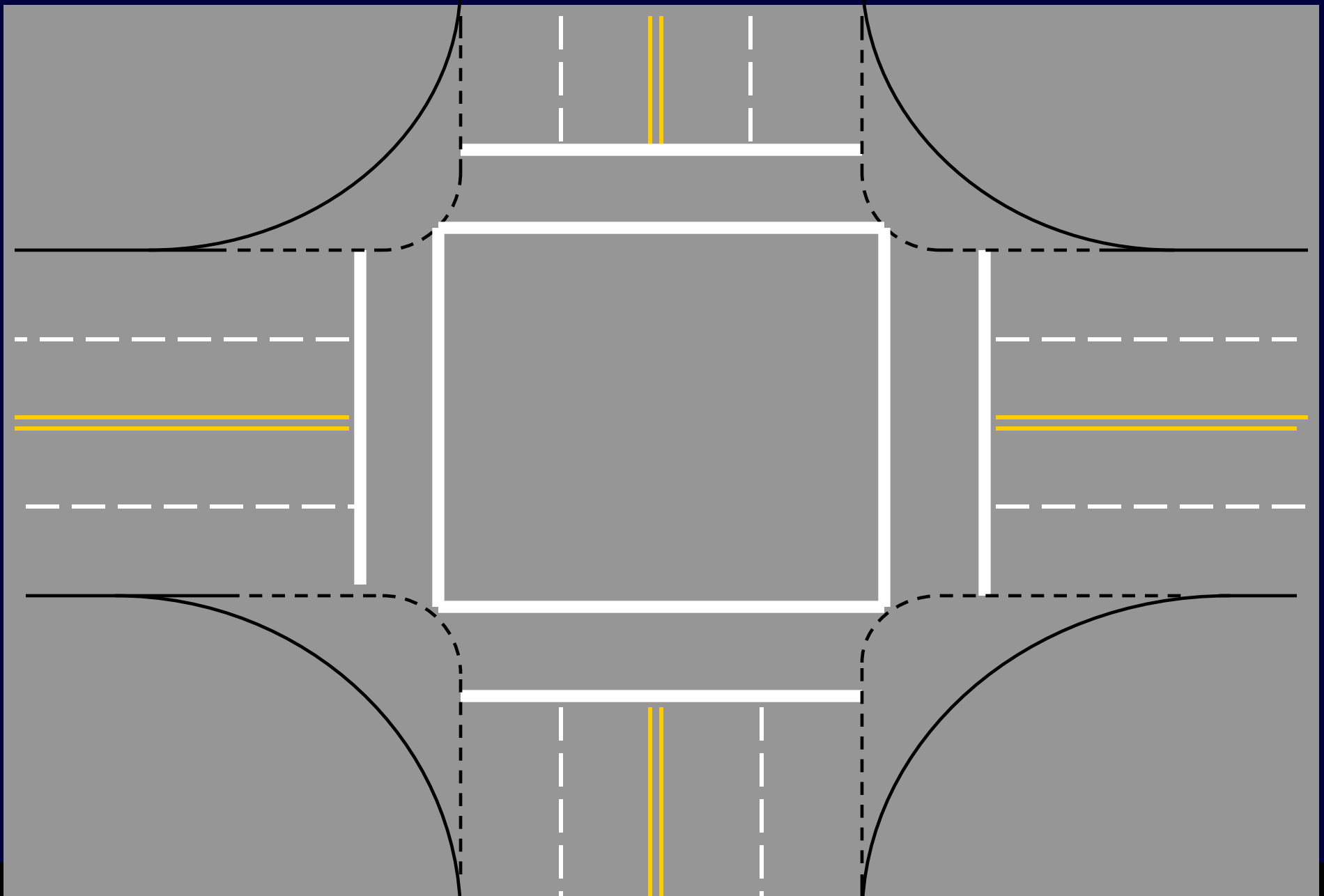
This square area is
the level landing

**Small radius makes it easy to place 2 ramps per corner,
with level landing, lined up with sidewalks and crosswalks**

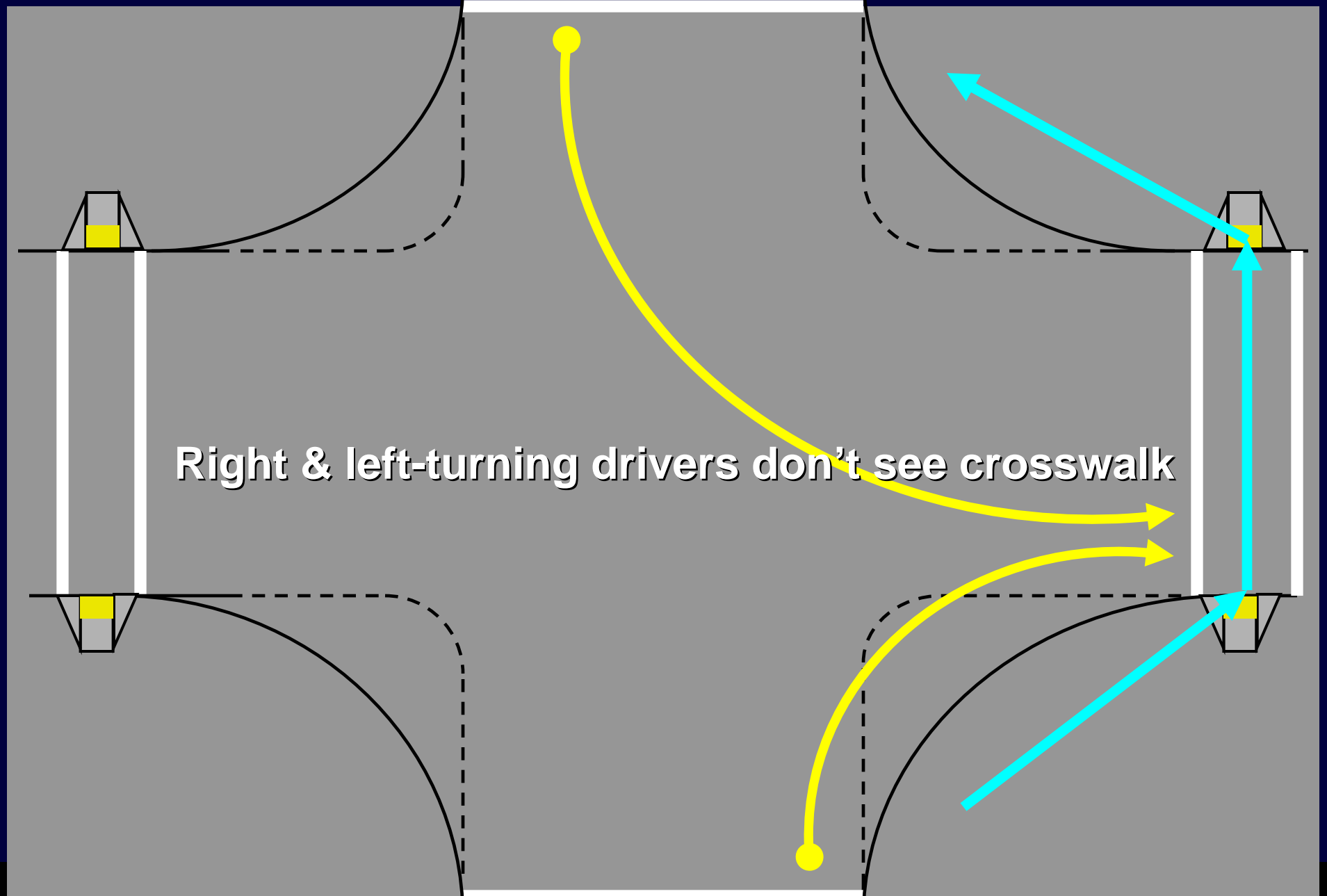
**Small corner radii allow two ramps,
short crosswalks, direct travel paths**



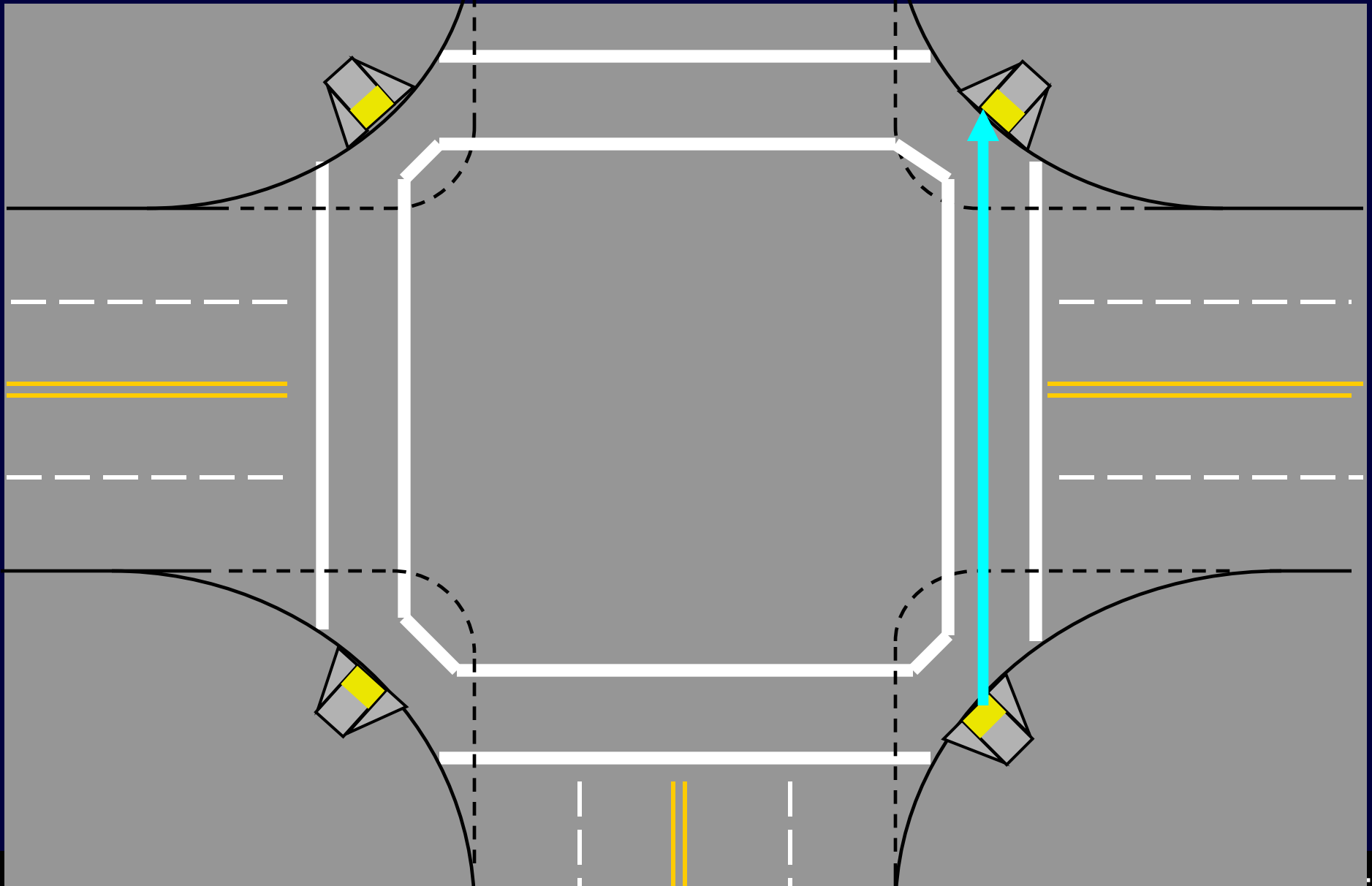
Larger radii create large undefined areas



Crosswalks at shortest crossing = longer walking distance

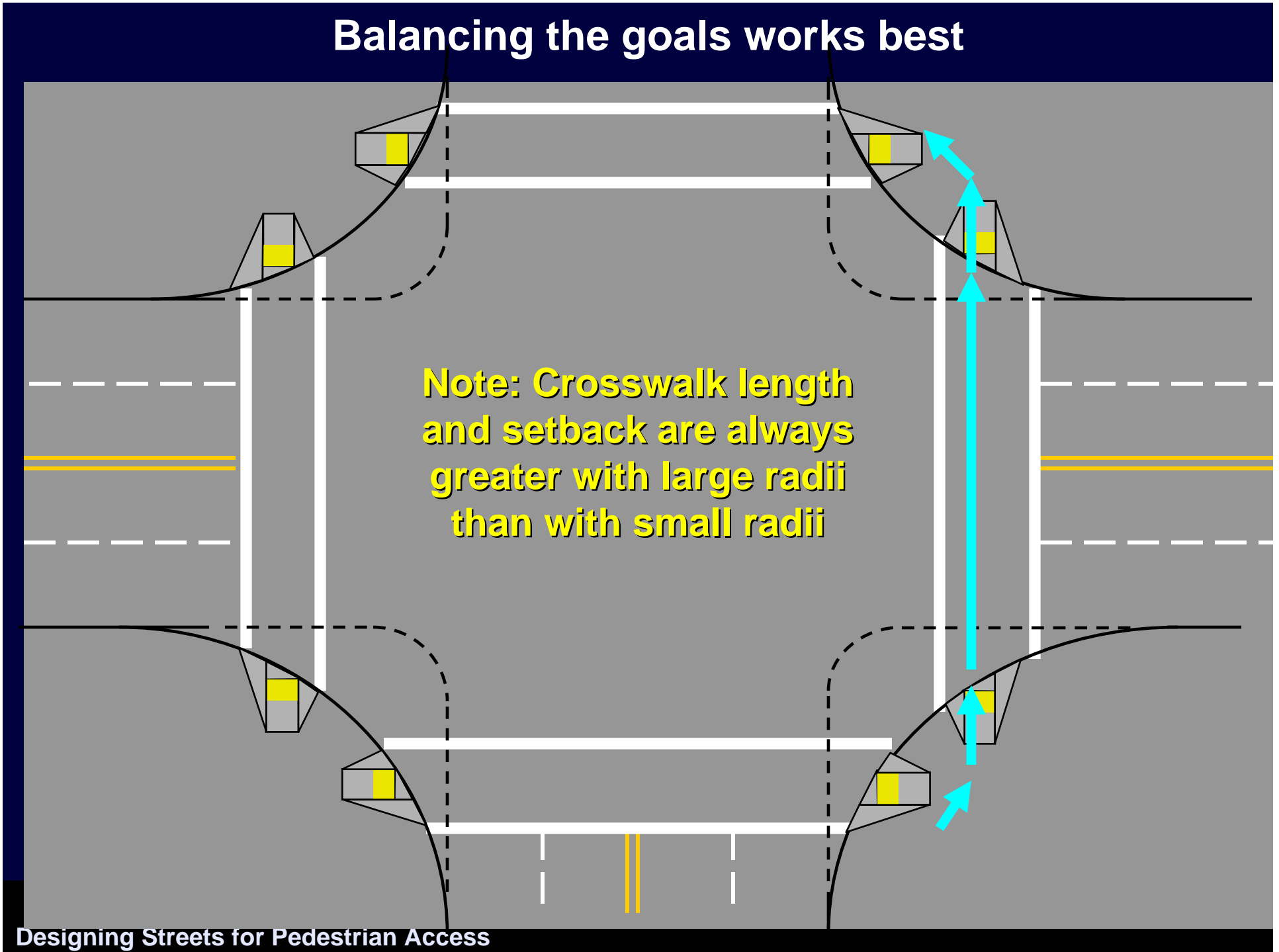


Single ramp reduces crosswalk setback but lengthens crosswalk and encourages diagonal crossings



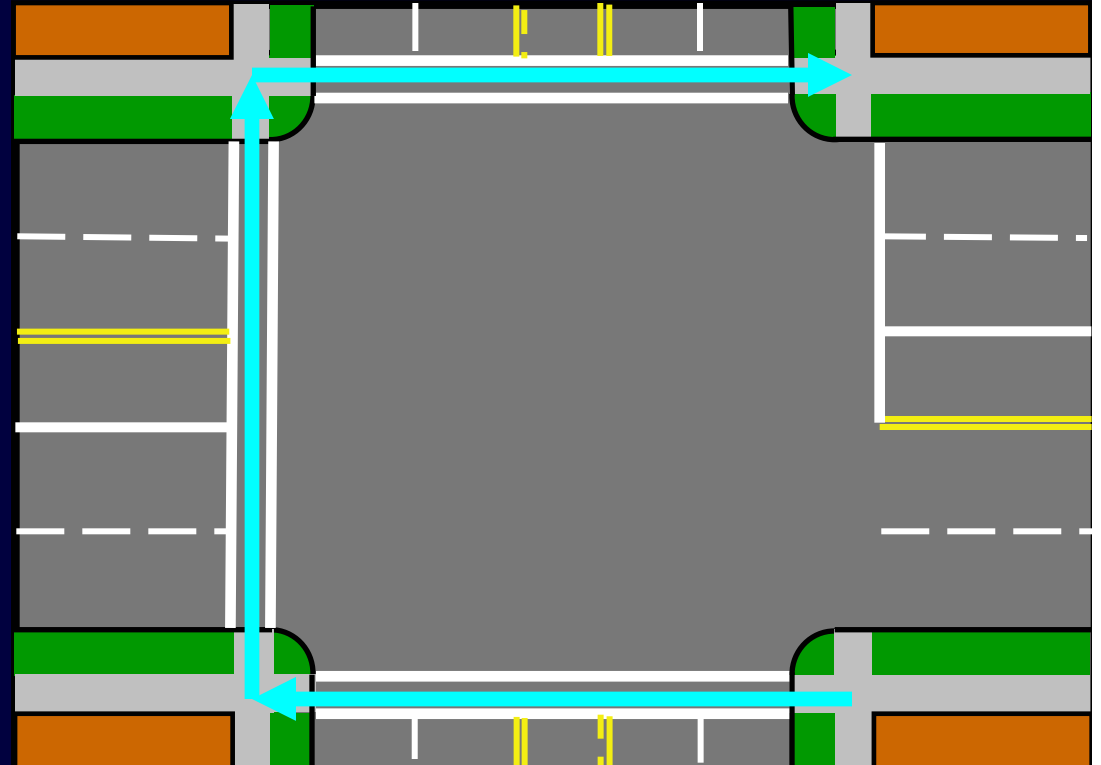
Balancing the goals works best

Note: Crosswalk length and setback are always greater with large radii than with small radii



Closed Crosswalks

Avoid closing crosswalks; crossing 15 lanes is harder and less safe than crossing 5 lanes



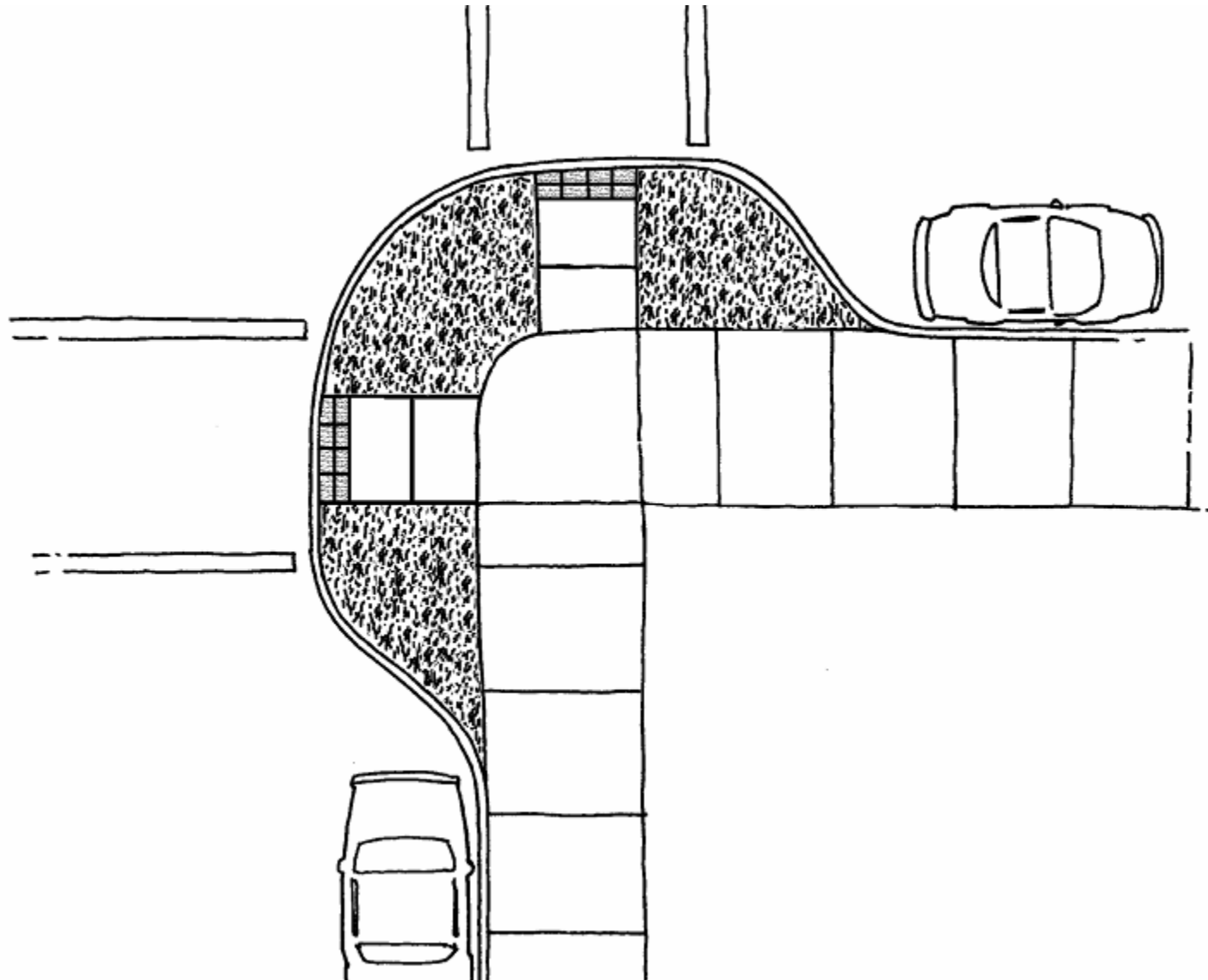
If crosswalk is closed, provide solid barrier and information about restricted crossing for peds with visual impairments

Curb Extensions

Curb extensions

- Reduce crossing distance
- Create room for ramps
- Improve visibility for both pedestrians & drivers
- Help pedestrians signal intent to cross
- Reduce vehicle delay





Curb extensions allow ramps to be correctly installed on narrow sidewalks

Right turn islands at intersections

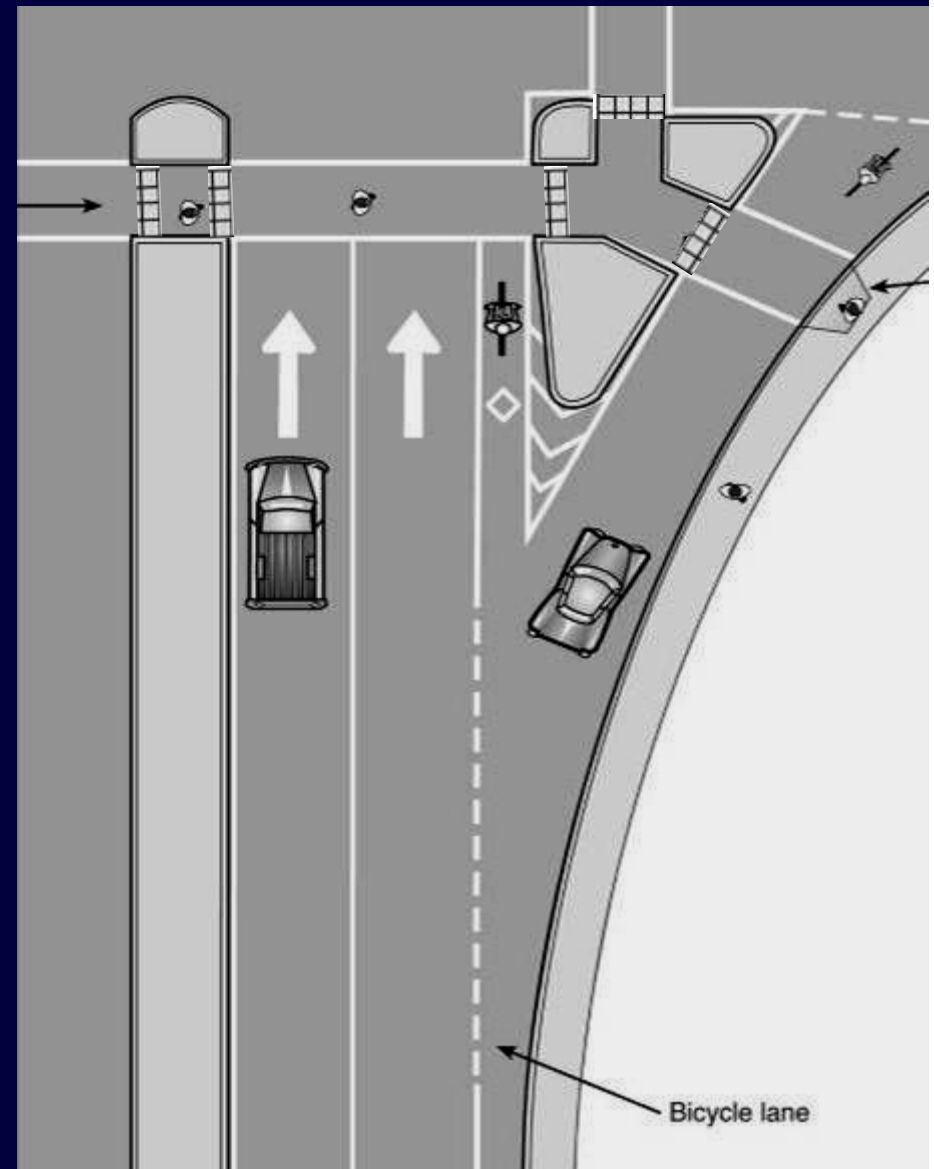
Benefits:

- Separate conflicts
- Provide refuge
- Reduce crossing distance
- Improve signal timing
- Provide wayfinding cues within island

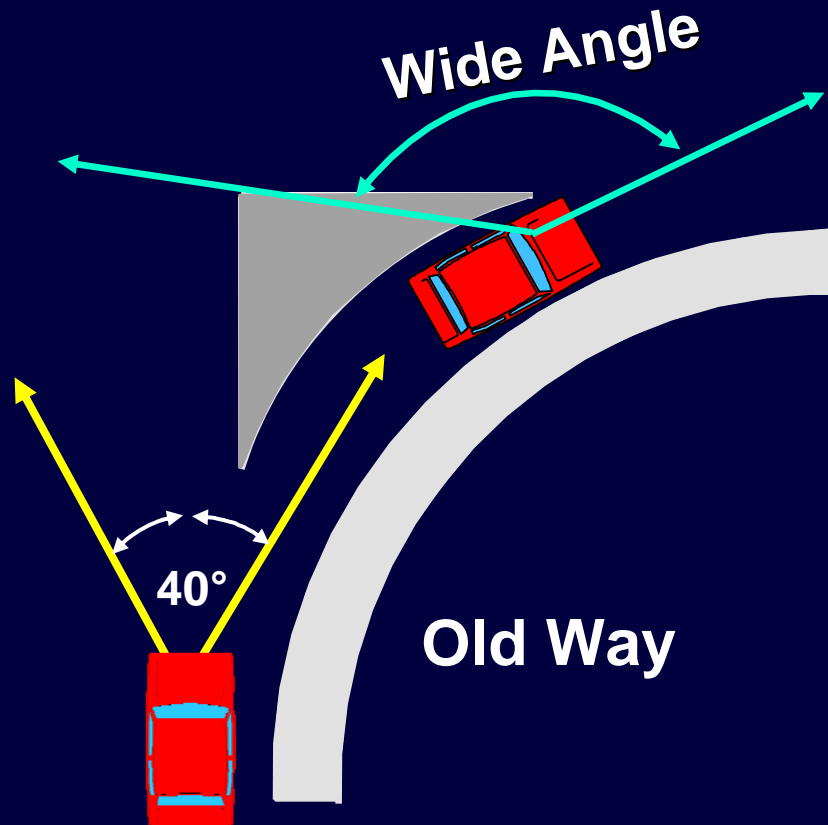
Issues for blind pedestrians:

- No cues to crosswalk location
- Free-flow traffic provides few clues for gap selection

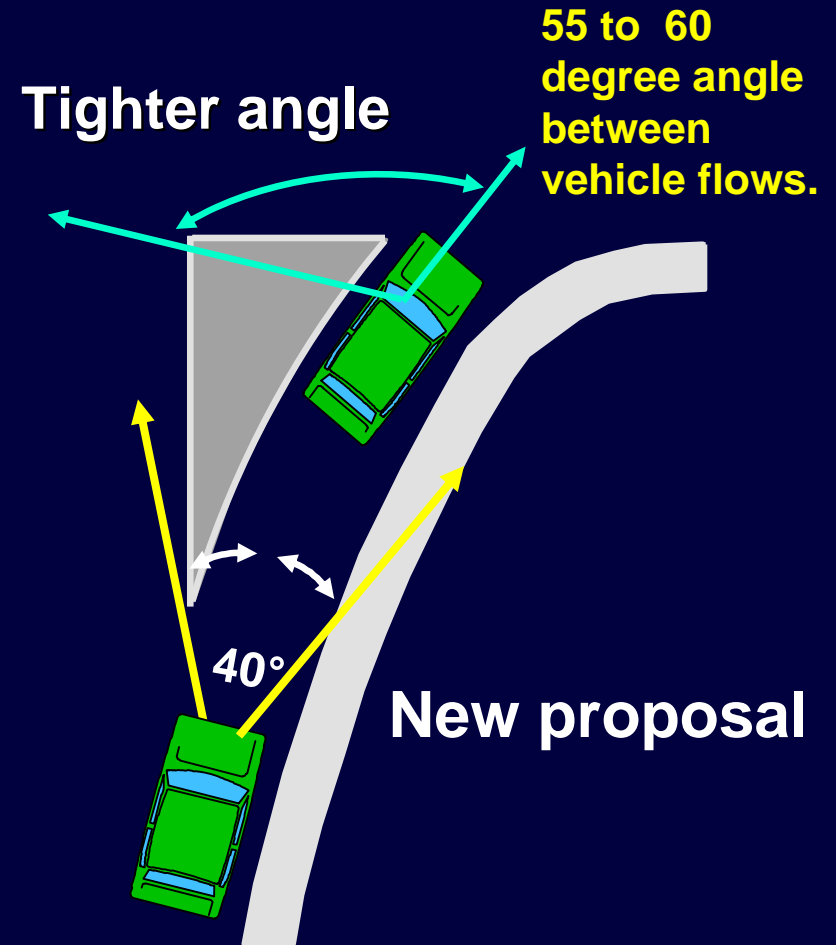
Signalized slip lane improves access for blind pedestrians



Right-Turn Slip Lane: Design for Pedestrians

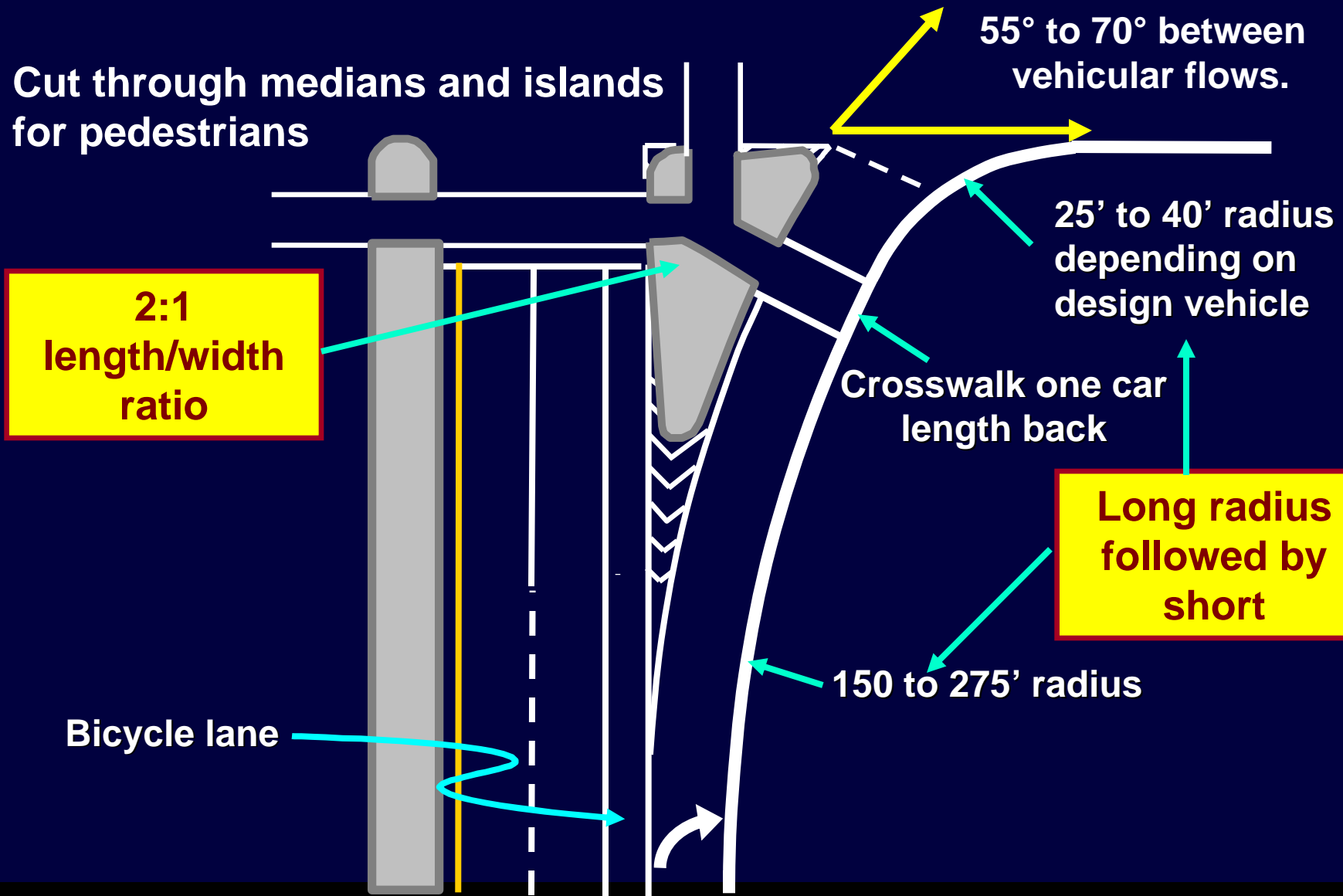


**High speed, head turner =
low visibility of pedestrians**



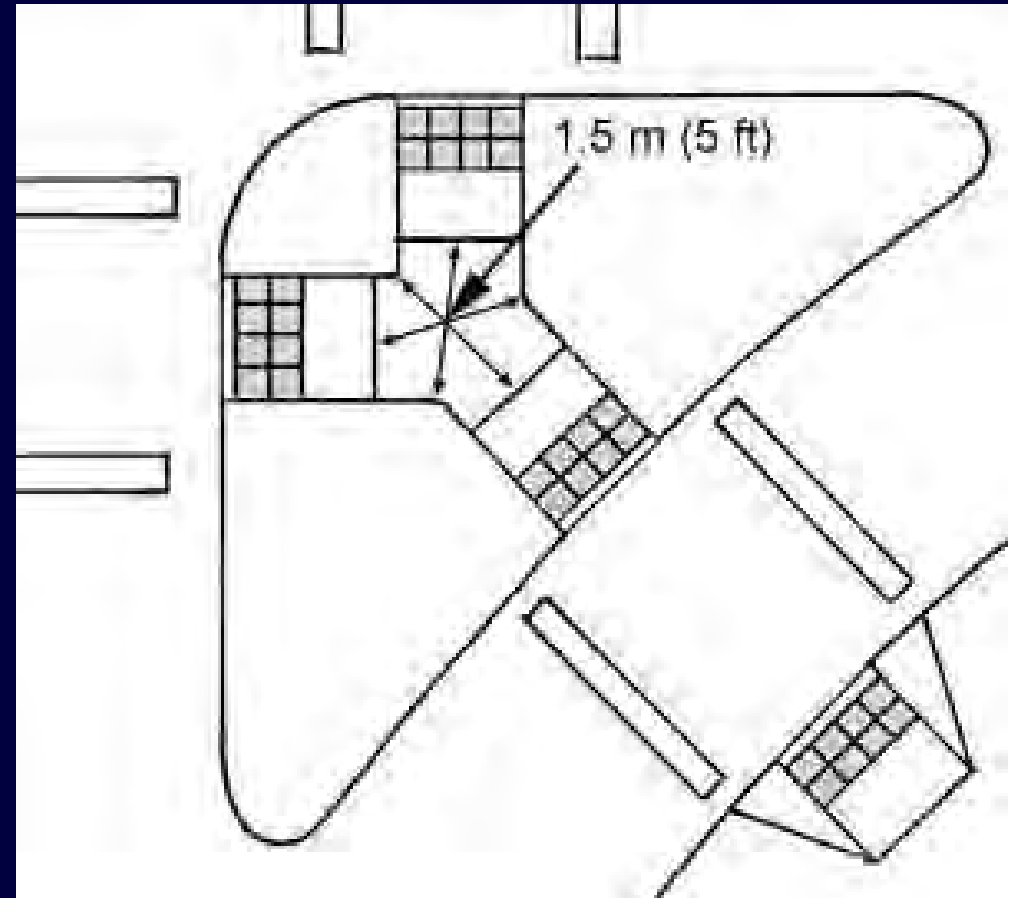
**Slow speed, good angle =
good visibility of pedestrians**

Right-Turn Slip Lane - Details



Right turn island details

- With slip lane, always use raised (*not painted*) island
- Provide turning space or level landing
- Align cut-through or ramps with crosswalks



Right turn islands



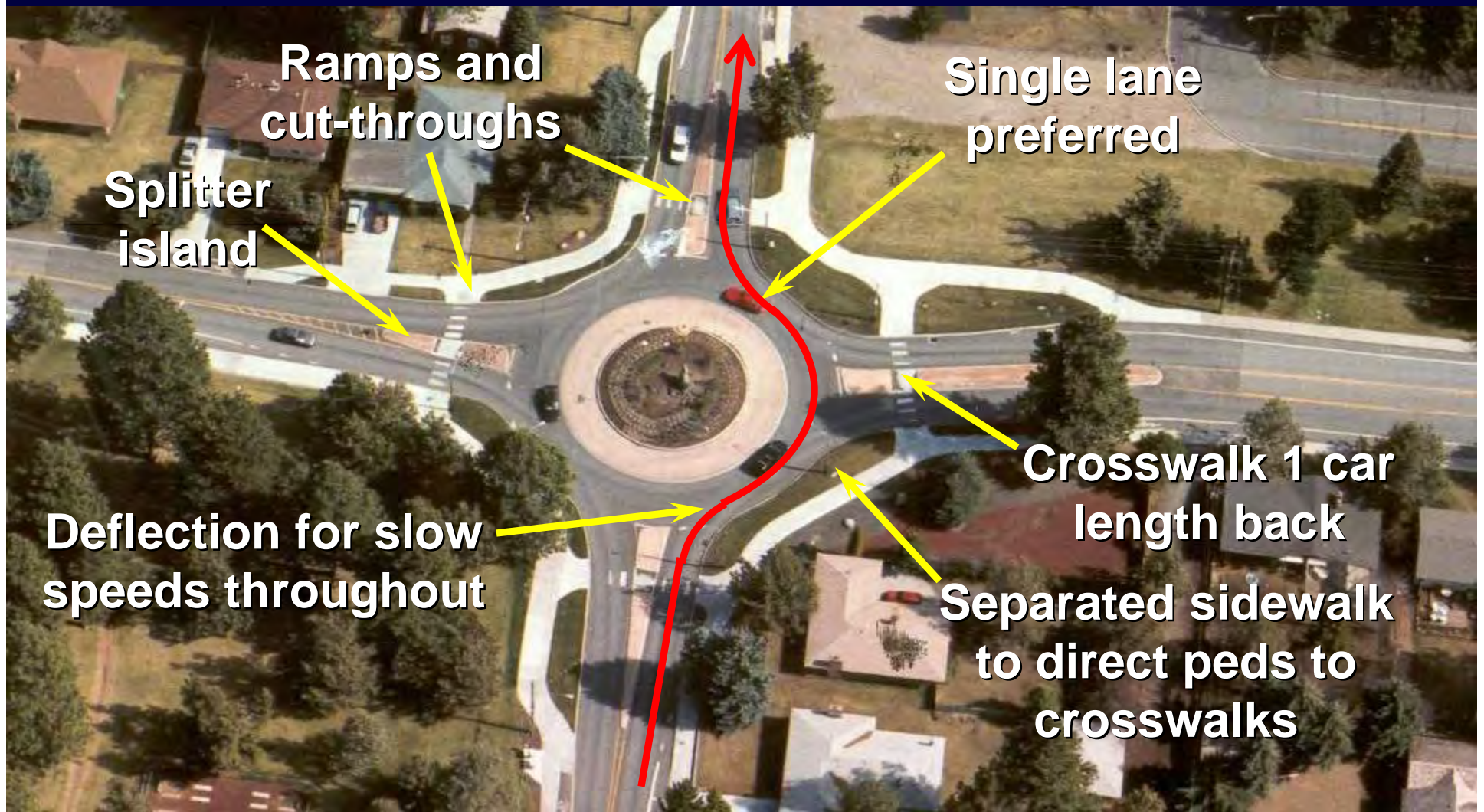
Good Design



Bad Design

Roundabouts

Important roundabout design features for pedestrian safety and access





**Most pedestrians can look for a gap,
then cross one leg at a time**



Roundabouts pose problems for pedestrians with vision impairments:

- **Crosswalk locations are not apparent**
- **Circulating traffic masks the sound cues that blind pedestrians use to analyze crossings**
- **Multiple threat crashes**



Multi-lane roundabouts add multiple threat risks to a pedestrian crossing and vehicle speeds will be higher because of lesser deflection

Roundabout Fencing



US considering signals at crossings of multi-lane roundabout entries and exits



Signalized pedestrian crossing

Questions?

Designing Pedestrian Facilities for Accessibility

Module 4: Curb Ramps and Other Transitions

What will be covered in Module 4

- Curb ramp technical provisions
- Detectable warnings
- Types of curb ramps
- Blended transitions
- Drainage issues



Curb ramps and other transitions

- **Purpose:**
 - Pedestrian connection from sidewalk to street
- **Typically installed at:**
 - Intersections (ramp at each end of each crosswalk)
 - Mid-block crossings (including trail crossings)
 - Accessible on-street parking spaces
 - Passenger loading zones

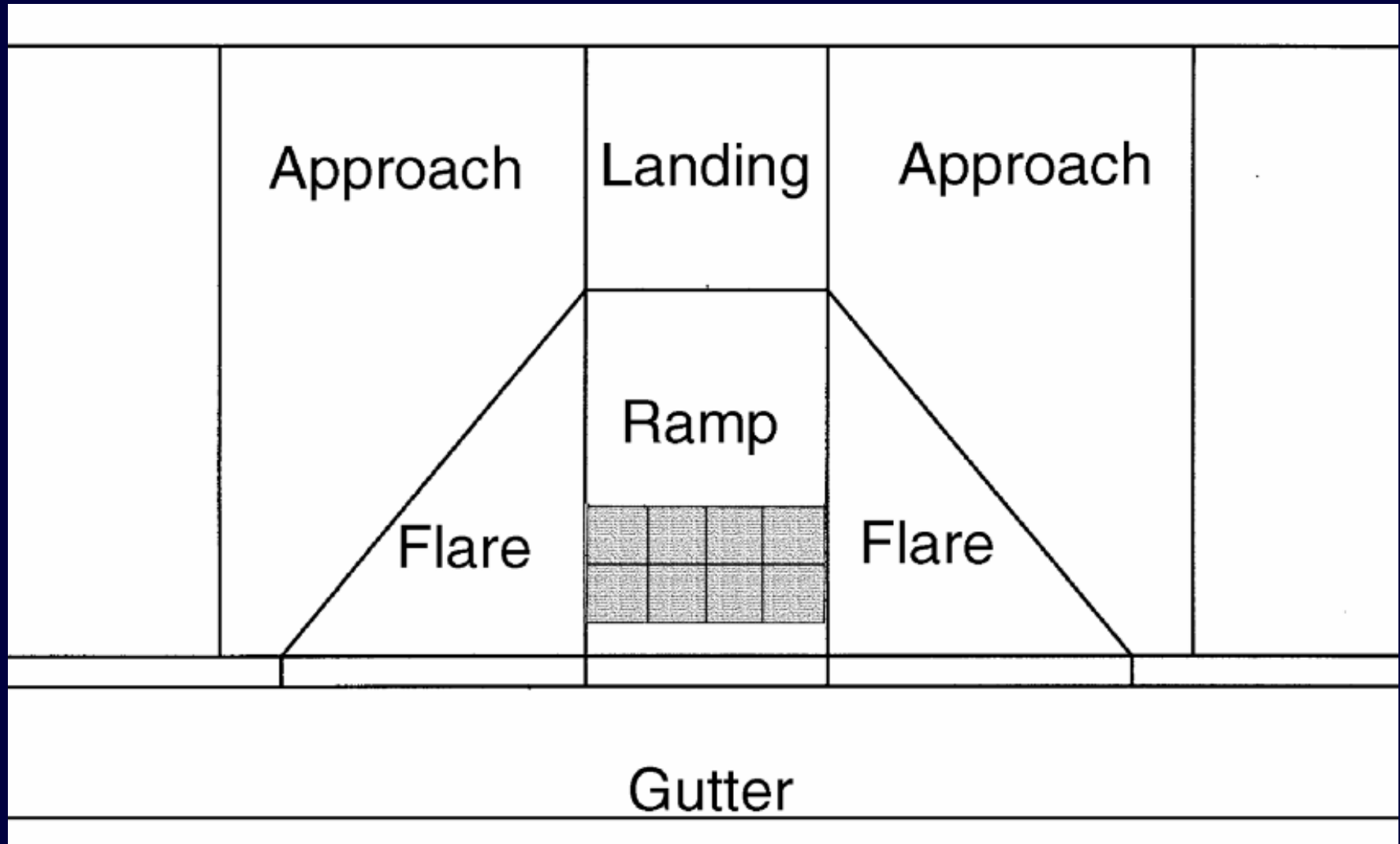
Curb ramps have many users...

- People using:
 - wheelchairs and walkers
 - strollers
 - delivery carts
 - rolling luggage

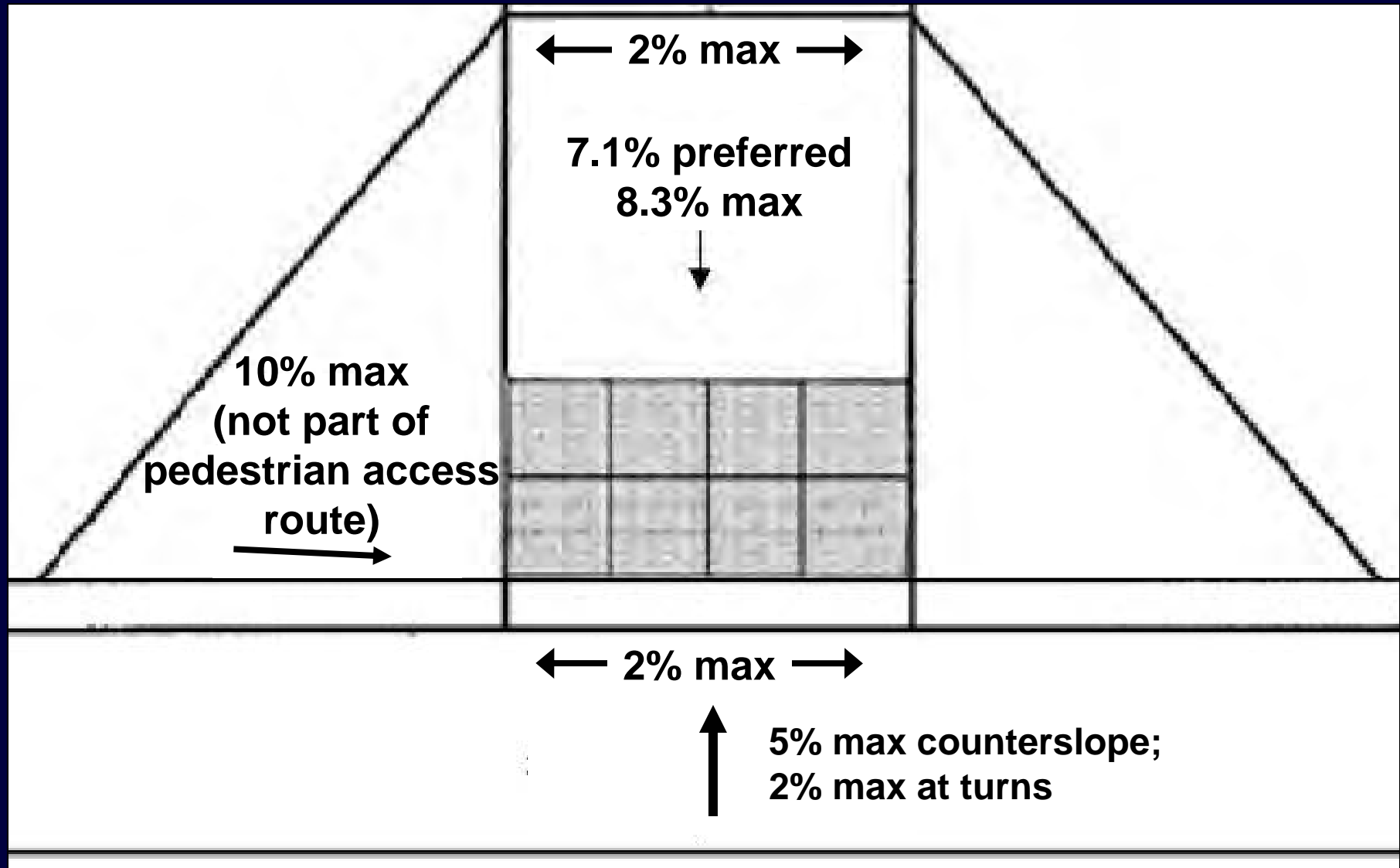


Curb Ramp Technical Provisions

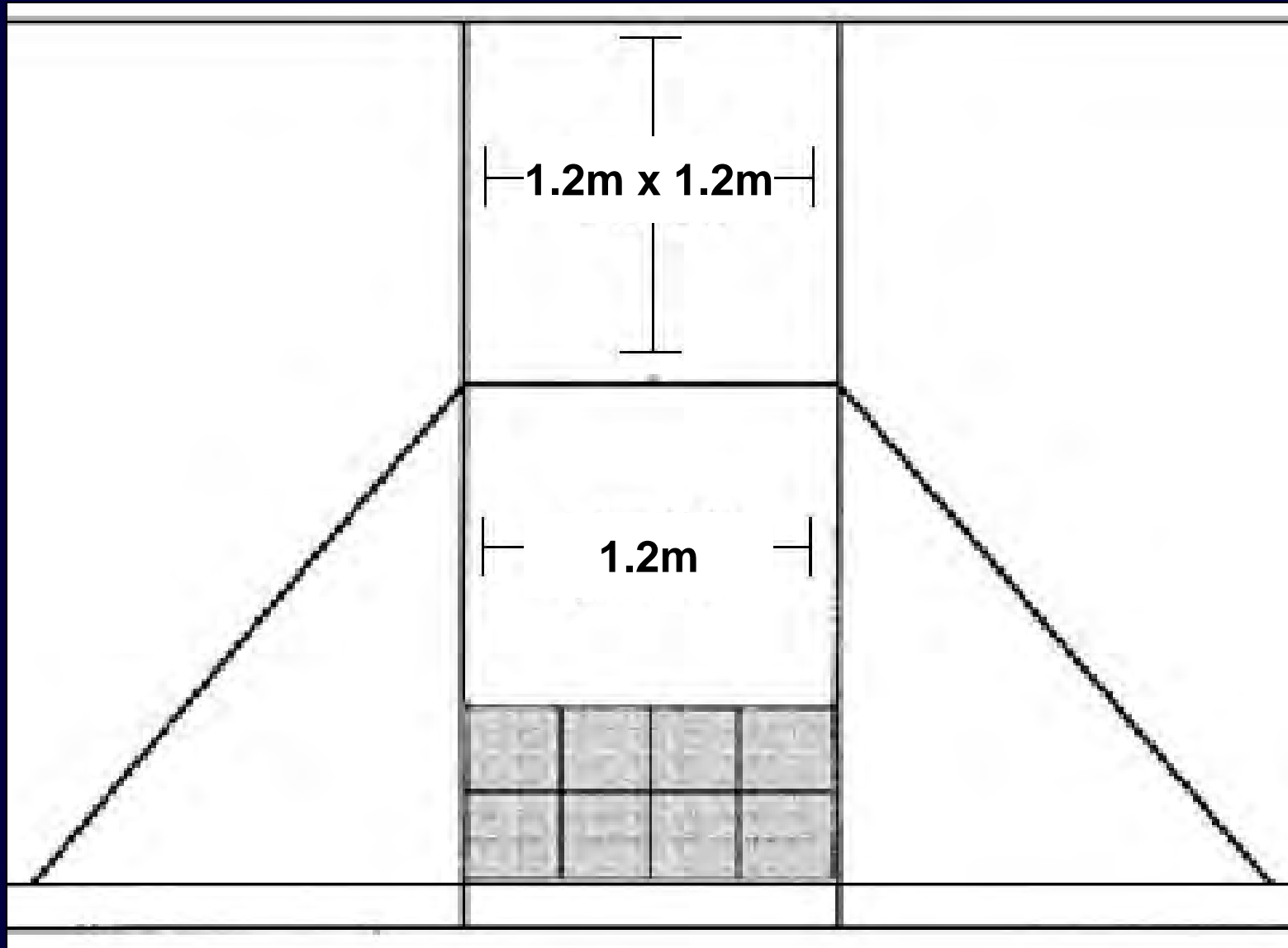
Curb Ramp Components



Curb Ramp Design: Slopes Summary

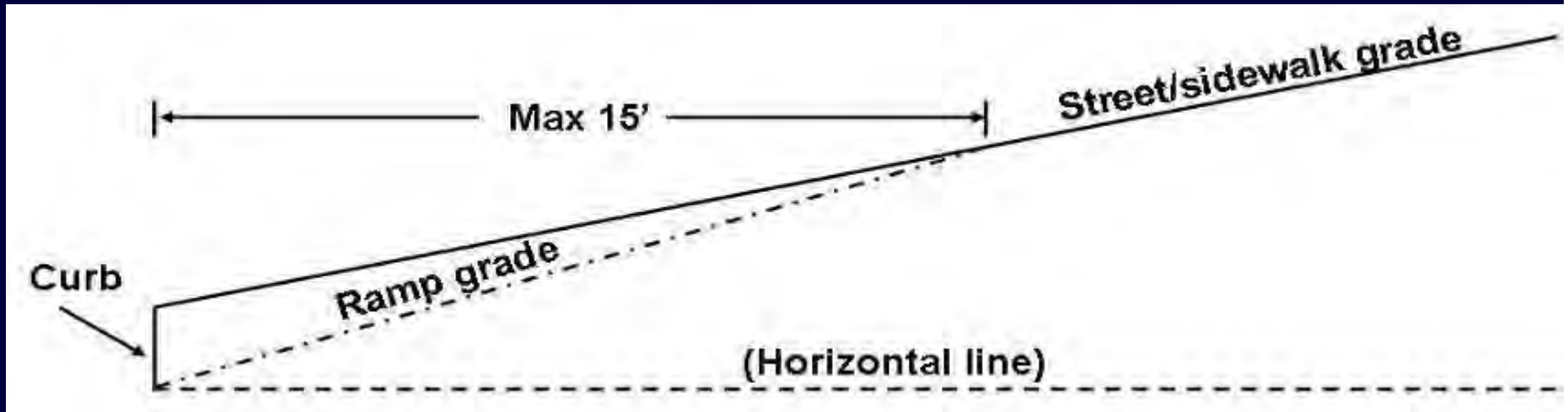


Curb Ramp Design: Dimensions Summary



Curb Ramp Grade

- **Maximum grade – 1:12 (8.3%)**
 - Recommended maximum grade to allow for construction tolerance – 1:14 (7.1%)
- **Least slope possible preferred (for least effort use)**
- **When ‘chasing grade’, curb ramp length need not exceed 15’, but slope must be uniform (PROWAG)**



Curb Ramp Width

- Recommended minimum: 1.2m
- Wider ramps are better: full crosswalk or sidewalk width avoids need to jockey for position or space
- Reduce concrete area by using returned curbs



Curb Ramp Surfaces

- Grates, covers, etc shouldn't be located on ramps or landings
- If they must be, then surface accessibility requirements apply
 - stable, firm, slip resistant
 - flush transitions
 - no changes in level



Curb ramp surface should be smooth



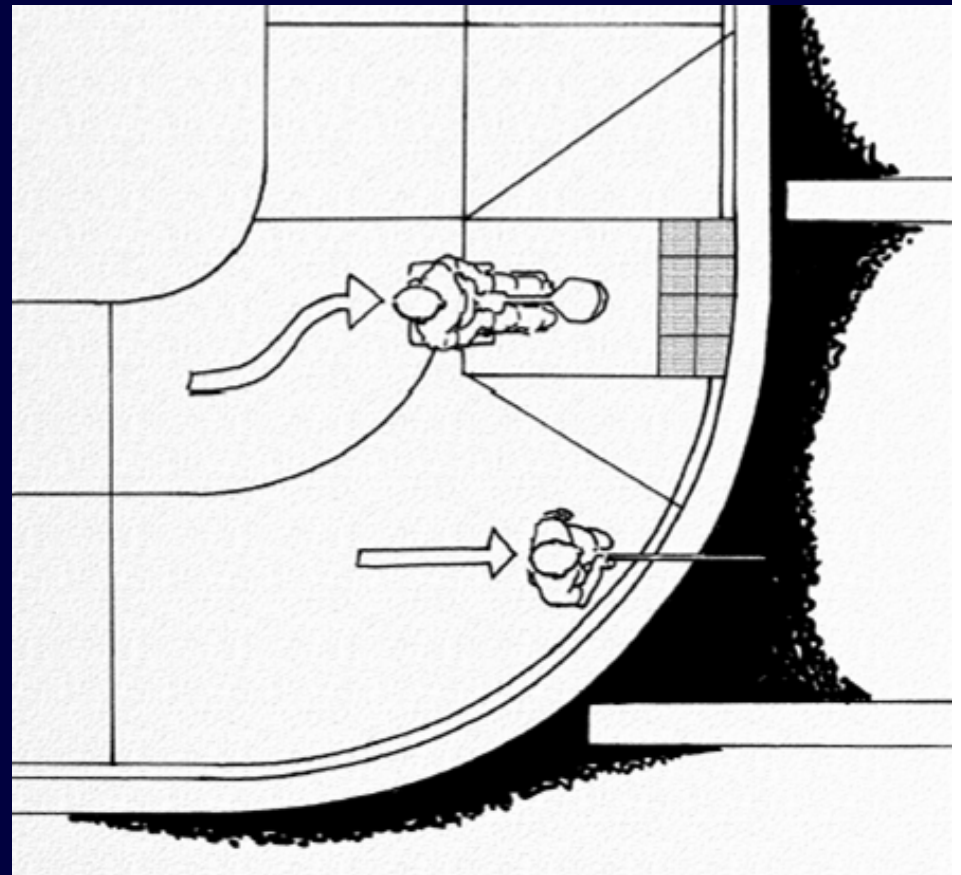
Poor design



Better design

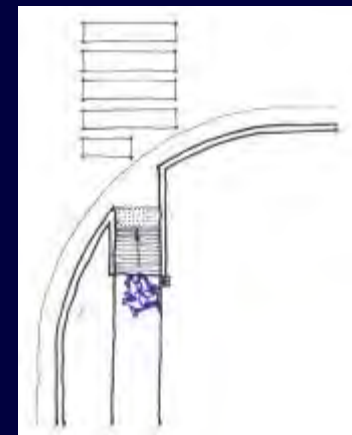
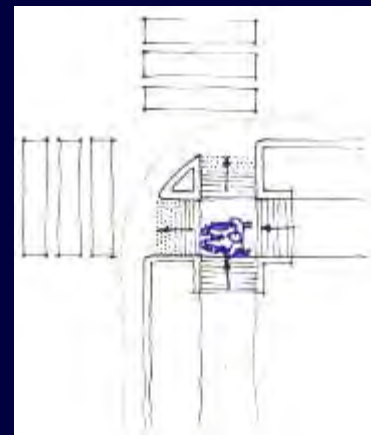
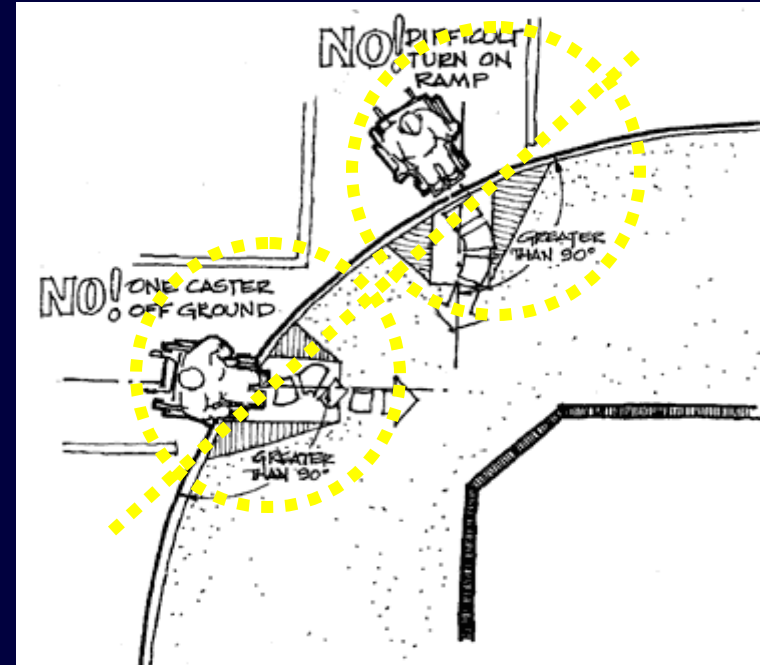
Curb Ramp Alignment

- Curb ramps aligned with crosswalks are effective in orienting users to crossing
- On small radius corners, curb ramp can be aligned with crosswalk and be perpendicular to curb

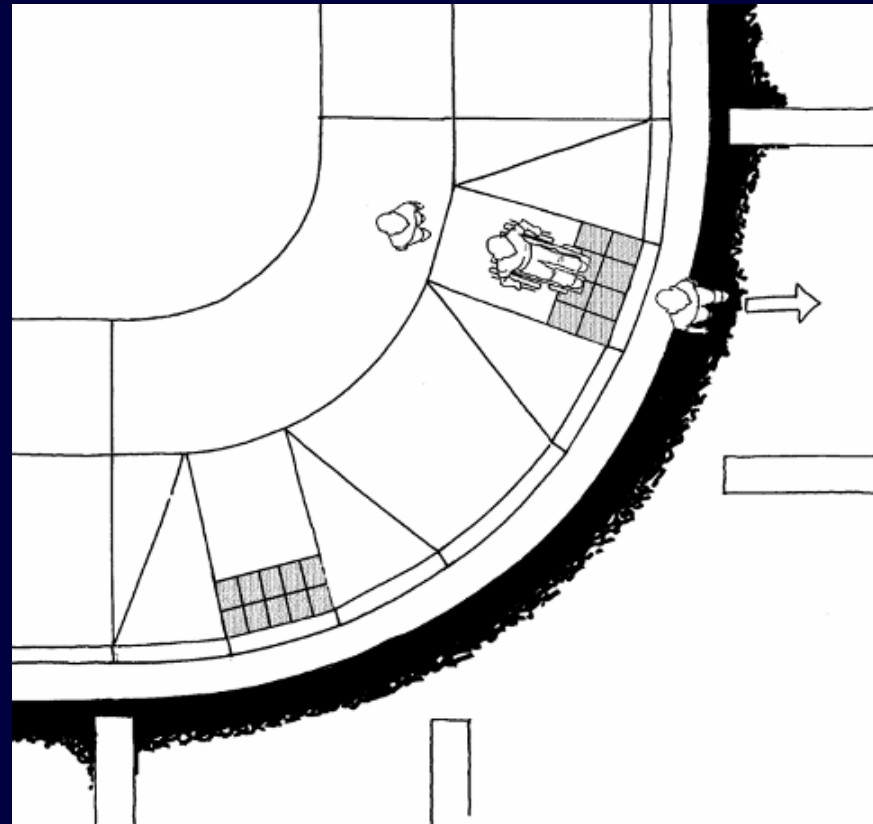
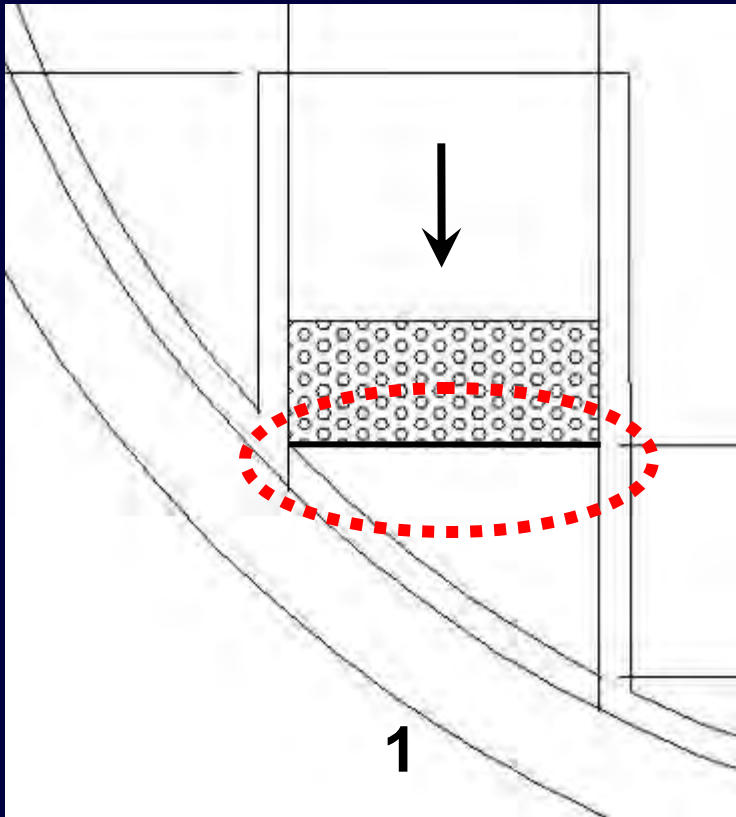


The curb ramp conundrum

- Grade breaks on curb ramps must be perpendicular to the ramp slope direction for wheelchair usability.
- BUT...curb ramps that are not in-line with the crossing can provide misleading directional cues
- It's possible to satisfy both criteria...



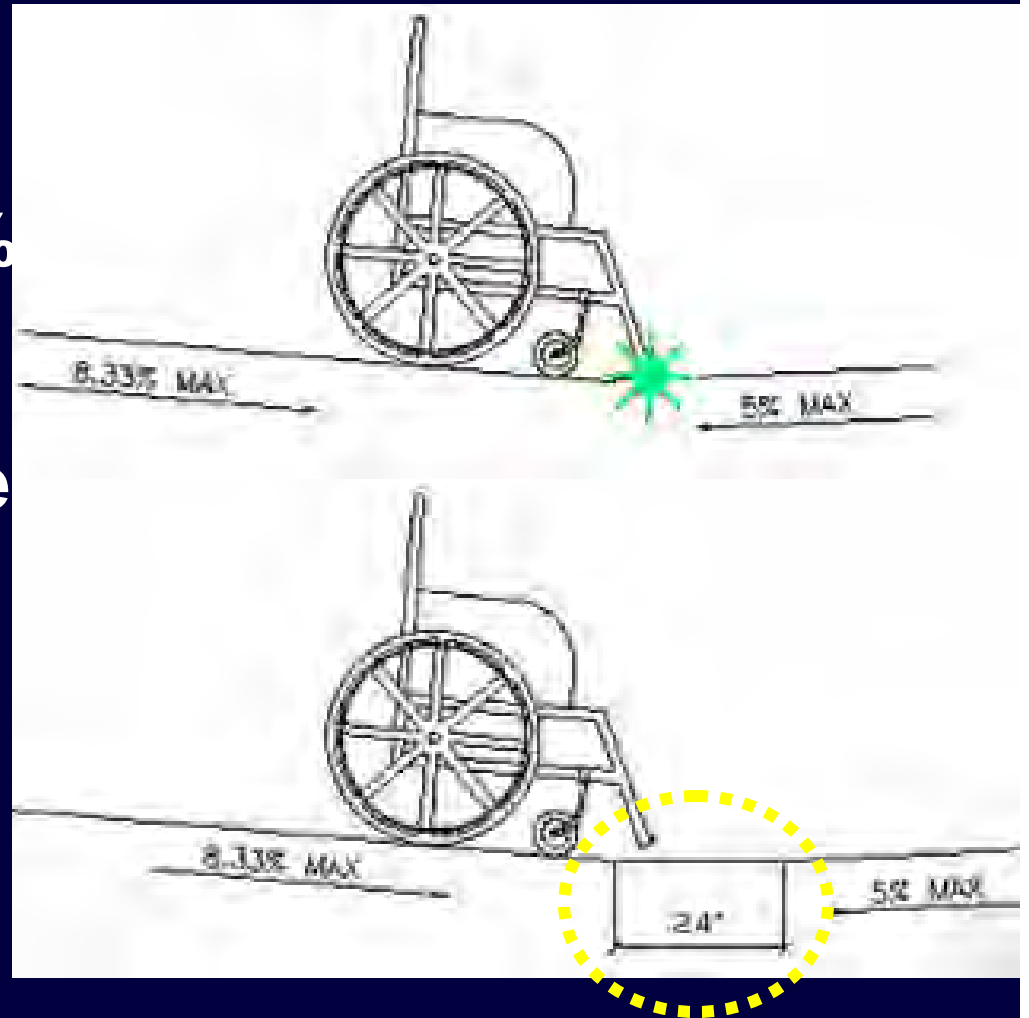
Alignment solutions for large radii



- 1. Preferred: align curb ramp with crosswalk and set grade break at toe, not at curb line**
- 2. Acceptable: Place curb ramps perpendicular to curb**

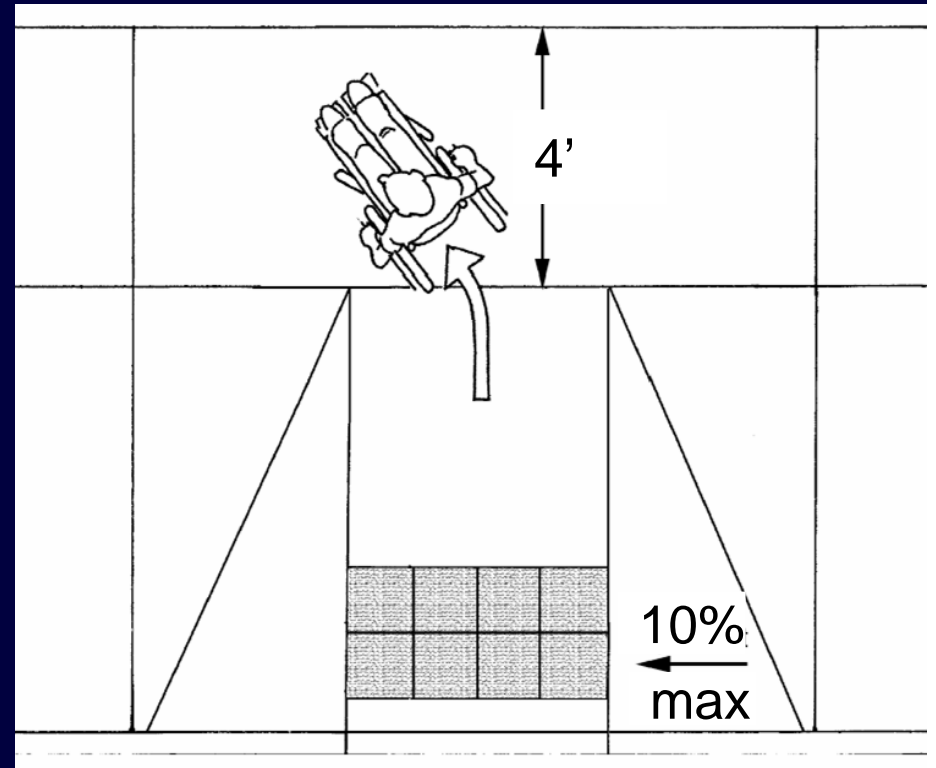
Change of Grade

- Limit to 8.3% ramp + 5% grade at the adjacent street = 13.3%
- Lesser slope is better
- Good practice: provide 0.6m level area for transition



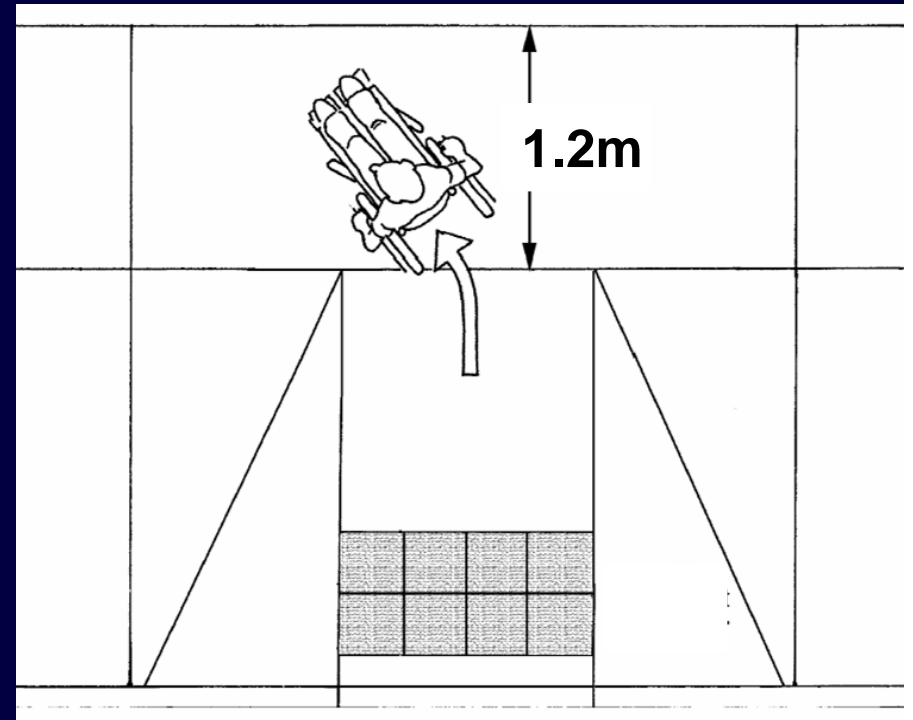
Flares

- Flares are not part of pedestrian access route; should be used wherever ramp might create a tripping hazard
- Slope: 1:10 (10%) max



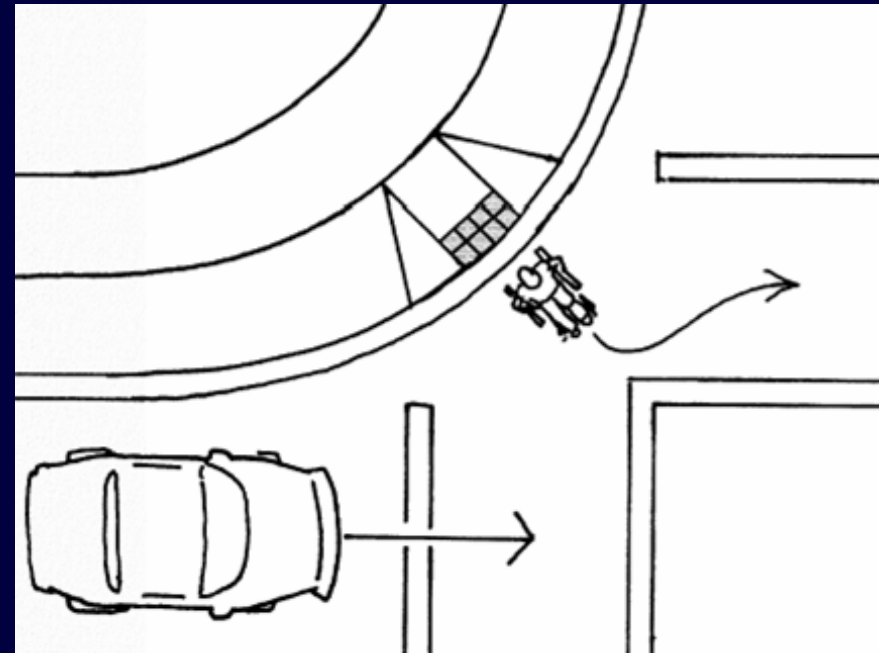
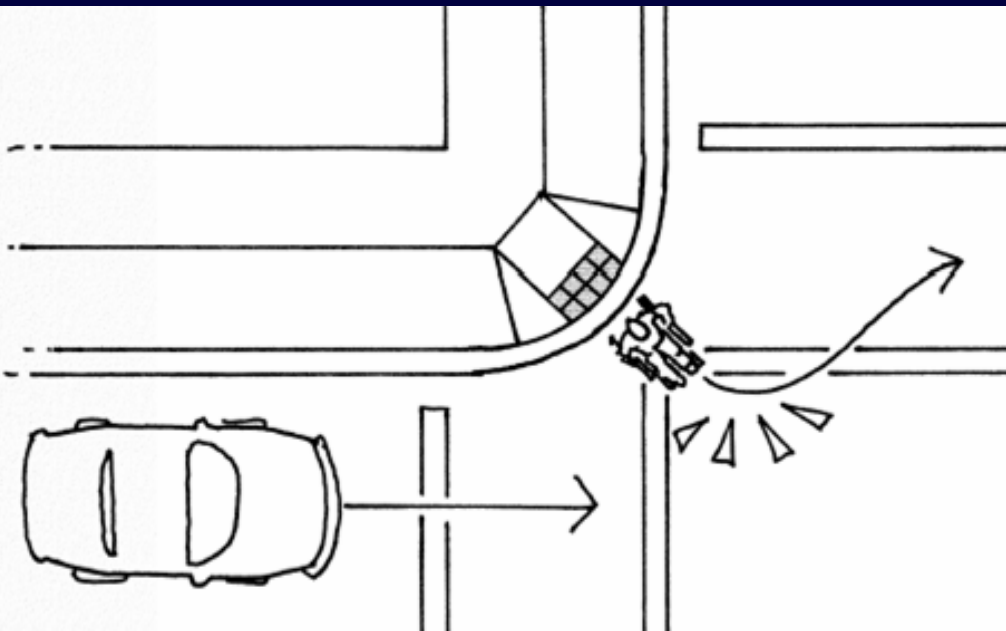
Landings

- Landing is required wherever a turn must be made at top or bottom of ramp to use sidewalk or enter crosswalk
- Landings may serve multiple ramps
- Landing slope: 2% max in any direction
- Landing should be curb ramp width and at least 1.2m deep
- 1.5m X 1.5m allows wheelchair users to turn more easily



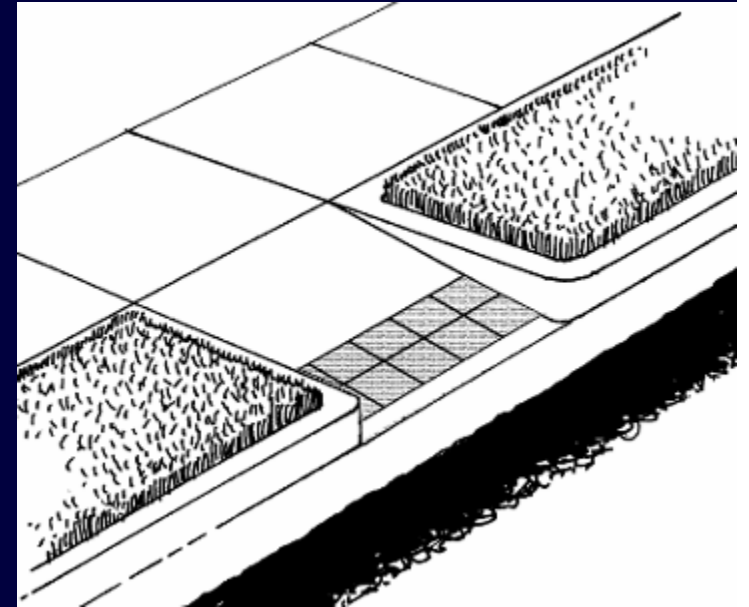
Bottom Landing

Bottom of ramp must have
1.2m X 1.2m level clear space
outside vehicle travel path



Curbed Ramps

- Curbs can be used instead of flares where ramp is shielded by a fixed object or landscaping
- Curbs provide directional cues, promoting wayfinding
- Curbs reduce concrete area

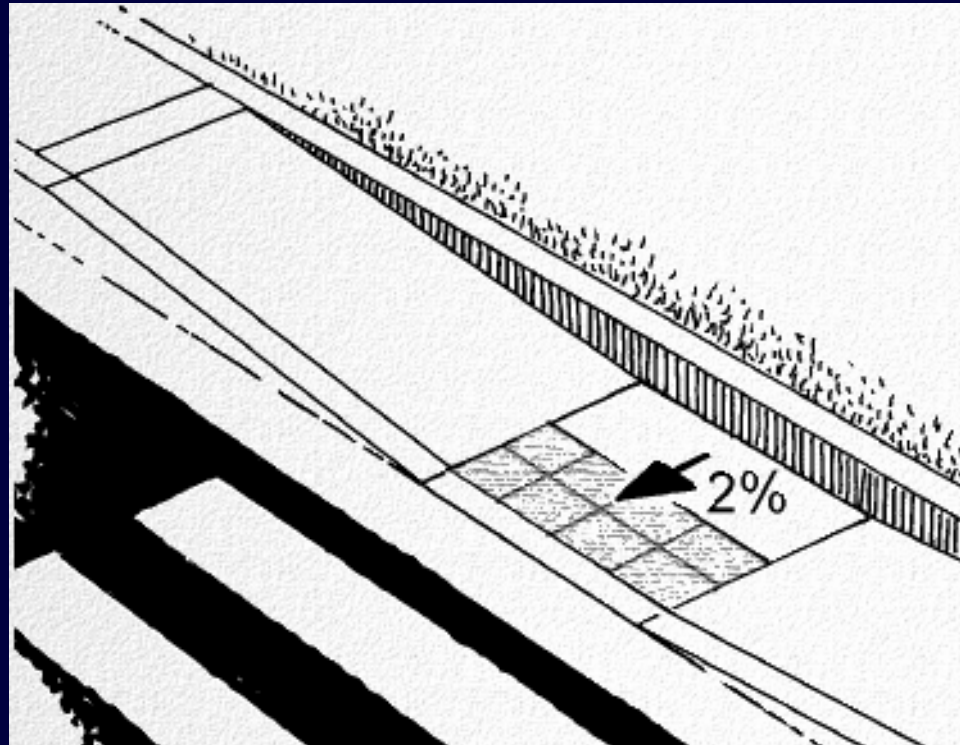
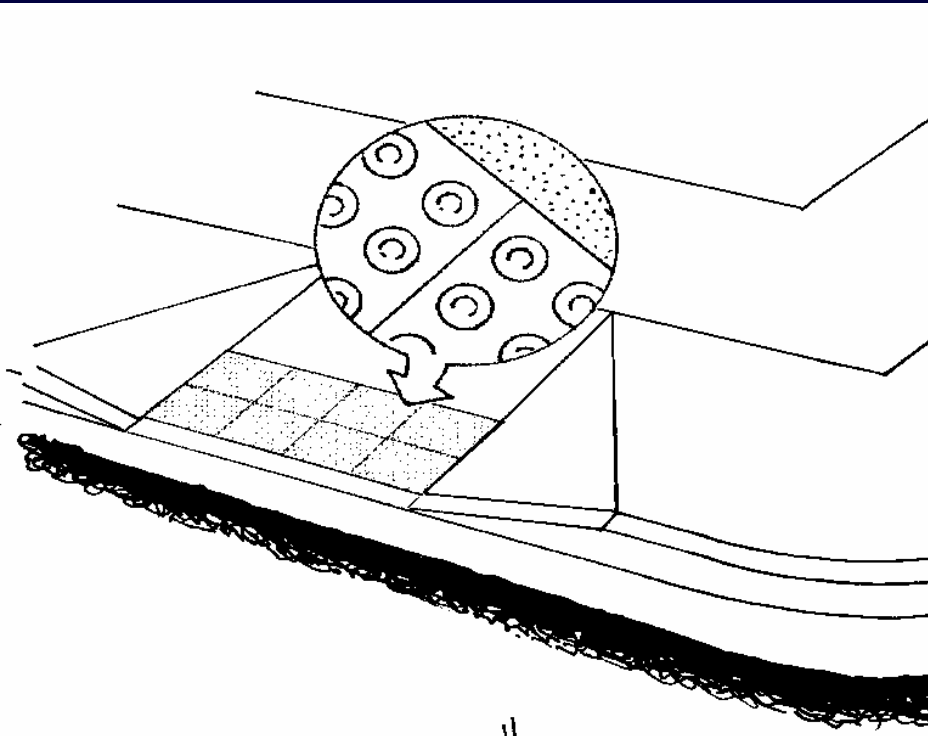




Flare needed on left (concrete)
Flare not needed on right (landscaping)

Detectable Warnings

Detectable Warnings (DWs)



Curbs identify the boundary between sidewalk and street; DWs at curb ramps and other street transitions replace that cue for pedestrians with visual impairments

Detectable Warning Placement

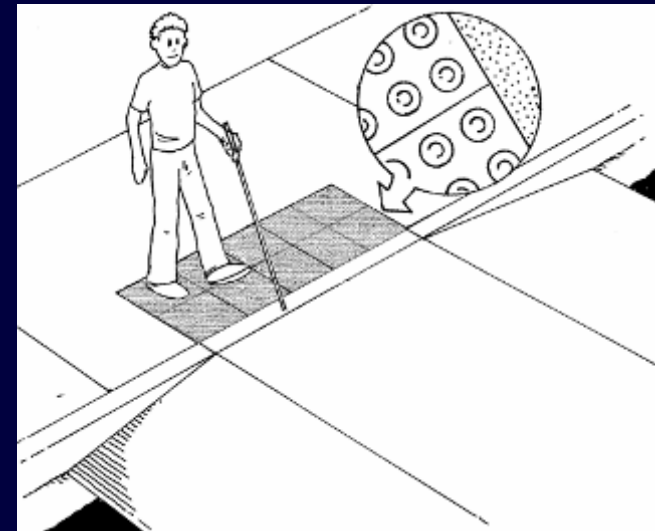
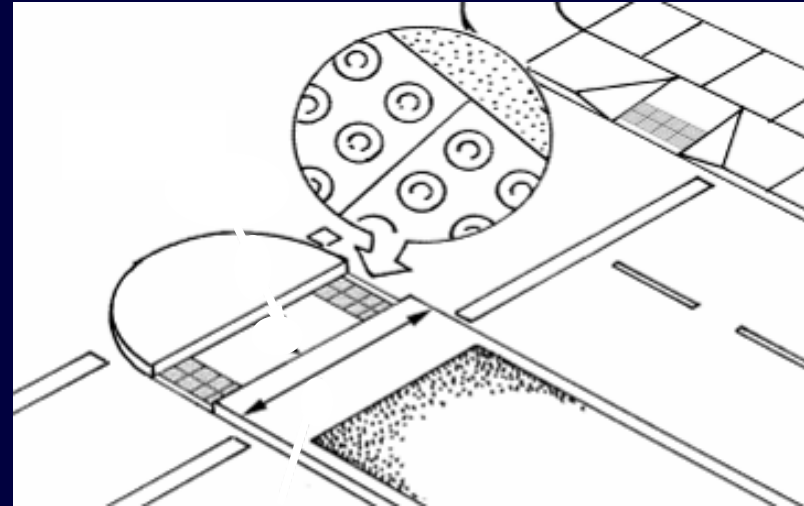
- Wherever a walkway crosses a vehicular way (except unsignalized driveways)
 - Intersections
 - Other pedestrian crossings
 - rail crossings
- Transit platforms

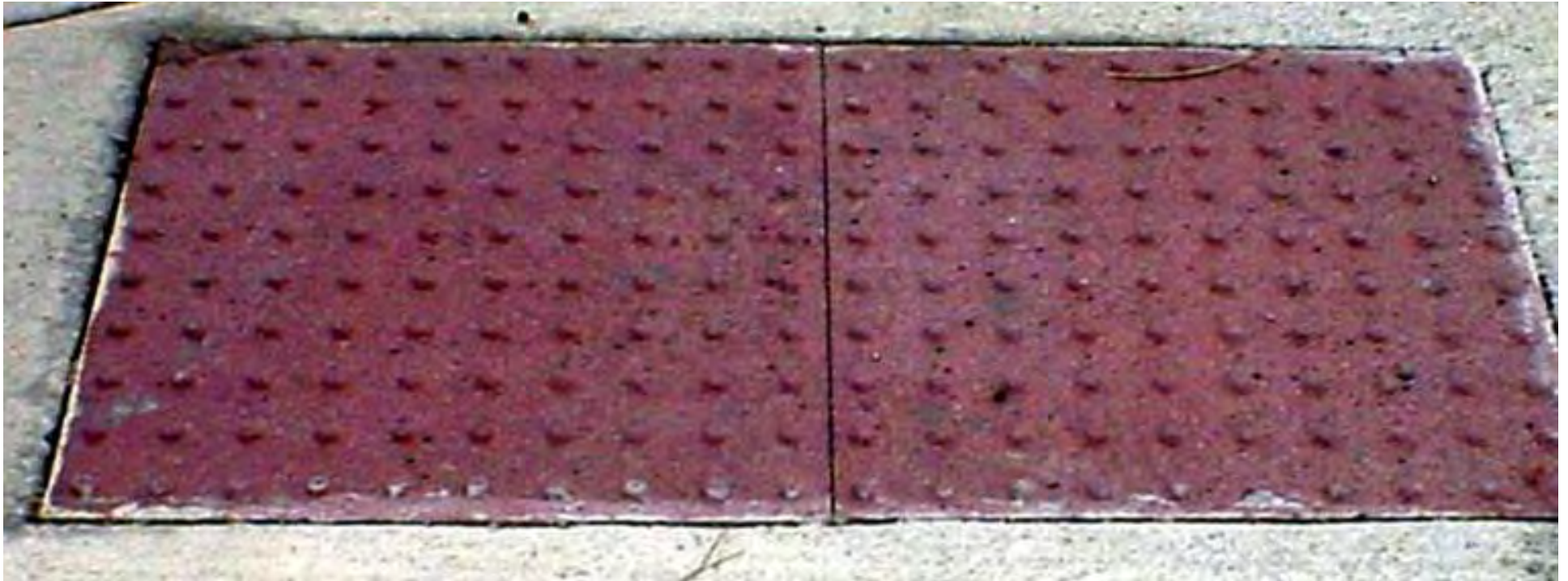


Detectable Warnings at Intersections and Other Street Crossings

DWs are used at:

- Curb ramps
- Medians and islands
- Raised crosswalks
- Depressed corners
- Shared-use path crossings





This distinctive design is the only truly detectable warning; many types are available



Other treatments have been tried but are not sufficiently detectable or have other problems

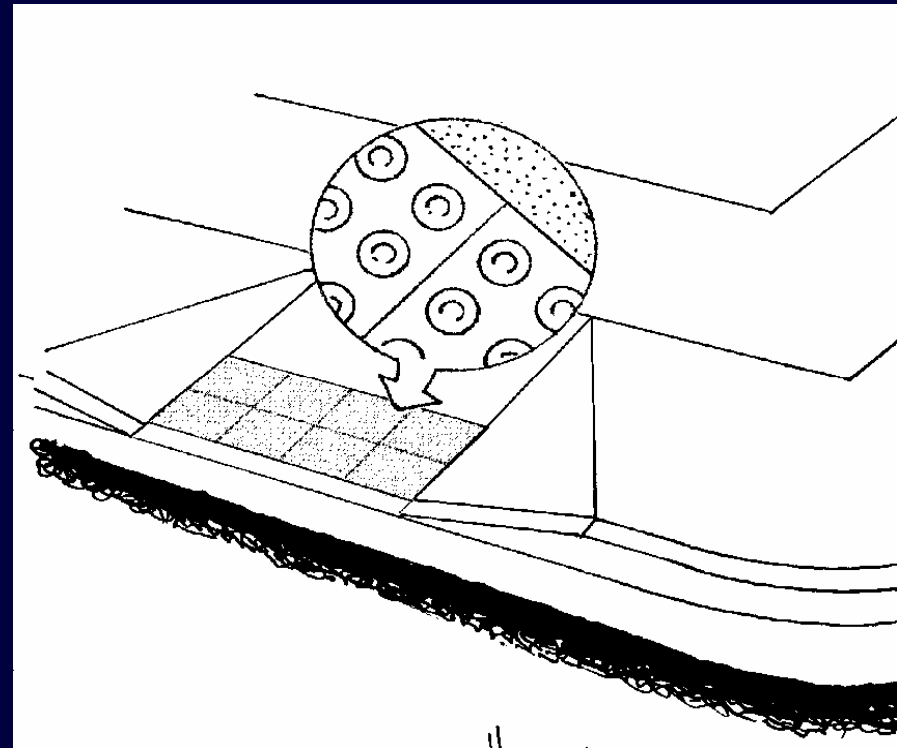
Detectable Warning Details



Detectable warnings should have visual contrast

DW placement & alignment on ramps

- 0.6m deep band of detectable warning is required at back of curb – not full length of ramp
- Align domes with direction of pedestrian travel on ramps
- Dome alignment is not significant on lower-slope blended transitions
- Not needed on flares



DWs not needed on flares

DWs not necessary the full length of the curb ramp

DWs even if other treatments are present



Curb Ramp Types

Curb Ramp Types

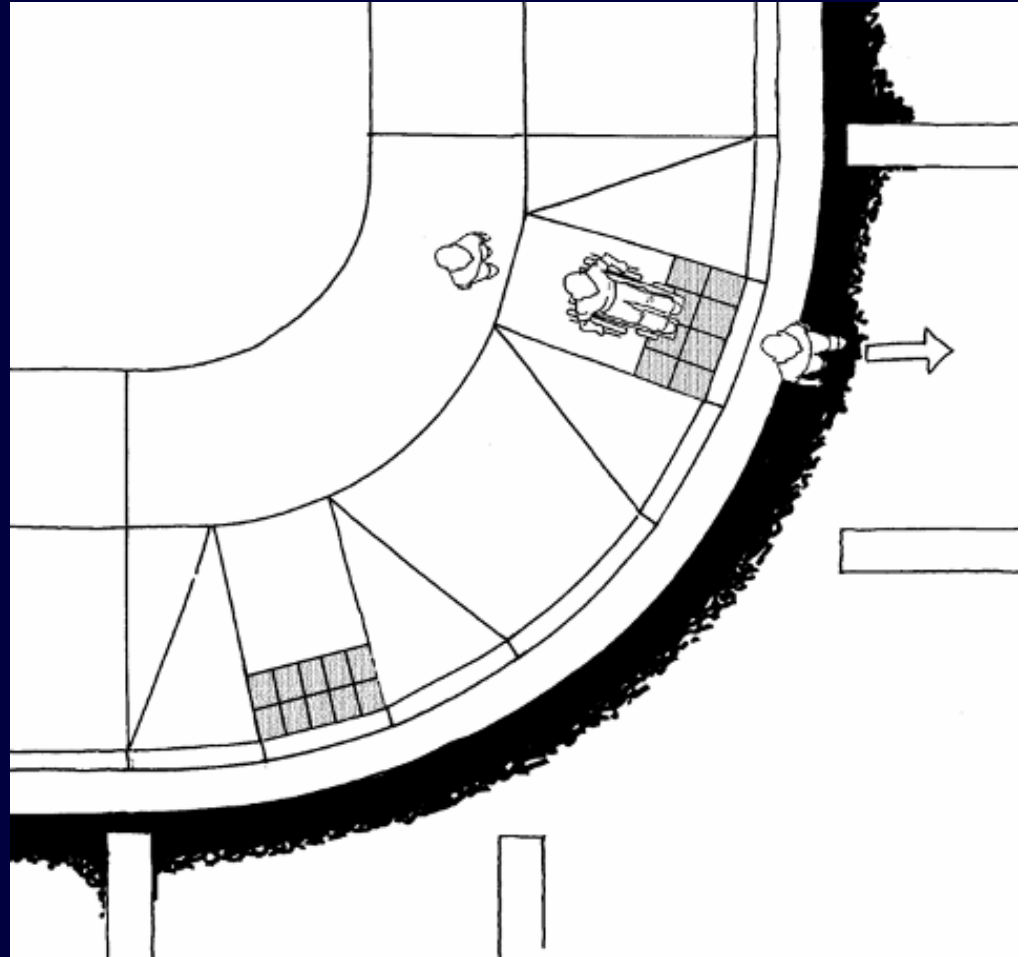
Classified by their design and position relative to sidewalk or street:

- 1. Perpendicular curb ramps**
- 2. Parallel curb ramps**
- 3. Combination ramps**
- 4. Built-up curb ramps**

Connections with slope less than 5% are called 'blended transitions' in PROWAG: raised crossings, depressed corners, etc.

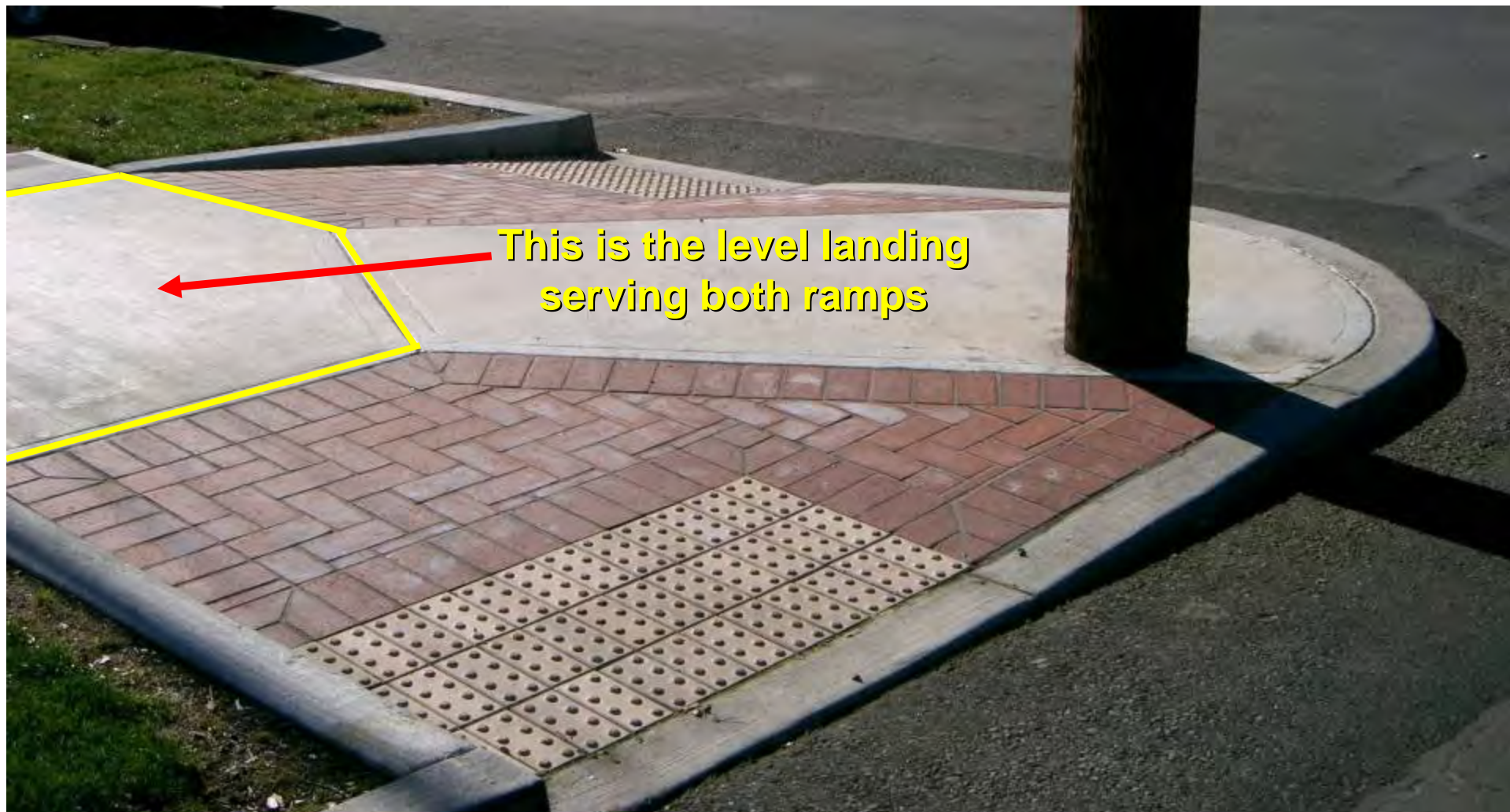
1. Perpendicular Curb Ramp

- Ramp slope perpendicular to curb
- Only ramp used by many jurisdictions...
- But there's a wide range of options for different situations

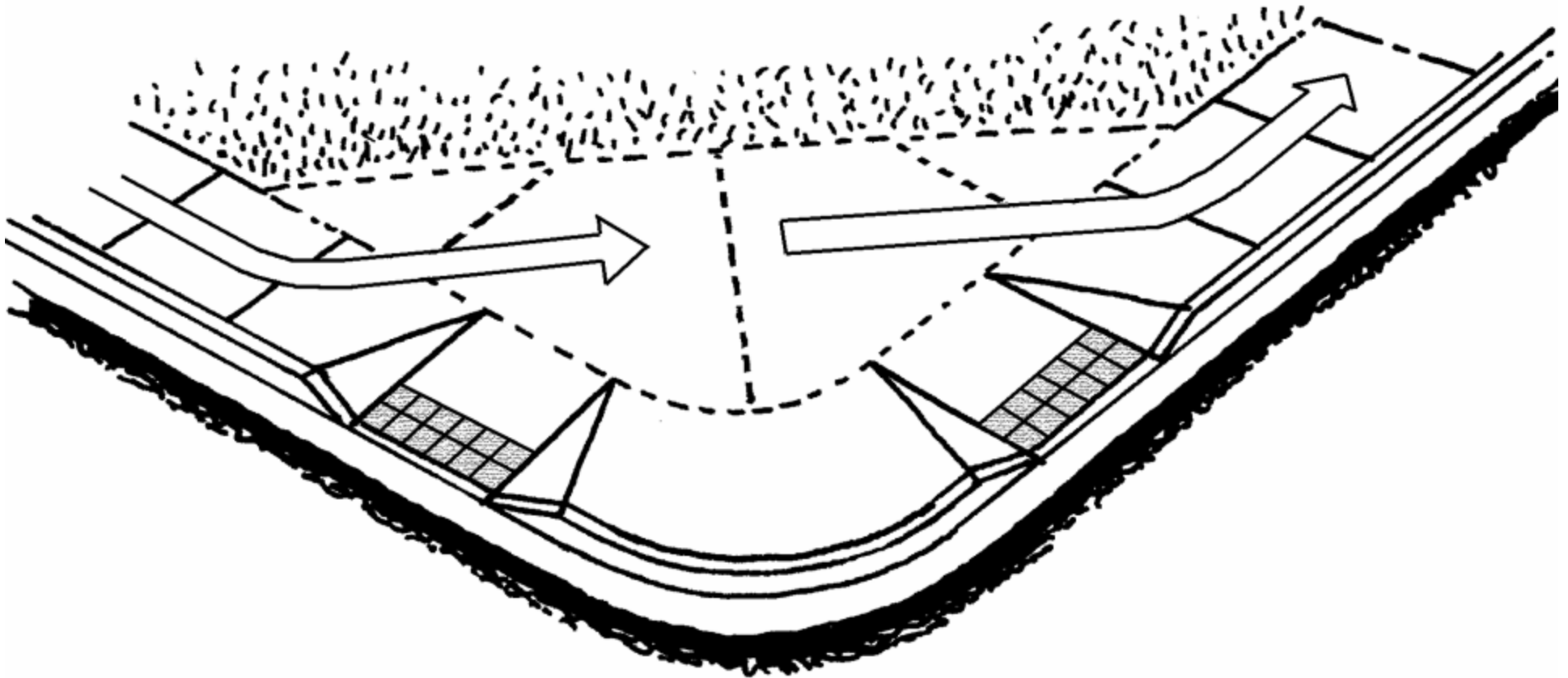




**Midblock perpendicular ramp with level landing
for turn at top to use the sidewalk**



Planter strip and small radius make it easy to place two ramps per corner, well-lined up with crosswalks; returned-curb edges provide useful cue to crossing direction



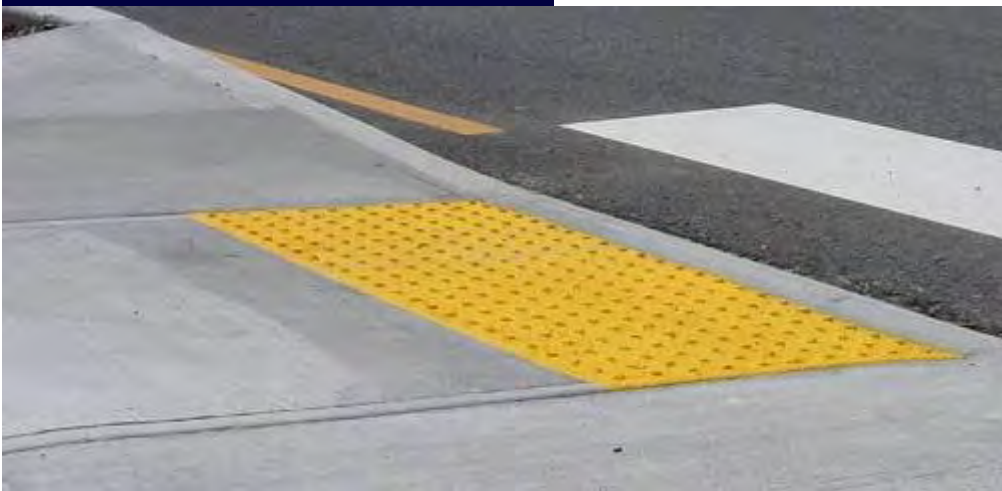
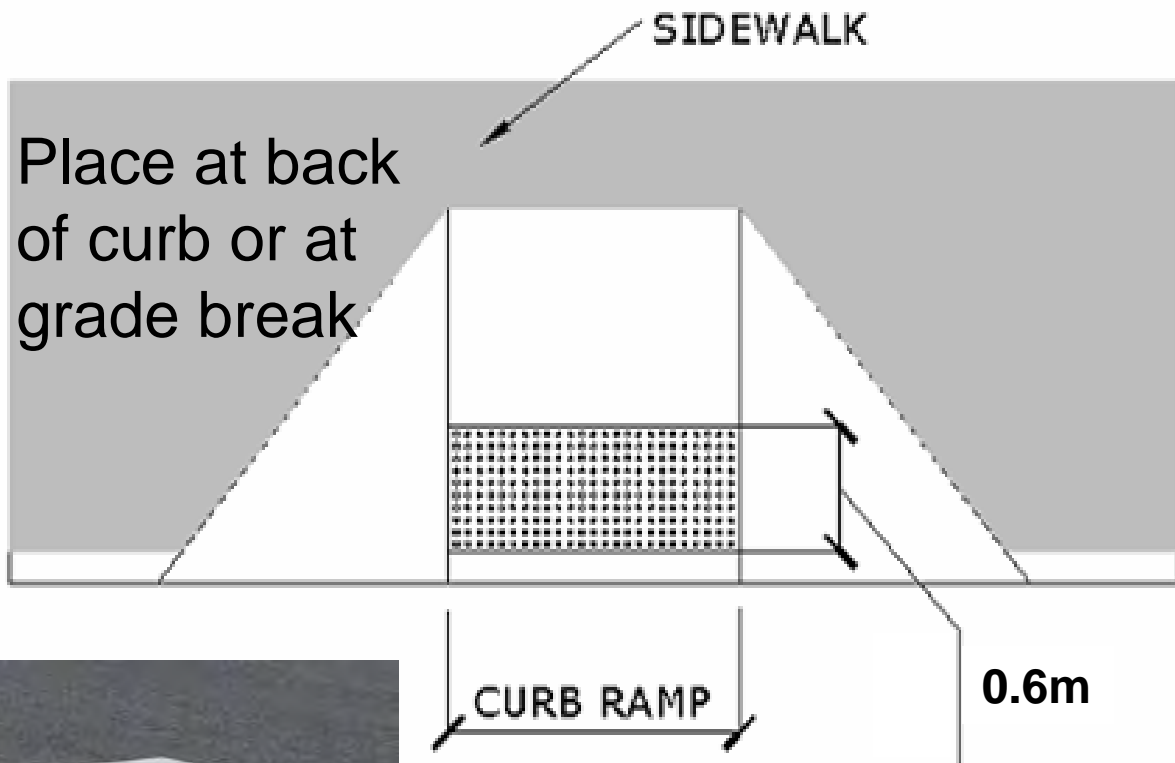
Ramps without landings can be retrofitted by adding landings behind the curb ramps





Perpendicular ramp with blocked landing: pedestrian must turn onto flare with rapidly-changing cross slope

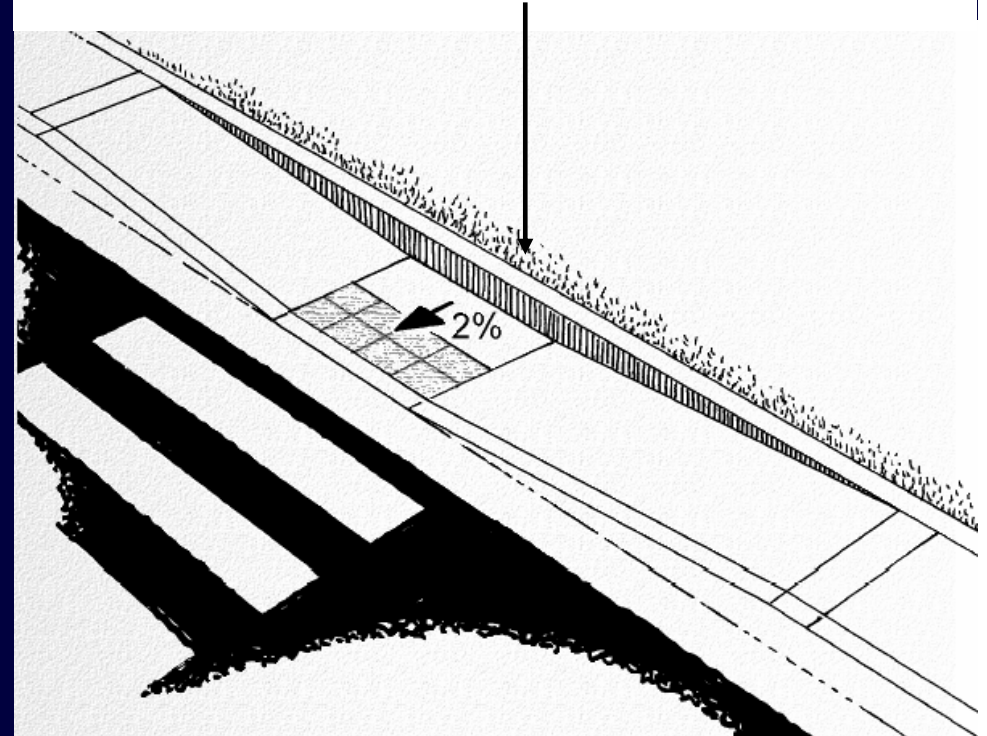
DW placement at perpendicular curb ramps

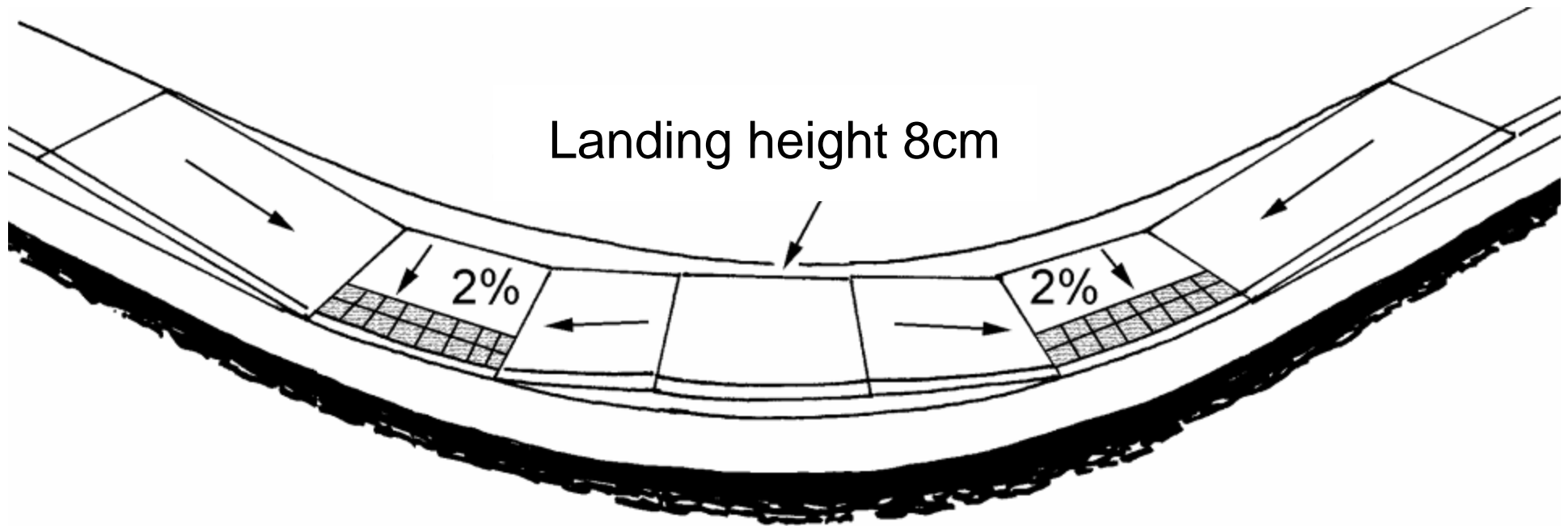


2. Parallel Curb Ramps

- Two ramps lead to a turning space at bottom
- Ramp parallel to curb
- Avoid entrapment: lengthen turning space to 1.5m for greater usability

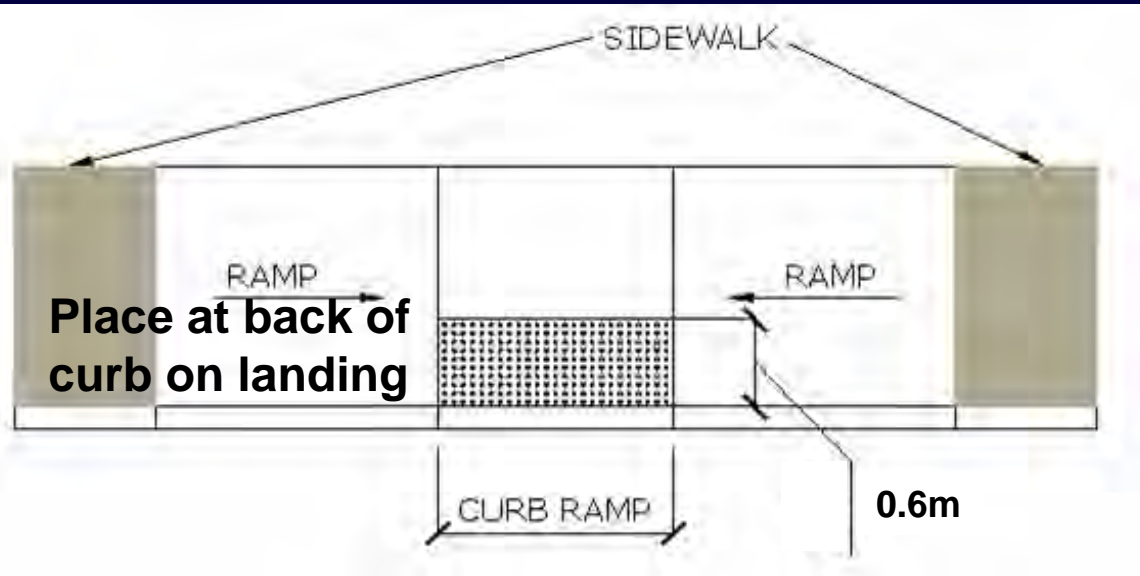
Curb at rear not required, but retains soil and provides edge for installation of ped button pole





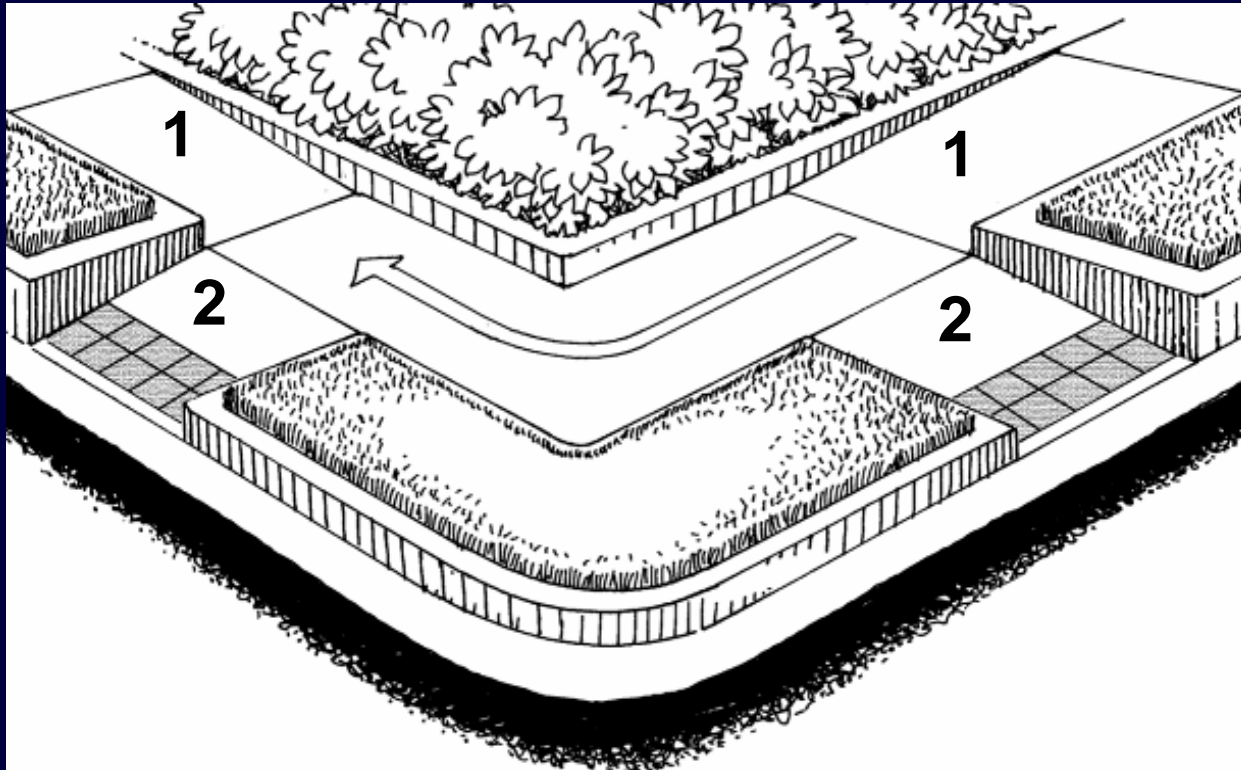
- 2 ramps preferred, but pedestrians continuing on sidewalk must negotiate 4 ramp grades
- Good practice: between 2 adjacent ramps, landing need not return to full curb height (recommend 8cm min for drainage); this allows ramps and crosswalks to be placed closer together and lessens the effort required

DW placement at parallel ramp



3. Combination Curb Ramps

1. Parallel ramps lower the elevation of the landing
2. Perpendicular ramps connect landing to street

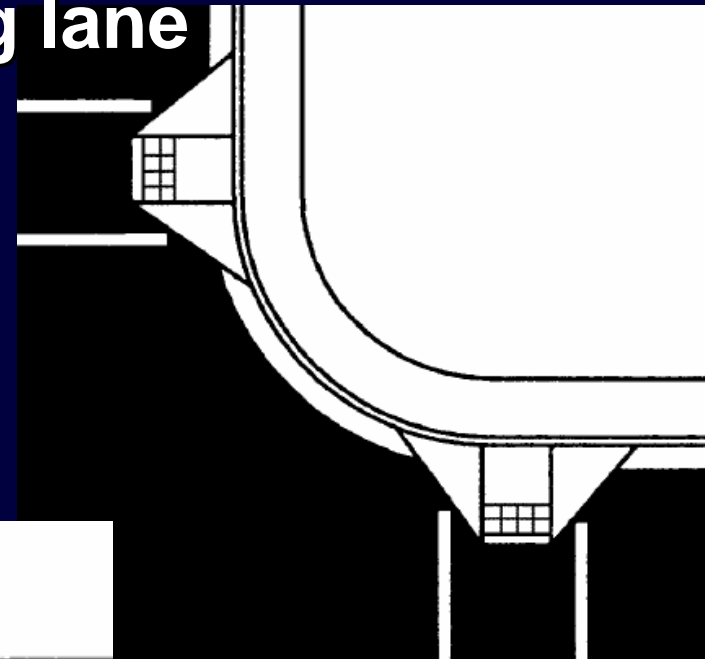


Useful where sidewalk is not wide enough
for a perpendicular curb ramp

4. Built-up Curb Ramps

Built-up ramps project from curb into street:

- **Users are exposed to vehicles**
- **Use where protected by parking lane**
- **May interfere with bicycling**
- **Drainage is difficult**
- **Partially built up ramp through gutter possible solution**



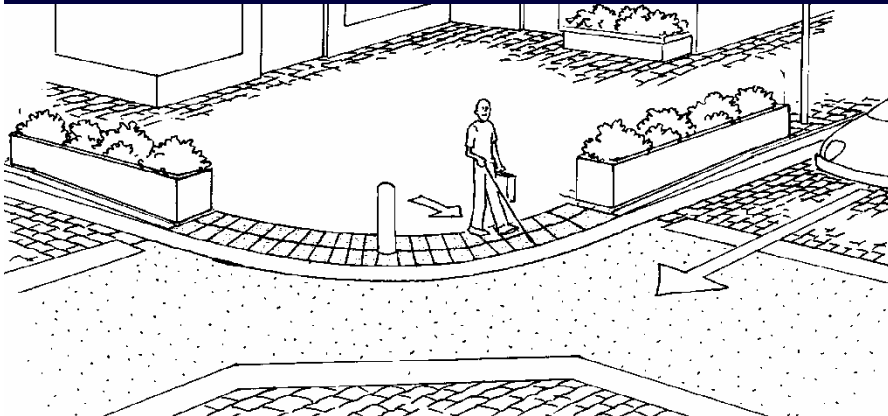
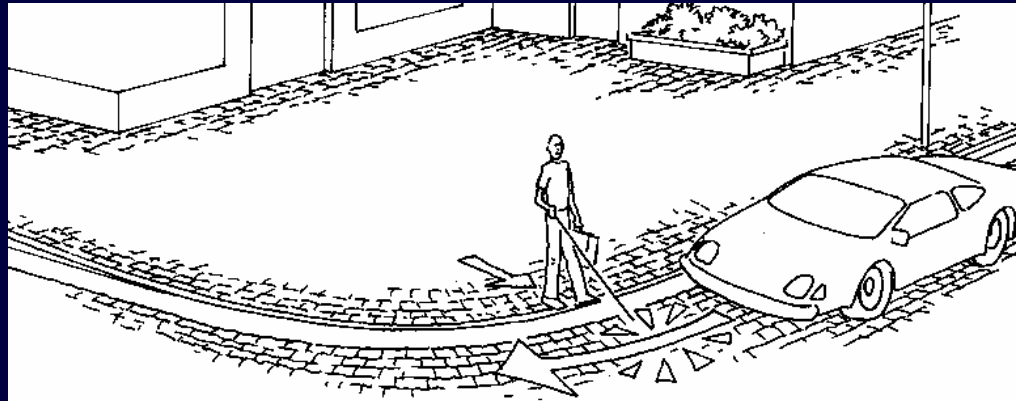


Built up curb ramp: not ideal, but a possible solution where existing sidewalk space is severely constrained

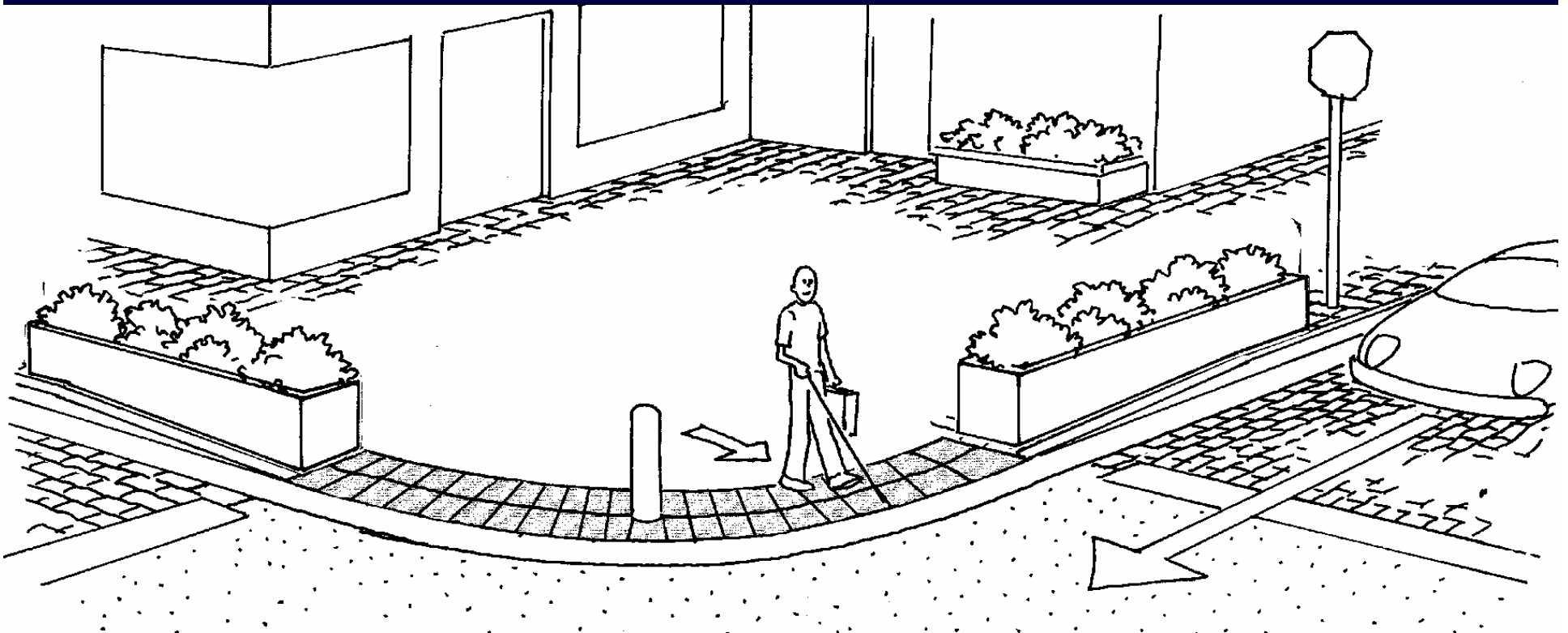
Blended Transitions

Blended Transitions

- Sidewalk elevation lowers to street with gradual change in slope (<5%)
- Children, people with cognitive impairments, dog guides may not distinguish street edge; DWs key
- May allow turning vehicles to encroach onto sidewalk (*mitigate with bollards*)



DW placement at blended transitions



Must be installed along entire flush transition



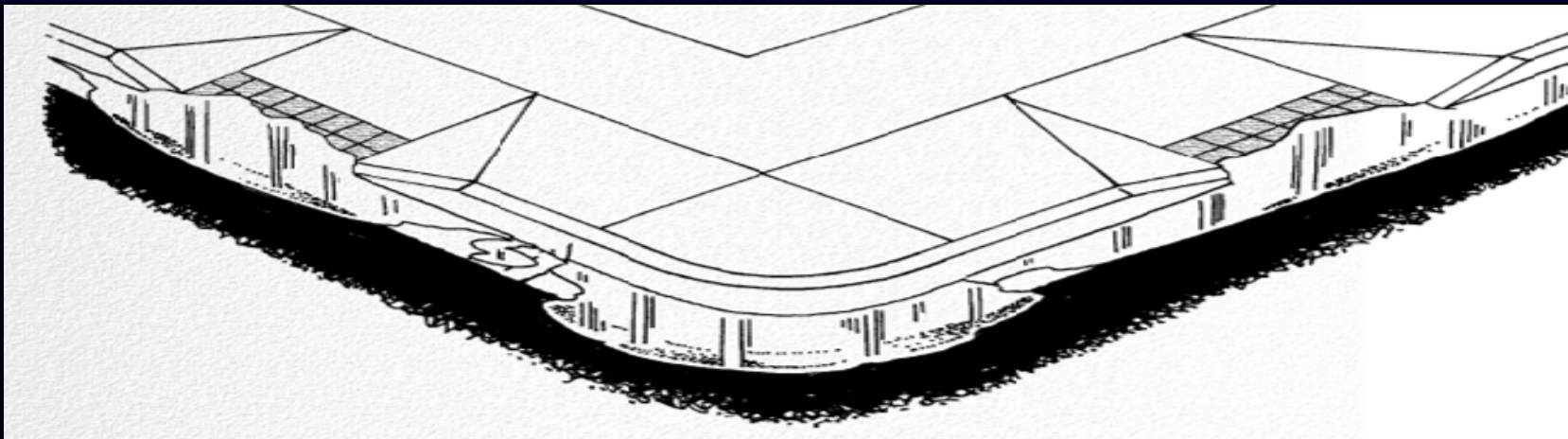
**Proper placement of DW on blended transition;
note that dome orientation is not an issue**

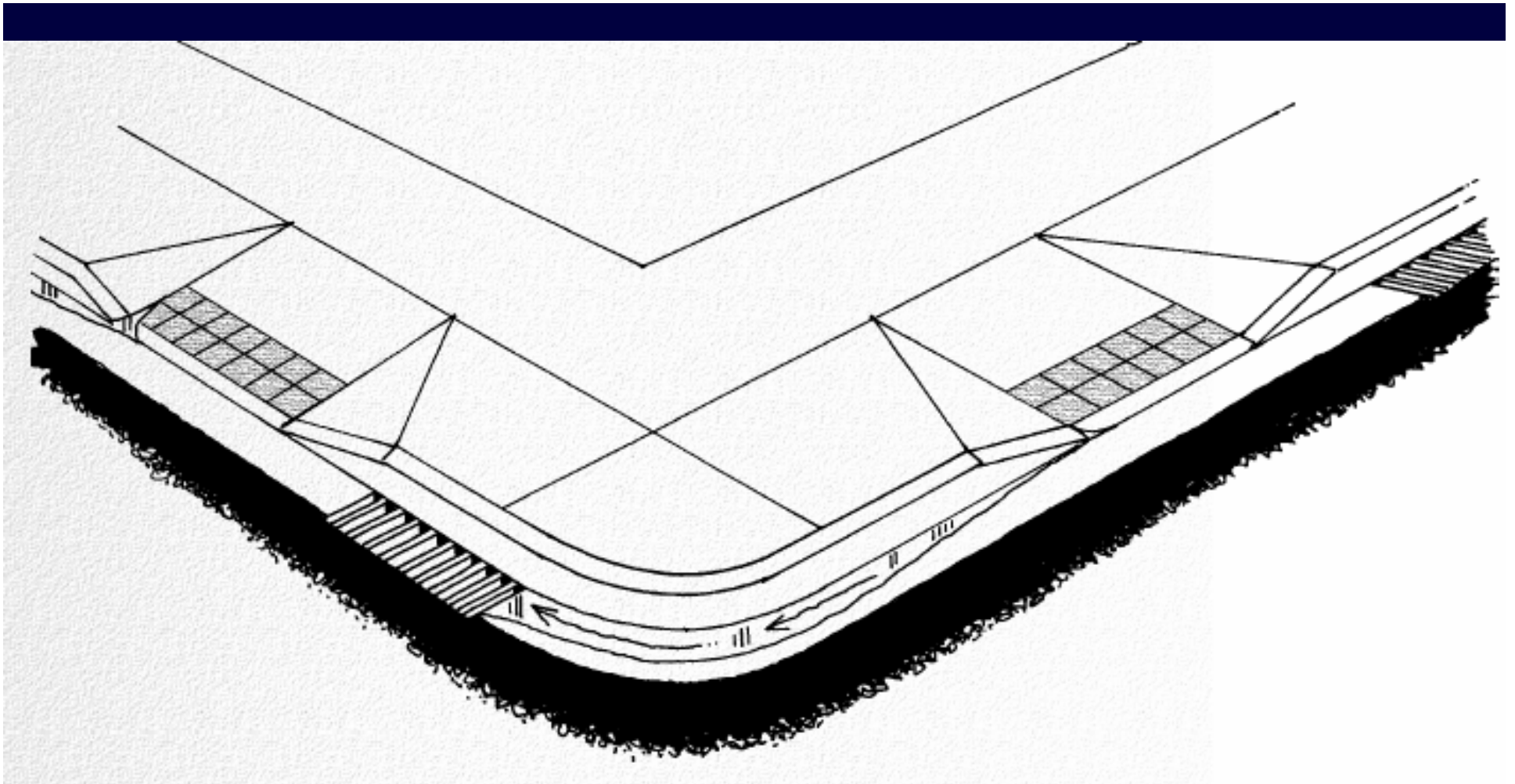
Drainage

Drainage at Curb Ramps

Water at the toe of a ramp can hide lips and holes; ice can affect traction. Plan upstream inlets to avoid ponding:

- Flat grades may result in standing water
- Consider trench drains at toe where water pools
- Consider projecting ramp toe through gutter where severe ponding is a problem

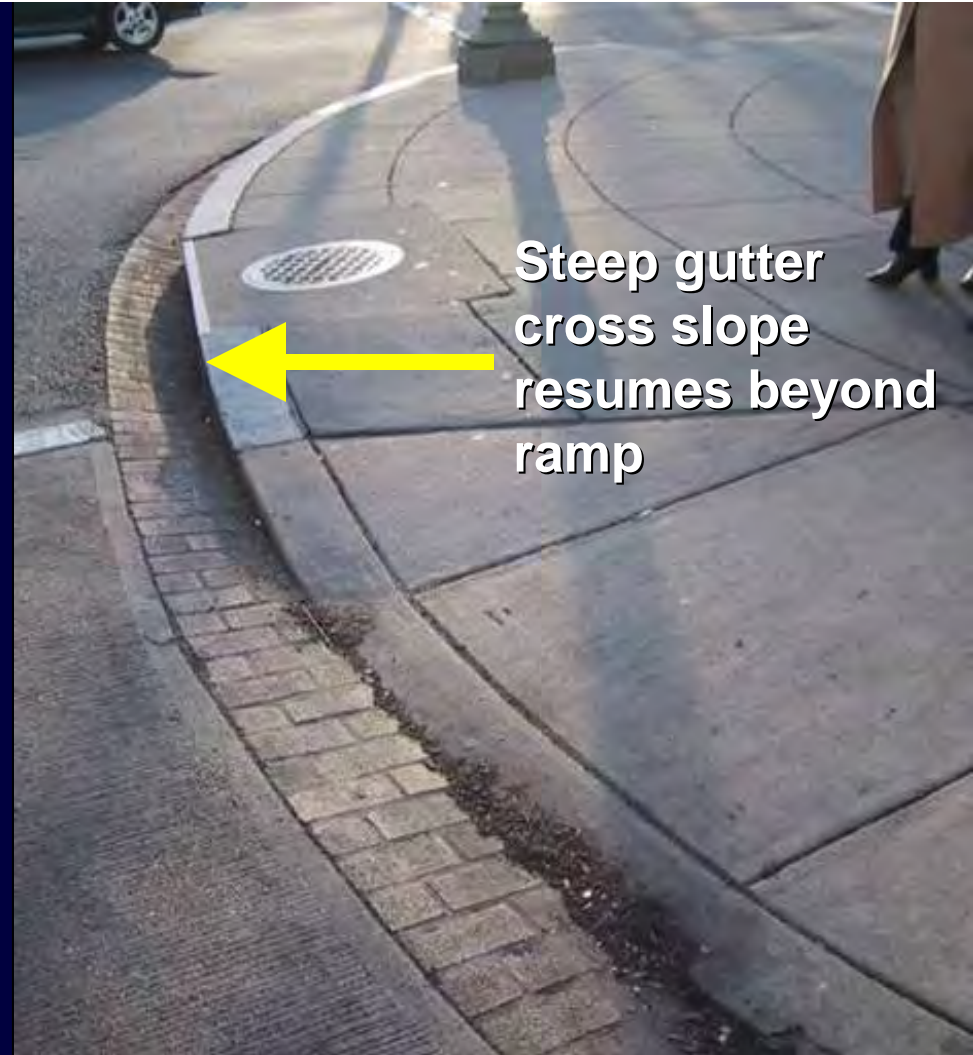




Drainage solution: inlets upstream of ramps



Drainage solution: inlets upstream of ramps



Other drainage solutions: gutter counter-slope flatter at ramp; projected ramp toe; trench drain at raised crossing

Questions?

EXERCISE: how do your standards for curb ramps compare to recommended best practices?

- **Width**
- **Slopes: running and cross slope**
- **Level landings for turning**
- **Detectable warnings**
- **Designs other than ‘standard’ perpendicular ramp**
 - Parallel, blended, combined

Designing Streets for Pedestrian Access

Module 5 Pedestrian Signals

IF YOU DON'T DESIGN OR INSTALL SIGNALS, WHY PAY ATTENTION?

Pedestrian pushbuttons must be located within accessible reach (next to curb ramps or level sidewalk areas)

Careful placement of Accessible Pedestrian Signals is essential to their function



What will be covered

- Pedestrian pushbuttons and pedestrian signal head locations
- Accessible pedestrian signals (APS)
 - Features
 - Location



Issues: What's wrong with this picture?

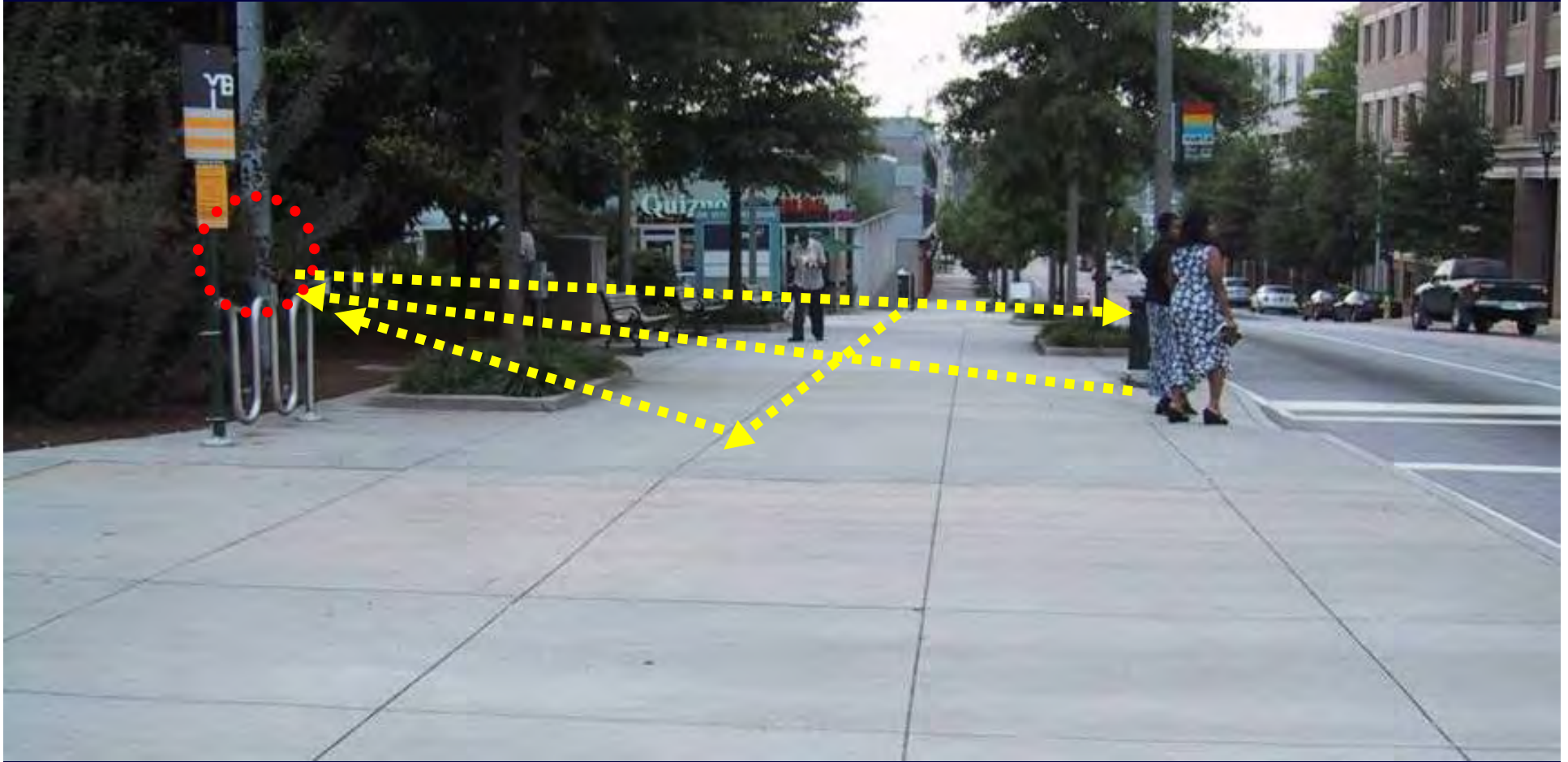


Let me count the ways...



- Too high
- Surface not paved between sidewalks and pole
- Can't tell which one controls which street
- Hard to find for pedestrians with visual impairments
- Buttons are too small and recessed

Issue: Pushbutton location



- Find the pushbutton. Now line up to cross.
- Missed your chance? Do it again

Pushbutton location

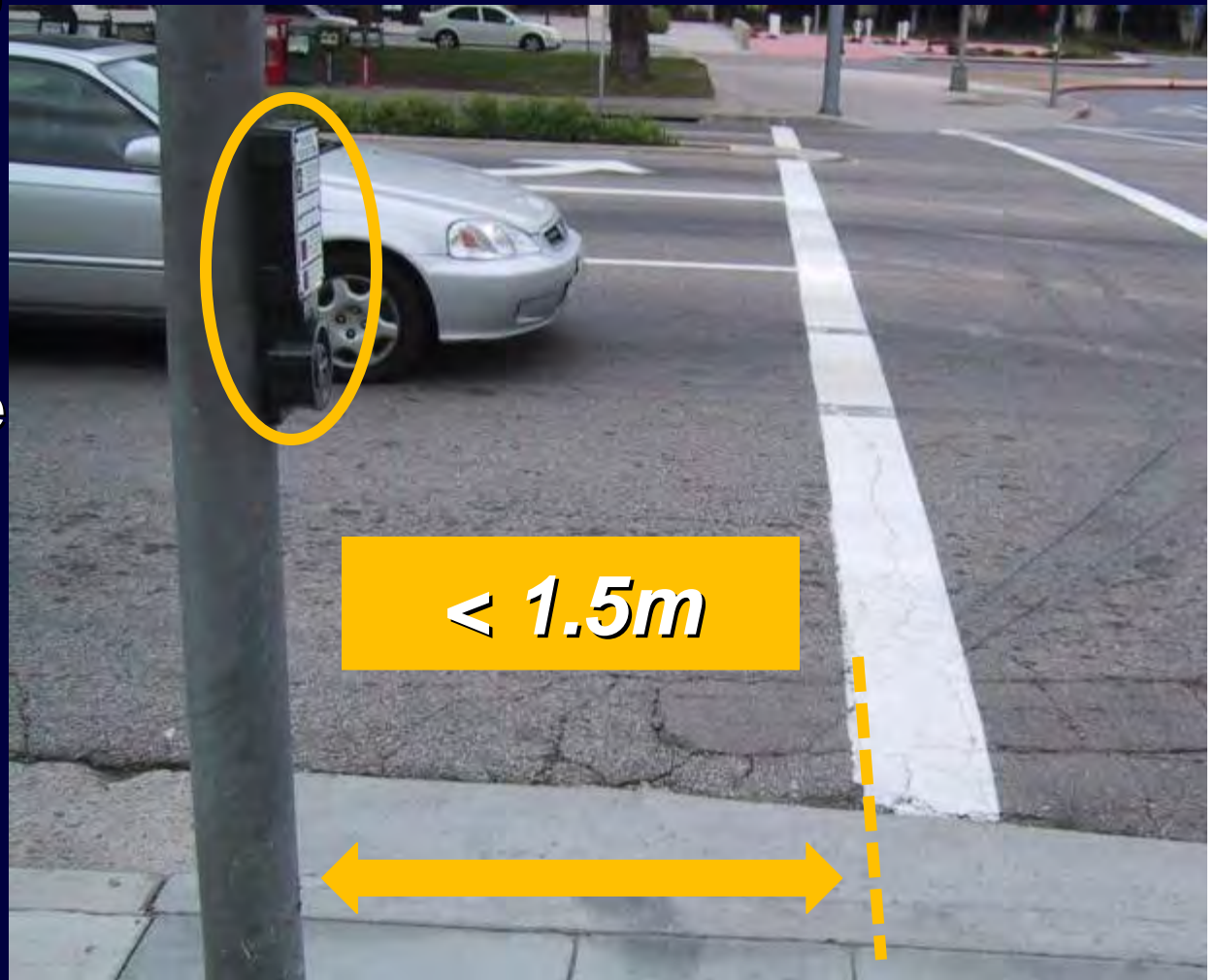
- Unobstructed
- Beside level all-weather surface
- Where there is a wheelchair accessible route from the pushbutton to the ramp



Route to ramp

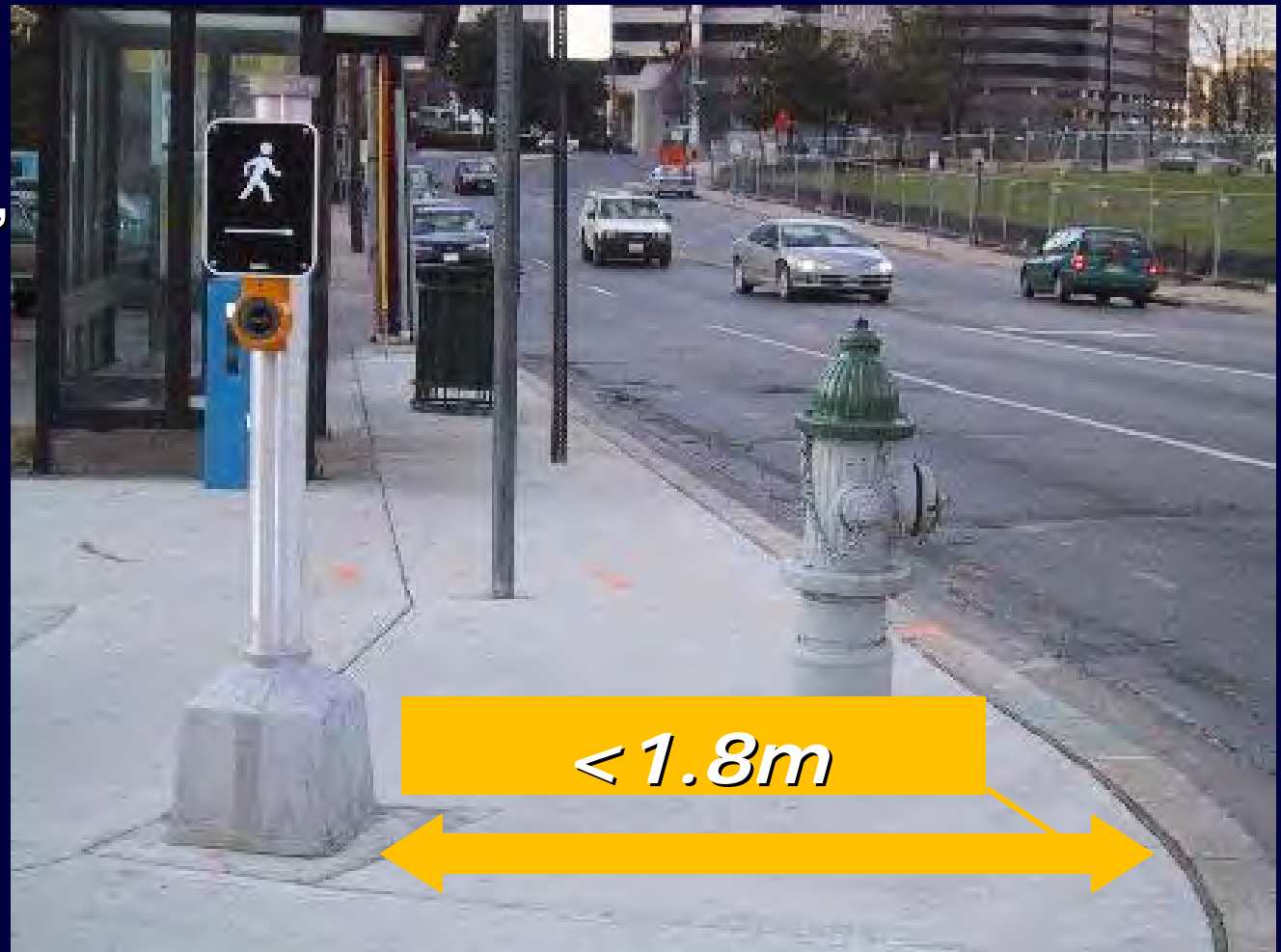
Pushbutton location

- Between curb ramp and crosswalk line furthest from intersection
- No more than 1.5m from crosswalk line



Pushbutton location

Between 0.5m
and 1.8m from
the edge of curb,
shoulder or
pavement



Pushbutton location

- Face of pushbutton parallel to crosswalk



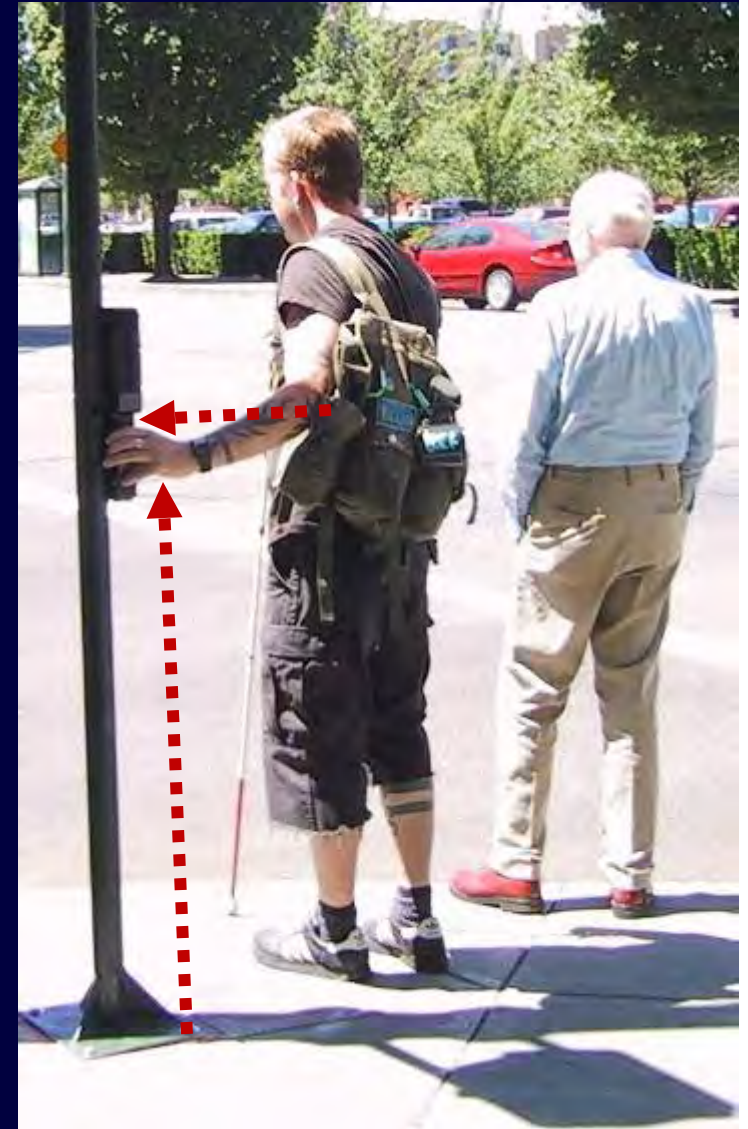
Pushbutton Location - Mounting Height

Vertical reach:

- Between 1m & 1.2m

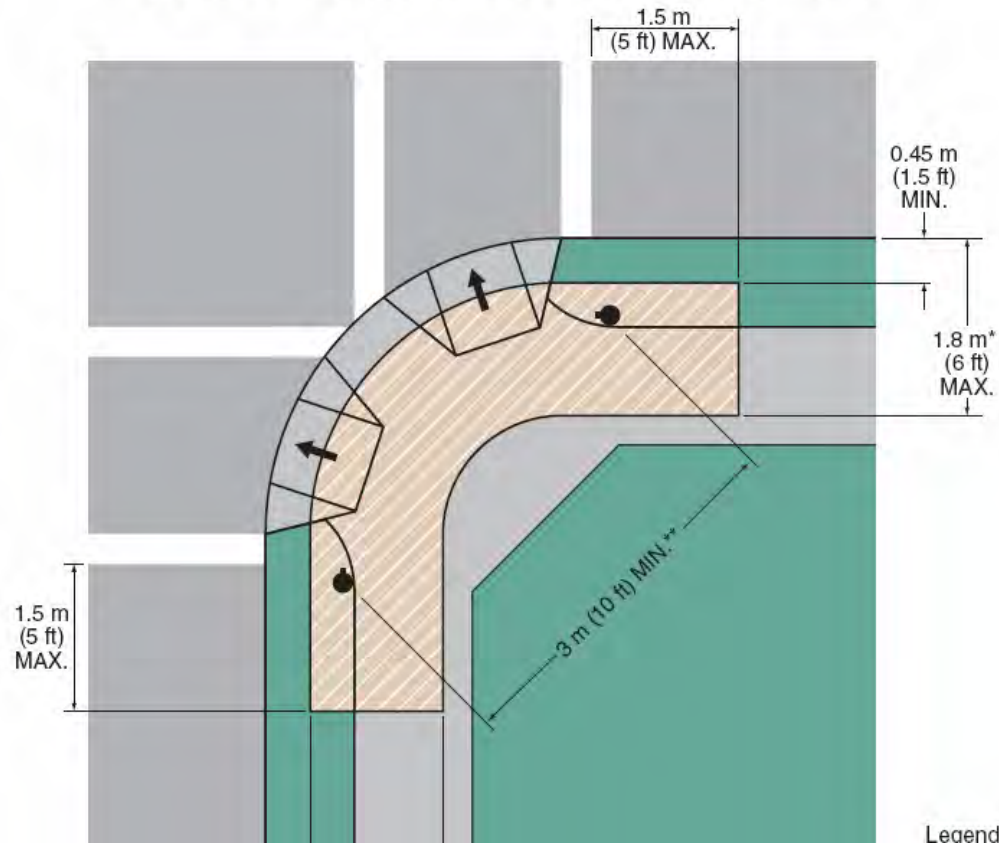
Horizontal reach

- 25cm max

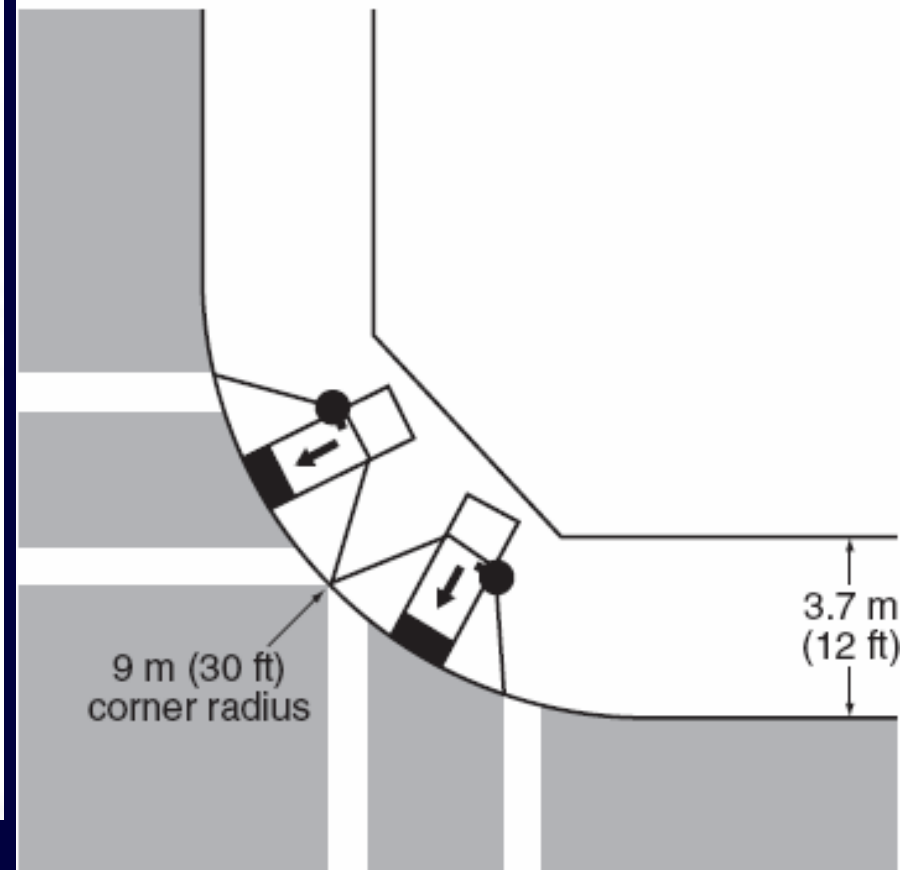


Proposed 2009 MUTCD Pushbutton Locations

Figure 4E-2. Recommended Pushbutton Locations

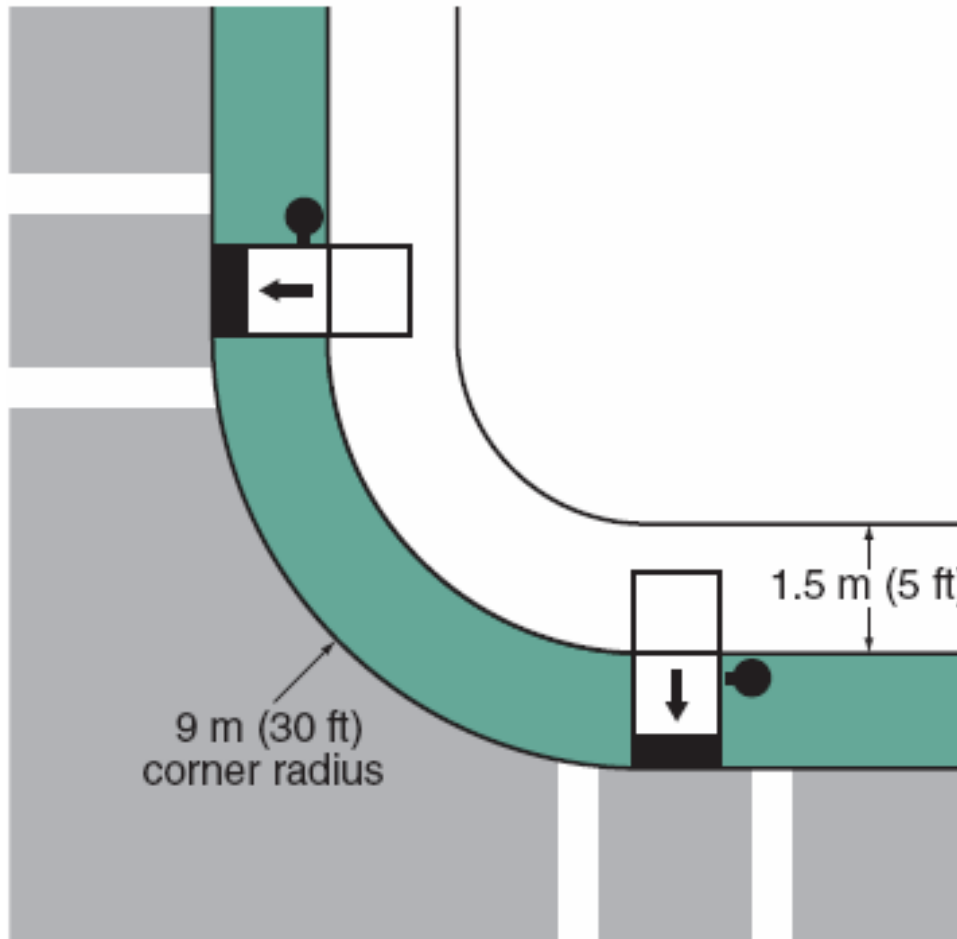


E - Perpendicular ramps with crosswalks close together

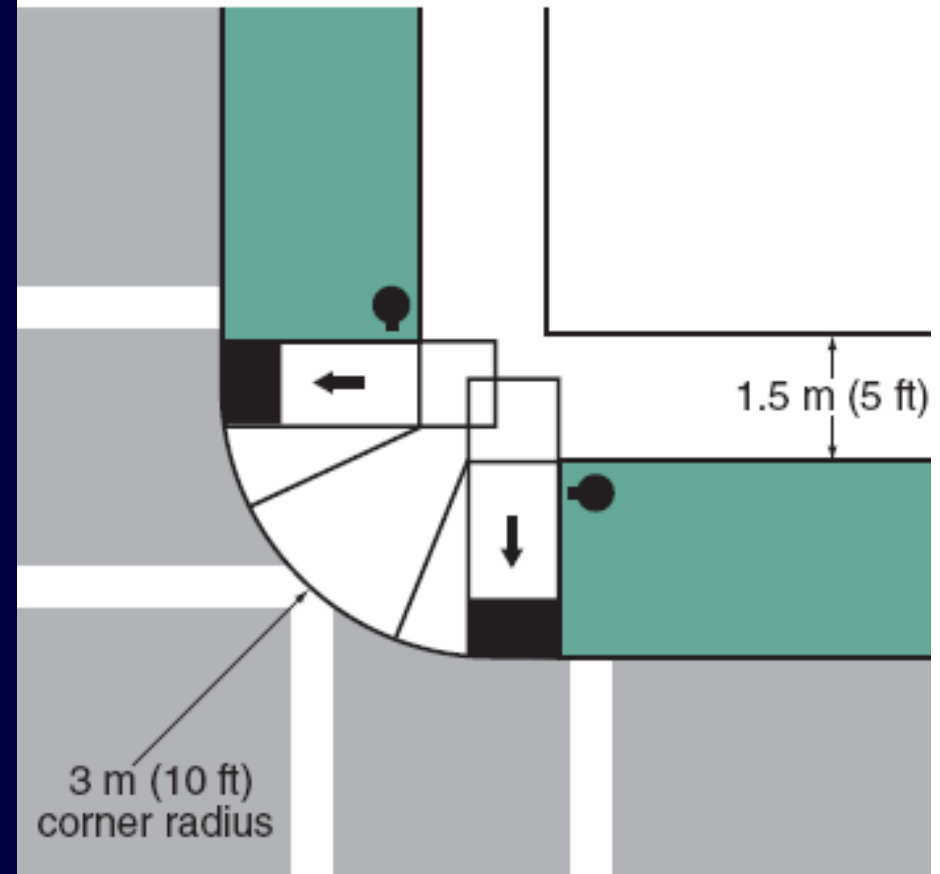


Proposed 2009 MUTCD Pushbutton Locations

F - Perpendicular ramps with sidewalk set back from road with crosswalks far apart



H - Perpendicular ramps with sidewalk set back from road with continuous sidewalk between ramps



Issue: Pushbutton operation

Recessed pushbutton with small diameter doesn't meet the 'closed fist' test for controls and operating mechanisms



Issue: Pushbutton size and operation

Size:

- 5cm diameter min
- Visual contrast with housing or mounting

Operation:

- Operable with one hand without grasping, pinching or twisting wrist
- Actuation force: 2 kg max



Issue: visual signal head placement



Good placement of visual signal head



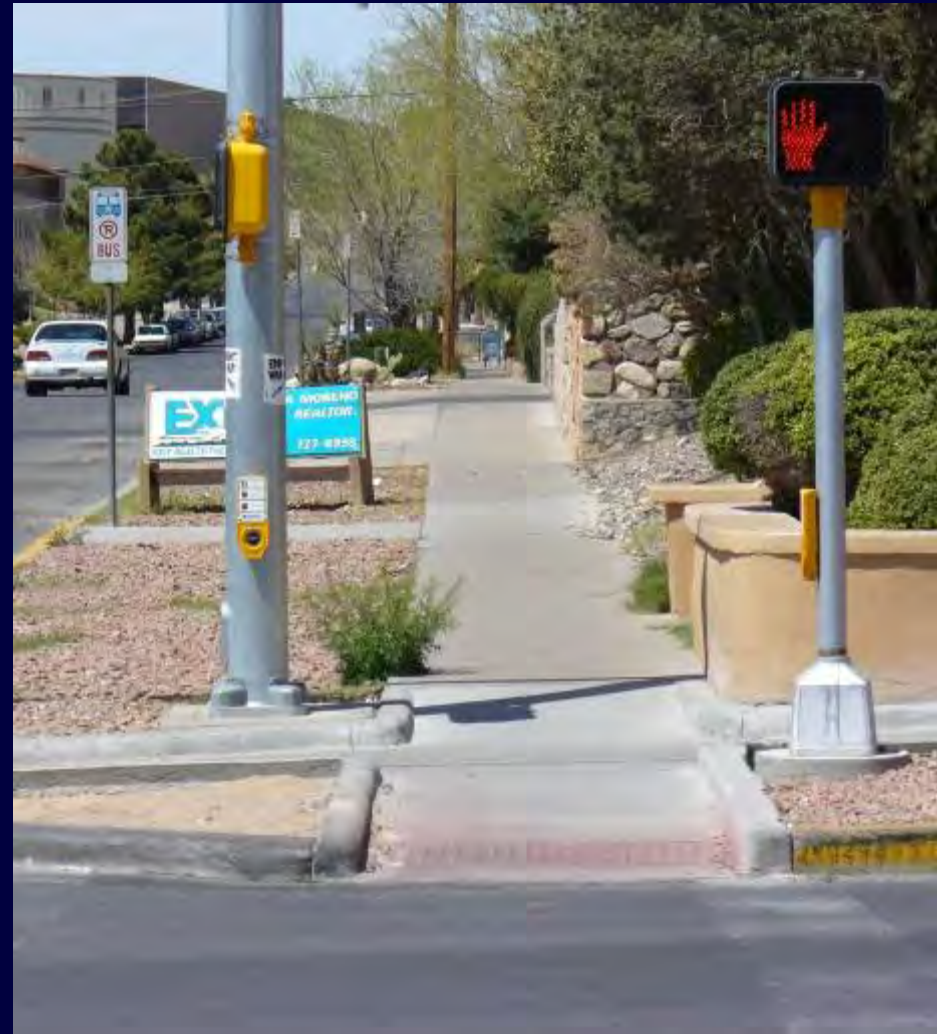
Good pedestrian pushbutton and pedestrian signal head placement

Good:

- Pushbutton separation
- Mounting height
- Horizontal reach (right)
- Visual display location

Pretty good:

- Horizontal reach (left)



Accessible Pedestrian Signals (APS)

- **Provide pedestrian signal information in usable formats, both audible and vibrotactile**
- **Benefit all pedestrians by providing redundant information**
- **Increase the efficiency of pedestrian timing (research shows reduction in vehicle delay)**

Travel without vision cues

Traditional techniques

- Listen and analyze traffic patterns
- Use traffic for alignment and crossing cues

Those techniques work when...

- Pushbutton use is not required
- Traffic movement is predictable
- There is a surge of cars starting and traveling parallel to crossing

Traditional techniques don't work at many intersections now



Pushbutton-integrated APS

- Other types of APS have been installed, but don't provide benefits of pushbutton-integrated devices
- *No longer recommended:*
 - Pedhead-mounted (cuckoo/chirps)
 - Vibrotactile-only




Key features: Pushbutton-integrated APS

- Speakers at pushbutton
- Pushbutton locator tone
- Tactile arrow
- Audible and vibrotactile walk indications
- Automatic volume adjustment



APS location is critical to proper functioning

Pushbutton Locator Tone

- Repeating tone, once per second from pushbutton (all the time during flashing and steady don't walk)
 - Informs approaching pedestrians there's a pushbutton
 - Enables pedestrians to locate pushbutton
- Volume set to be heard within 6 to 12', or at building line, whichever is less 
- Different sounds acceptable (three examples)

Tactile / vibrotactile arrow

- Aligned with direction of travel on crosswalk
- May be on pushbutton, or on part of device, or on sign above pushbutton



Tactile Arrow – examples



WALK indications

- **Audible WALK indication: tone or speech message during WALK**
- **Vibrotactile WALK indication: arrow (or other surface on pushbutton unit) vibrates during WALK**

Provides signal information to people with hearing impairment

Must be located close to crosswalk

Example of rapid tick walk indication



- **Pushbutton locator tone, followed by rapid tick walk indication**
 - **Hear the locator tone during flashing and steady don't walk**
 - **Walk indication during WALK**

(Click photo to play sounds)

Example of speech walk indication

- Pushbutton locator tone, followed by speech walk indication
 - Hear the locator tone during flashing and steady don't walk
 - Walk indication during WALK
- Must be accompanied by:
- Tactile arrow
- Pushbutton information message



Automatic Volume Adjustment

- **APS adjusts in response to ambient sound:**
 - Quiet when traffic is quiet
 - Louder when traffic is louder
- **Increased volume can be provided by some devices “on request”**
 - Requested by pushing pushbutton in for over 1 second
 - Called “audible beaconing”

APS location is critical

- Provides information to user at departure point
 - Audible (can be quieter)
 - Vibrotactile within reach
- Imposes less cognitive load on pedestrians
 - “I have pushed the button on my left”
 - “The WALK indication is coming from my left”
 - “That sound is for my crosswalk”



APS location example



APS location example

**Additional pedestal
can be installed to
locate APS and
pushbutton close
to crosswalk
controls**



Additional APS Features: Pushbutton Information Message

- Message provides street names and other intersection information
 - Necessary if speech WALK indications are used
- Plays when pushbutton is pressed for 1 second or more, during steady or flashing DON'T WALK



(Click photo to play message)

QUESTIONS?

Designing Streets for Pedestrian Access

Module 6 Maintenance and Temporary Traffic Control

What will be discussed

- **Temporary Traffic Control for Pedestrian Facilities**
- **Appropriate Barricades**
- **Alternate Routes**
- **Public Information**

Temporary Pedestrian Routes

Includes:

- Sidewalks
- Shared Use Paths
- Curb Ramps
- Crosswalks (marked and unmarked)
- Pedestrian signals
- Access to transit stops and shelters



Tools to Minimize Impacts

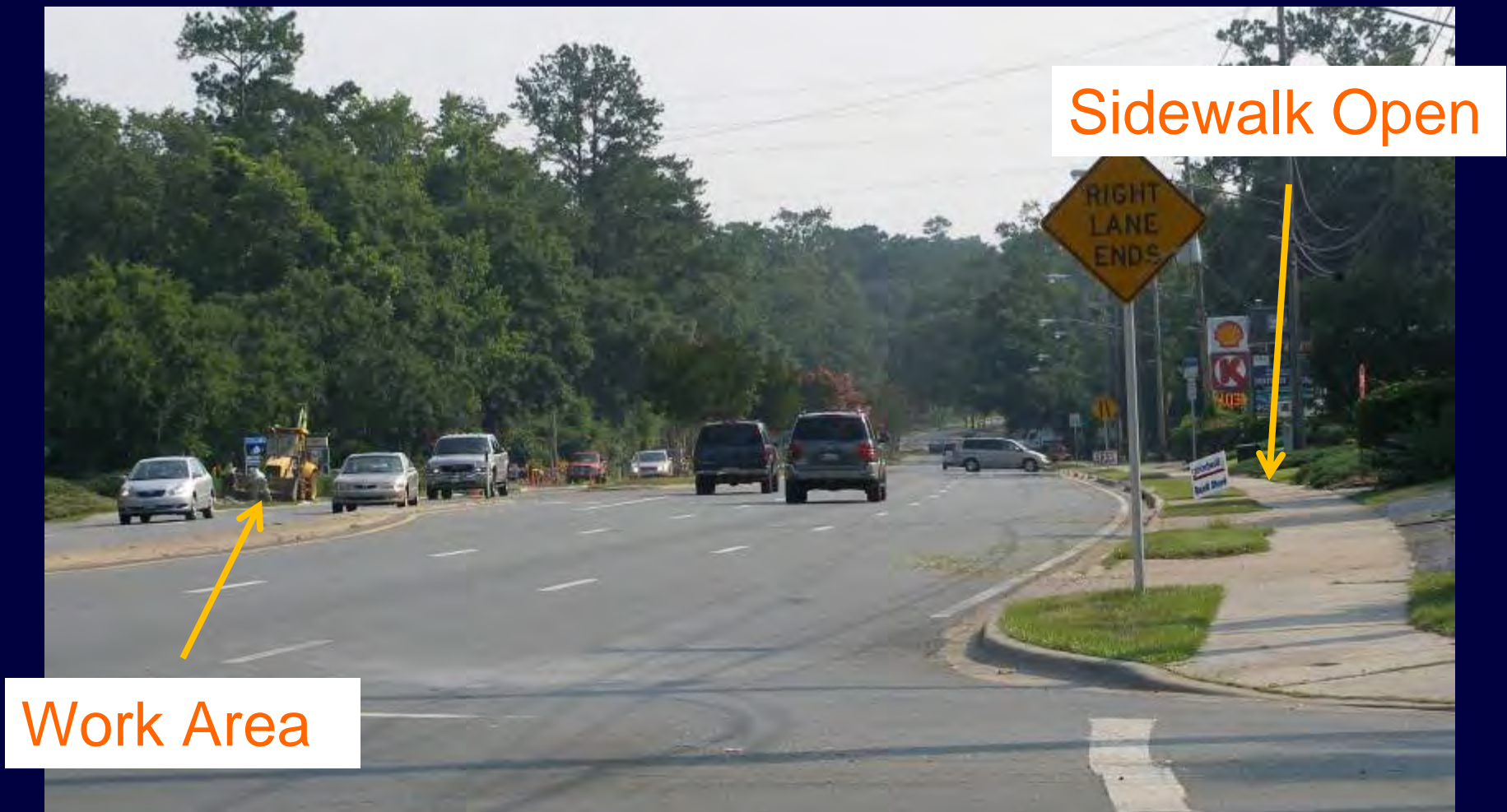
- **Construction Phasing**
- **Use of Detailed Plans**
- **Signing and Staging of Work at Location**
- **Effective Barriers**
- **Accessible Alternate Routes**
- **Inspector Training**
- **Public Information**

Construction Phasing

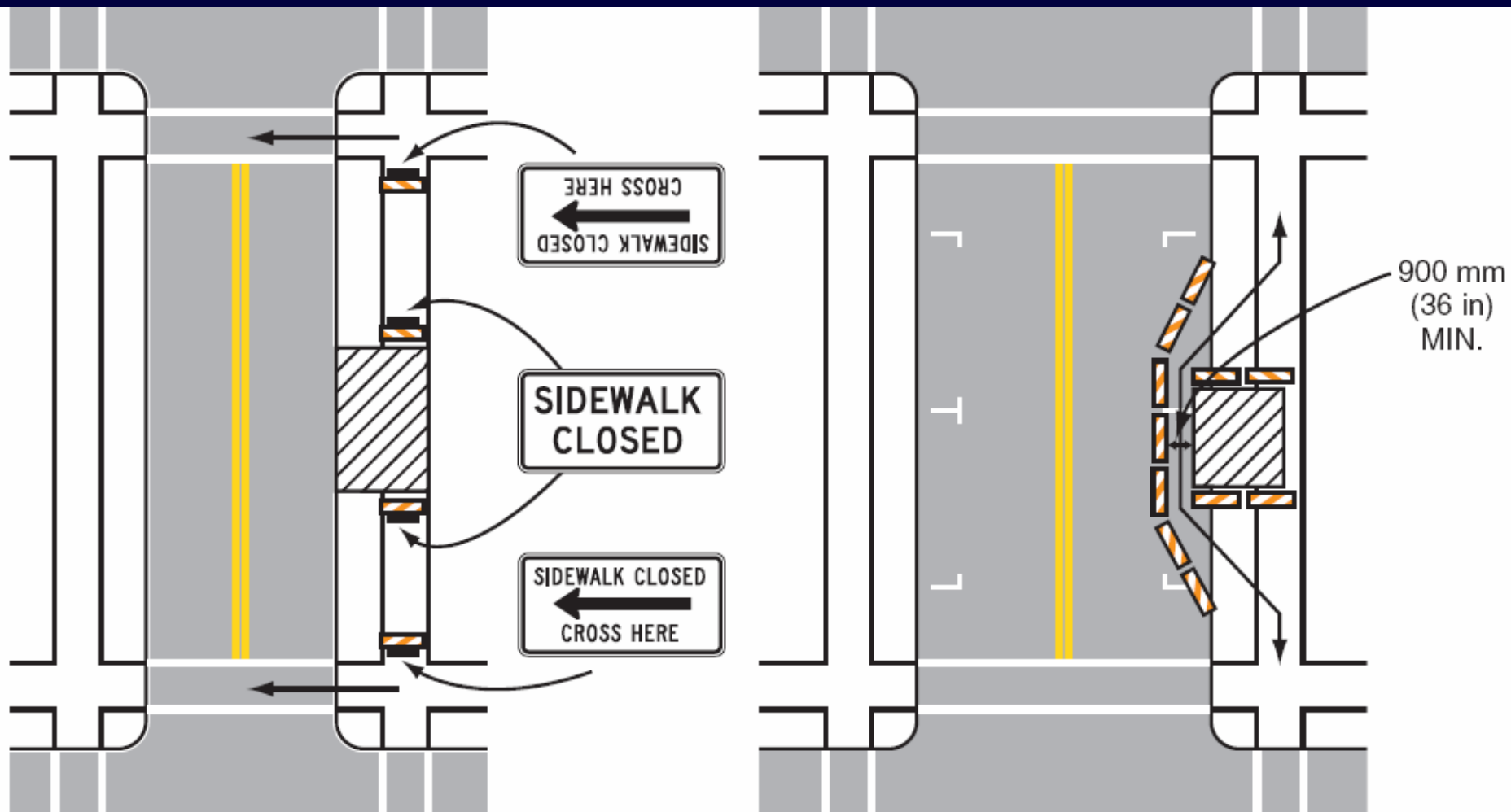
- Build new sidewalk early in project
- When replacing sidewalks, work on one side of street at a time, length that can be replaced next day
- On bridges, build sidewalk wide enough to accommodate two-way bicycle and pedestrian travel
- Maintain accessible crossings through work zone



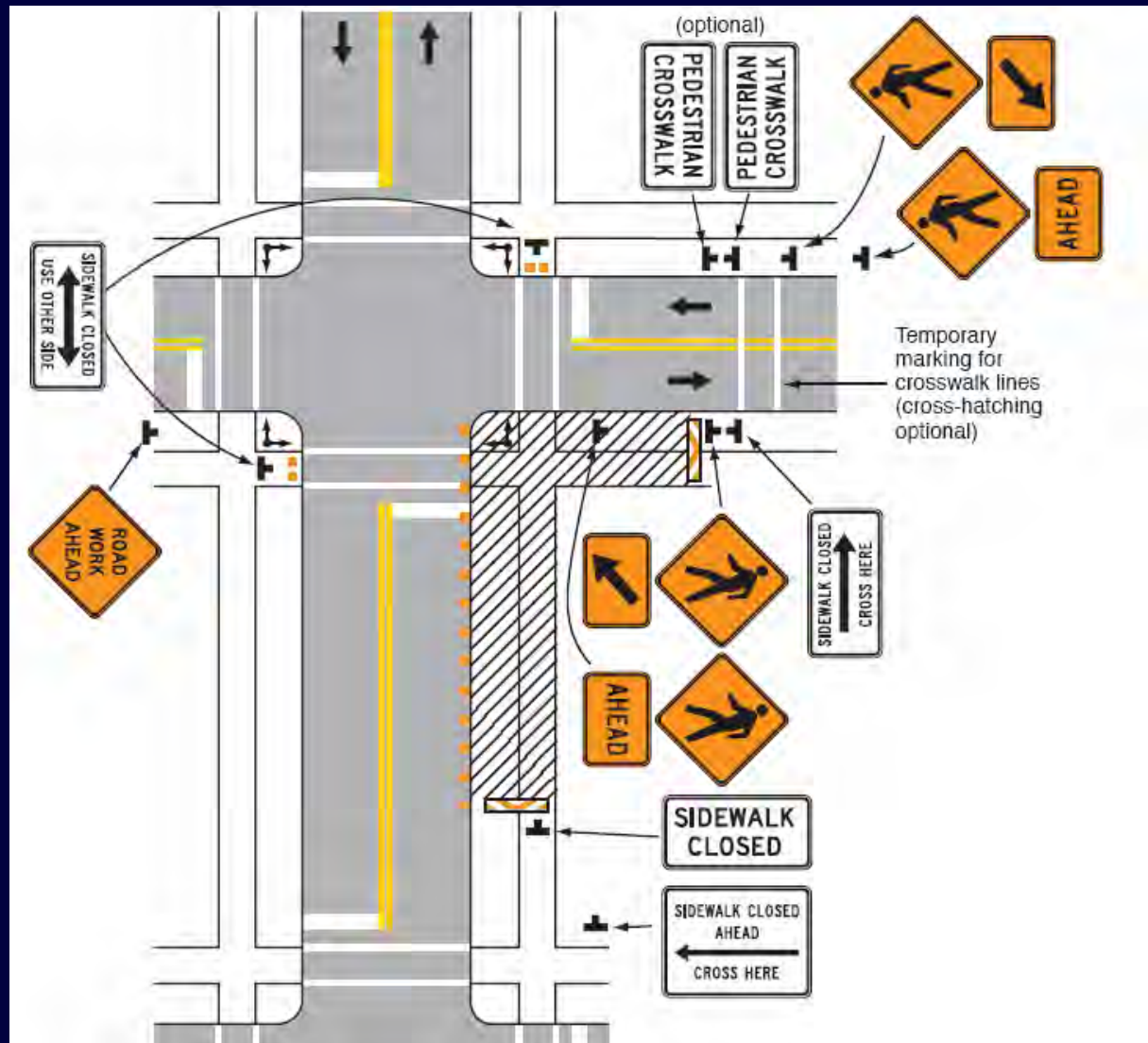
Staging to Maintain Alternate Route



Sample Sidewalk Detour Figure



Sample Crosswalk Closure Figure



Typical construction site problems

- “Sidewalk Closed” sign placed too far down the block
- No alternate route
- Barrier does not provide adequate warning



Better option!

- “Sidewalk Closed” sign placed in advance of construction impact
- Does not block access to ramp or push button
- At accessible, controlled crossing point



Additional sign downstream reinforces message



Alternate Route





Provide temporary curb ramps where needed

Curb Cut Ramps



identify temporary locations in plans

Sign Placement in Work Area – Maintain Clear Sidewalk



- Use appropriate scale signs & type to convey message
- Limit signs placed on sidewalk to those needed to maintain pedestrian route



Barriers

- Accessible barricades should be provided when construction occurs in the public right-of-way
- Barriers defining the alternate route should:
 - Be 0.9 & 1.1m high and continuous within 15cm of the ground
 - Extend perimeter of construction site or entire length of alternate route





Provide crash-worthy barriers when temporary route is in roadway



Min 0.9m wide, 1.2m preferred.

Extend barrier around entire construction area

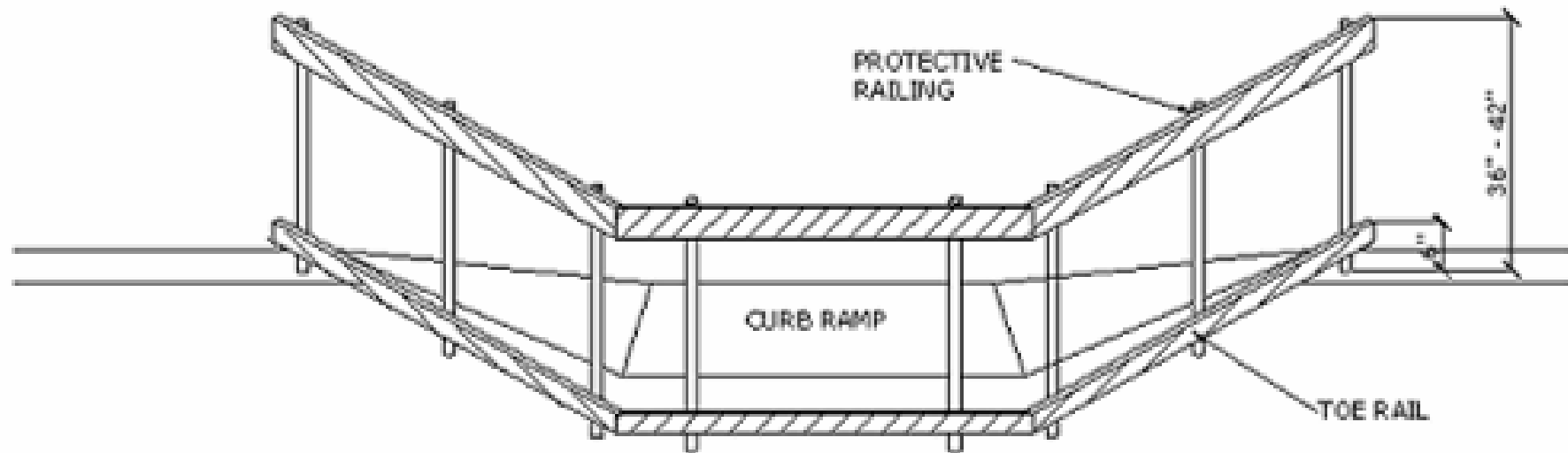


**Design solution:
Turn protruding blocks and make them visible.**

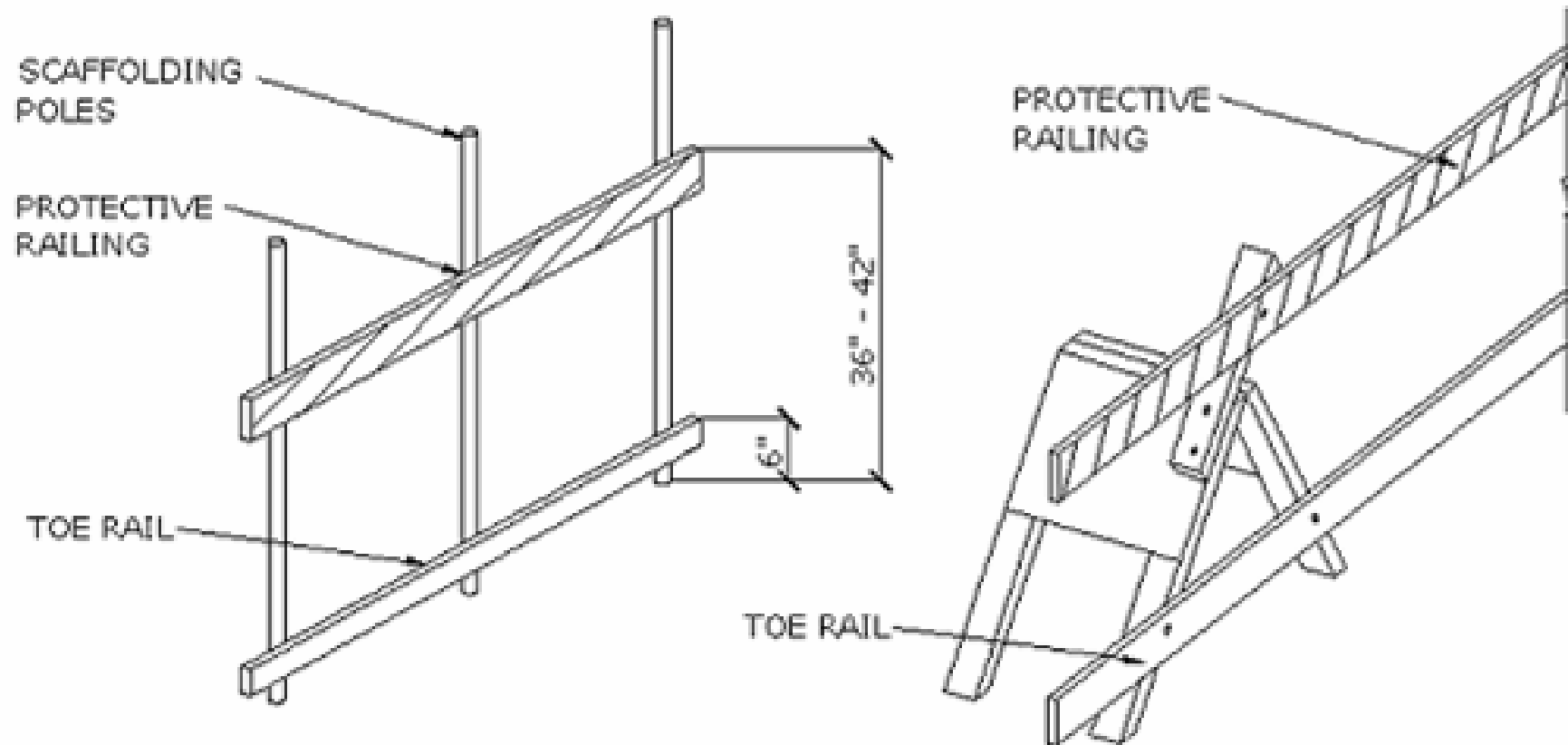
Typical construction site problems



**Ineffective barriers (plastic tape)
around site doesn't provide detection.**



Effective detectable barricade at curb ramp to indicate a temporary crosswalk closing.



Examples of methods to construct detectable barricades.



**Examples of accessible barricades
tested at event in 2004.**

Typical construction site problems



Pedestrian zone blocked by materials or equipment

Typical construction site problems

- Restricted access to curb ramps, crosswalks
- Alternate routes not provided
- Pedestrians forced to take circuitous, unpredictable or dangerous routes





Design solution: Temporary ramps and boardwalks ensure smooth continuous surface



Design solution: Innovative use of aluminum panels to create temporary ramp and boardwalk