Pedestrian Facility Design

Overview

Pedestrians can be viewed as the foundation of the transportation system as essentially every trip begins and ends with pedestrians. This is a diverse group with different facilities needs. There are four primary design elements for pedestrians that will be discussed. Strengths of different facility types, how to plan for the American with Disabilities Act (ADA), and theories such as Universal Design will all be discussed to give planners and advocates a better idea of how to create a welcoming pedestrian environment.

Learning Objective:

- Identify the needs of different types of pedestrians
- Apply the concepts of the "4 Ds" to pedestrian facilities.
- Compare types of facilities that are available in the pedestrian environment
- Judge which types of facilities are appropriate in different environments

Suggested Use

_x_ Professional Development _x_ Graduate Level _x_ Undergraduate

Time Required

__ Less than 1 hour __ 1 hour _x_ 2-3 hours __ Half-day Workshop __ Full-day Workshop

Instructions

1. Announce purposes and give brief overview of the day
2. Give lecture
3. Summarize lecture and discussion
4. Assignments
5. Circulate handouts and evaluations

Lecture

"Pedestrian Facilities Planning"

1. Nature of Walking
2. Pedestrian Characteristics
3. Pedestrian Design Elements
4. Design for Walking & ADA
5. Discussion

Materials/Handouts

- FHWA Pedestrian Facility Design

- "Dangerous by Design 2011: Solving the Epidemic of Preventable Pedestrian Deaths." Report by Transportation for America.

Assignments and Activities

Description of group/individual work, discussion, audit, etc.

Suggested Readings

"Improving Pedestrian Access to Transit – An Advocacy Handbook". WalkBoston.
http://safety.fhwa.dot.gov/ped_bike/docs/fta.pdf

"Improving Pedestrian Access to Transit Stations in Less Walkable Environments". Park, RyanSherman.
http://www.walk21.com/papers/Park.pdf

"Roadway and Pedestrian Facility Design" from WalkingInfo.Org:
http://www.walkinginfo.org/engineering/roadway.cfm

"Dangerous by Design 2011: Solving the Epidemic of Preventable Pedestrian Deaths." Report by Transportation for America. http://t4america.org/docs/dbd2011/Dangerous-by-Design-2011.pdf

Related Modules

- Bicycle Facilities Design
- Bicycle and Pedestrian Master Planning
- Trail Design

April Bertelsen, Pedestrian Coordinator for the City of Portland, contributed significant content to this presentation.

This lecture will cover the following topics:

-The nature of walking
-Pedestrian Characteristics
-Pedestrian Design Elements
-Design for Walking and ADA
-Discussion

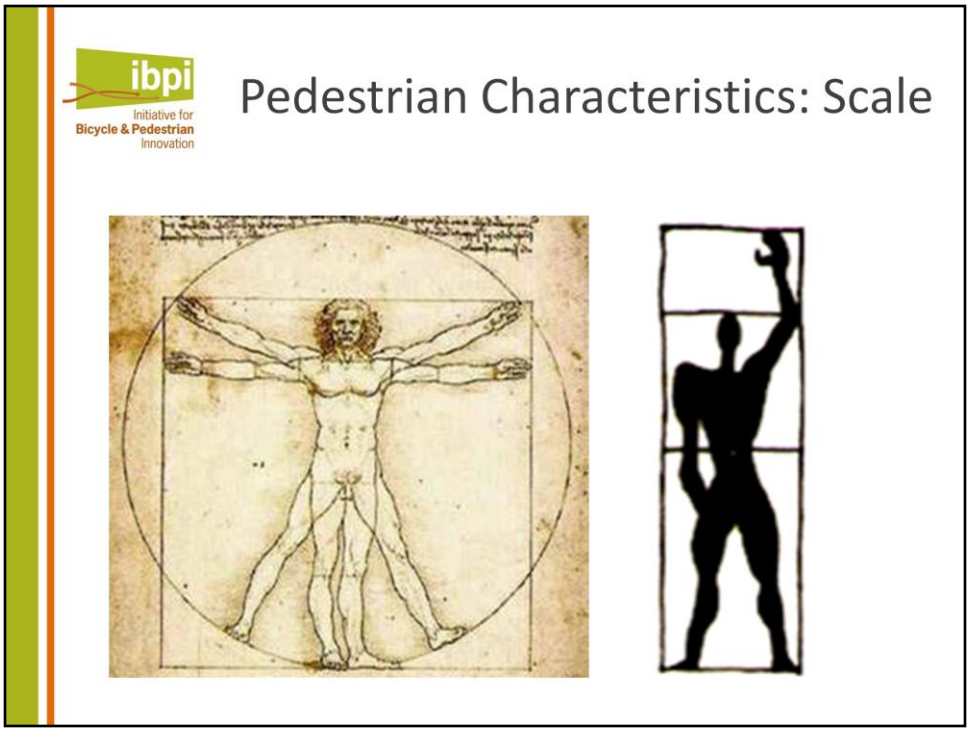
Nature of Walking: Recreation

People think of walking as a recreational activity, something to do for exercise, which is often done on a trail or in a park setting

But walking for transportation is also important

-Either for short trips for errands, shopping, or dining,

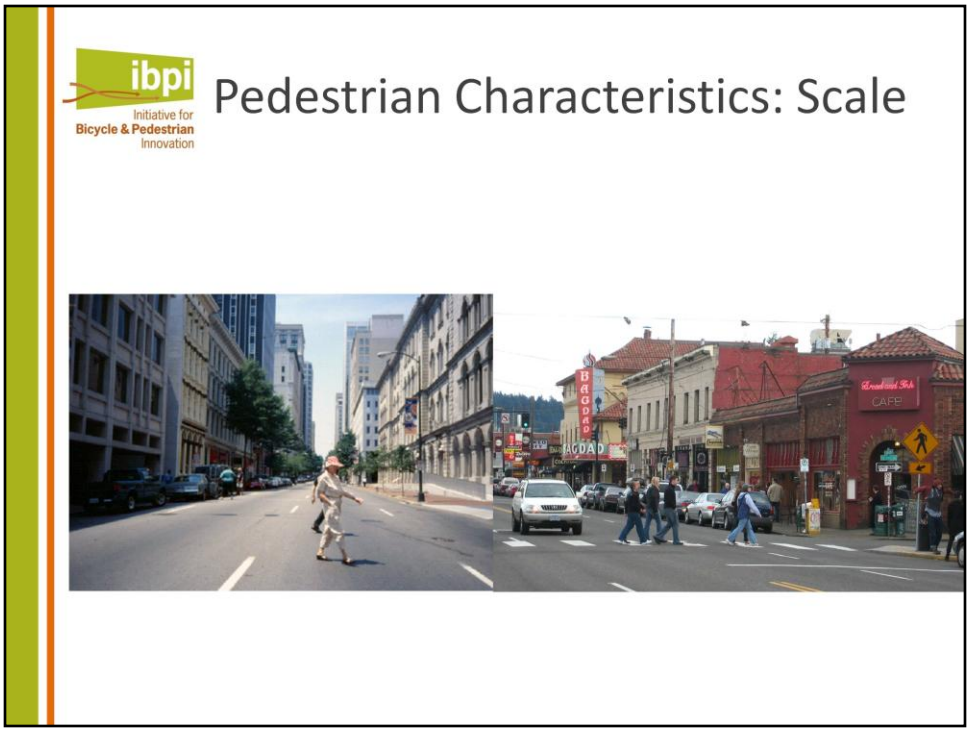
-or to access other forms of transportation, such as transit



To design pedestrian facilities well, we need to first consider the end user – the pedestrian.

In this section, we will discuss some characteristics of pedestrians that should be considered when designing facilities for walking. The first characteristic is scale.

Most adults are somewhere between 5 and 6 feet tall.



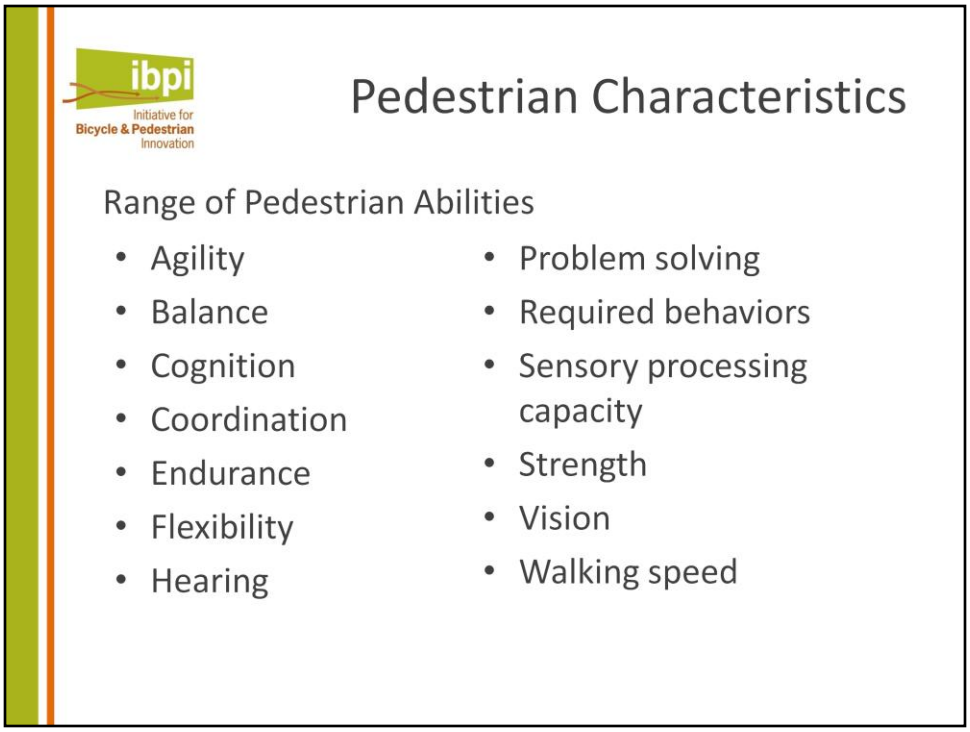
This means that the scale of the street and surrounding buildings can have a positive or negative effect on the walking environment.

These photos illustrate the difference between a place that is appropriately scaled for walking, and one that is not.

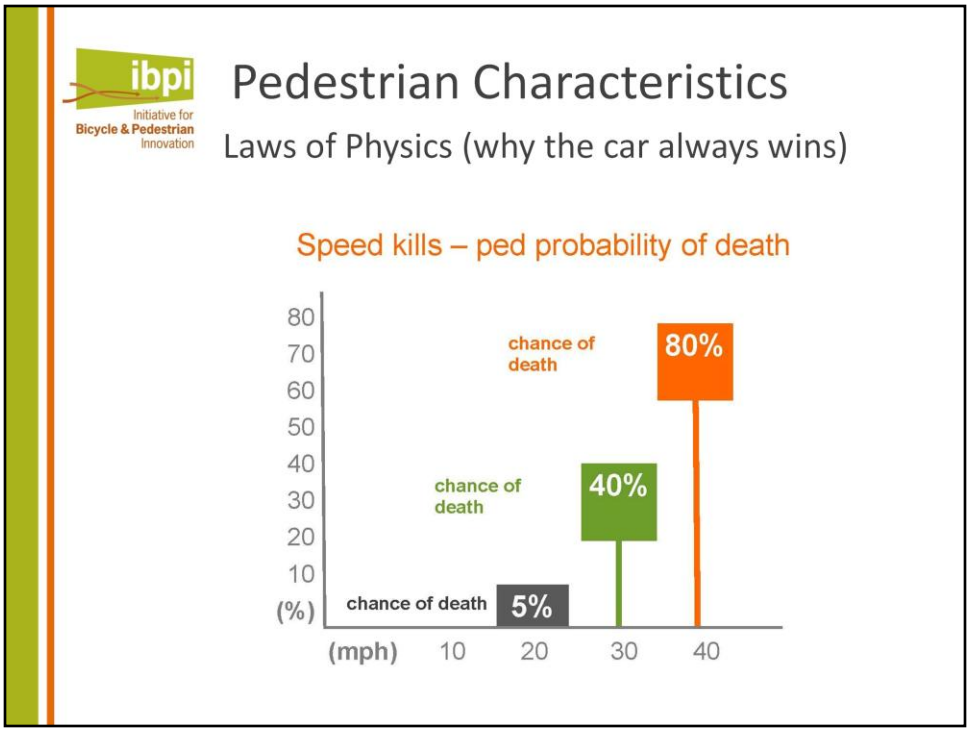
Another important pedestrian characteristic is speed. This primarily affects the amount of time it takes to cross the street and affects the length of crossings and the signal timing.

Older pedestrians often travel at a speed of about 2 miles per hour
But, signal timing standards assume an average pace of 4 miles per hour.

You can see how this discrepancy can create a dangerous situation for slower pedestrians, who cannot complete their crossing before the signal changes.

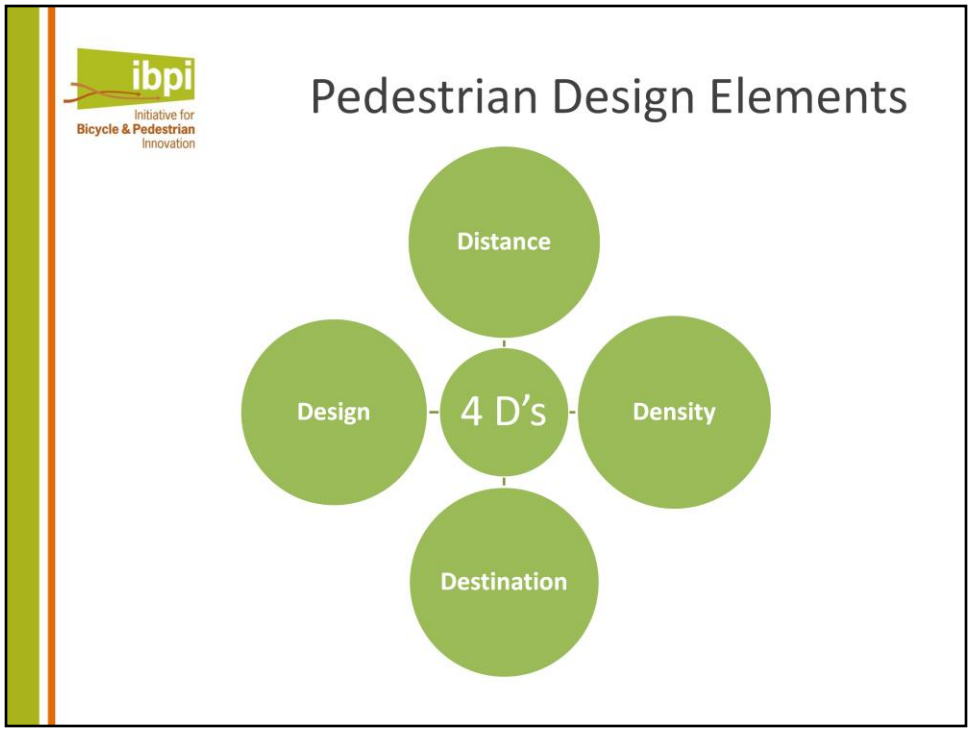


This list illustrates the range of abilities that should be considered when designing a safe and accessible walking environment.

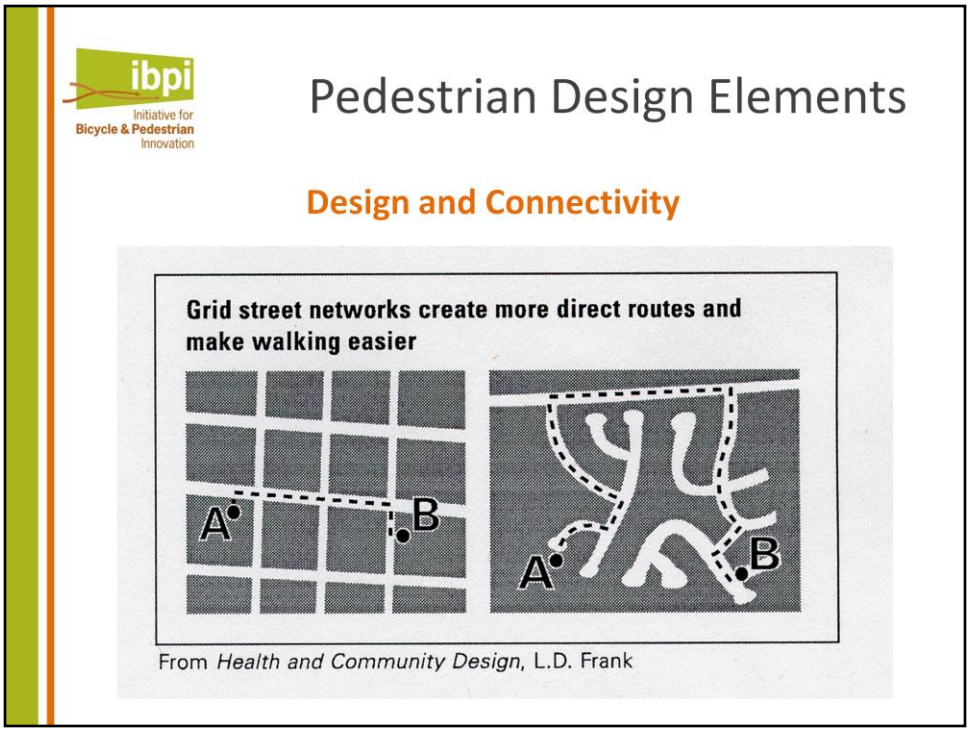


Another characteristic to consider is the relationship between pedestrians and motor vehicle speeds. As you can see, if a vehicle is traveling at 20 mph, the pedestrian's chance of death is quite small.
If you increase the speed to 30 mph, the chance of death is close to 50%.
When a motor vehicle is traveling 40 mph, the pedestrian's chance of death rises to approximately 85%.

This is the rationale for slower speed limits, especially in school zones, residential areas, and other high pedestrian volume areas.

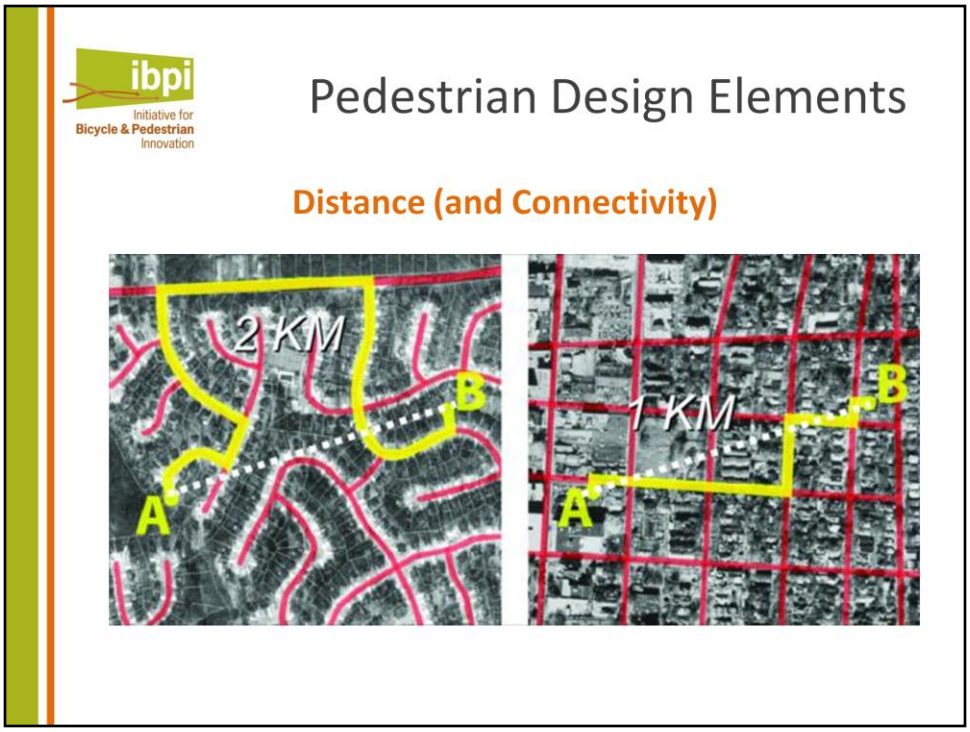


In this section, we will discuss the four primary design elements for the pedestrian environment, also known as the four Ds:
Distance
Density
Destination
Design



Distance is important because most people are not willing to walk very far.
Planners generally use ¼ - ½ mile as the distance a pedestrian will travel.
But, as these diagrams illustrate, it's not just the distance as the crow flies.

The distance between two points is affected by the connectivity of the street network.
The illustration on the left shows a direct route between point A and point B
In the illustration on the right, the distance between the two points is the same.
However, because the street network is disconnected, the actual travel distance between the two points is much greater.



Here is another example, showing that the walking distance is doubled between the two points on this map if the street network is not well-connected.

Destinations are also an important element.

People need meaningful places to go within their “walkshed” or “bikeshed”
These are the majority of non-work related trips, such as

- Going to or taking children to school
- Doing errands
- Shopping and recreation

Density is the next design element to consider for the pedestrian environment. Density refers to the number of buildings, uses or people in a given area. Here we can see that homes and commercial uses are spread out, resulting in low density.

By contrast, these areas are quite dense, with buildings right next to each other, and often two or more stories tall.

Density relates to distance and destinations because places that are denser often provide more destinations that are nearby, within a reasonable walking distance.

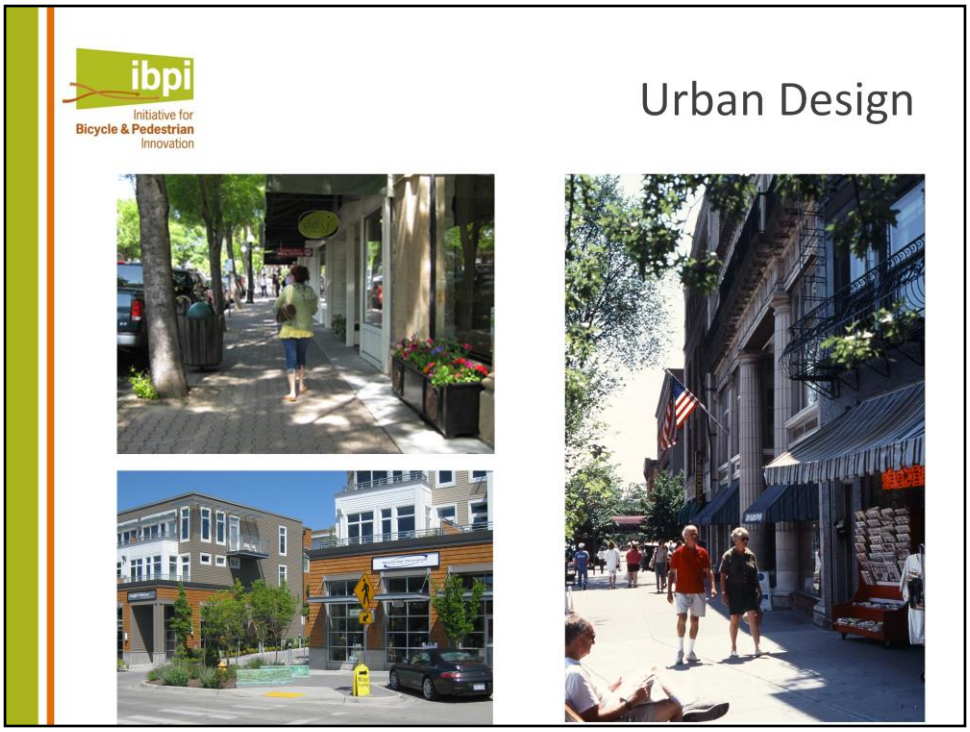
The final element is design

Generally speaking, we talk about both urban design and street design. Urban design, or site design, is about the buildings and the site – the private side of the equation.

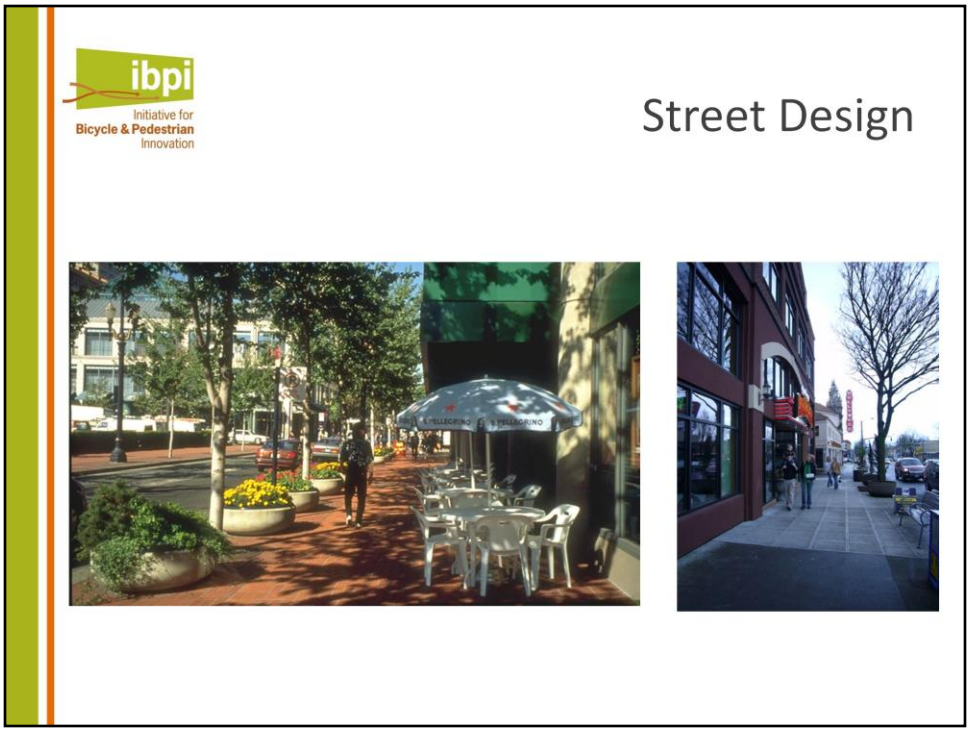
Buildings that come right up to the sidewalk provide a pleasant pedestrian experience, reduce the distance that pedestrians need to walk to access shops and offices, and reduce dangerous driveways that cross the sidewalk.

Good urban design guidelines will also help ensure a good walking environment that creates places that are “permeable” – meaning that passers-by can see into the businesses and easily enter.

Blank walls and covered windows do not invite people to walk or enjoy the experience.



Urban design also helps ensure that places are built to a human scale that do not overwhelm the pedestrian.



Street and streetscape design is about what we do in the right-of-way – the public space – and how we allocate that space. So when we refer to streets, we are talking about the space from building front to building front – not necessarily just the vehicular lanes

To encourage walking, the streetscape design needs to provide interest as well as safety for the pedestrian.

The next section will discuss more of the specific pedestrian design elements in the right of way.

This section will cover:

- Sidewalk Corridors
- Corners
- Crossings
- Signals

Any discussion of design for walking must include some of the basic tenets of the Americans with Disabilities Act (ADA)

The law establishes the overall intent:
The first was the Rehabilitation Act of 1973
This was then superseded by Americans with Disabilities Act Civil Rights Law in 1990

Regulations detail the law with specific requirements
ADA Title II (28 CFR Part 35)
Rehab Act Section 504 (49 CFR Part 27)

Standards provide guidance for design. These include
Uniform Federal Accessibility Standards (UFAS)
ADA Standards for Accessible Design (ADAAG)
Public Rights-of-Way Accessibility Guidelines (PROWAG)

Key Points of the ADA:
- It is Civil Rights law, thus, it is anti-discrimination law
- It is focused on providing equal access to everyone.

To design and construct a building or street that has barriers to some users, is to deny access, and thus a form of discrimination.
The aim is to meet the spirit of the law where possible, not just minimum standards and guidelines.

The basic requirements of the ADA cover new construction, existing facilities, and individual accommodations. The first two typically apply to the public right of way. The individual accommodation is most often encountered in buildings.

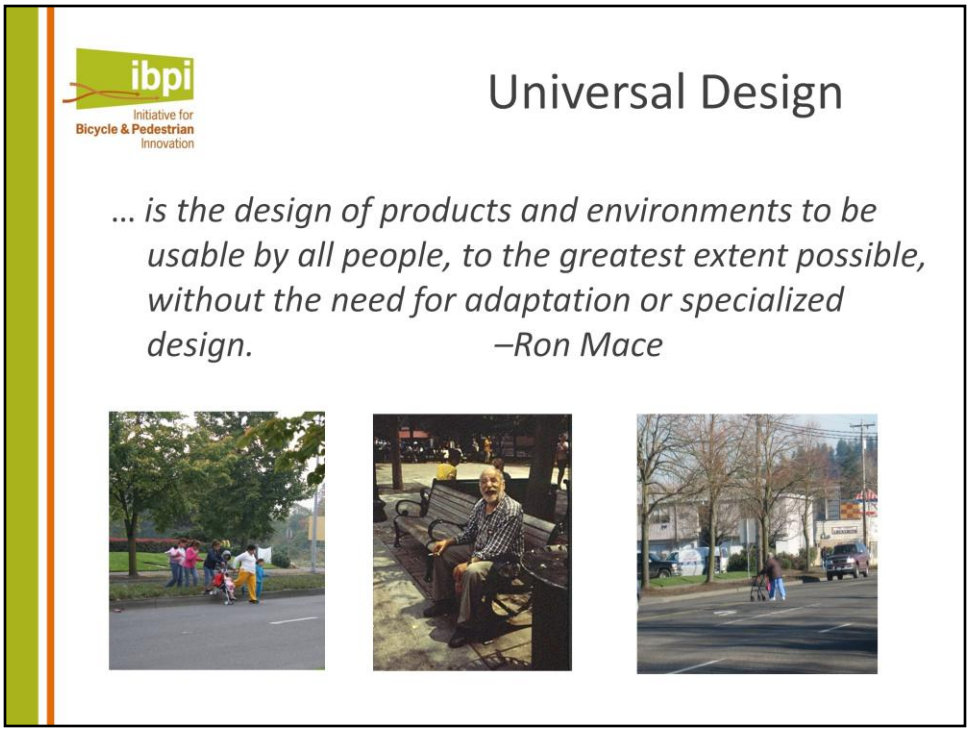
New construction & altered facilities must be "accessible to and usable by" people with disabilities.
Existing facilities, policies & programs must be evaluated for discrimination & develop a modification plan. "Program Access" & "Transition Plan."
Individual Accommodations. Individuals must be reasonably accommodated, where necessary, to their use of a covered program.

Why is the ADA important?

20% of the U.S. population are people with disabilities
40% of people age 65 & over have disabilities
Some of our disabilities are not visible to others, including some physical, sensory and cognitive disabilities (reference the earlier slide on the range of pedestrian abilities)

Many of us will experience temporary disabilities at some point life. Ex: broken leg with crutches.

Also, we are an aging society.
As baby boomers age, and as more veterans return home with disabling injuries,
… the number of people with disabilities is expected to **double** in the next 20 years.



The solution is a concept called universal design – this is the the design of environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.

Thus, universal design has broader benefits beyond addressing specific needs of the disabled.

Ron Mace was one of the developers of the Center for Universal Design.

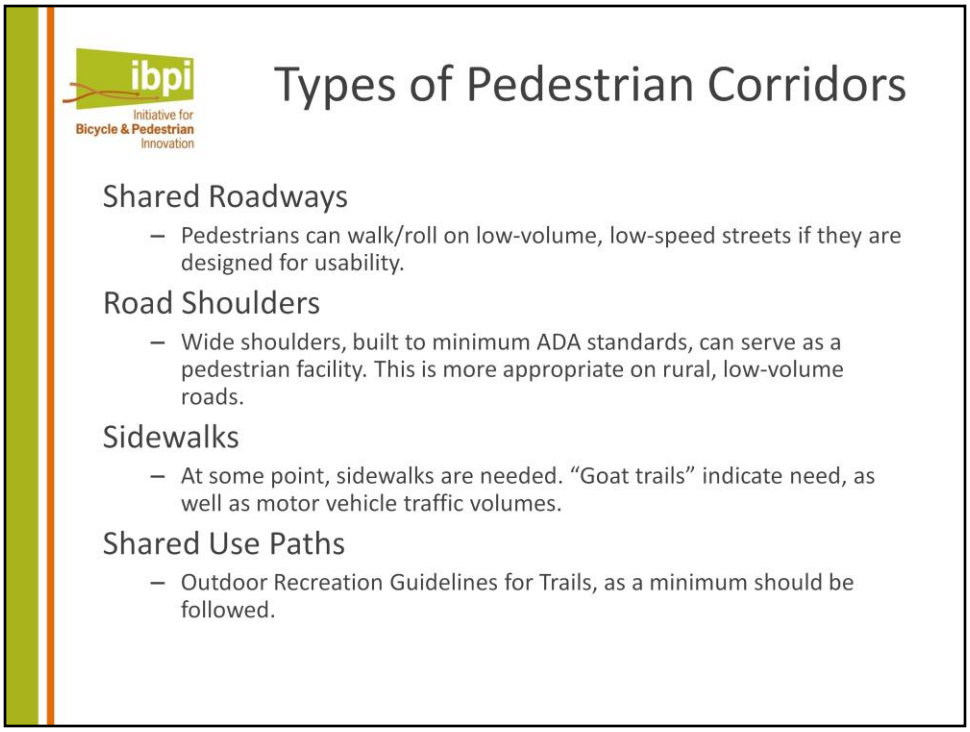
When we design for walking, the first element is the sidewalk corridor.

This may sound basic, but there are many places where there are no sidewalks. In fact, many communities have unimproved streets that are not even paved. While traffic volumes may be low, these streets present many dangers for pedestrians.

Many other places have paved streets, but still lack sidewalks.

These are more typical in rural areas, where roadways have minimal improvements

Or in suburban communities that were built without sidewalks,
-Either to save money
- or based on the assumption that no would walk there
--or a combination of both



The Sidewalk Corridor refers to the part of the pedestrian system from the edge of the roadway to the edge of the right-of-way.

In its most basic form, it should be accessible, wide enough, safe and continuous. Sidewalk corridors, or pedestrian access routes, can take several forms:

Shared Roadways

Pedestrians can walk/roll on low-volume, low-speed streets if they are designed for usability.

Road Shoulders

Wide shoulders, built to minimum ADA standards, can serve as a pedestrian facility. This is more appropriate on rural, low-volume roads.

Sidewalks

At some point, sidewalks are needed. "Goat trails" indicate need, as well as motor vehicle traffic volumes.

Shared Use Paths

Outdoor Recreation Guidelines for Trails, as a minimum should be followed.

Pedestrian Access Routes Must be Accessible:

The ADA requires
Minimum Width: 4 ft minimum continuous & unobstructed clear width, exclusive of the width of the curb.

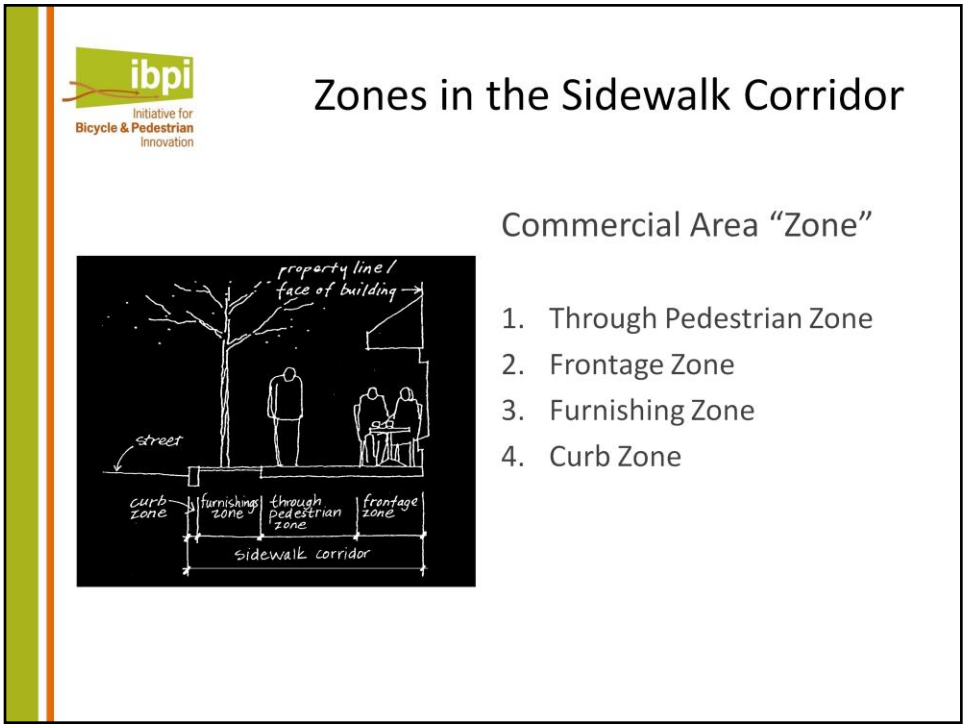
Passing Space: If less than 5 ft wide, passing spaces shall be provided at intervals of 200 ft maximum. Passing space shall be 5 ft wide & 5 ft long.

Maximum Cross Slope: 2% Max. cross slope along route

Surface: Surface shall be firm, stable and slip resistant, with minimal surface discontinuities.

Ideally, the sidewalk corridor also will have landscaping, provide places for people to interact and it should contribute to the quality of place.

Often sidewalks zones are different in residential areas, where pedestrian volumes are typically low, and commercial districts, where greater numbers of pedestrians will be present.



An important concept for sidewalks in commercial and business areas is the Zone System in the sidewalk corridor

These include the
-Through pedestrian zone, which is kept clear to allow pedestrians to safely walk and pass;
- the frontage zone, which, depending on the width, can allow for sidewalk dining, outdoor retail displays, or a place for pedestrians to window-shop and view displays
-the furnishing zone, which, as the name implies, provides space for sidewalk furnishings, such as benches, trash cans, bike racks, news racks and lighting. It also is the place to locate street trees, utility boxes, A-board signs (if allowed in your community) and other items that need to be out of the through zone. The furnishing zone also provides a buffer between the through zone and the street, which is especially important if there is no on-street parking to protect pedestrians from moving vehicles.
-Curb zone, which is simply the space for the curb.

In residential areas, the sidewalk corridor generally comprises the through zone and a buffer of landscaping, lawn and/or street trees which may be called a planting strip in some parts of the country.

The through zone is the area that provides the access required by the ADA

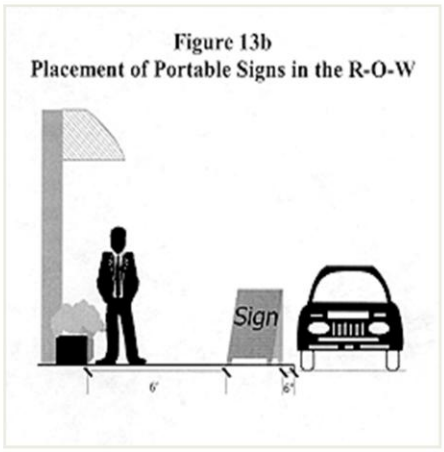
These examples illustrate the zone concepts in sidewalk corridors of varying widths.

You can see that the narrowest sidewalk corridor does not have adequate space to accommodate outdoor café seating, while the medium-width corridor can handle small tables.

Only the very wide, 15-foot, corridor, has room to allow larger tables and planters, while still leaving a generous through zone.

Here is a good example of the furnishing zone, where all of the elements that need to be in the right of way, are properly located.

Sidewalk Corridors



Portable signs, often called A-Boards or Sandwich Boards, also should be placed in the furnishing zone.

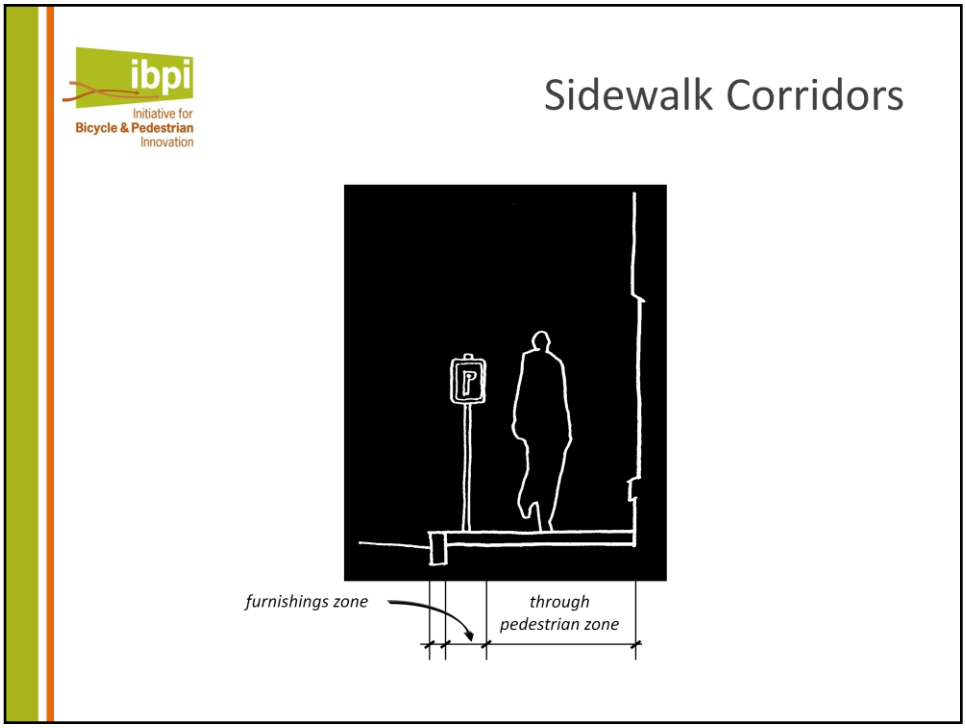
Here, the city's design guidelines clearly state the proper placement for these signs in the furnishing zone, and the proper placement in the sidewalk corridor.

ibpi
Initiative for Bicycle & Pedestrian Innovation

Sidewalk Corridors

A-boards not in furnishing zone

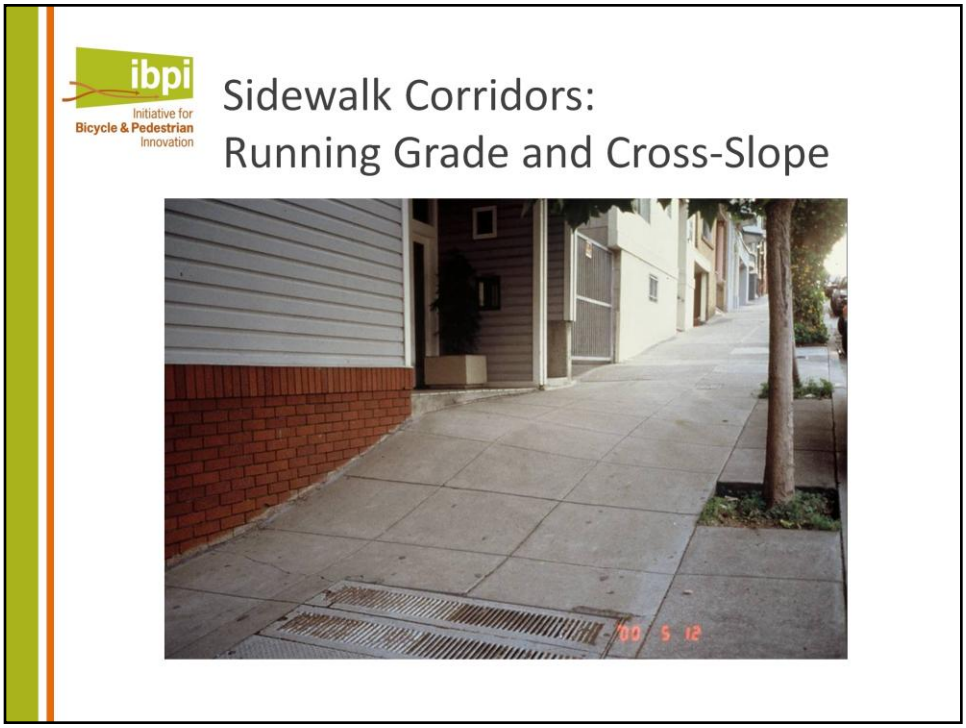
Here is an example where the A-boards were incorrectly placed next to the building. You can see how they encroach into the through zone and do not provide adequate room for walking and passing. Proper placement of the signs in the furnishing zone would free up more space for the through zone.



A through zone must be maintained, even in narrow environments. This may mean that there is no room for additional features in the sidewalk corridor.

Here is an example of a constrained right of way that did not use the zone concept to lay out the elements in the right of way. Even though the space is tight, if all of the elements had been correctly placed according to the zone principles, there would still be a pedestrian through zone, albeit a narrow one, that could meet the ADA.

Sometimes we have to make trade-offs, but these are generally done on a case-by-case basis. Here, the City of Portland opted to give up a little bit of the pedestrian through zone to make space for this heritage tree.



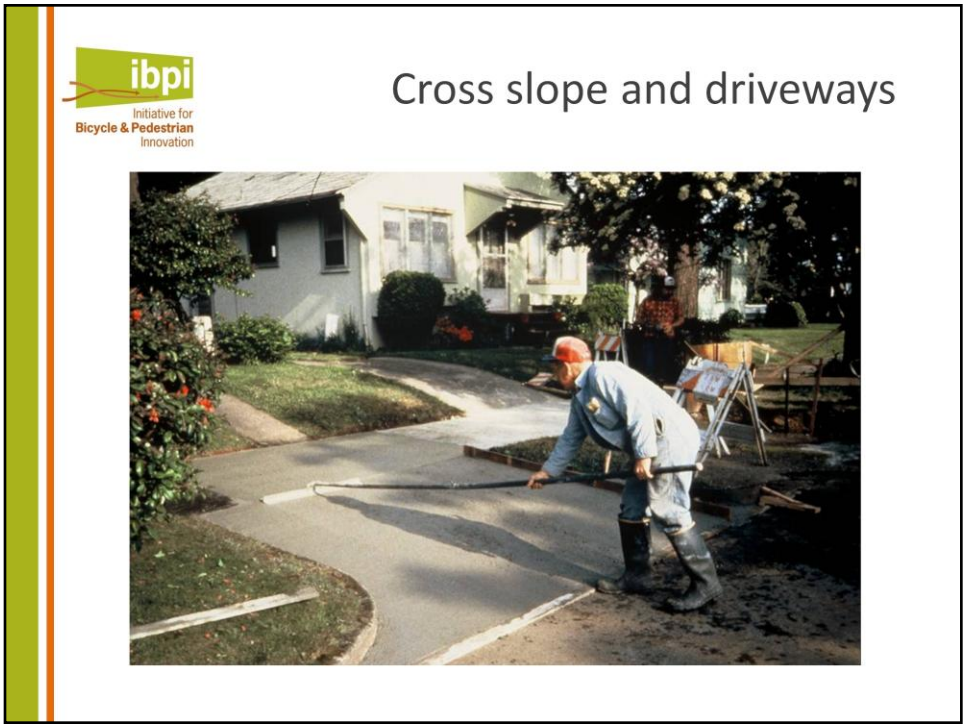
Running grade and cross slope are two important concepts in sidewalk design.

The running grade is the grade, or slope of the sidewalk as you would walk along it

There is no limit on running grade for sidewalks in the public right-of-way, as long as they are no steeper than the adjacent street.

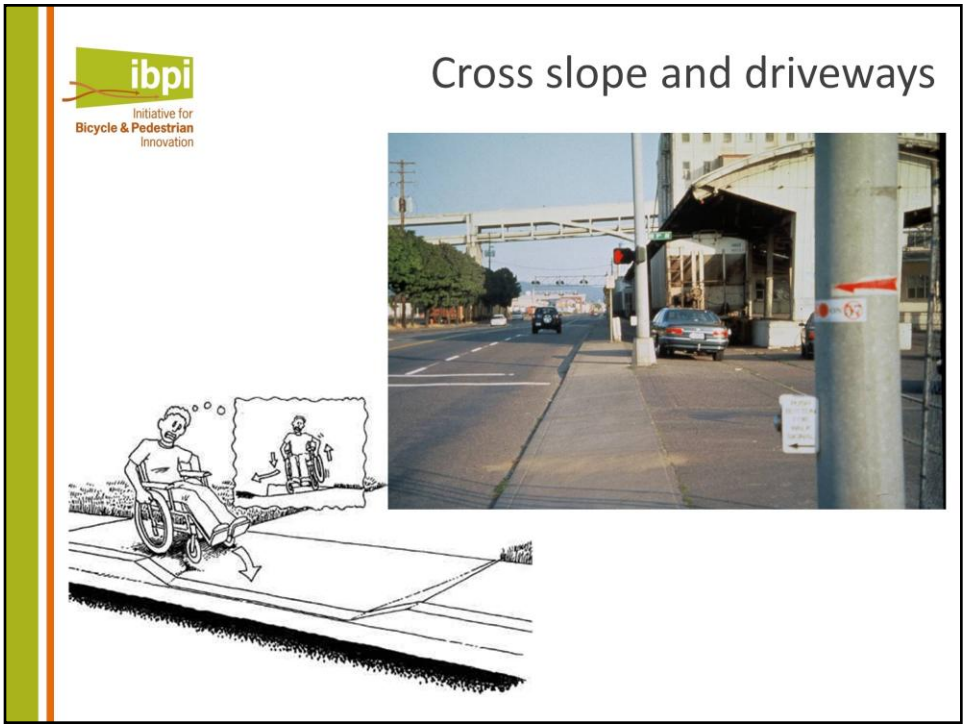
The cross-slope is the slope of the sidewalk across its width. The cross-slope should be less than 1/4" per foot, or 2% to meet ADA

We can't assume that just because the sidewalk is steep, no one in a wheelchair will use it. The steeper the street, the more important it is that the cross slope be minimized. In this extreme example from San Francisco, you can see how the sidewalk has been warped so that the fall line is a diagonal, resulting in a cross slope that is visibly more than 2%



Driveways crossing the sidewalk can create problems for the sidewalk's cross slope.

This example shows the best case for pedestrians: the sidewalk continues flat and all the slope of the driveway apron is in the furnishings zone. However, this is not always the case.



The photo is an example of the worst case. The sidewalk is narrow, and the entire sidewalk is sloped as the driveway apron. This does not meet ADA.

In this case, the entire sidewalk has been used to achieve the driveway entering the parking garage on the right. By using the full width of the sidewalk, it appears that the cross slope is appropriate.

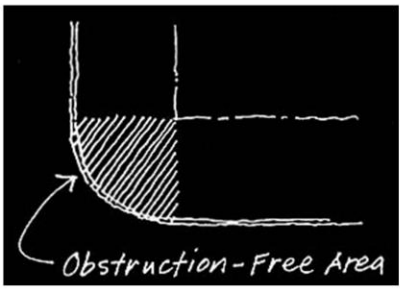
In this section, we will discuss design guidelines for street corners

Pedestrian activities are concentrated at street corners.

Good street corners
-are clear of obstructions,
-let pedestrians see and be seen,
-separate pedestrians from traffic, and
-are accessible.

Guidelines for Street Corners

Space between the curb and the extension of the property lines to the curb

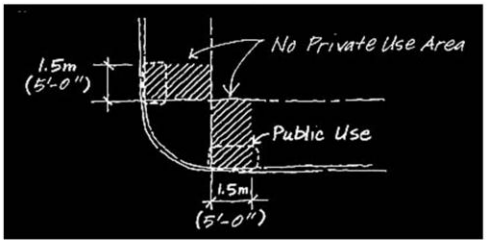


The first concept of corner design is the obstruction-free area.

This is the space between the curb and the extension of the property lines to the curb

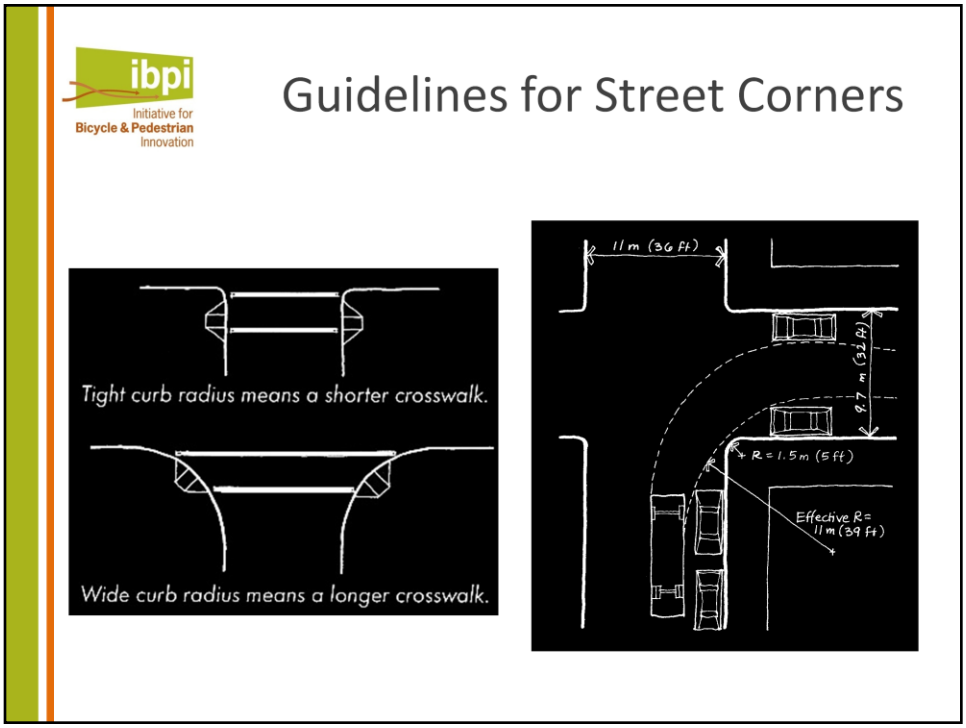
Guidelines for Street Corners

Public uses are encouraged to locate in the furnishings zone of the "No Private Use" Area



Then there is a "No private use" area, for five feet on either side of the obstruction-free area. Public uses, such as signal pole bases and street light bases are encouraged to locate in this area.

Here is an example which violates this principle. You can see that both the café chairs and the newsracks are located in the zone which should be reserved for the public uses, such as the utility pole.



There needs to be adequate room for pedestrians at the corner.

One way of achieving that is to minimize the corner radius.

In general, the smaller the better for pedestrians.

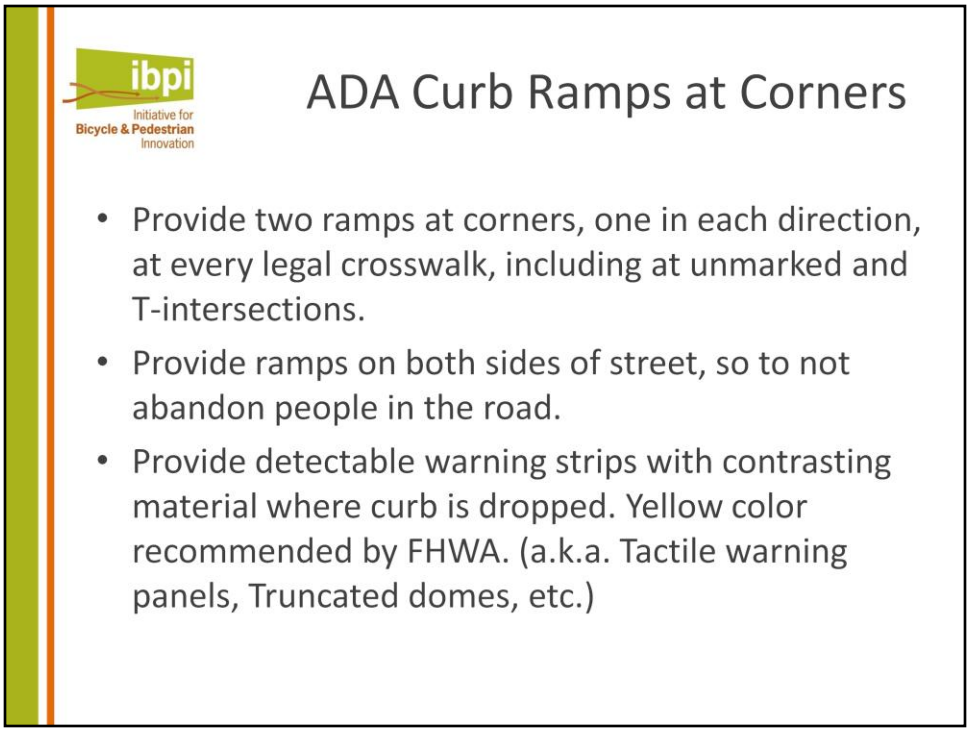
A tight curb radius provides more pedestrian area at the corner, allows more flexibility in the placement of curb ramps, results in a shorter crosswalk, and requires vehicles to slow more as they turn the corner.

The presence of a parking lane or a bike lane creates an “effective radius” that allows a designer to use a curb radius that is tighter than the turn radius of a design vehicle.

A very important element of street corners are Curb Ramps and Landings.

There should be a curb ramp for every crosswalk, typically two per corner. There are three variables to address:
First, there should be no more than 2% cross slope in the ramp.
Second, the direction of the ramp should be aligned with the direction of the crosswalk
Third, the ramp should be in the line of travel. The first consideration, minimizing cross slope, is the most important.

(Note the yellow, tactile panels)



Specifically, the ADA requirements include providing:

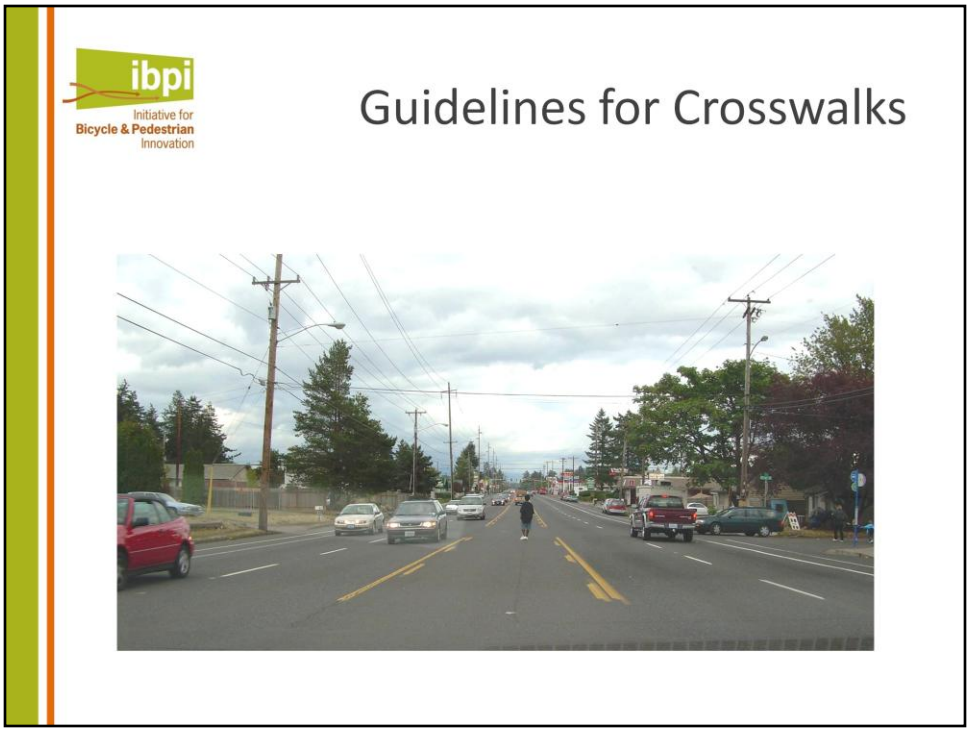
- two ramps at corners, one in each direction, at every legal crosswalk, including at unmarked and T-intersections.
- ramps on both sides of street, so to not abandon people in the road.
- detectable warning strips with contrasting material where curb is dropped. Yellow color recommended by FHWA. (a.k.a. Tactile warning panels, Truncated domes, etc.) (*See previous photo*)

Curb extensions, also known as “bulb-outs” are an option that extends the corner in one or both directions.
Typically, these are done where there is on-street parking.
They extend into the roadway approximately the width of the on-street parking lane.

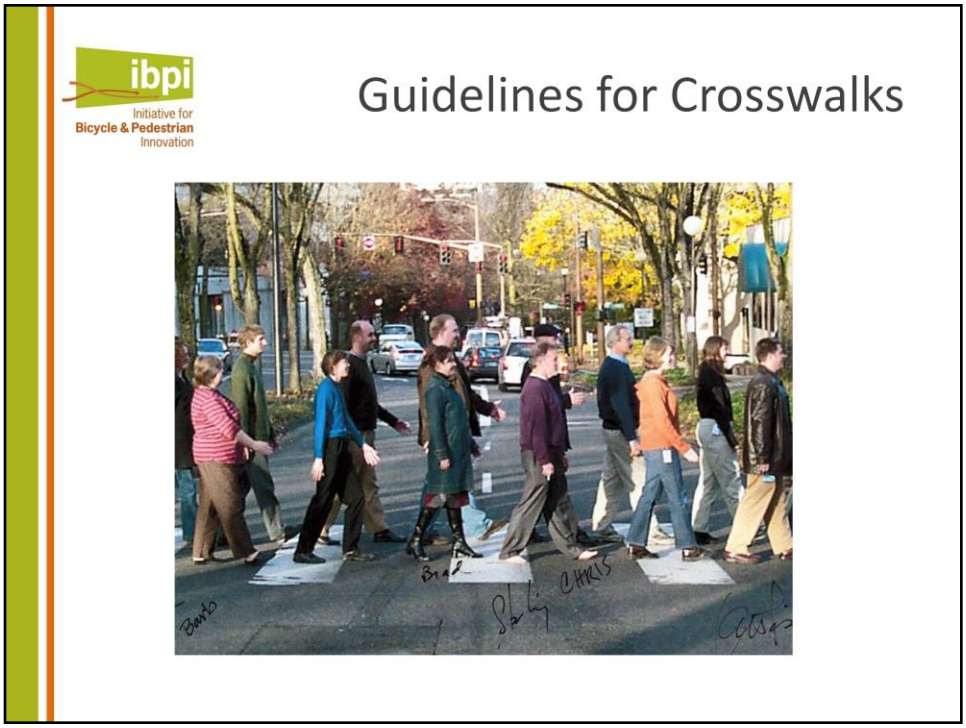
Curb extensions have several benefits. They
- provide more room at the corner,
-Improve the visibility of pedestrians
-Shorten the crossing distance, which limits the time pedestrians are in the roadway

-One disadvantage is they can impact the position of bicycles in the travel lane

These photos illustrate the same corner, which received a curb extension on both sides. Note the additional room at the corner.

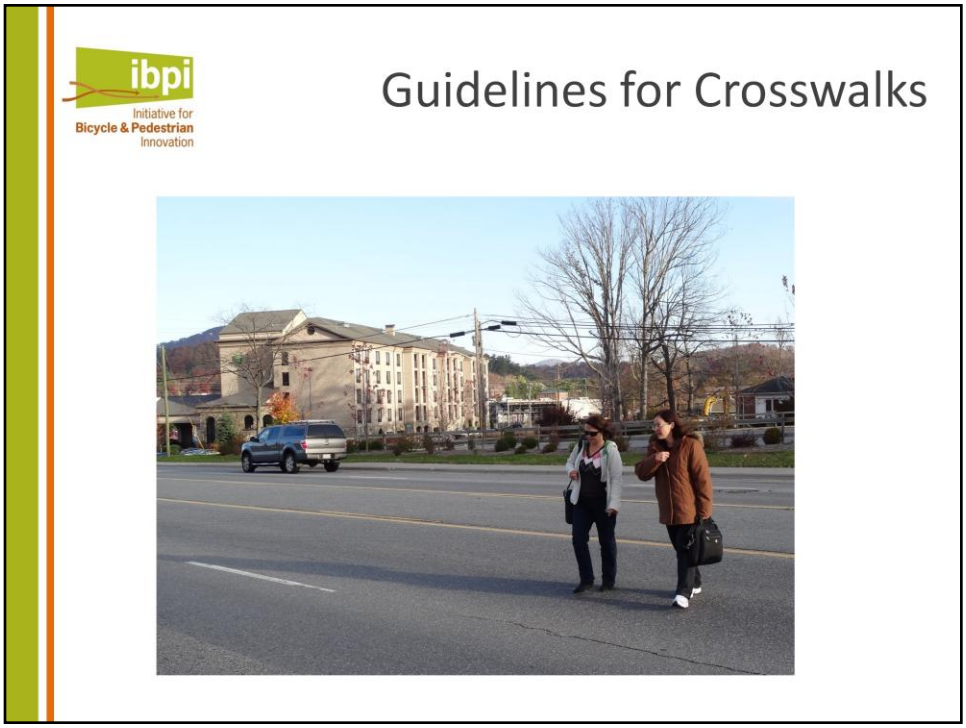


One of the first questions about crossings is whether to mark the crossing or not



Crosswalks are a critical element of the pedestrian network

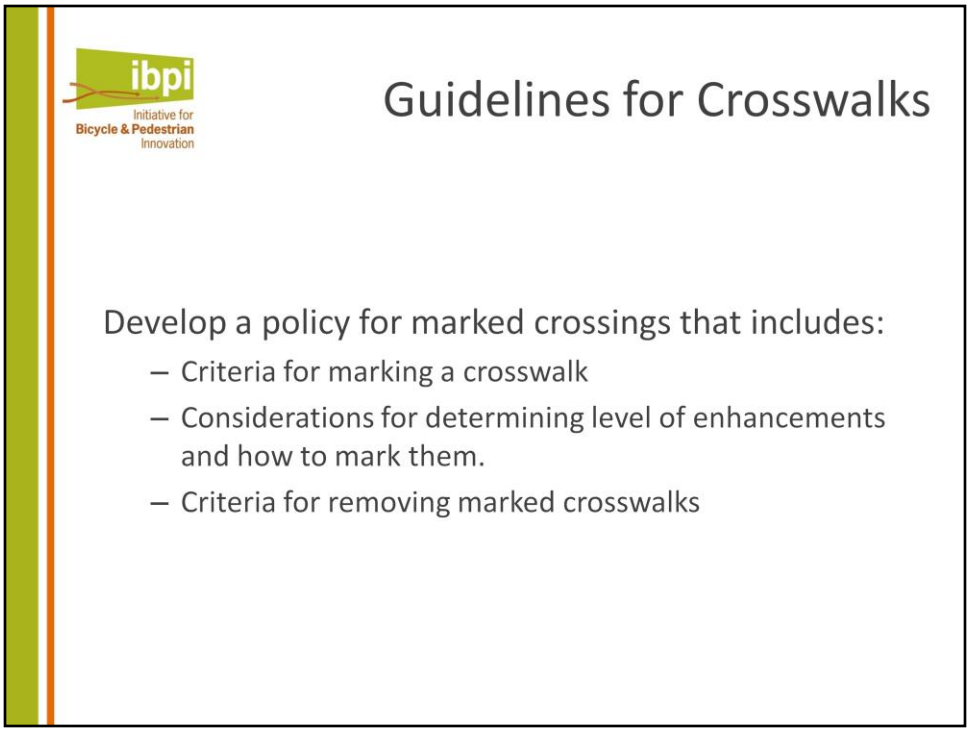
Good crosswalks
-make it obvious where to cross,
-Are placed at appropriate intervals
-allow pedestrians to see and be seen,
-provide adequate crossing time, and
- limit pedestrian exposure and conflict points with traffic



In designing and implementing crosswalk improvements, a first consideration is the frequency of crossing opportunities.

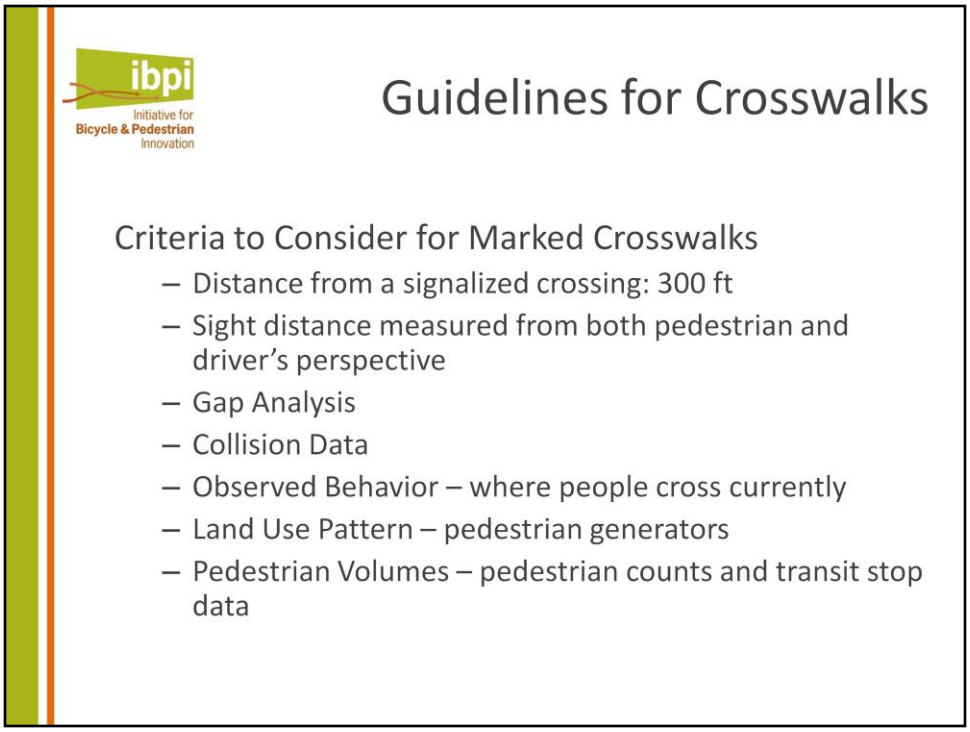
As we discussed, people tend to cross when there are uses on the other side to draw them, and they generally don't like to go out of their way.

The distance between comfortable opportunities to cross the street should be related to the frequency of uses along the street. In areas with many pedestrian generators, opportunities to cross should be frequent.



A community should have an adopted policy for marked crosswalks that includes

Criteria for marking a crosswalk
Considerations for determining level of enhancements and how to mark them.
Criteria for removing marked crosswalks



Some of the criteria to consider for inclusion in such a a policy includes:

Distance from a signalized crossing: 300 ft
Sight distance measured from both pedestrian and driver's perspective
Gap Analysis
Collision Data
Observed Behavior – where people cross currently
Land Use Pattern – pedestrian generators
Pedestrian Volumes – pedestrian counts and transit stop data

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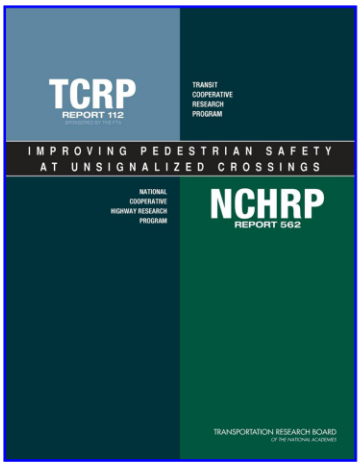
Guidelines for Crosswalks

Determine Crossing Treatments:

Follow NCHRP Recommendations &Worksheet



The National Cooperative Highway Research Program (NCHRP) Report 562 provides guidance and worksheets to help determine the appropriate crossing treatment for a given location.

Guidelines for Crosswalks

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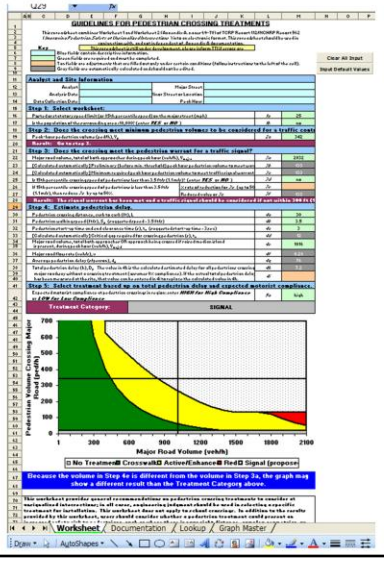
WORKSHEET 1: PEAK-HOUR, 35 MPH (55 KM/H) OR LESS

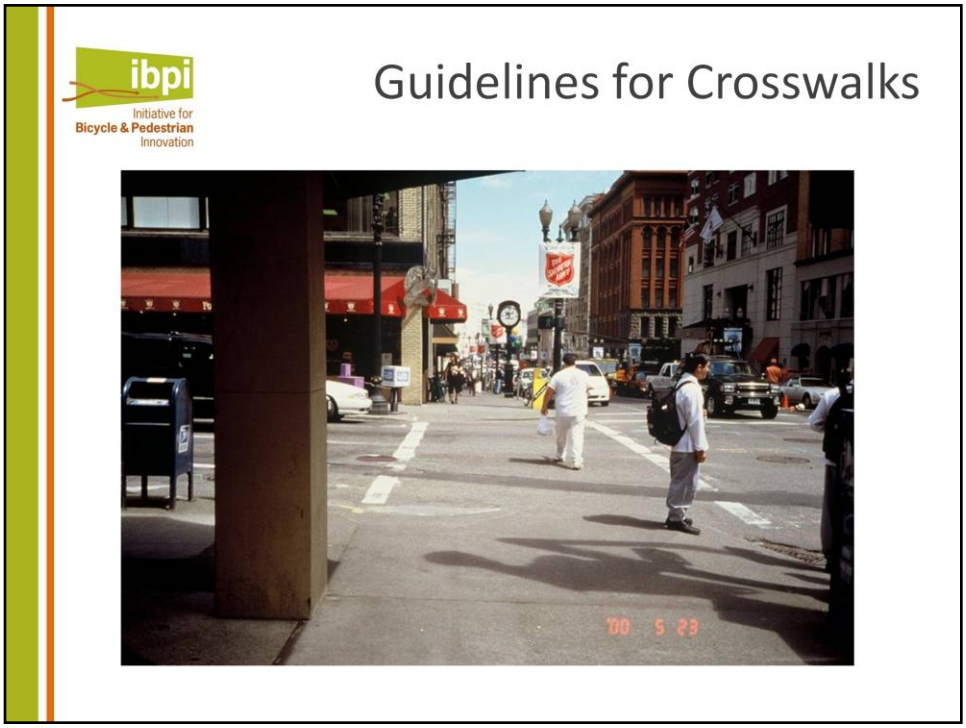
Analyst and Site Information		
Analyst: Analysis Date: Data Collection Date:		Major Street: Minor Street or Location: Peak Hour:
Step 1: Select worksheet (speed reflects posted or statutory speed limit or 85th percentile speed on the major street): a) Worksheet 1 – 35 mph (55 km/h) or less b) Worksheet 2 – exceeds 35 mph (55 km/h), communities with less than 10,000, or where major transit stop exists		
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a TCD type of treatment?		
Peak-hour pedestrian volume (ped/h), V_p		2a
If 2a ≥ 20 ped/h, then go to Step 3.		
If 2a < 20 ped/h, then consider median refuge islands, curb extensions, traffic calming, etc. as feasible.		
Step 3: Does the crossing meet the pedestrian volume warrant for a traffic signal?		
Major road volume, total of both approaches during peak hour (veh/h), V_{maj}		3a
Minimum signal warrant volume for peak hour (use 3b for V_{maj}), SC $SC = (0.00021\ V_{maj}^2 - 0.74072\ V_{maj} + 734.125)/0.75$ OR [(0.00021 3a² – 0.74072 3a + 734.125)/0.75]		3b
If 3b < 133, then enter 133. If 3b ≥ 133, then enter 3b.		3c
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce 3c by up to 50 percent; otherwise enter 3c.		3d
If 3b ≥ 3d, then the warrant has been met and a traffic signal should be considered if not within 300 ft (91 m) of another traffic signal. Otherwise, the warrant has not been met. Go to Step 4.		
Step 4: Estimate pedestrian delay.		
Pedestrian crossing distance, curb to curb (ft), L		4a
Pedestrian walking speed (ft/s), S_p		4b
Pedestrian start-up time and end clearance time (s), t_s		4c
Critical gap required for crossing pedestrian (s), $t_c = (L/S_p) + t_s$ OR [(4a/4b) + 4c]		4d
Major road volume, total both approaches or approach being crossed if median refuge island is present during peak hour (veh/h), V_{maj}		4e
Major road flow rate (veh/s), $v = V_{maj}/3600$ OR [4e/3600]		4f
Average pedestrian delay (s/person), $d_p = (e^{vt_c} - v\,t_c - 1) / v$ OR [$(e^{4f\,x\,4d} - 4f\,x\,4d - 1) / 4f$]		4g
Total pedestrian delay (h), $D_p = (d_p \times V_p)/3,600$ OR [(4g-2a)/3600] (this is estimated delay for all pedestrians crossing the major roadway without a crossing treatment – assumes 0% compliance). This calculated value can be replaced with the actual total pedestrian delay measured at the site.		4h
Step 5: Select treatment based upon total pedestrian delay and expected motorist compliance.		
Expected motorist compliance at pedestrian crossings in region, Comp = high or low		5a

Total Pedestrian Delay, D_p (from 4h) and Motorist Compliance, Comp (from 5a)	Treatment Category (see Descriptions of Sample Treatments for examples)
$D_p \geq 21.3$ h (Comp = high or low) OR 5.3 h ≤ D_p < 21.3 h and Comp = low	RED
1.3 h ≤ D_p < 5.3 h (Comp = high or low) OR 5.3 h ≤ D_p < 21.3 h and Comp = high	ACTIVE OR ENHANCED
D_p < 1.3 h (Comp = high or low)	CROSSWALK

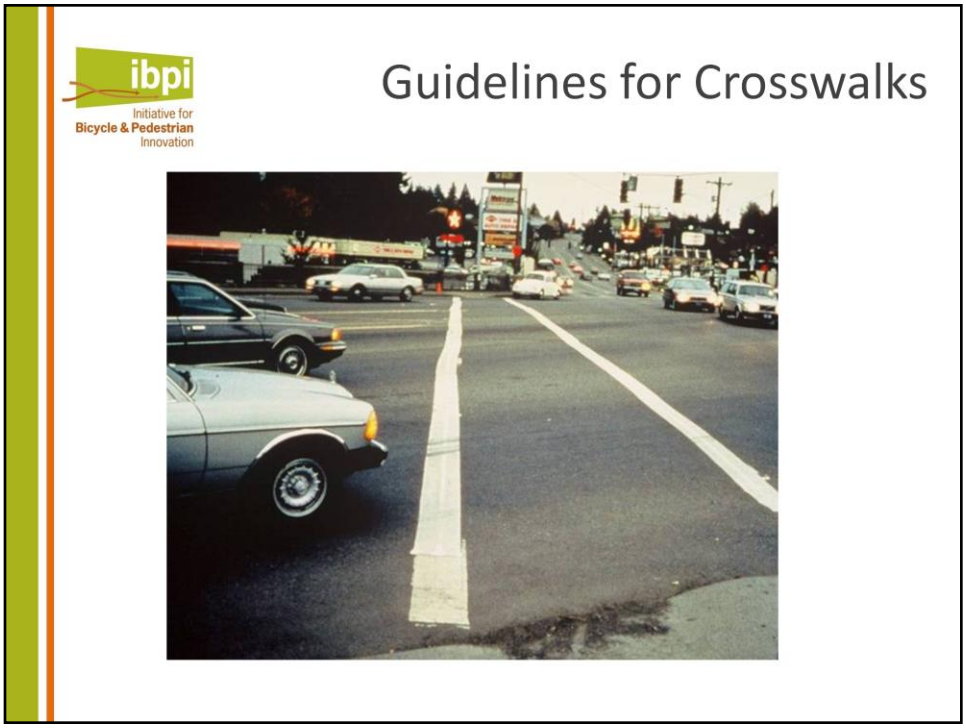
Figure A-2. Worksheet 1.



Here is an example of one of the worksheets in the NCHRP report.

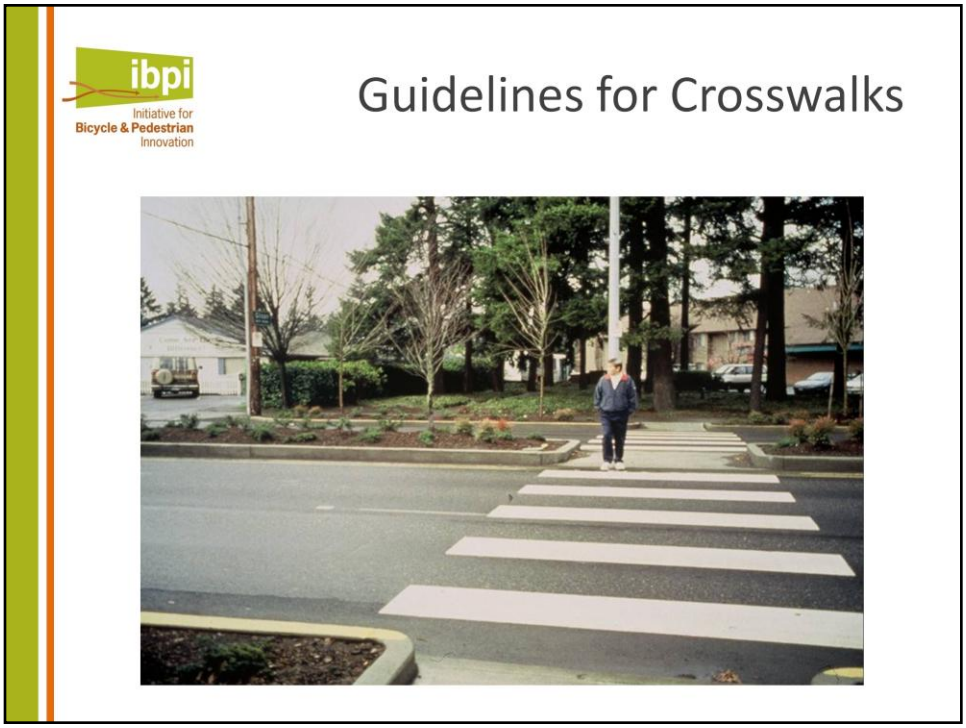


Marked crossings, or crosswalks, should align with the through pedestrian zone of the sidewalk In this case, the crosswalk aligns with the entire sidewalk corridor, which is fine. (Note this is an older crosswalk that has not yet been updated to ADA with the yellow tactile strips.)

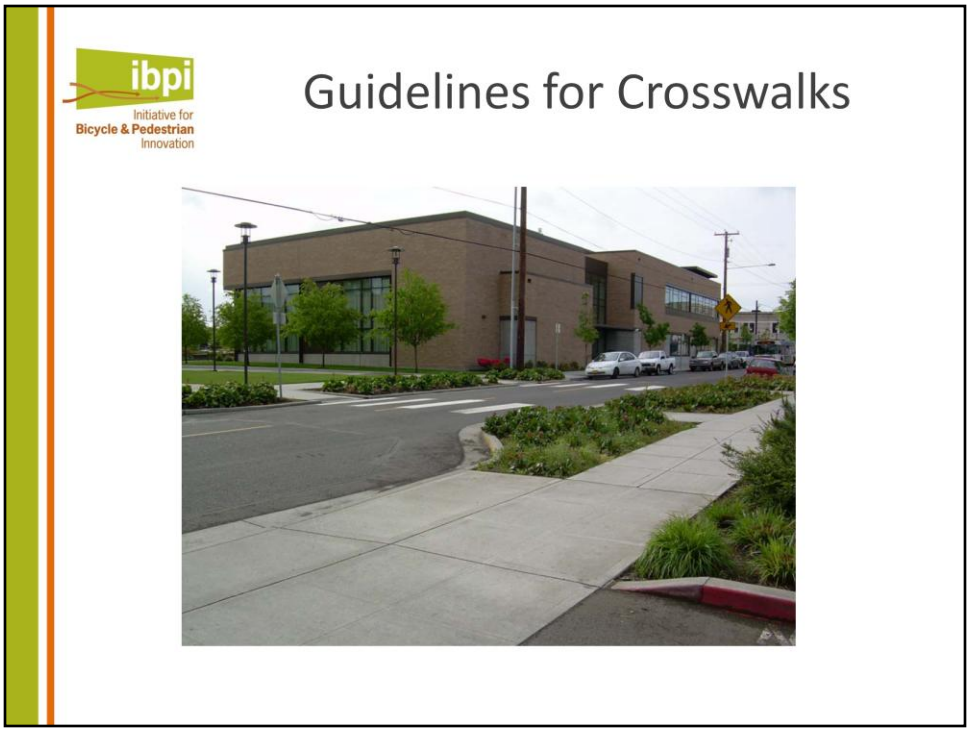


Parallel crosswalk markings are used where traffic is controlled, as at this signal. This example also shows a very long crosswalk. Portland's guidelines suggest that about 50' is the longest pedestrians should have to travel in a crosswalk without some type of refuge.

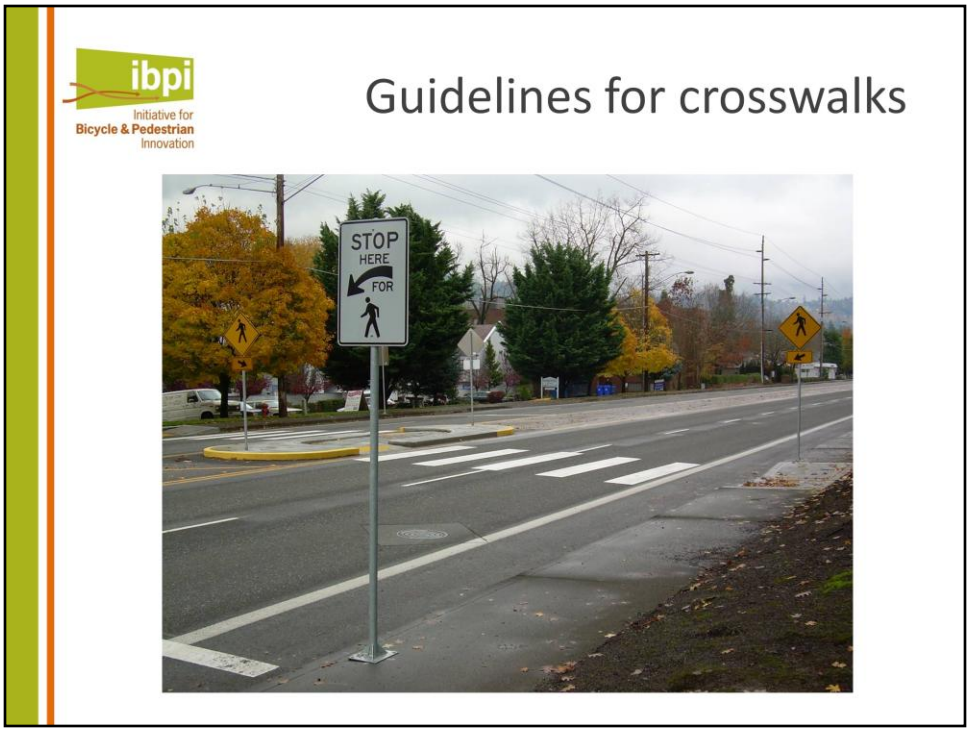
This is a **good discussion opp**—what do the students think of this crossing situation?



Ladder crossings are used at school crossings and at mid-block crossings.

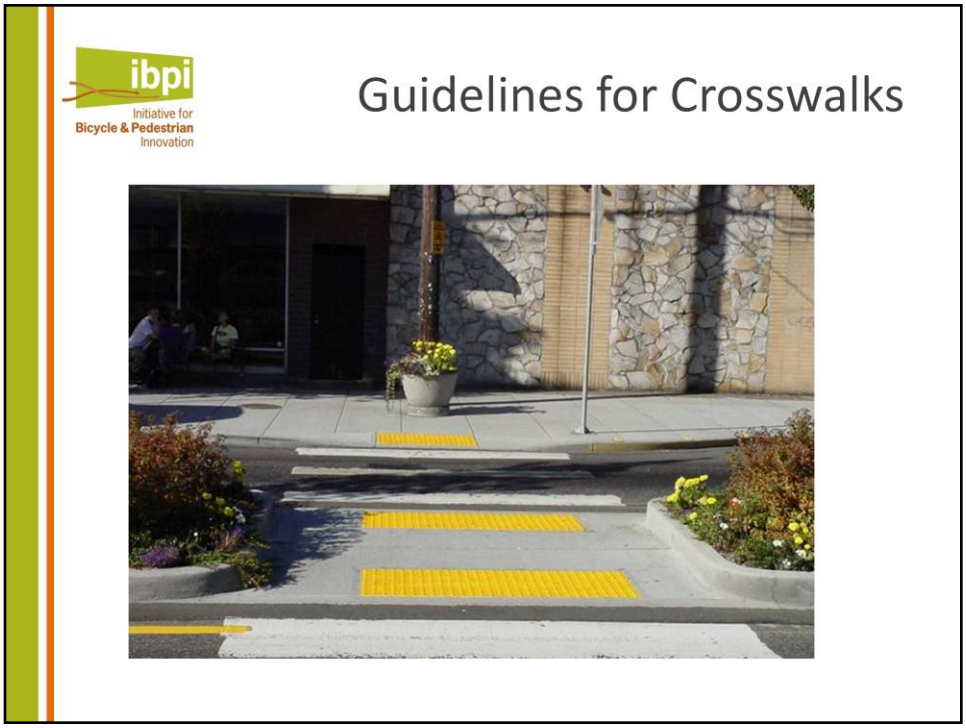


Here is an example of a raised crosswalk with curb extensions
The curb extensions narrow the crossing distance and make the pedestrians more visible
While the raised crosswalk serves as a speed bump to slow traffic



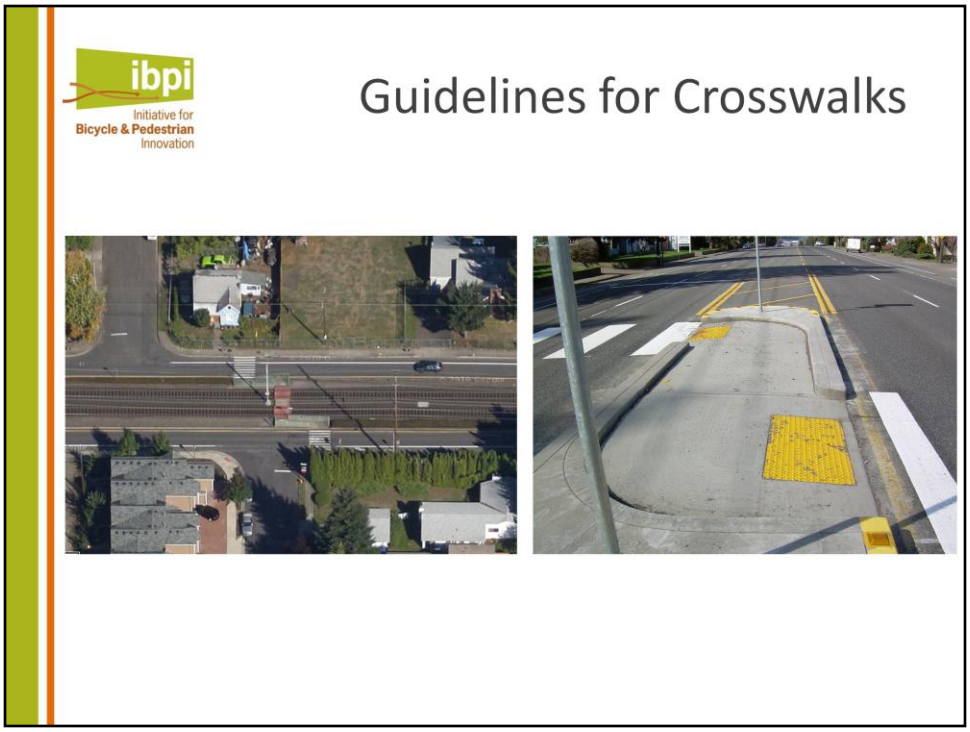
Median refuge islands are another option for crossings. These are particularly effective for wider roadways and those with more than one land of vehicle travel in each direction.

Similar to curb extensions, refuge islands narrow the crossing distance for pedestrians and make them more visible.
In addition, these refuges allow pedestrians to cross only one direction of vehicular travel at a time, which typically provides more crossing opportunities than if the pedestrian had to wait for a gap in traffic from both directions

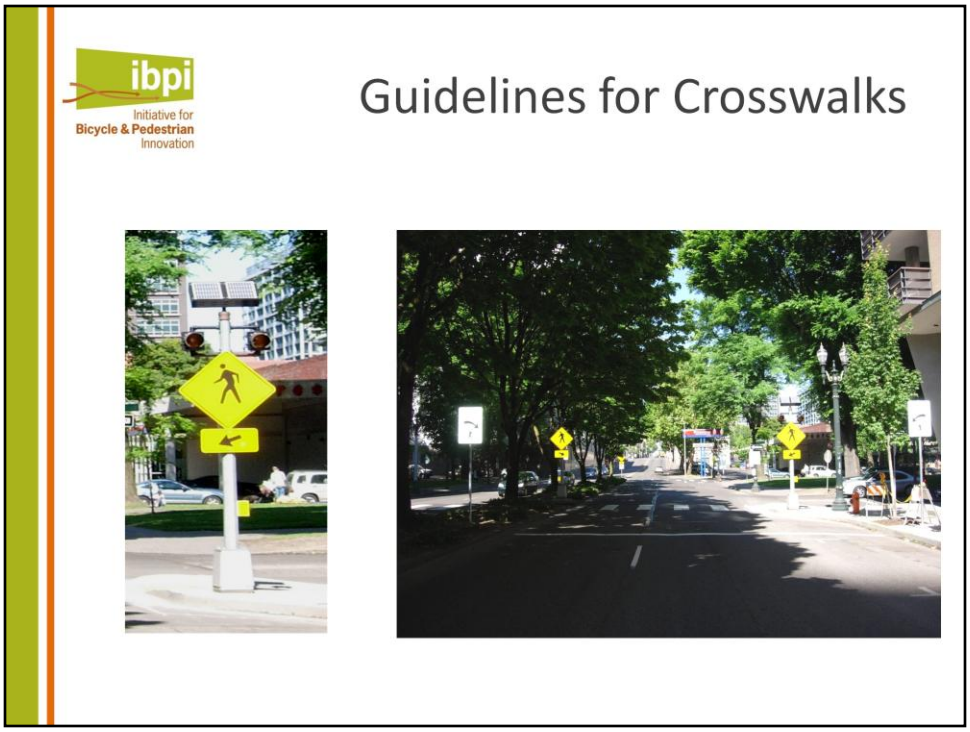


Here is an example of a straight median refuge island.

Note that the detectable warnings are required at every point where the pedestrian enters the roadway.



This is another configuration of a median refuge island, often called a “Z crossing”. This design has the added benefit of channeling pedestrians to face the on-coming traffic before entering the second crosswalk, thus helping to ensure they are looking for oncoming vehicles.



Crosswalks may or may not be enhanced with signs and beacons.

Here is an example of a crosswalk with indicator signs, and a standard beacon with wig-wag flashing yellow light.

This section will address guidelines for pedestrian signals

The flashing “don’t walk” phase is confusing because pedestrians are unsure how long the phase will last and often will attempt to cross anyway.

These are now being replaced with new countdown signals. These are much more clear because they communicate the number of seconds remaining to cross the street. It is up to the pedestrian to determine whether or not they can safely cross, taking into account their walking speed and the crossing width.

A leading pedestrian phase means that the pedestrian signal will indicate that pedestrian can begin walking before the traffic signal turns green. This is often used where there is a high volume of vehicular right turns, because it allows the pedestrians to get a head start before the driver attempts to turn right.

Passive detection devices can sense when a pedestrian is still in the cross walk and prevent the signal from changing until the pedestrian is safely on the other side. This is especially useful in places with a high volume of slower pedestrians who may need more time to cross the street safely, but extending the walk cycle in the signal timing is not an option due to other operational considerations.

Note the older woman crossing who may require more time than the ped signal allows. There is no ped refuge island available.

HAWK Pedestrian Beacons

The name stands for High Intensity Actuated Walk signal (now often called "**pedestrian hybrid beacon**")

It is intended to alert drivers to stop for pedestrians who wish to cross and make the signal more visible

Here is an example of a median refuge island, coupled with curb extensions, at a mid-block crossing location.

This is a three-lane cross section with two vehicle travel lanes and one center turn lane, located in a neighborhood commercial district.

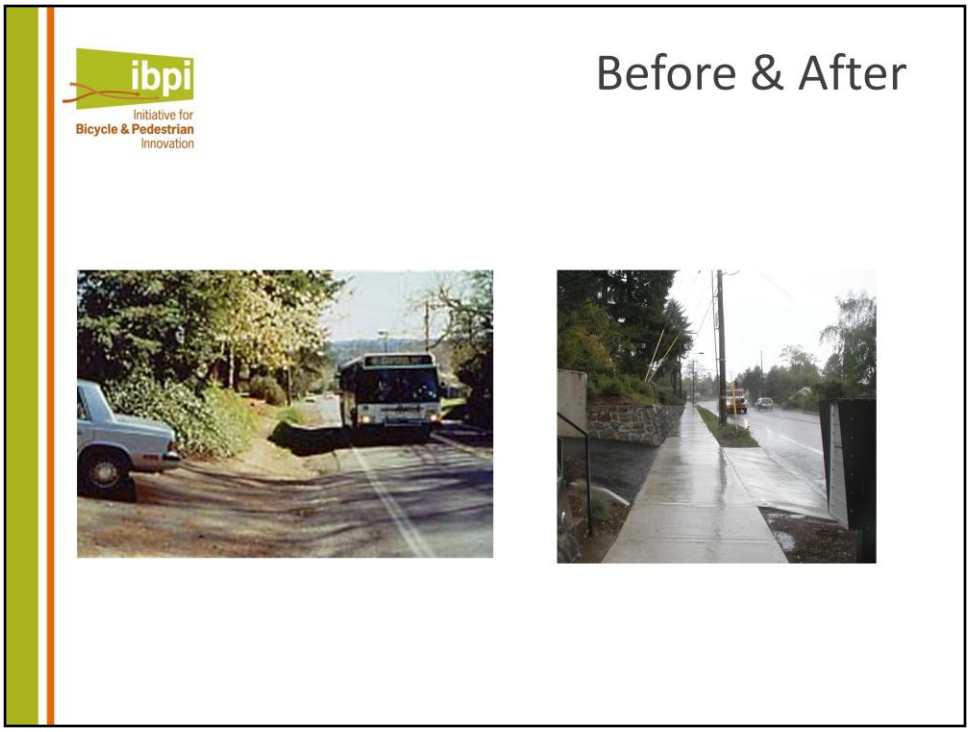
Another example on the same street. Again, it incorporates curb extensions and a median refuge island.

This one is at a corner location, and has a longer curb extension to accommodate a transit stop.

This example illustrates the use of a median refuge island and curb extensions on a four-lane street to improve the pedestrian crossing environment. This design serves several purposes:

1. Narrows crossing distances
2. Allows the pedestrian to cross one direction of vehicle travel at a time
3. Improves visibility

On another Portland street, this example illustrates the use of curb extensions to accommodate transit stops while also serving pedestrian crossing needs.



This suburban roadway lacked any type of pedestrian facility before improvements. This project constructed new sidewalks and a small furnishing zone to provide a buffer from the moving vehicles and a place to locate utilities.

Many communities are now incorporating stormwater management facilities into their rights-of-way. These have many environmental benefits, but need to be designed carefully to ensure pedestrian access is not compromised.

Where there is no on-street parking, the planters can extend to the curb.

However, where on-street parking is allowed, a landing area must be provided to allow for passengers to exit vehicles, and access points across the planting areas should be incorporated so passengers can easily access the sidewalk without walking to the end of the block.

This swale is incorporated into the curb extension of a mid-block crossing.
Note that the plantings are low to ensure that drivers can see pedestrians waiting to cross.

Another example where the swale is incorporated into a curb extension, this time at a corner.
The swale ends before the corner, allowing adequate space at the corner for ramps in both directions, properly aligned with the sidewalk and line of travel.

On residential streets, the swales may be placed in the roadway, with care to end the swale well before the corner. These have the added benefit of visually narrowing the street, which helps to reduce vehicle speeds.

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Discussion

Pedestrian Facilities Planning

Thanks to April Bertelsen, Pedestrian Coordinator, City of Portland, Oregon, for contributing significant content to this presentation

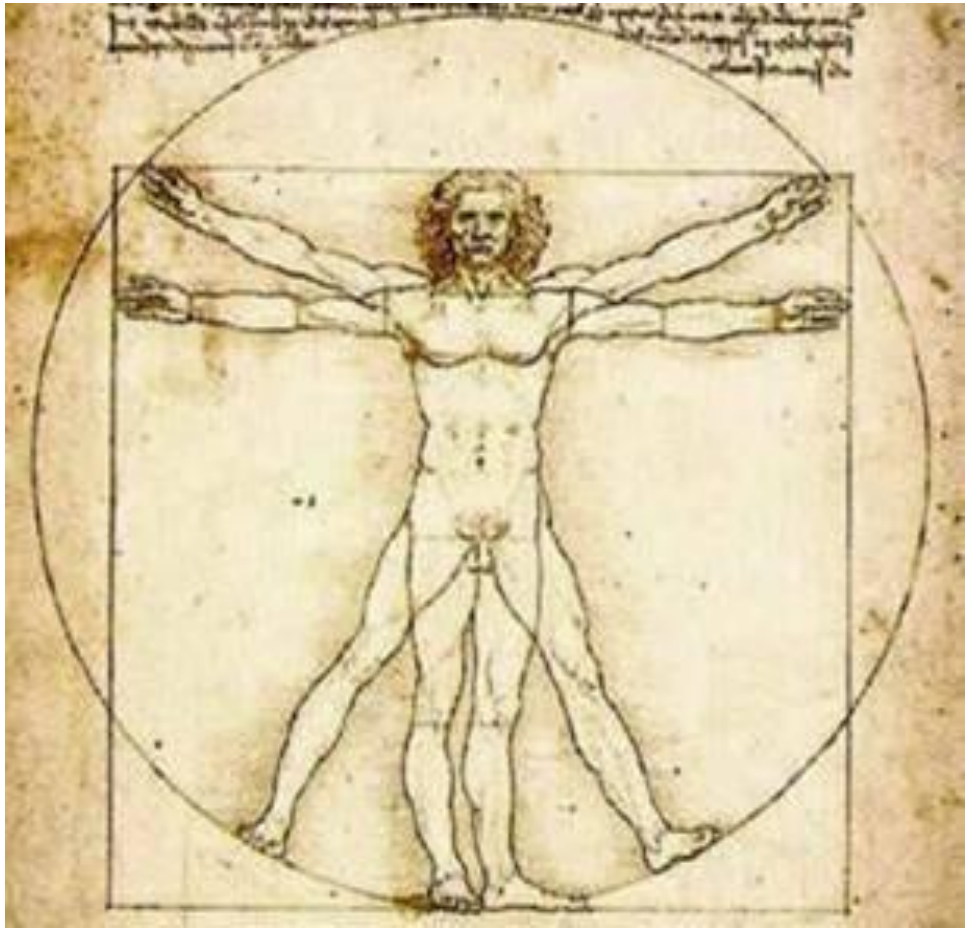
Overview

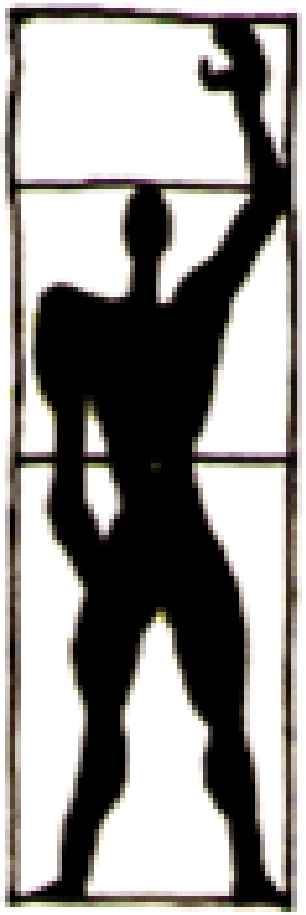
- Nature of Walking
- Pedestrian Characteristics
- Pedestrian Design Elements
- Design for Walking & ADA
- Discussion

Nature of Walking: Recreation

Nature of Walking: Transportation

Pedestrian Characteristics: Scale





Pedestrian Characteristics: Scale

Pedestrian Characteristics: Speed

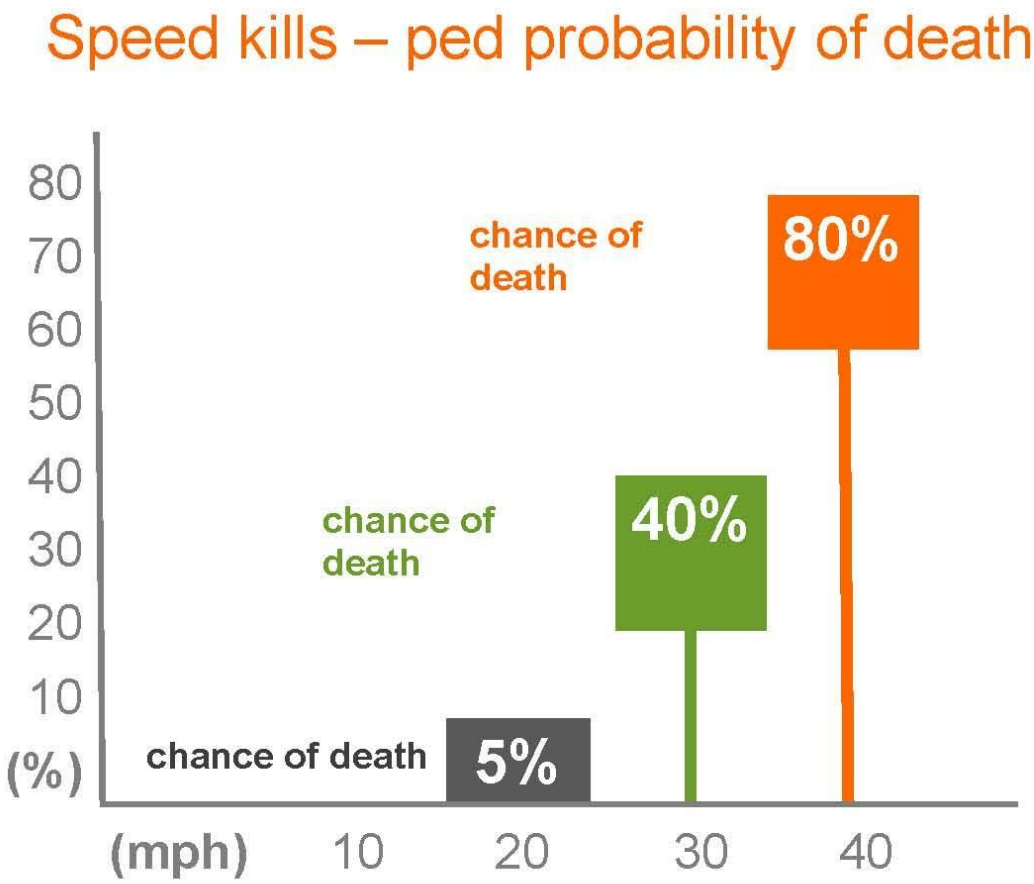
Pedestrian Characteristics

Range of Pedestrian Abilities

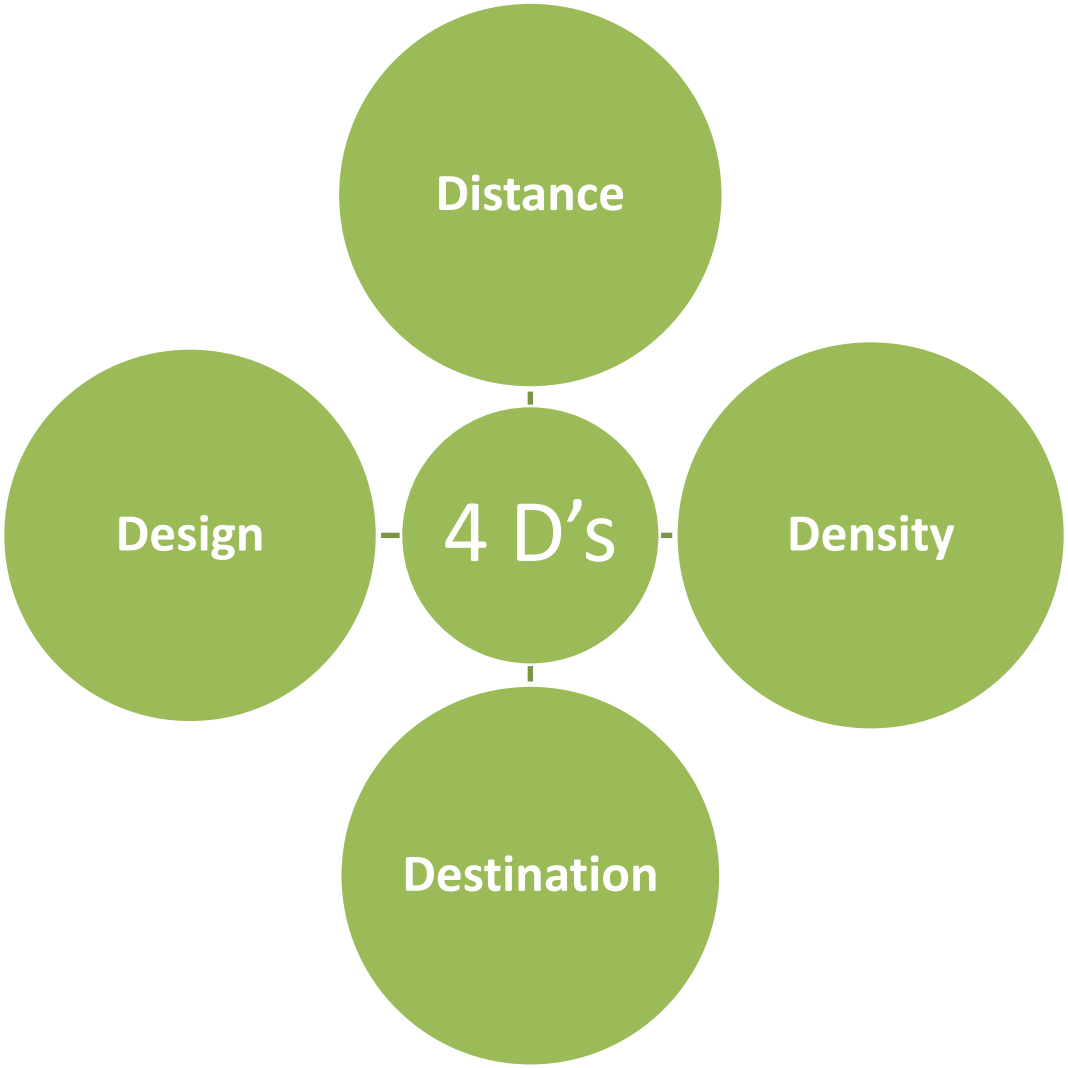
- Agility
- Balance
- Cognition
- Coordination
- Endurance
- Flexibility
- Hearing
- Problem solving
- Required behaviors
- Sensory processing capacity
- Strength
- Vision
- Walking speed

Pedestrian Characteristics

Laws of Physics (why the car always wins)

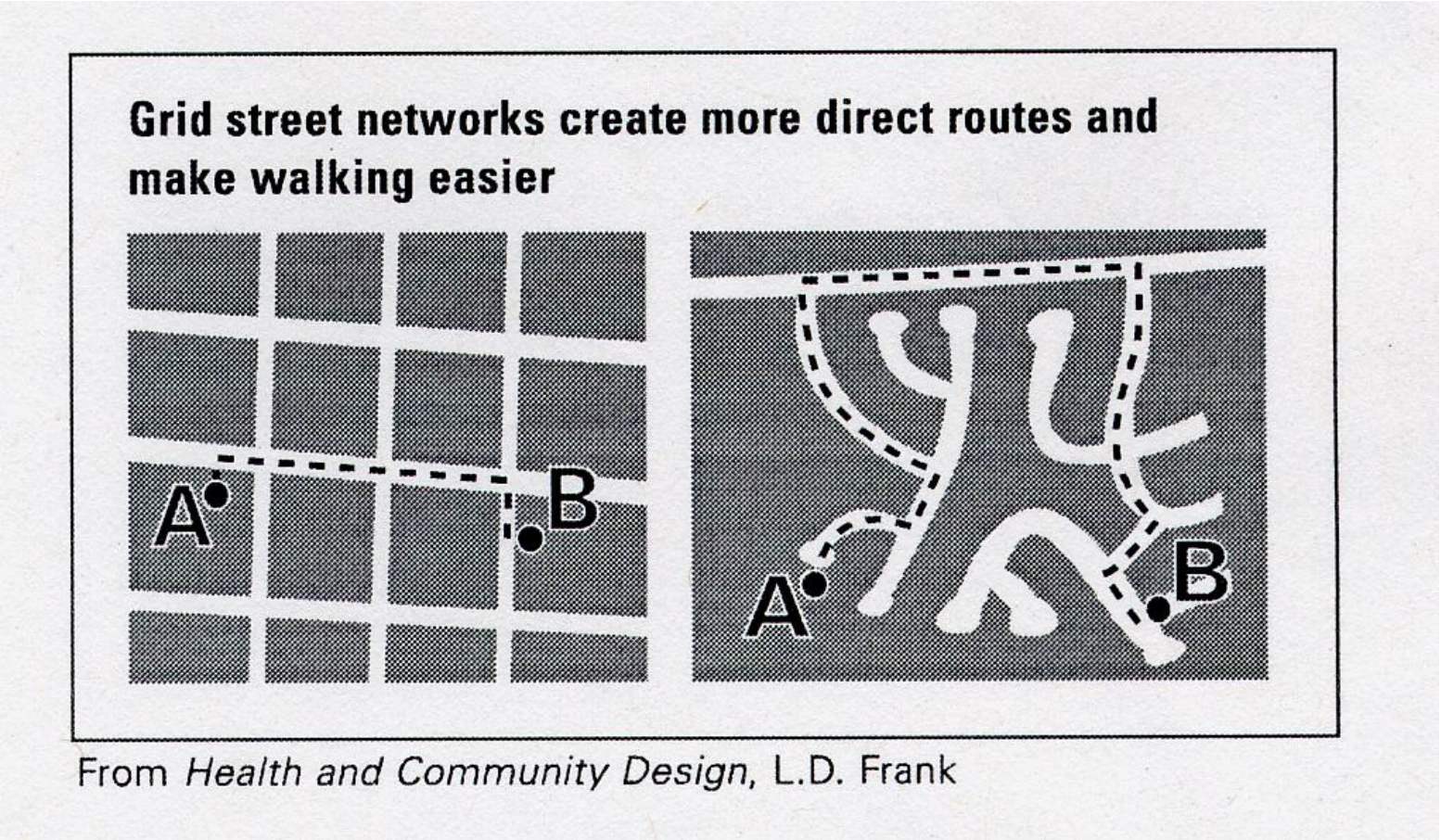


Pedestrian Design Elements



Pedestrian Design Elements

Design and Connectivity



From *Health and Community Design*, L.D. Frank

Pedestrian Design Elements

Distance (and Connectivity)

Pedestrian Design Elements

Destination

Pedestrian Design Elements

Density

Pedestrian Design Elements

Density

Design

- Urban or Site Design
- Street and Sidewalk Design

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Urban Design

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Street Design

Design for Walking

- Sidewalk Corridors
- Corners
- Crossings
- Signals

Americans with Disabilities Act (ADA)

- Law
- Regulations
- Guidelines

Basic Requirements

- New construction & altered facilities must be "accessible to and usable by" people with disabilities.
- Existing facilities, policies & programs must be evaluated for discrimination & develop a modification plan. "Program Access" & "Transition Plan."
- Individual Accommodations: Individuals must be reasonably accommodated, where necessary, to their use of a covered program.

People with Disabilities

20% of the U.S. population are people with disabilities

40% of people age 65 & over have disabilities

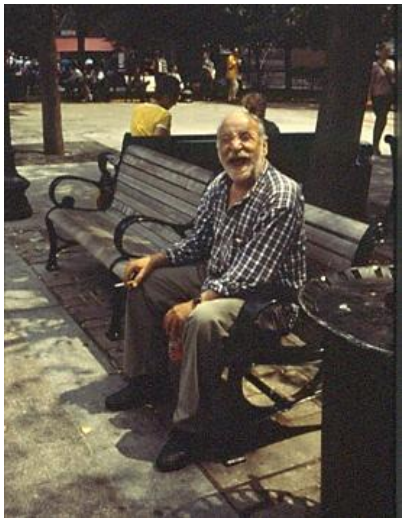
- Some of our disabilities are not visible to others, including some physical, sensory and cognitive disabilities.

Many of us will experience a temporary disability at some point life. Ex: broken leg with crutches.

The number of people with disabilities is expected to **double** in the next 20 years

Universal Design

… is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. *–Ron Mace*



Design for Walking: Sidewalk Corridors

Sidewalk Corridors

Types of Pedestrian Corridors

Shared Roadways

- Pedestrians can walk/roll on low-volume, low-speed streets if they are designed for usability.

Road Shoulders

- Wide shoulders, built to minimum ADA standards, can serve as a pedestrian facility. This is more appropriate on rural, low-volume roads.

Sidewalks

- At some point, sidewalks are needed. “Goat trails” indicate need, as well as motor vehicle traffic volumes.

Shared Use Paths

- Outdoor Recreation Guidelines for Trails, as a minimum should be followed.

Requirements for Pedestrian Corridors

Minimum Width: 4 ft minimum continuous & unobstructed clear width, exclusive of the width of the curb.

Passing Space: If less than 5 ft wide, passing spaces shall be provided at intervals of 200 ft maximum. Passing space shall be 5 ft wide & 5 ft long.

Maximum Cross Slope: 2% Max. cross slope along route

Surface: Surface shall be firm, stable and slip resistant, with minimal surface discontinuities.

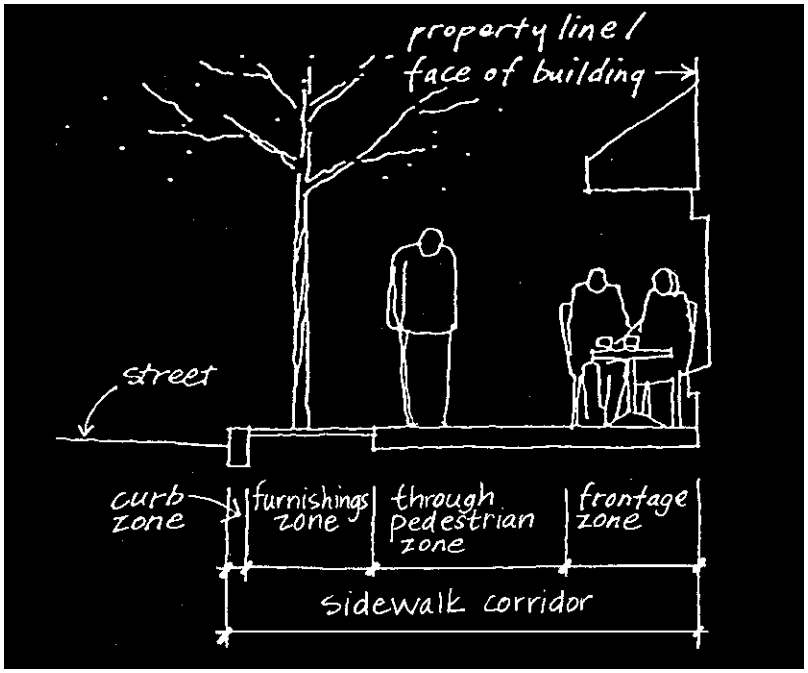
Sidewalk Corridors

Sidewalk Corridor:

Pedestrian system from edge of roadway to edge of Right-of-Way

- Include landscaping
- Place for interaction
- Contribute to quality of place

Zones in the Sidewalk Corridor



Commercial Area "Zone"

1. Through Pedestrian Zone
2. Frontage Zone
3. Furnishing Zone
4. Curb Zone

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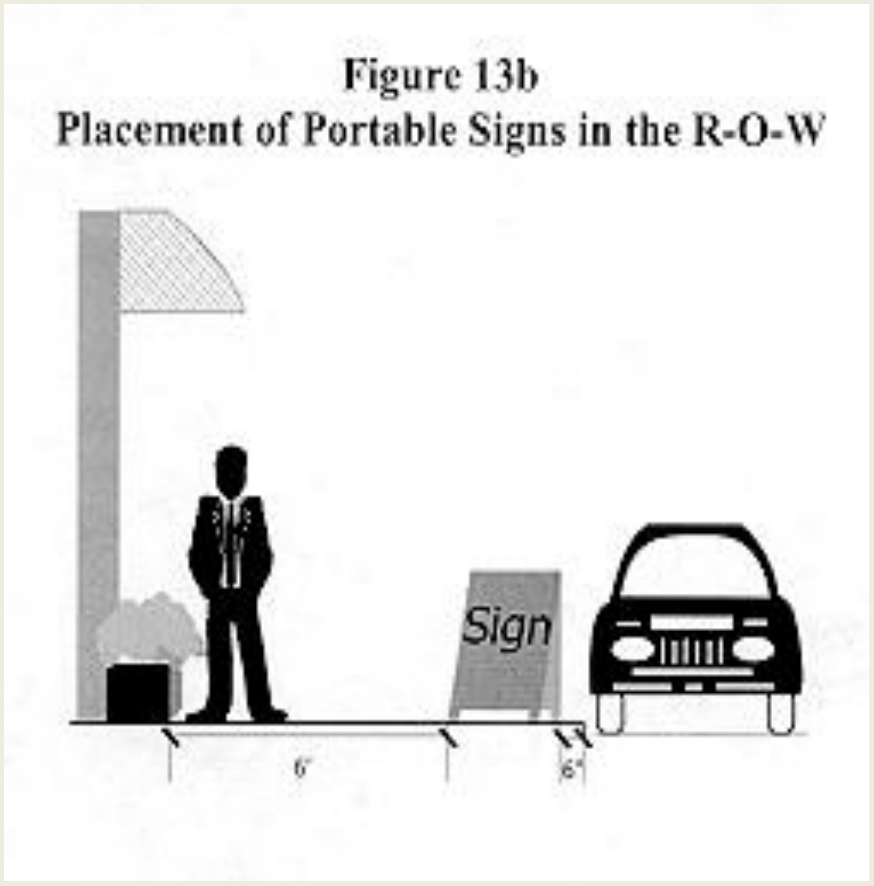
Sidewalk Corridors

Sidewalk Corridors

Furnishing Zone

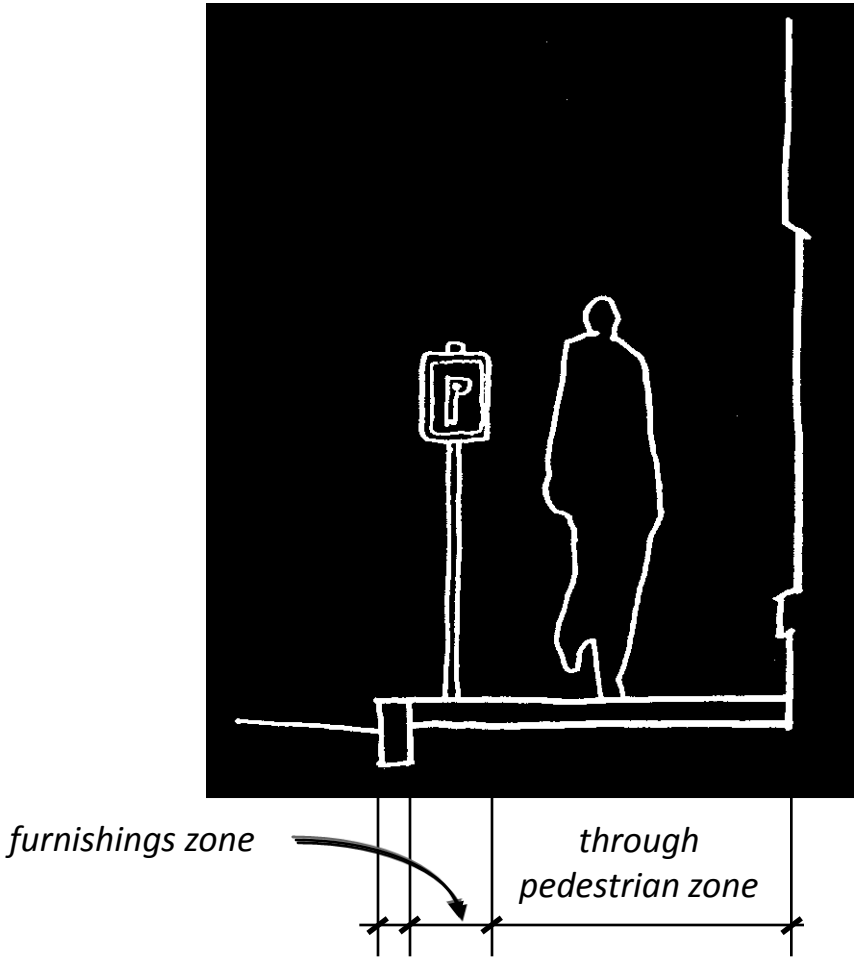
Sidewalk Corridors



Sidewalk Corridors

A-boards not in furnishing zone

Sidewalk Corridors



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Sidewalk Corridors

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Sidewalk Corridors

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Sidewalk Corridors: Running Grade and Cross-Slope

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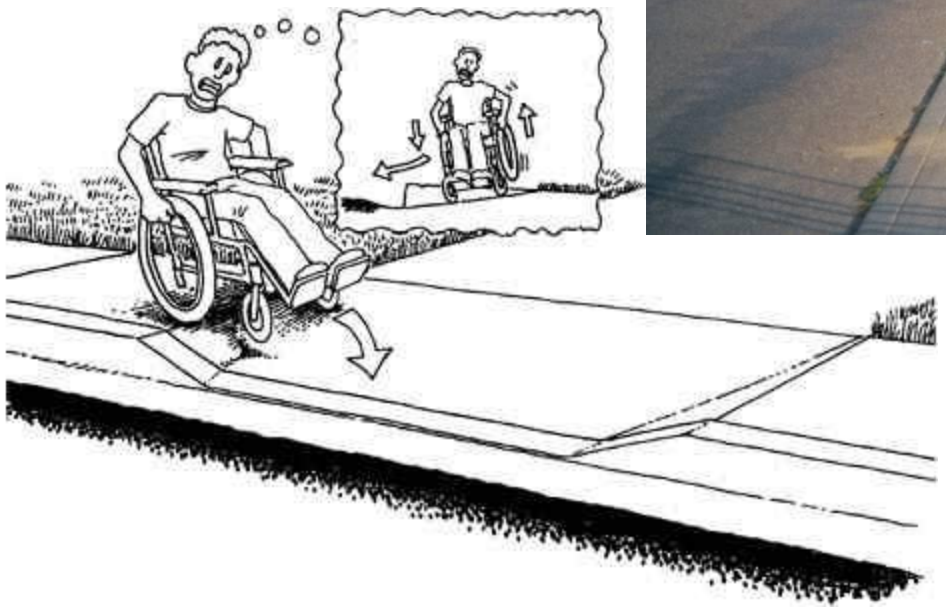
Cross slope and driveways

Cross slope and driveways



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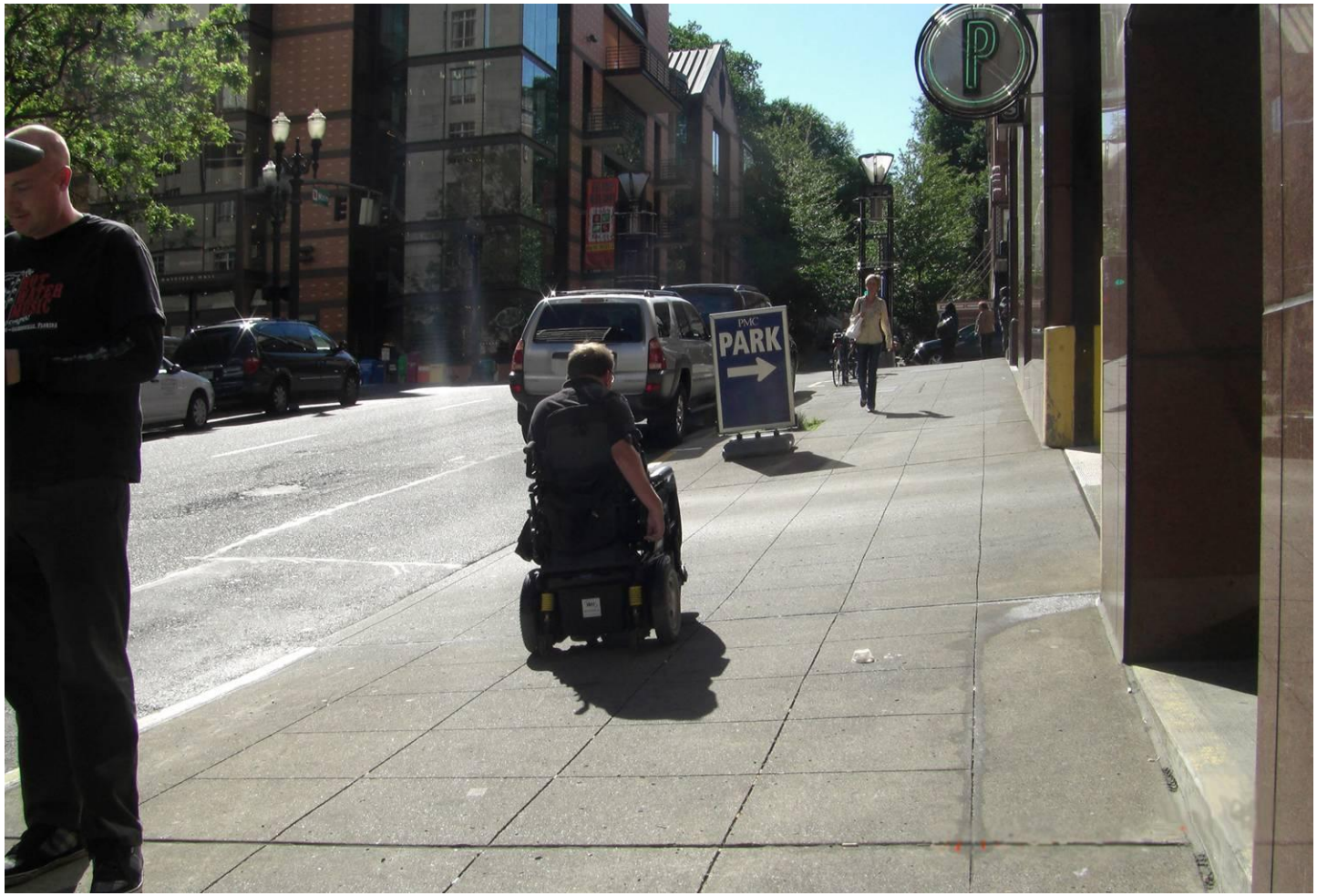
Cross slope



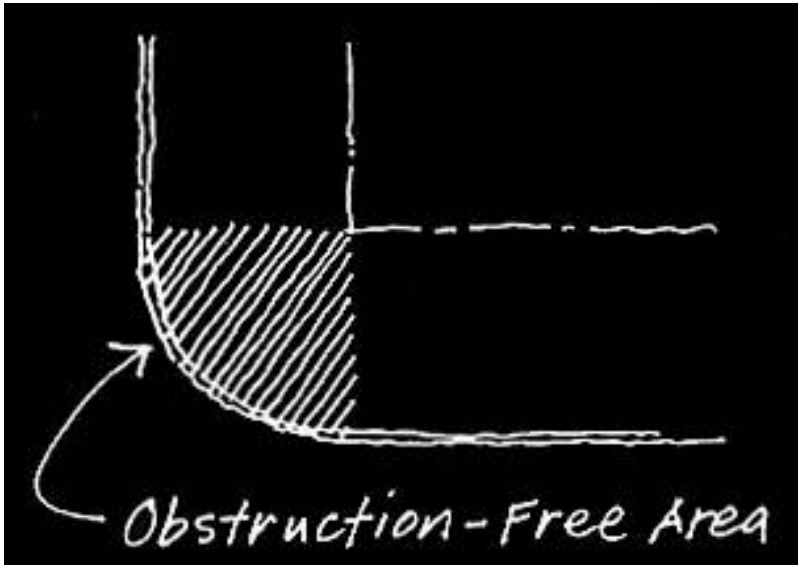
Guidelines for Street Corners

Good street corners

- Clear of obstructions
- Let pedestrians see and be seen
- Separate pedestrians from traffic
- Accessible

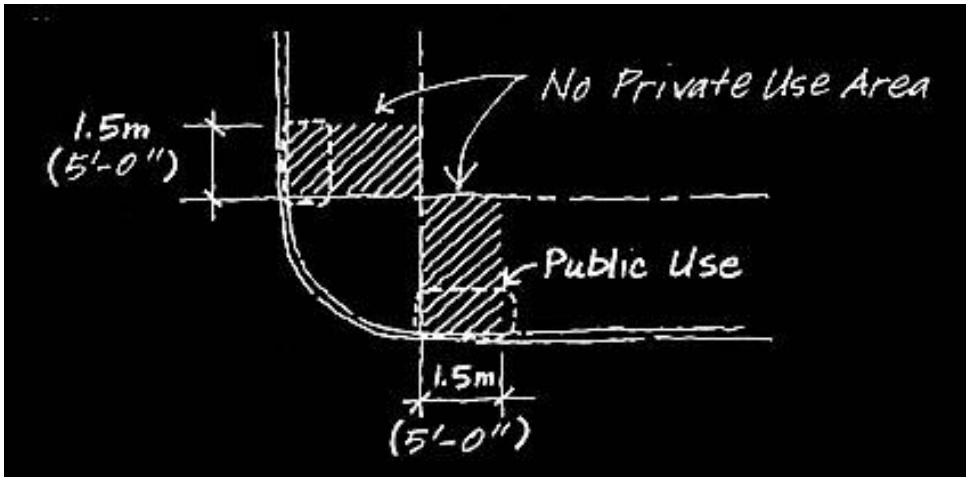
Guidelines for Street Corners

Space between the curb and the extension of the property lines to the curb



Guidelines for Street Corners

Public uses are encouraged to locate in the furnishings zone of the “No Private Use” Area



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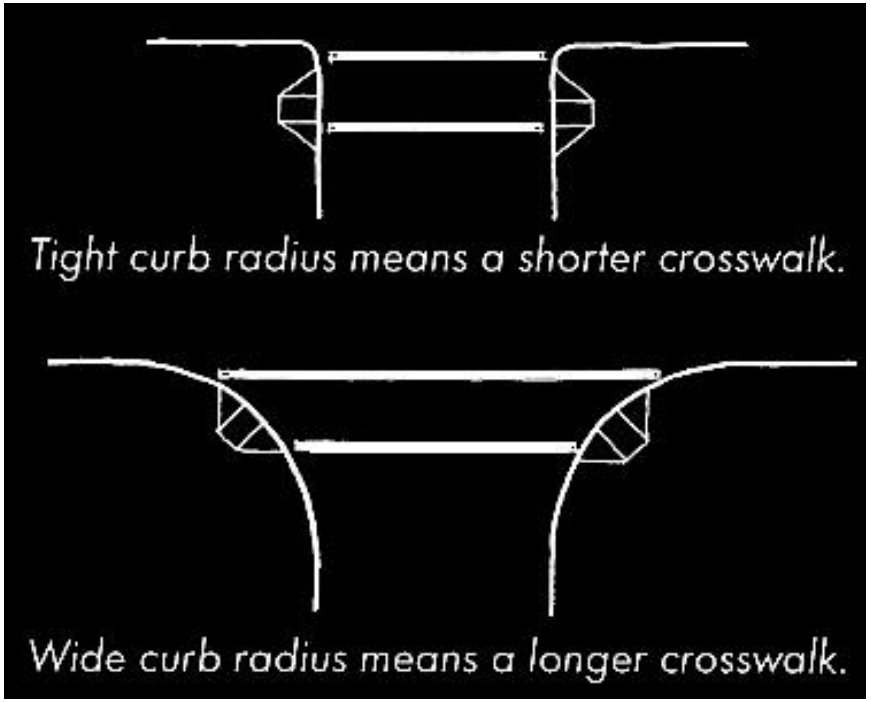
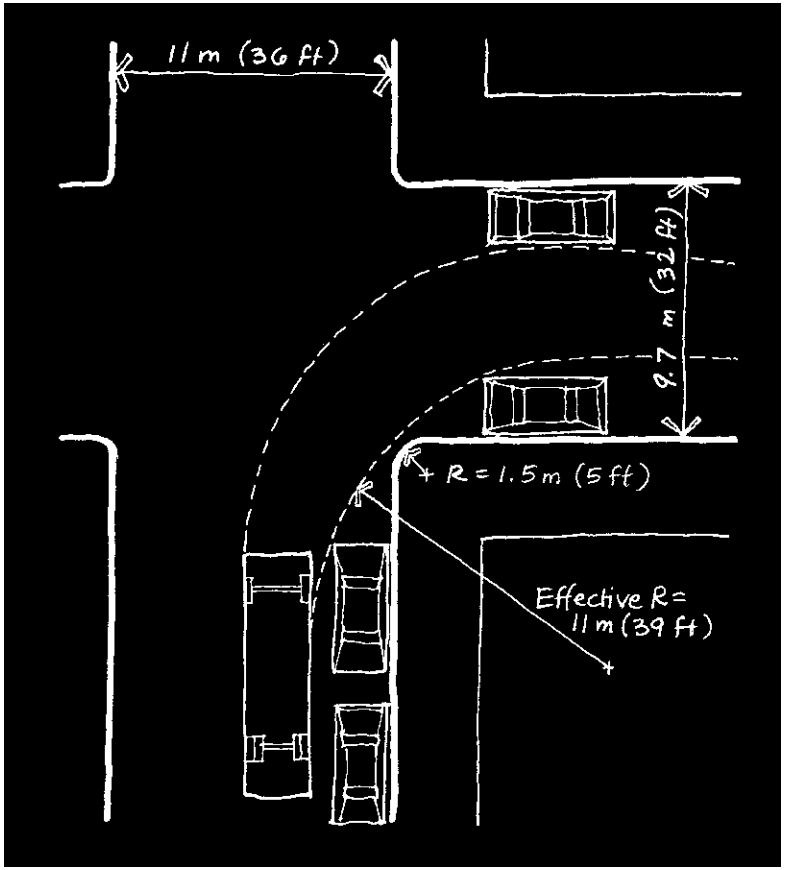
Guidelines for Street Corners

Guidelines for Street Corners





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Guidelines for Street Corners

ADA Curb Ramps at Corners

- Provide two ramps at corners, one in each direction, at every legal crosswalk, including at unmarked and T-intersections.
- Provide ramps on both sides of street, so to not abandon people in the road.
- Provide detectable warning strips with contrasting material where curb is dropped. Yellow color recommended by FHWA. (a.k.a. Tactile warning panels, Truncated domes, etc.)

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Guidelines for Street Corners

Guidelines for Street Corners

Before

After

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Guidelines for Crosswalks

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Guidelines for Crosswalks

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Guidelines for Crosswalks

Guidelines for Crosswalks

Develop a policy for marked crossings that includes:

- Criteria for marking a crosswalk
- Considerations for determining level of enhancements and how to mark them.
- Criteria for removing marked crosswalks

Guidelines for Crosswalks

Criteria to Consider for Marked Crosswalks

- Distance from a signalized crossing: 300 ft
- Sight distance measured from both pedestrian and driver's perspective
- Gap Analysis
- Collision Data
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Guidelines for Crosswalks

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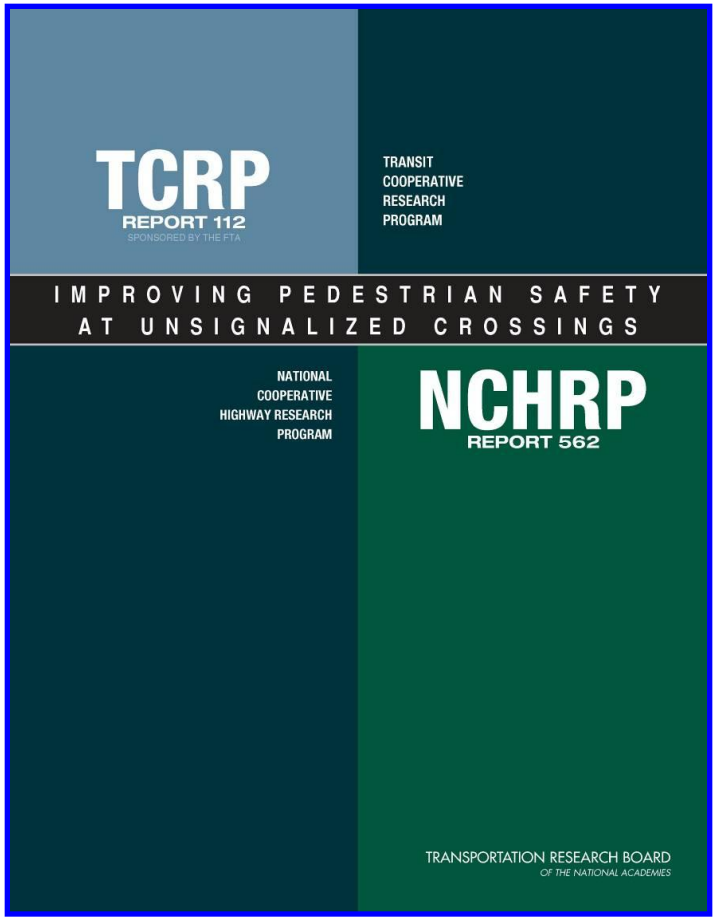

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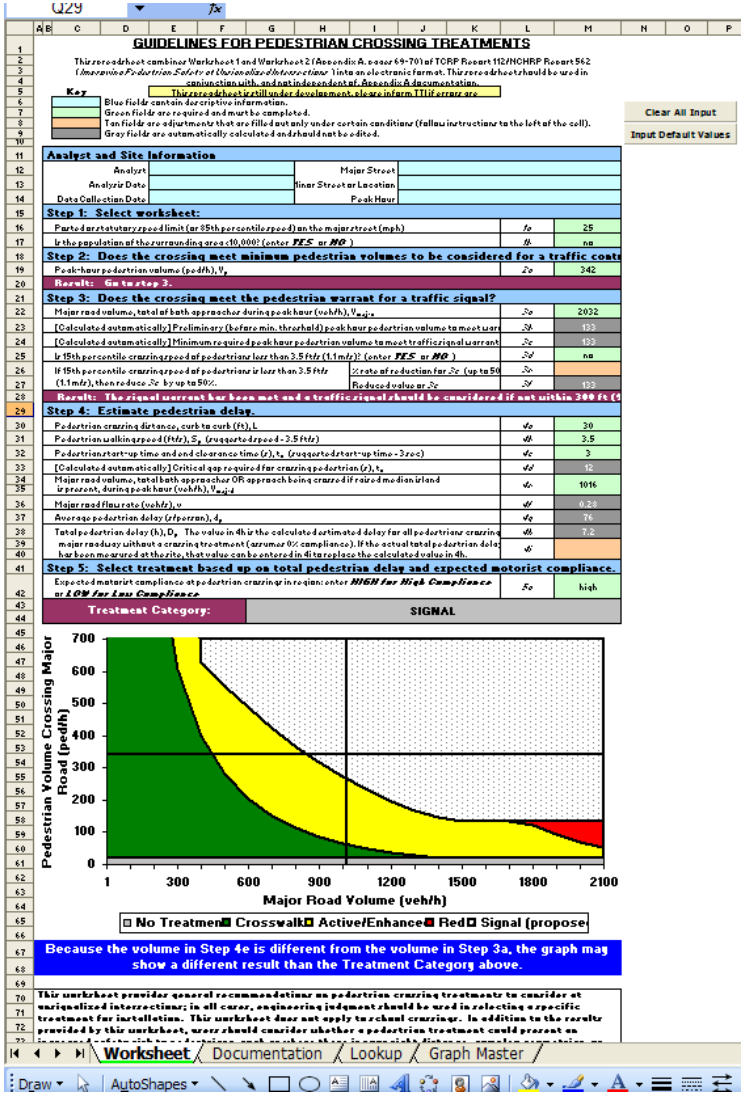
Peak-hour pedestrian volume (ped/h), V_p		*2a*	
If *2a* ≥ 20 ped/h, then go to Step 3.			
If *2a* < 20 ped/h, then consider median refuge islands, curb extensions, traffic calming, etc. as feasible.			
Step 3: Does the crossing meet the pedestrian volume warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	
Minimum signal warrant volume for peak hour (use *3a* for $V_{maj\text{-}s}$), SC $SC = (0.00021\ V_{maj\text{-}s}^2 - 0.74072\ V_{maj\text{-}s} + 734.125)/0.75$ OR $[(0.00021\ 3a^2 - 0.74072\ 3a + 734.125)/0.75]$		*3b*	
If *3b* < 133, then enter 133. If *3b* ≥ 133, then enter *3b*.		*3c*	
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50 percent; otherwise enter *3c*.		*3d*	
If *2a* ≥ *3d*, then the warrant has been met and a traffic signal should be considered if not within 300 ft (91 m) of another traffic signal. Otherwise, the warrant has not been met. Go to Step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	
Pedestrian walking speed (ft/s), S_p		*4b*	
Pedestrian start-up time and end clearance time (s), t_s		*4c*	
Critical gap required for crossing pedestrian (s), $t_c = (L/S_p) + t_s$ OR [*(4a/4b) + 4c)*]		*4d*	
Major road volume, total both approaches or approach being crossed if median refuge island is present during peak hour (veh/h), $V_{maj\text{-}s}$		*4e*	
Major road flow rate (veh/s), $v = V_{maj\text{-}d}/3600$ OR *[4e/3600]*		*4f*	
Average pedestrian delay (s/person), $d_p = (e^{v\ tc} - v\ t_c - 1) / v$ OR $[\ (e^{4f \times 4d} - 4f \times 4d - 1) / 4f\ ]$		*4g*	
Total pedestrian delay (h), $D_p = (d_p \times V_p)/3{,}600$ OR *[(4g×2a)/3600]* (this is estimated delay for all pedestrians crossing the major roadway without a crossing treatment – assumes 0% compliance). This calculated value can be replaced with the actual total pedestrian delay measured at the site.		*4h*	
Step 5: Select treatment based upon total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region, Comp = high or low		*5a*	

Total Pedestrian Delay, D_p (from *4h*) and Motorist Compliance, Comp (from *5a*)	**Treatment Category** (see Descriptions of Sample Treatments for examples)
$D_p \geq 21.3$ h (Comp = high or low) OR $5.3\ h \leq D_p < 21.3$ h and Comp = low	RED
$1.3\ h \leq D_p < 5.3$ h (Comp = high or low) OR $5.3\ h \leq D_p < 21.3$ h and Comp = high	ACTIVE OR ENHANCED
$D_p < 1.3$ h (Comp = high or low)	CROSSWALK

Figure A-2. Worksheet 1.



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Guidelines for Crosswalks

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Guidelines for Pedestrian Signals

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High-intensity **A**ctuated **W**al**K**

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Before & After

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Stormwater Management Facilities

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Discussion

Pedestrian Facility Design

Exercise 1: Urban Design Walkability Audit

Assignment Description for *Instructor*:

This has been adapted from Active Living Research's Measurement Tool. Operational definitions and measurement protocols were developed for five urban design qualities: imageability, visual enclosure, human scale, transparency, and complexity. The operational definitions take the form of statistically-derived equations that link objectively measured physical features of the environment to ratings of urban design qualities. To aid in the dissemination of the measures, a field survey instrument and training manual have been developed for use by researchers in their efforts to study relationships between the built environment and walking behavior.

Instructor Prep Work:

- Review the excel spreadsheet and project description.
- Identify street segments in an urban environment.
- Review Active Living Research's Website: http://www.activelivingresearch.org/node/10635

Time Required for Students:

- 2 hour street observation
- Students write up observations and discuss findings in class

Assignment:

Students should complete the street audit on a selected number of segments and present results with other students to facilitate comparisons.

Pedestrian Facility Design

Exercise 1: Urban Design Walkability Audit

Assignment Description for Students:

This assignment has been adapted from Active Living Research's Measurement Tool. Operational definitions and measurement protocols were developed for five urban design qualities: imageability, visual enclosure, human scale, transparency, and complexity. The operational definitions take the form of statistically-derived equations that link objectively measured physical features of the environment to ratings of urban design qualities. To aid in the dissemination of the measures, a field survey instrument and training manual have been developed for use by researchers in their efforts to study relationships between the built environment and walking behavior.

Time Required:

- 2 hour observation
- Write up observations and in-class discussion

Assignment:

Students should complete the street audit on a selected number of segments and present results with other students to facilitate comparisons.

Pedestrian Facility Design

Exercise 2: ADA Experiential Learning

Assignment Description for *Instructor*:

This assignment will have students experience being a pedestrian with limited mobility or vision to understand how pedestrian facilities are functioning. Students should work in groups for safety. Student groups will take turns walking in an area with the assistance of their group to test how the pedestrian environment feels when mobility or sight is restricted.

Instructor Prep Work:

Some organizations may have vision restricted goggles, wheelchairs, or other tools to help facilitate this exercise. Without these tools, blindfolds of varying sight restrictions can be used (for instance, some blindfolds that allow some visibility, while others may remove all sight). Choose an appropriate area near or on campus for the students to experience limited mobility.

Time Required:

- 30-45 minutes

Assignment:

Class discussion of the experience and facilities.

Pedestrian Facility Design

Exercise 2: ADA Experiential Learning

Assignment Description for Students:

This assignment will have you experience being a pedestrian with limited mobility or sight to see how pedestrian facilities are functioning. Students should work in groups for safety. Student groups will take turns walking in an area with the assistance of their group to test how the pedestrian environment feels when mobility or sight is restricted.

Things to consider

- What barriers came up that you might not normally encounter?
- Were there features in the pedestrian environment you found helpful to getting around? What were they?
- What cues did you rely on for mobility?
- What could be done to improve the pedestrian environment?

Time Required:

- 30-45 minutes, in class exercise

Assignment:

Class discussion of the experience and facilities.