DESIGNING IN CONTEXT OF COMPLETE STREETS

DESIGN

Module 5

Crossing the Road

Lighting

Transit

WHAT TYPE OF CROSSING WOULD YOU INSTALL?

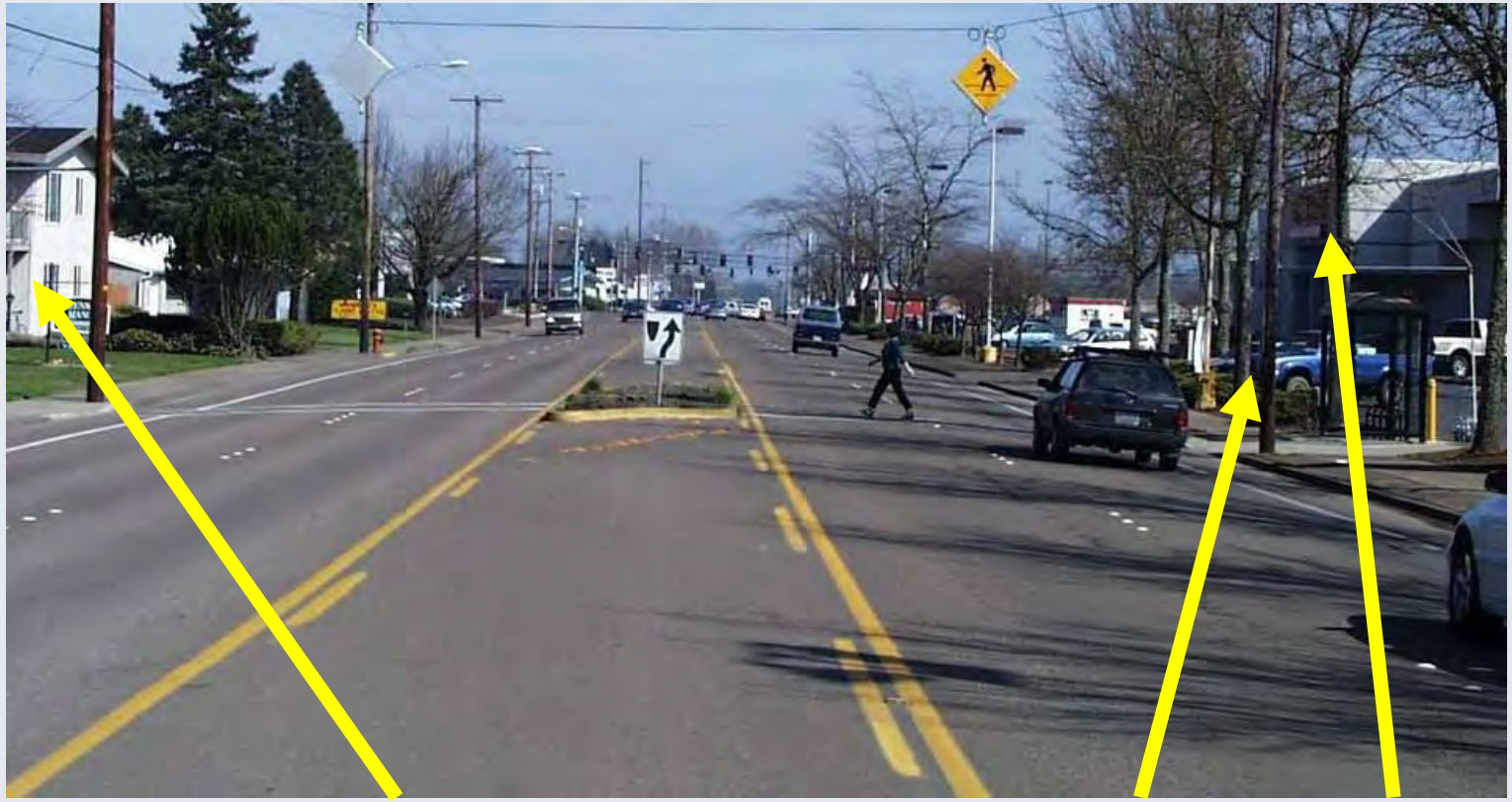
CROSSING THE ROAD

Why Crosswalk Markings?

- To indicate to pedestrians where to cross
- To indicate to drivers where to expect pedestrians
- At mid-block locations, crosswalk markings legally establish the crosswalk.

CROSSING THE ROAD

How to determine where to mark a crosswalk?
Consider origins and destinations



In this case, apartments across from bus stop & stores

MARKED CROSSWALK MUST BE VISIBLE TO BOTH PEDESTRIAN AND DRIVER

What the pedestrian sees

What the driver sees

(same crosswalk)

HIGH VISIBILITY CROSSWALK MARKINGS

Place longitudinal markings to avoid wheel tracks, reducing wear & tear & maintenance

WARNING ON BRICK CROSSWALKS

CREATIVE BUT NOT COMPLIANT

CROSSING THE ROAD

- Marked vs. Unmarked Analysis
- Speeds < or = to 40 mph
  - Two-lane roads: No significant difference in crash rate
  - Multilane roads (3 or more lanes)
    - Under 12,000 ADT: no significant difference in crash rate
    - Over 12,000 ADT w/ no median: crashes marked > crashes unmarked
    - Over 15,000 ADT & w/ median: crashes marked > crashes unmarked

TEXT IN THE 2009 MUTCD

Text in the 2009 MUTCD Section 3B.18

- New marked crosswalks alone, **without other measures designed to reduce traffic speeds**, shorten crossing distances, enhance driver awareness of the crossing, and/or provide active warning of pedestrian presence, should not be installed across uncontrolled roadways where the speed limit exceeds 40 mph or either:
  - Has 4 or more lanes without a raised median or island and ADT of 12,000 or more, or
  - 4 or more lanes with raised median island and ADT of 15,000 or more

Photo Credit Chicago DOT

SOME OTHER MEASURES

Part 1

- High Visibility Markings
- Illumination
- Signing
- Advance Stop Bars
- Median Islands
- Raised Crosswalks
- Curb Extensions

Part 2

- RRFB
- PHB
- Pedestrian Signals
- Road Diets

EDC4 STEP Treatments Underlined

every day counts
An Innovation Partnership with States

EXAMPLES OF CROSSING TABLES

UNCONTROLLED CROSSWALK DECISION MATRIX
(Treatments to be applied only if evaluations of conditions indicates that the treatment will provide a significant safety benefit)

Roadway Type (Number of Travel Lanes and Median Type)	Vehicle ADT ≤ 9,000			Vehicle ADT >9,000 to 12,000			Vehicle ADT >12,000 to 15,000			Vehicle ADT >15,000		
	Posted Speed Limit											
	≤30 mph	35 mph	40 mph	≤30 mph	35 mph	40 mph	≤30 mph	35 mph	40 mph	≤30 mph	35 mph	40 mph
Two lanes	C/1	C/1	P/2	C/1	C/1	P/2	P/2	P/3	P/3	P/2	P/3	P/3
Three lanes	C/1	C/1	P/2	C/1	P/2	P/2	P/2	P/2	P/3	P/2	P/3	P/3
Multilane (four or more lanes with raised median)	C/1	C/2	P/2	C/2	P/2	P/3	P/2	P/2	P/3	P/3	P/3	P/3
Multilane (four or more lanes without raised median)	C/1	P/2	P/3	P/2	P/2	P/3	P/3	P/3	P/3	P/3	P/3	P/3

C - Candidate sites for marked crosswalks*. An engineering study is required to determine whether a marked crosswalk will provide a significant safety benefit. A site review may be sufficient at some locations, while a more indepth study of vehicle speeds, sight distance, vehicle mix, and other factors may be needed at other sites. It is recommended that a minimum utilization of 20 pedestrian crossings per peak hour (or 15 or more elderly and/or child pedestrians) be confirmed at a location before placing a high priority on the installation of a crosswalk treatment. See Crossing Treatment Type Number 1.

P - Possible increase in pedestrian crash risk if crosswalks alone are added without other pedestrian facillity enhancements. If the evaluation determines that a crosswalk would provide a significant safety benefit, then crosswalk locations should be enhanced with other pedestrian crossing improvements such as those shown in Crossing Treatment Types Number 2 or 3.

Minimum crosswalk treatments at uncontrolled locations should follow the requirements of the Manual on Uniform Traffic Control Devices (most current version).

Crossing Treatment Types:

1 - High visibility Crosswalk Striping is recommended, and consideration of additional treatments such as a Pedestrian Refuge Island and/or Advanced Yield Lines and street lighting.

2 - Crossing treatments such as a Pedestrian Refuge Island, Overhead Pedestrian Crossing Signs, Flashing Beacons, Yield Lines, parking removal between crosswalk and Yield Lines and street lighting should be considered. Additional information is available in the NDOT Flashing Beacon policy.

3 - Crossing treatments such as a Pedestrian Hybrid Beacon, Pedestrian Signal, or Two-Stage Crossing, Stop or Yield Lines, parking removal between crosswalk and Yield Lines and street lighting should be considered. Installation of traffic signals cannot be considered unless traffic conditions meet warrant criteria specified in the Manual on Uniform Traffic Control Devices.

***NRS 484A.065 "Crosswalk Defined"** Crosswalk means: 1. That part of a highway at an intersection within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or, in the absence of curbs, from the edges of the traveled portions of highways; or 2. Any portion of a highway at an intersection or elsewhwere distinctly indicated for pedestrian crossing by lines or other markings on the surface.

Nevada DOT 8 /14/14

Table 1 Total Pedestrian Delay – Treatment Selection Guidance

Speed	Motorist Compliance	Total Pedestrian Delay Type: Low (< 1.3 ped-hrs)	Medium-Low (≥ 1.3 to < 5.3 ped-hrs)	Medium-High (≥ 5.3 to < 21.3 ped-hrs)	High (≥ 21.3 ped-hrs)
≤ 35 mph	Low	Consider Marking Crosswalk	Consider Supplemental Treatments	Move to Step 4	Move to Step 4
	High	Consider Marking Crosswalk	Consider Supplemental Treatments	Consider Supplemental Treatments	Move to Step 4
> 35 mph	Low	Consider Supplemental Treatments	Consider Supplemental Treatments	Move to Step 4	Move to Step 4
	High	Consider Supplemental Treatments	Consider Supplemental Treatments	Consider Supplemental Treatments	Move to Step 4

Figure 16 illustrates a plotted point in the Medium-High category. In this example, because the Total Pedestrian Delay is Medium High, the speed is less than 35 mph, and motorist compliance is low, Table 1 indicates that the evaluator move to Step 4 to continue to assess the crossing location for a Pedestrian Hybrid Beacon.

Example Scenario

- Crossing location: road in an urban area.
- Speed limit or 85th percentile operating speed: 35 mph or less.
- Crossing distance: 36 ft.
- Peak-hour vehicle volume: 2,000.
- Peak-hour pedestrian volume: 20.
- Motorist Compliance: Low

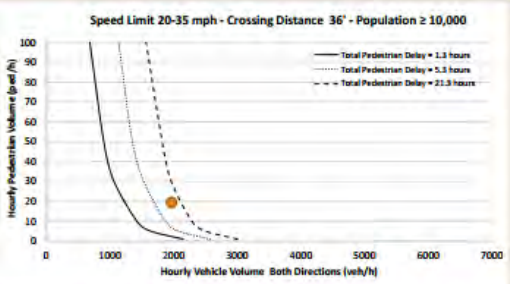


Figure 16 Example scenario using the "Speed Limit 20-35 mph – Crossing Distance 36' – Population ≥ 10,000" chart from Appendix C.to determine Total Pedestrian Delay type. Example shows a Medium-High delay between 5.3 and 21.3 ped-hrs.

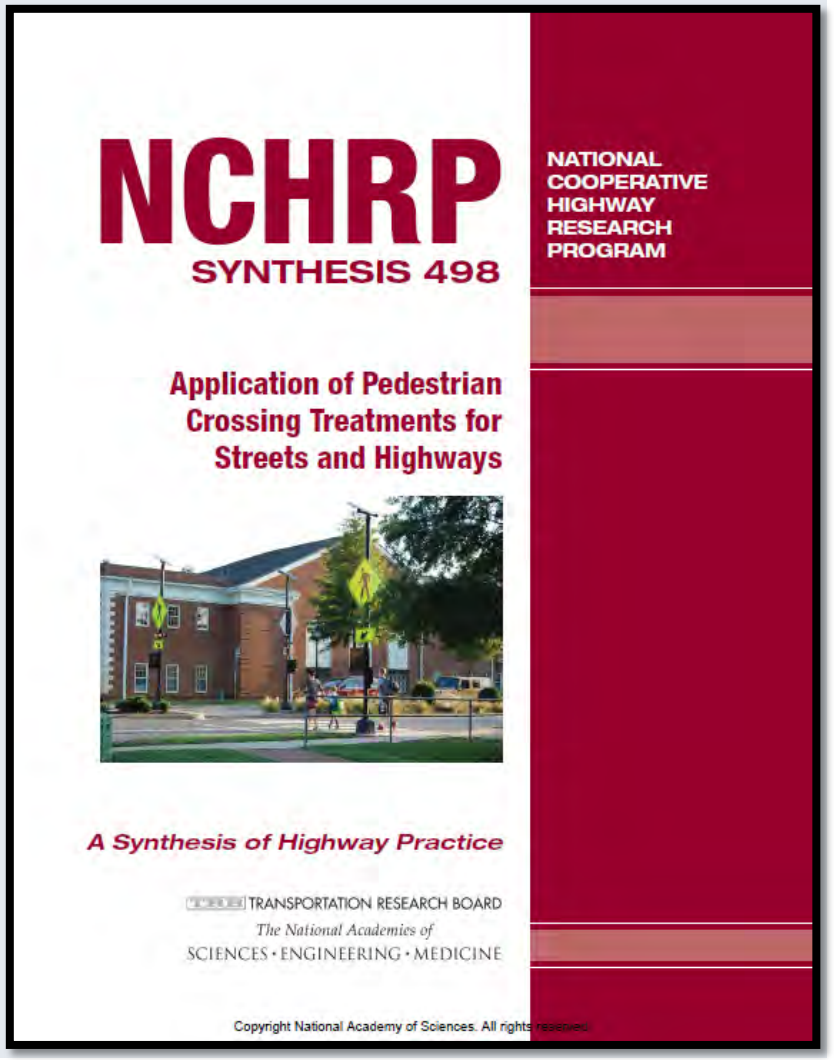
NC Ped Crossing Research Report FHWA/NC/2014-15

2016 SYNTHESIS OF APPLICATIONS OF PEDESTRIAN CROSSING TREATMENTS

Free pdf version online

Study was carried out by

1. Surveying state departments of transportation (DOTs) and local transportation agencies
2. Identifying and synthesizing current recommended practice and policy guidance
3. Performing a comprehensive literature review of safety evidence for more than 25 pedestrian crossing treatments.



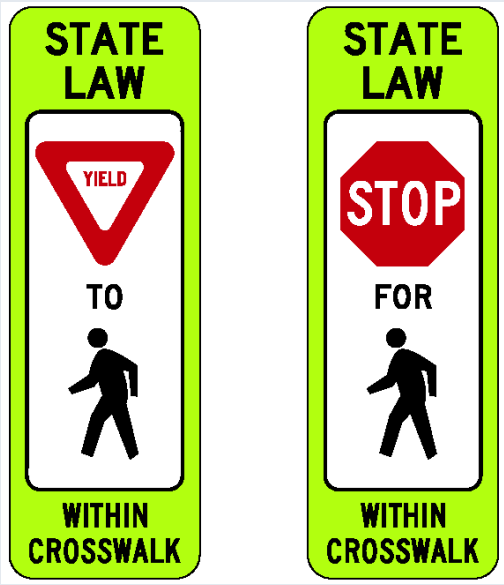
CROSSING THE ROAD - SIGNING

2009 MUTCD Sec. 2C.50 & Fig. 2C-10

Placement

IN-STREET PEDESTRIAN CROSSING SIGNS

- Tampa FL



R1-6 R1-6a

MUTCD signs

Yield or Stop depends on state law

2009 MUTCD Section 2B.12 and Figure 2B-2

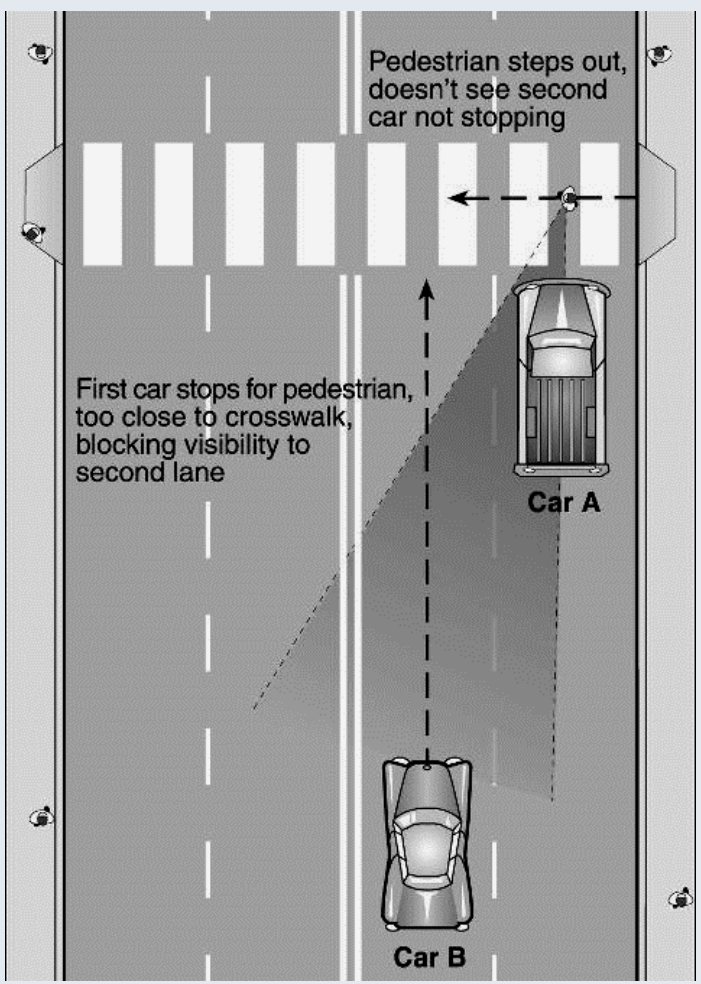
ADVANCED STOP/YIELD BAR

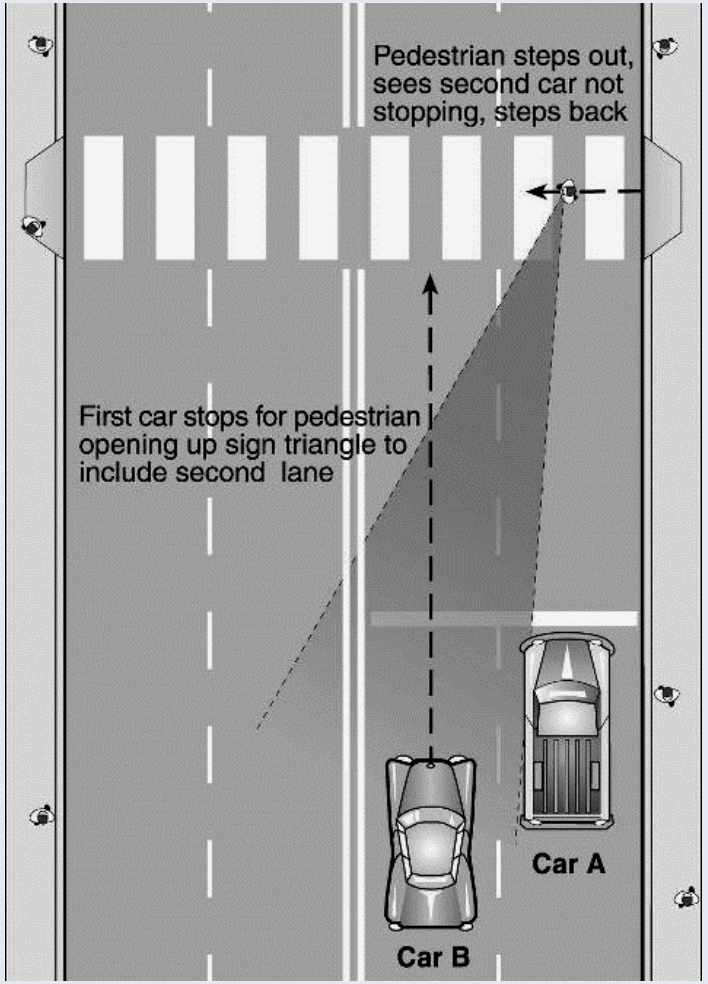
Without (Image Left)

- 1st car stops to let pedestrian cross, blocking sight lines
- 2nd car doesn't stop, hits pedestrian at high speed

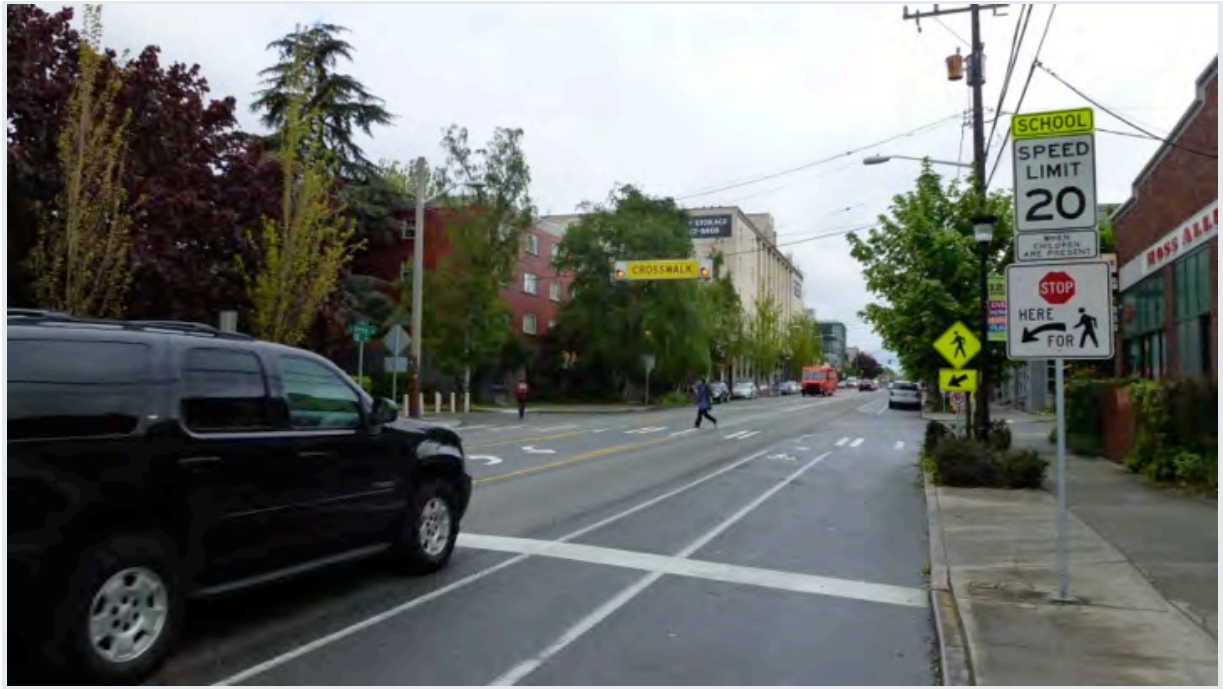
With (Image Right)

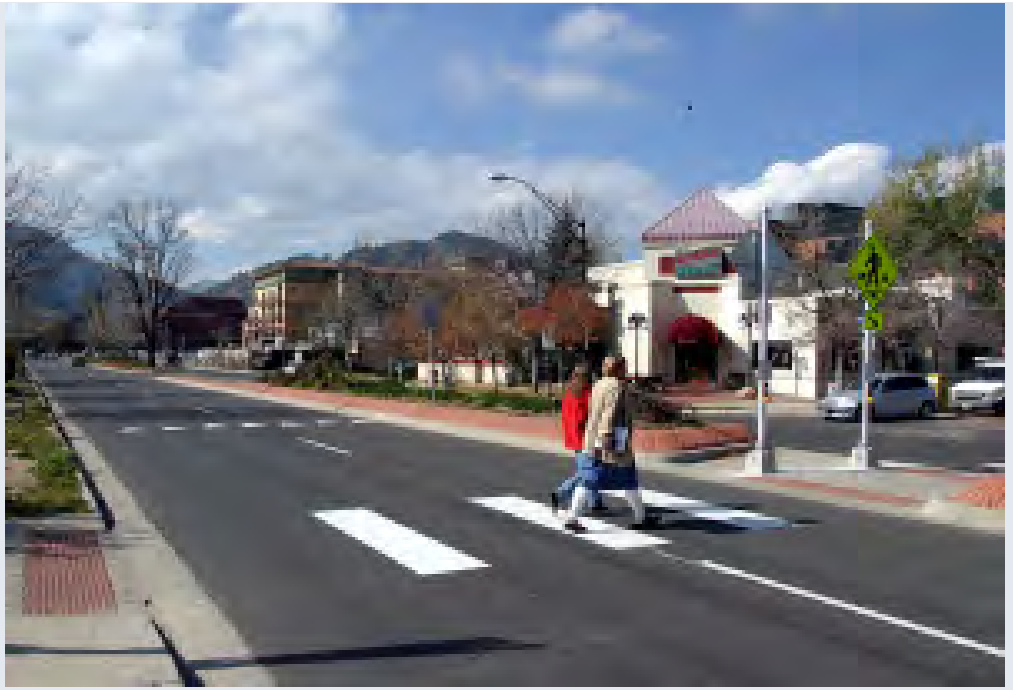
- 1st car stops further back, opening up sight lines
- 2nd car can be seen by pedestrian





ADVANCE STOP LINE AND SIGN





R1-5b

R1-5c

2009 MUTCD Section 3B.16

MUTCD Sec. 2B.11 and Figure 2B-2

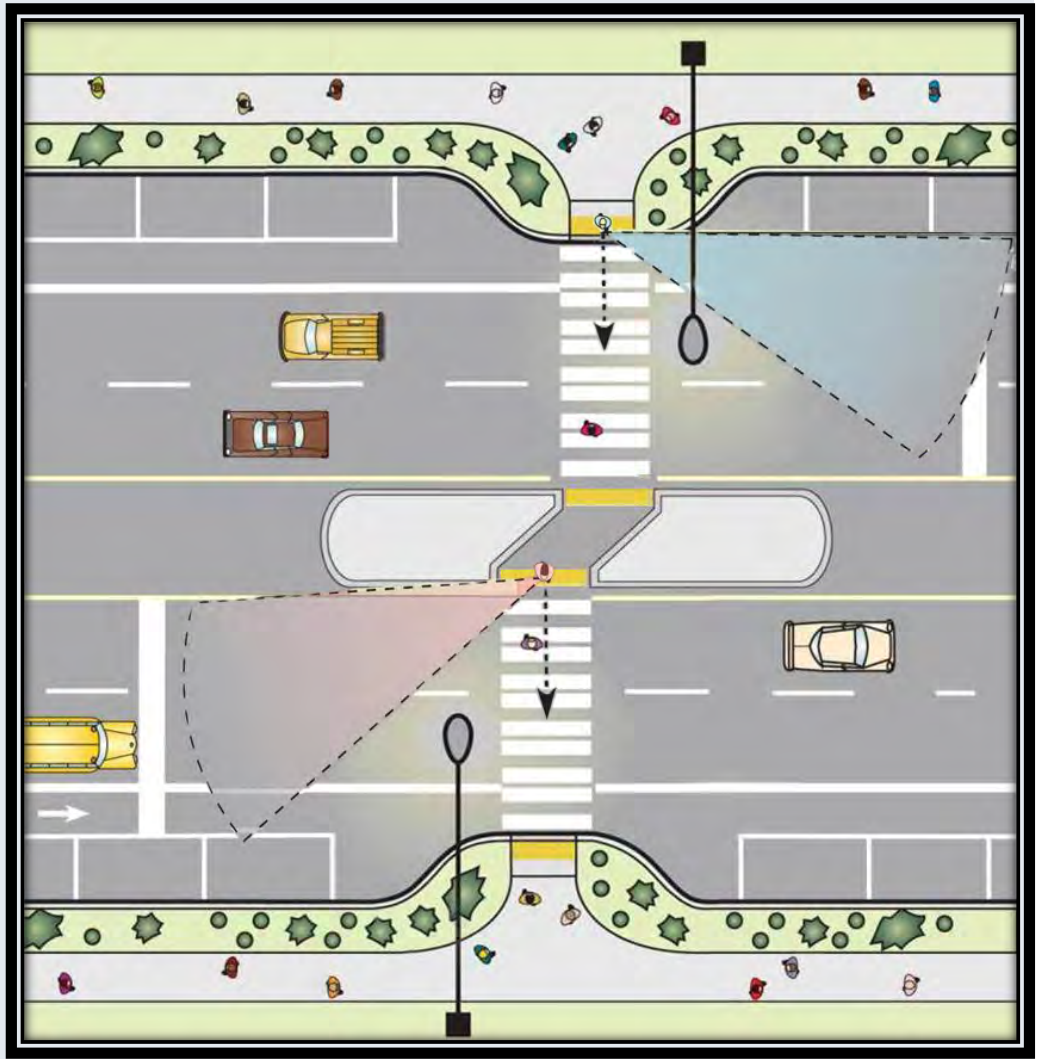
R1-5

R1-5a

CROSSING THE ROAD: MEDIAN AND ISLANDS

Crossing island at marked crosswalk - same principle:

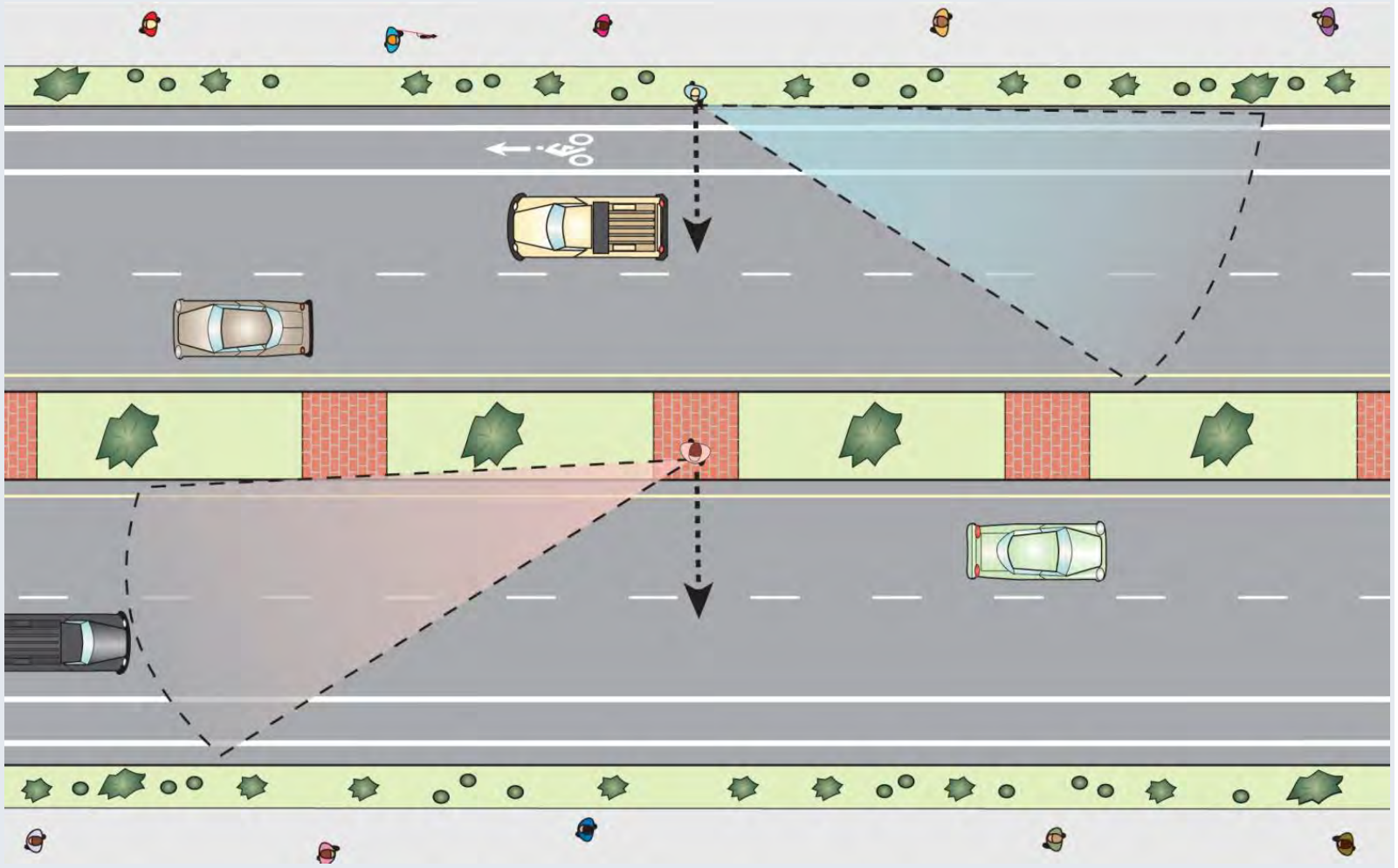
Breaks long complex crossing into two simpler crossings



CROSSING THE ROAD - RAISED MEDIANS AND ISLANDS

Continuous raised median –

Breaks long complex crossing into two simpler crossings



A FLUSH MEDIAN IS NOT A REFUGE

ADD A RAISED ISLAND

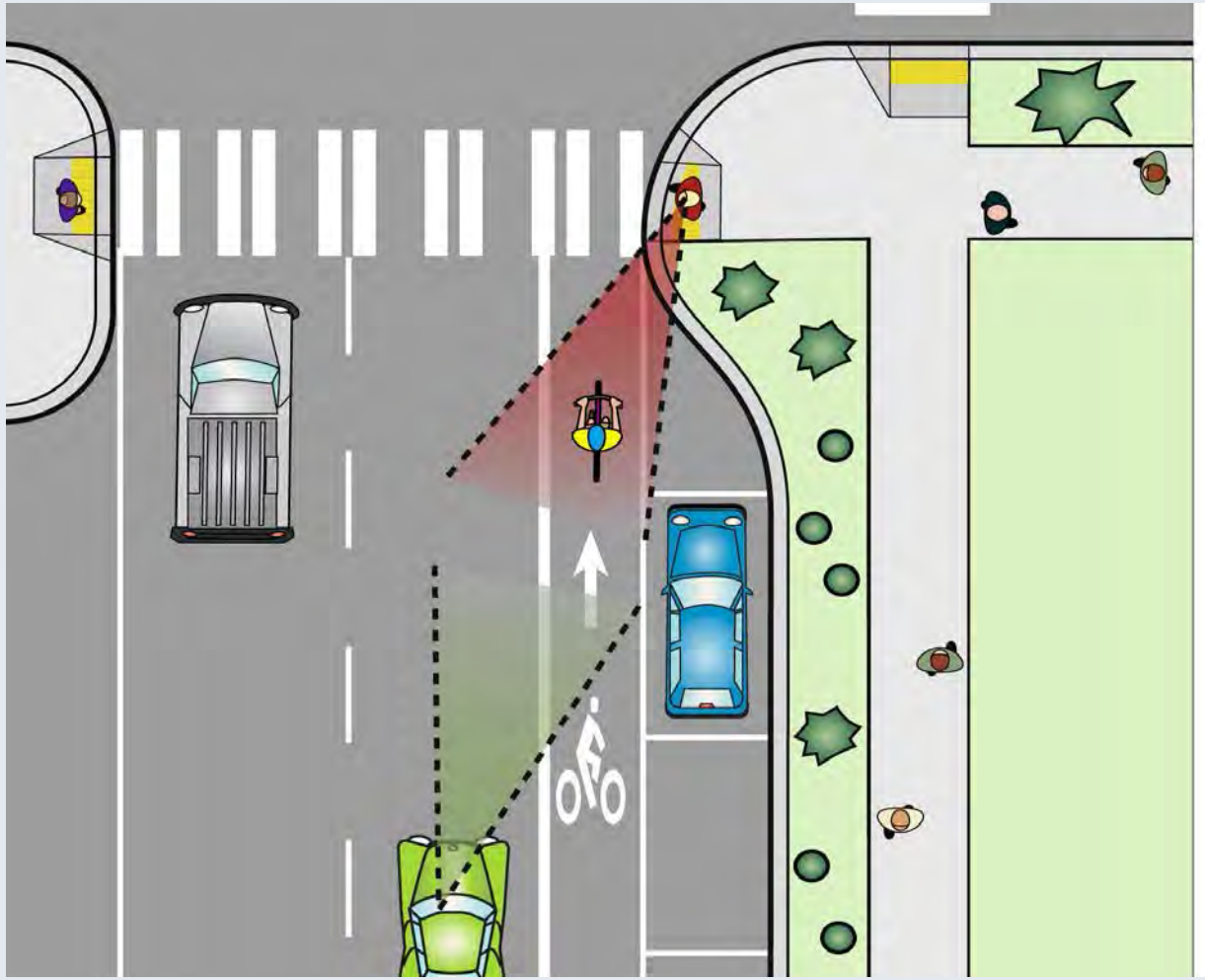
CURB EXTENSIONS

When

- Limited Sight Distance
  - Pedestrians & Vehicles
  - Vehicles and Signs
- Want to put two curb ramps in
- Discourage High speed turning
- High number of pedestrians waiting on corner

Where

- Wherever there is 24/7 on-street parking
  - Intersections
  - Midblock



CROSSING THE ROAD - CURB EXTENSIONS

Pedestrians wait where they can see - in front of parked cars

Curb extension places pedestrian where they can see and be seen

PARKING LANE LOOK AND FEEL AS SIDEWALK AND CURB EXTENSION

PARKING INTEGRATED WITH SIDEWALK

PARKING INTEGRATED WITH SIDEWALK

CURB EXTENSIONS

- Bollards, planters, & other fixed objects may be placed at the back of curb to protect pedestrians and prevent vehicles from driving onto the sidewalk.

Warren & Smith Streets, Brooklyn DOT

PAINT & DELINEATOR POSTS

RAISED CROSSWALKS

RAISED CROSSWALK

- Mostly two-lane streets and residential collectors
- Raised intersections have been used in residential, central business district, and other commercial zones.
- Lower speeds
- Improved motorist yielding at some locations
- CMF estimate of 0.70 for all crashes
  - CRF 30%
- CMF estimate of 0.64 for all fatal injury crashes
  - CRF 36%

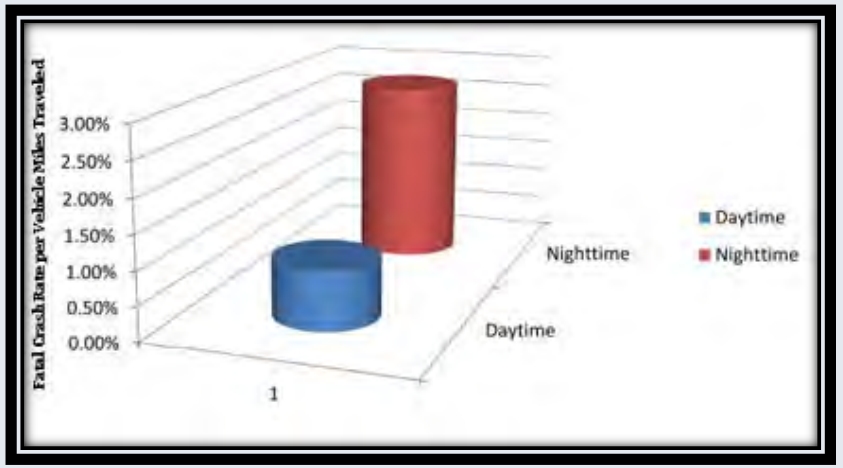
FHWA LIGHTING HANDBOOK - 2012

Guidance Document: supplement AASHTO, IES & CIE guides

- Policy and guidance
- Basic terms and concepts
- Warranting criteria
- Lighting impacts
- Application considerations
- Other systems and issues

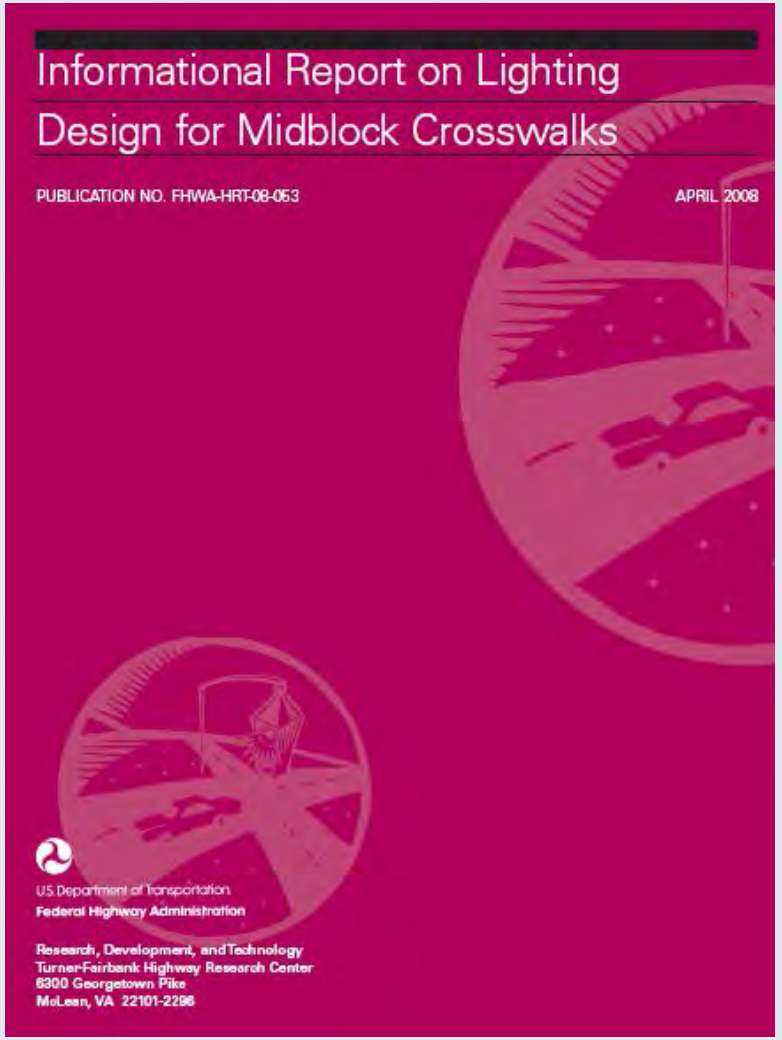
NIGHTTIME VS DAYTIME FATALITIES

- Fatal crash numbers in daylight are about the same as in darkness, but only 25 percent of vehicle-miles traveled occur at night
  - Nighttime fatality rate is three times the daytime rate
- Lighting for pedestrian safety can also benefit vehicle safety



CROSSING THE ROAD - LIGHTING

- Informational Report on Lighting Design for Midblock Crosswalks
- FHWA-HRT-08-053
  - April 2008
  - Available at
    - http://www.fhwa.dot.gov/publications/research/safety/08053/index.cfm



CROSSING THE ROAD - LIGHTING

Fig 11. Traditional midblock crosswalk lighting layout

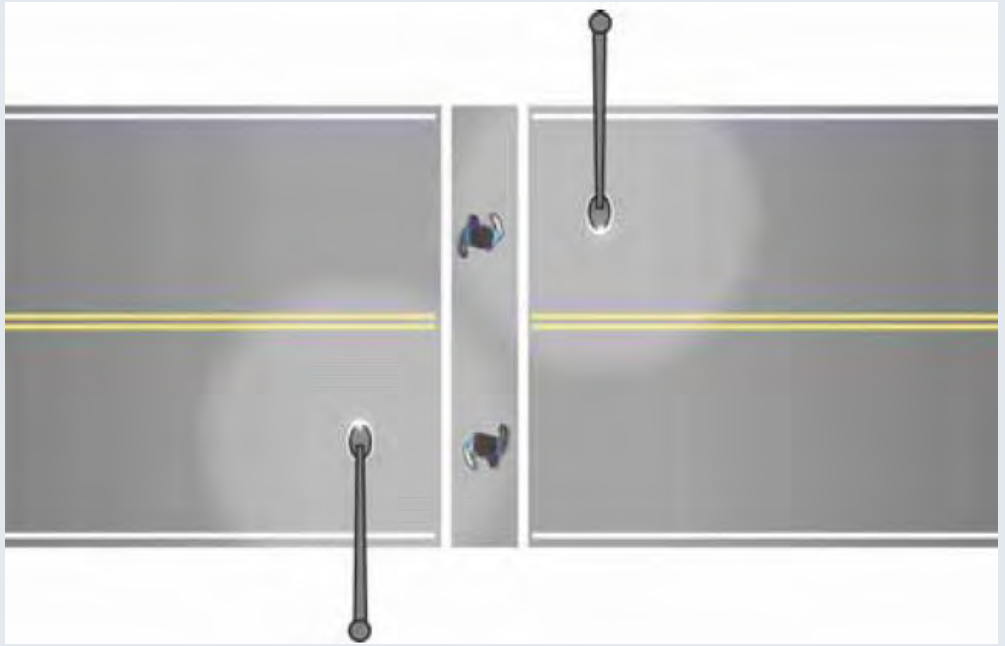
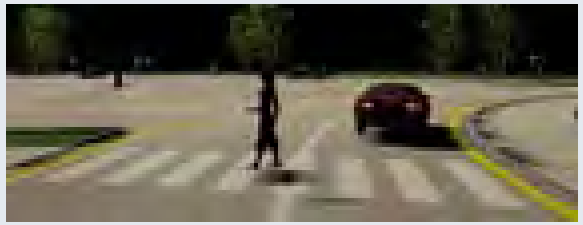
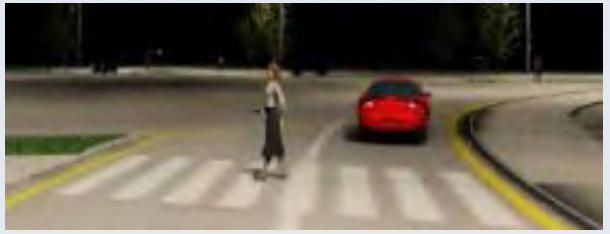


Fig 12. New design for midblock crosswalk lighting layout

Recommended Lighting Level: 20 lux at 5’ above pavement





LIGHHTING - CROSSWALKS AT INTERSECTIONS

- No specific research done to address higher background luminance typically found at intersections
- 30 vertical lux considered conservative estimate

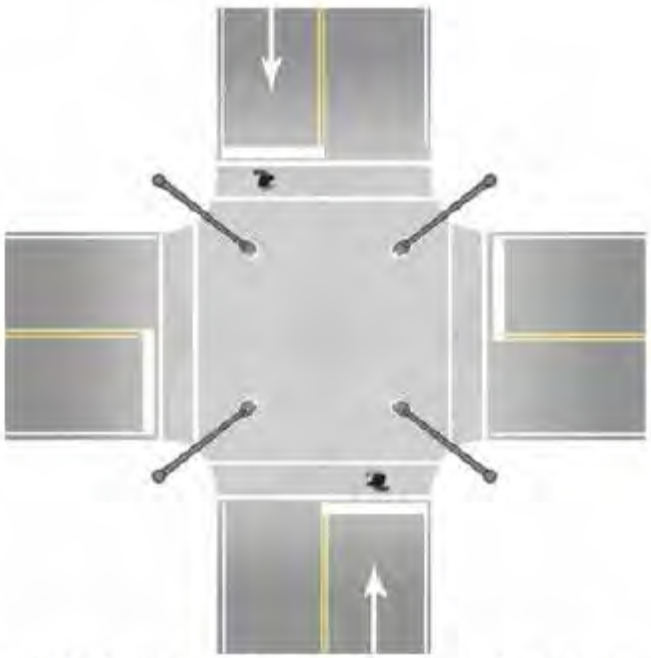


Figure 13. Drawing. Traditional intersection lighting layout.

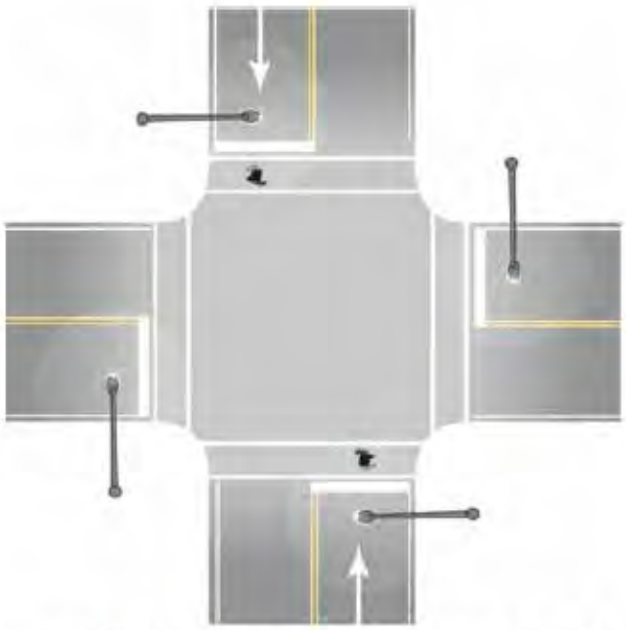
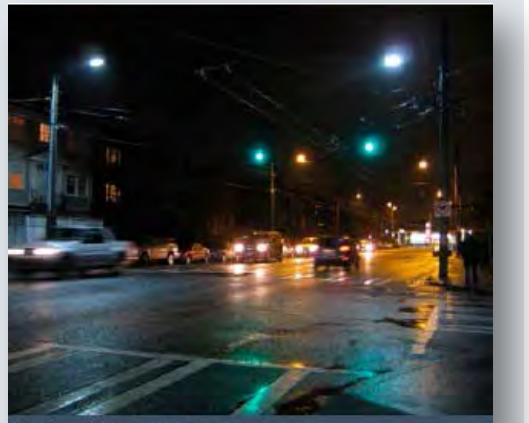


Figure 14. Drawing. New design for intersection lighting layout for crosswalks.

ROADWAY VS. PEDESTRIANWAY

- Roadway lighting typically 25 ft or higher
  - Overhead streetlights
  - Light source over roadway
- Road lighting may be sufficient for motorists to navigate & avoid obstacles
  - Often insufficient for specialized pedestrian needs
- Pedestrian-level lighting pedestrian needs typically 20 ft or less (18 ft on non-arterials) from the surface



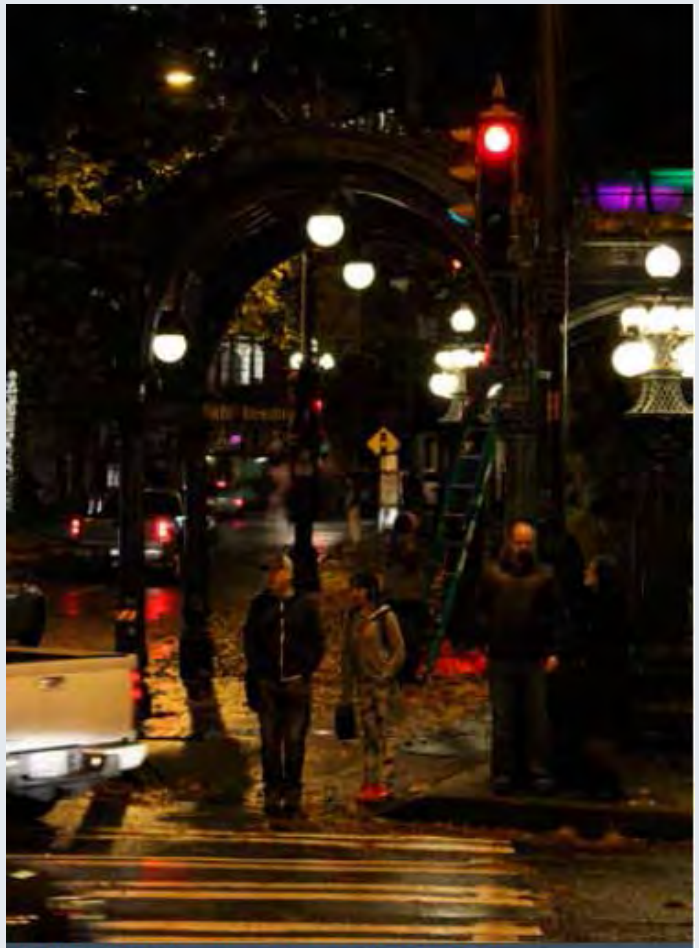
LED Streetlights on 10th Ave E

Pedestrian lighting in South Lake Union

PEDESTRIAN-LEVEL LIGHTING

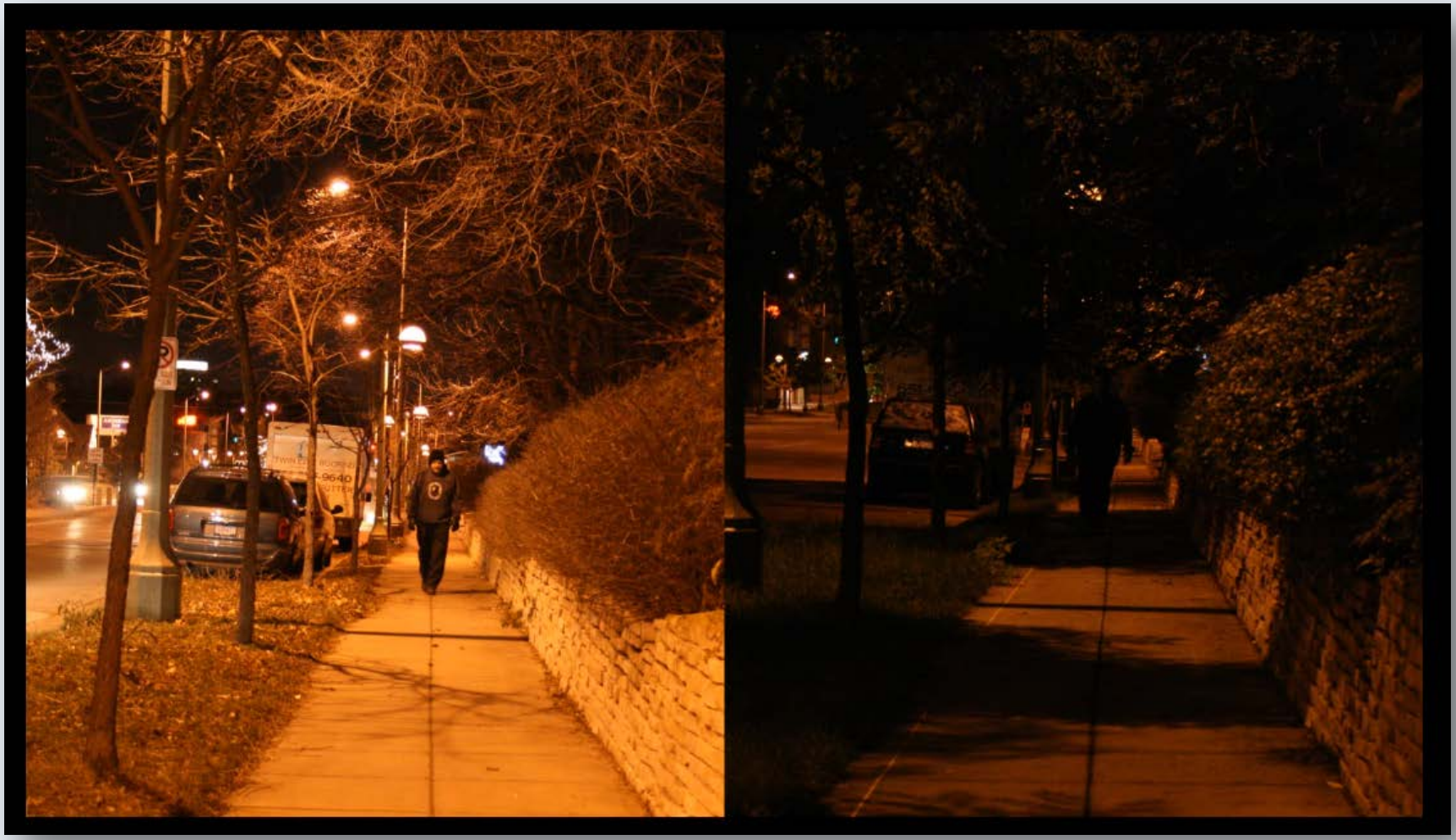
Purposes

- Help pedestrians safely navigate sidewalks & pathways
- Provide for visibility & security at all hours
- Extend hours a business district is active
- Encourage walking as part of an active lifestyle
- Improve access to transit & other services at night/early morning



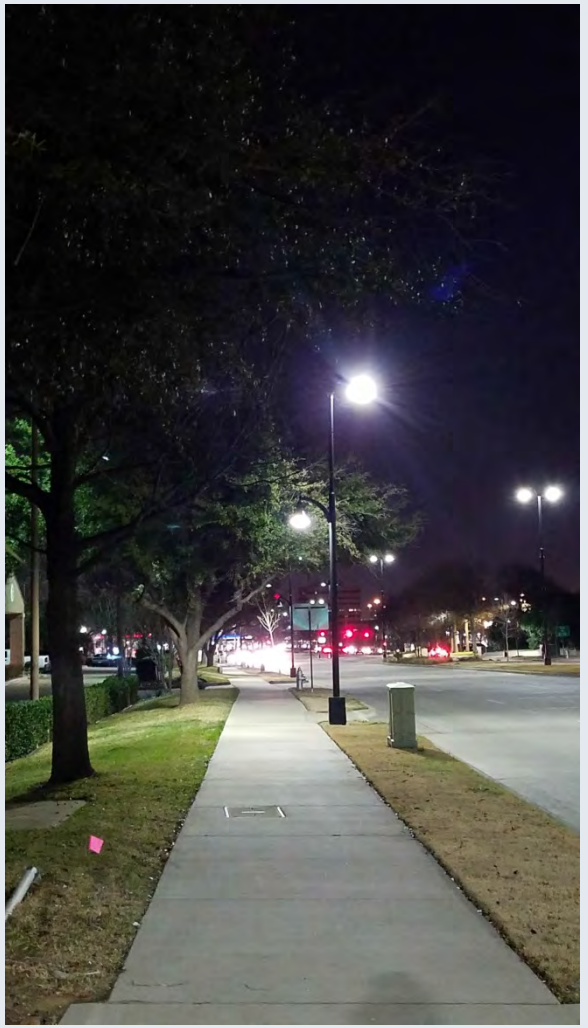
Pedestrian lights at 1st Ave and Yesler Way

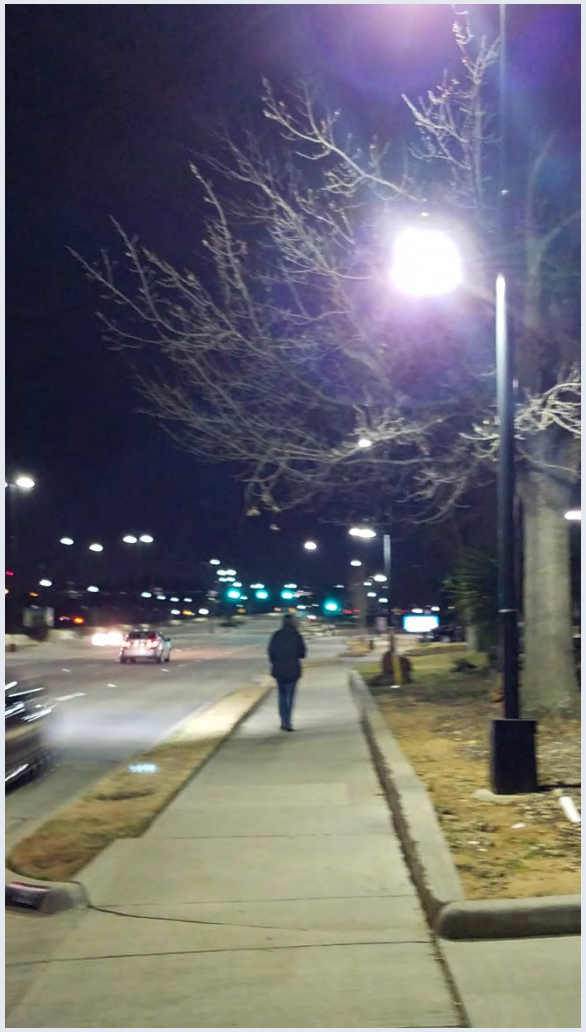
LIGHTING
CONSIDER TREE EFFECTS

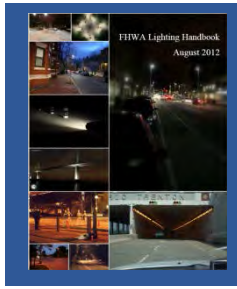


TRR 2120 - Trees, Lighting, and Safety in Context-Sensitive Solutions

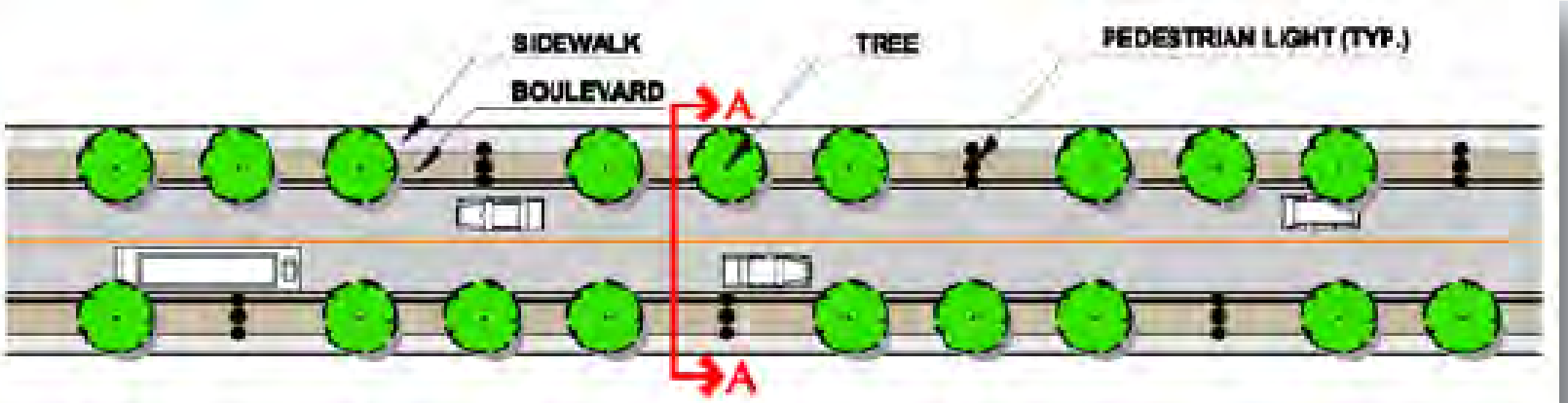
ARLINGTON LIGHTING LAMAR BLVD



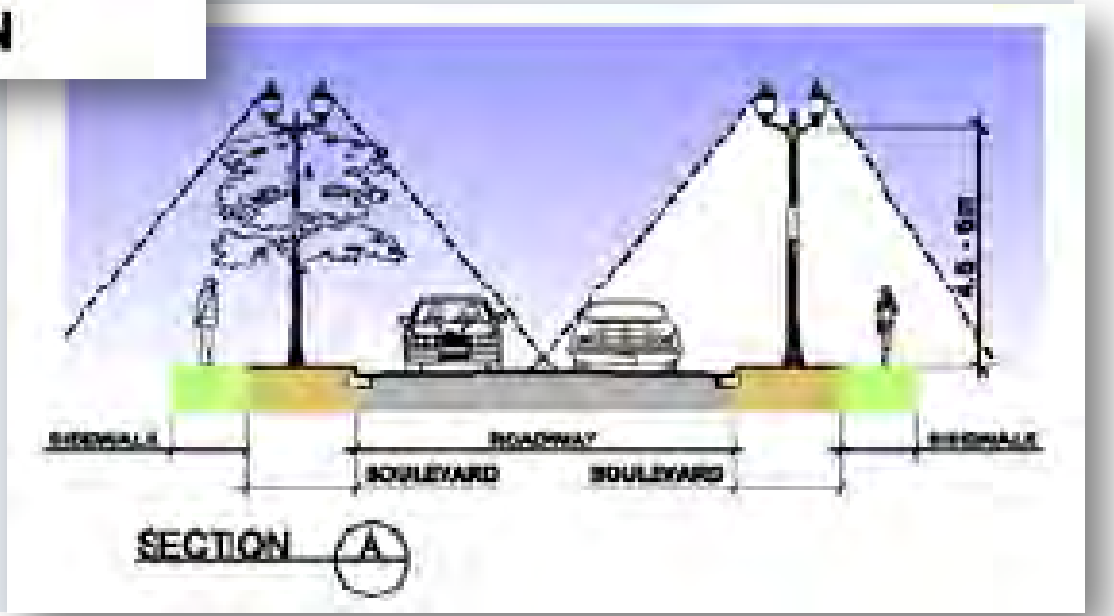


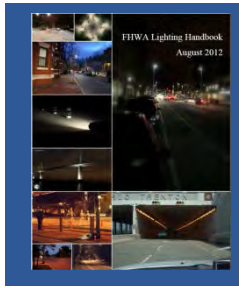


STREETSCAPE LIGHTING LAYOUTS

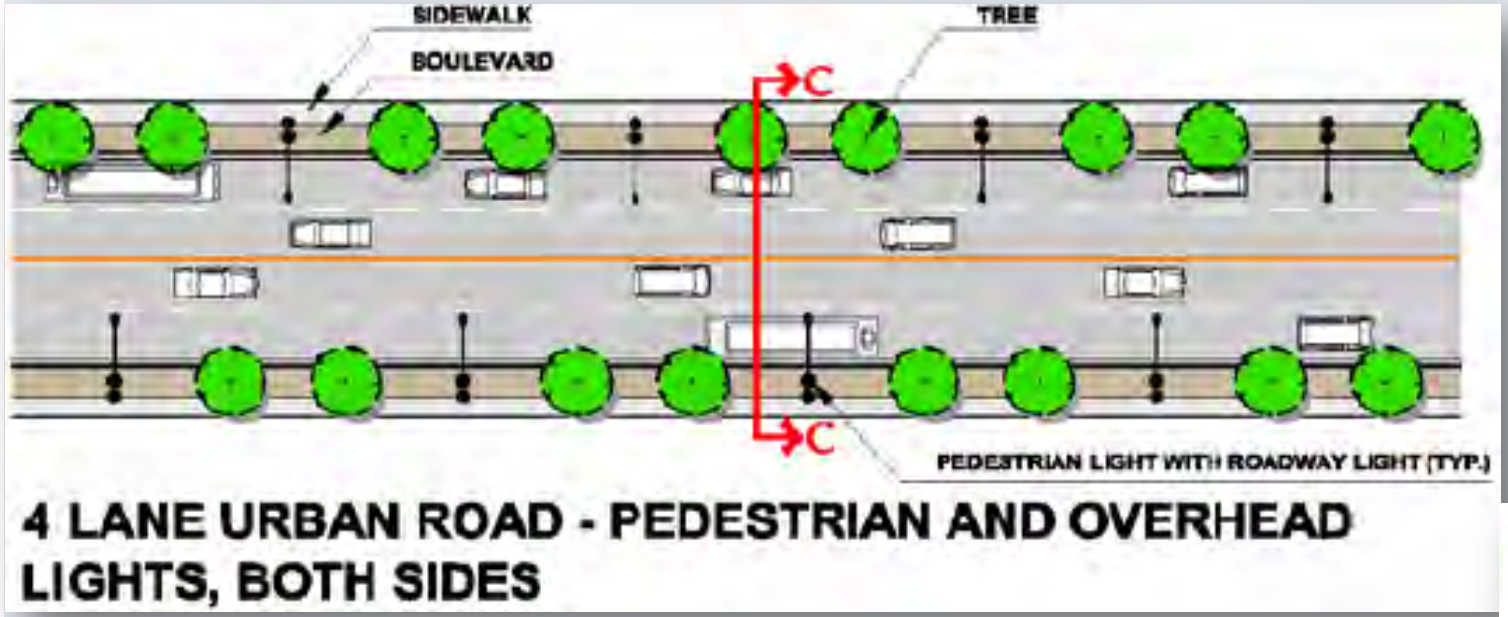


2 LANE URBAN ROAD - PEDESTRIAN LIGHT OPTION

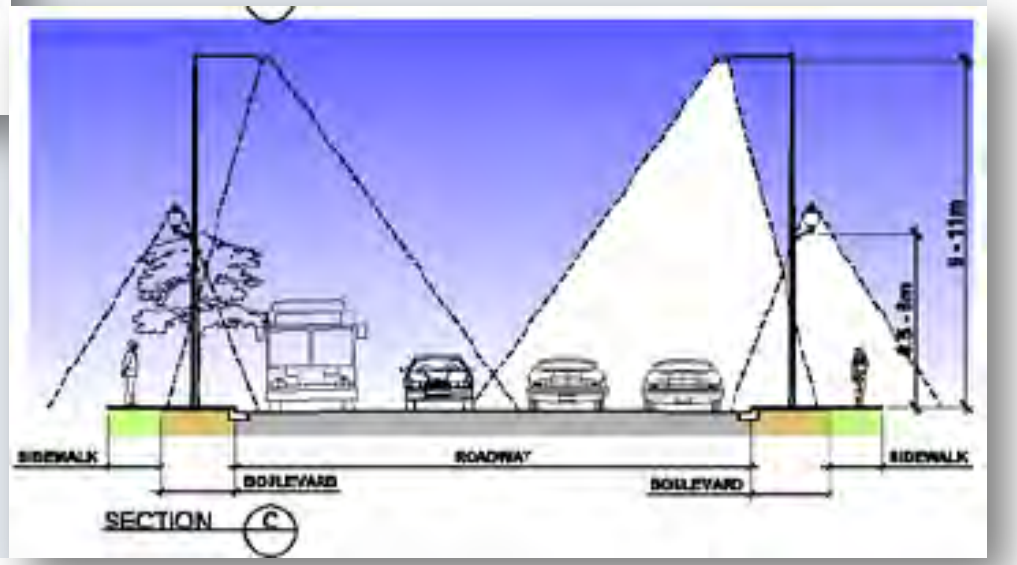




STREETSCAPE LIGHTING LAYOUTS



4 LANE URBAN ROAD - PEDESTRIAN AND OVERHEAD LIGHTS, BOTH SIDES



LED STREET LIGHTS

Advantages

- Lower energy use
- Longer lamp life
- No warm-up time
- Good light quality
- Directional (less light pollution)
- Environmentally friendly

Disadvantages

- High initial cost
- Luminous efficacy
- Sensitive to heat
- Long-term performance issues

CROSSWALK LIGHTING BOLLARD BASED TESTS

- New Jersey field test
- Fluorescent System
  - Mounted at the ends of a crosswalk
  - Provides vertical illumination on pedestrians in crosswalk

Figure 23. a) View of crosswalk lighting while looking south; b) view of crosswalk lighting while looking north

- Aspen CO field test
- LED
- High contrast visibility with low glare

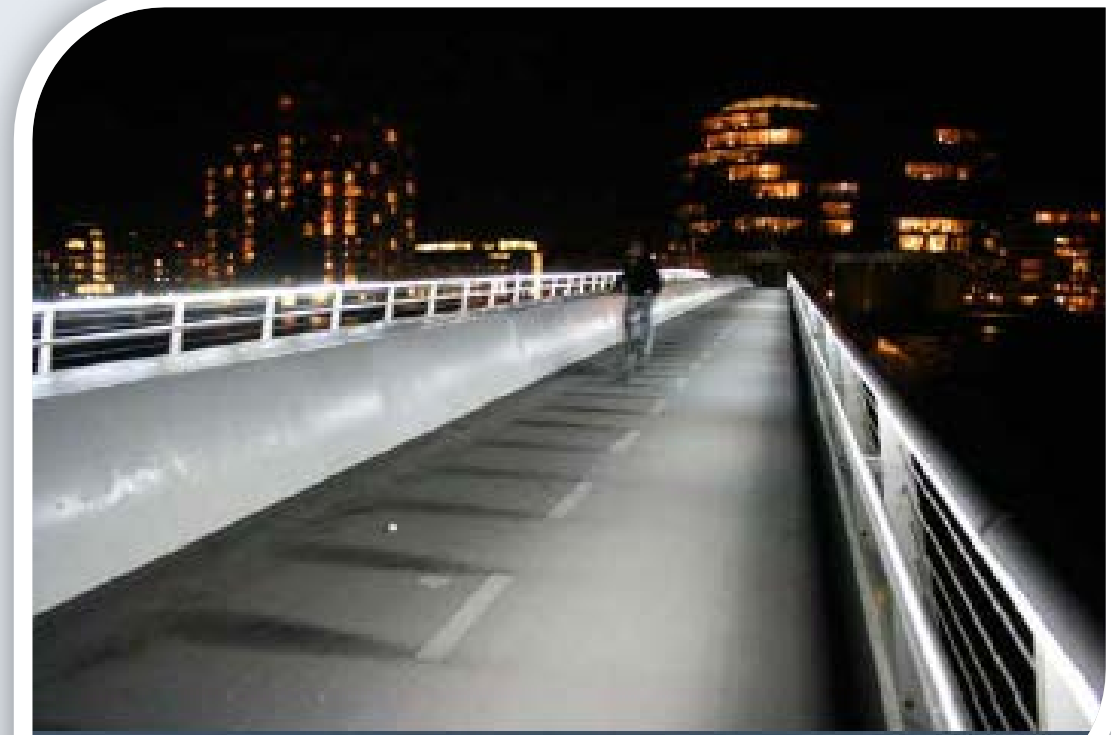
LIGHTING – SIDEWALK BOLLARDS

- When light needed at a lower level due to obstructions, tree canopies or nearby residential buildings where a pole-mounted light would be obtrusive
- When a need to restrict vehicle movements and access
- To delineate walkways in a curb-less environment

Bollard-style lights on Louisa walkway

LIGHTING - HANDRAIL

- Handrail lighting is a relatively new technology
- Provides a lighted strip integral to the underside of a handrail.
- Particularly effective on bridges and other structures to provide an alternative to pole mounted lights that can add weight and are more intrusive due to their mounting height



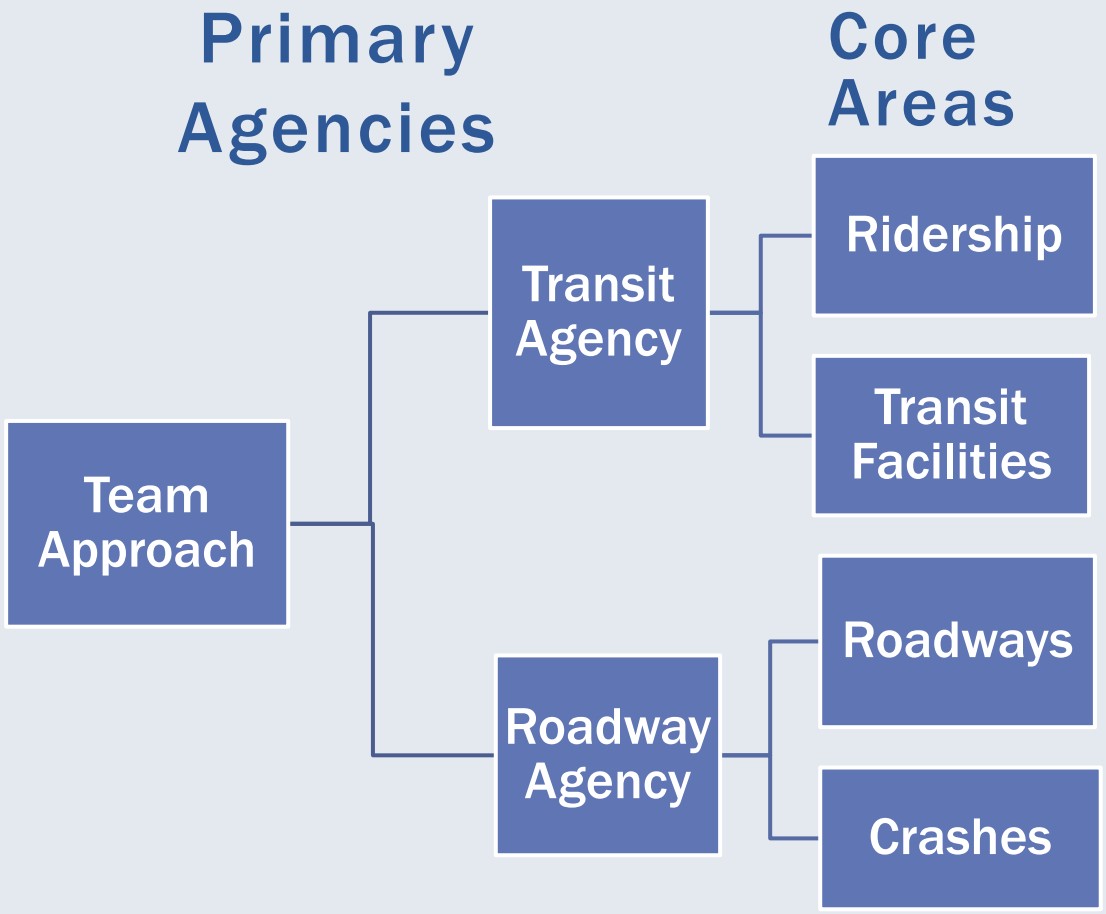
Lighted handrail on a bicycle/pedestrian bridge (Copenhagen)

GENERAL CONSIDERATIONS FOR TRANSIT

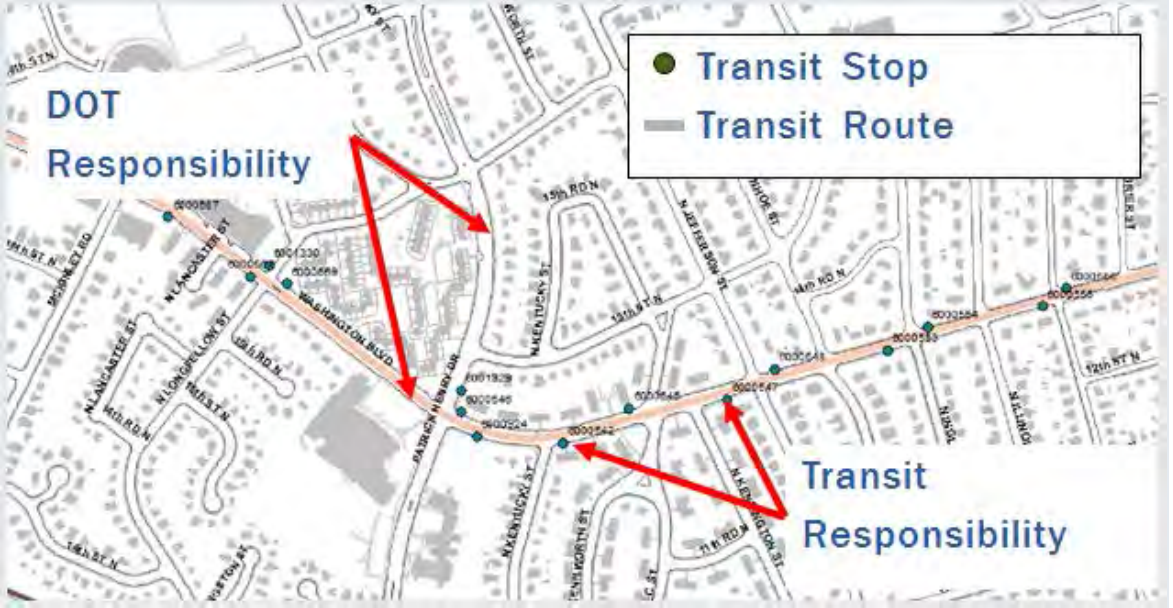
THE GOAL OF TRANSIT

- The primary goal of transit is to carry passengers between residences, employment, and other destinations in a safe, efficient, and reliable manner.
- The physical safety of ALL passengers is vital to the success of any transit system- not only to retain riders, but to encourage new riders.

AGENCY CONSIDERATIONS



Transit vs.DOT Responsibility:



AGENCY CONSIDERATIONS

- Focus resources on areas of need
  - High-Use Locations (ridership)
    - Busy Corridors
    - Busy Stops near key generators or high transfer activity
  - Infrastructure Gaps/Needs
    - Sidewalks
    - Crossings
    - ADA compliance
  - Safety Considerations
    - High incident locations

PASSENGER DEMAND

- Waiting space should meet passenger demand
- This may change as routes change and land use changes

KEY GENERATORS

- Understand activities and locations that generate demand
- Understand pedestrian paths

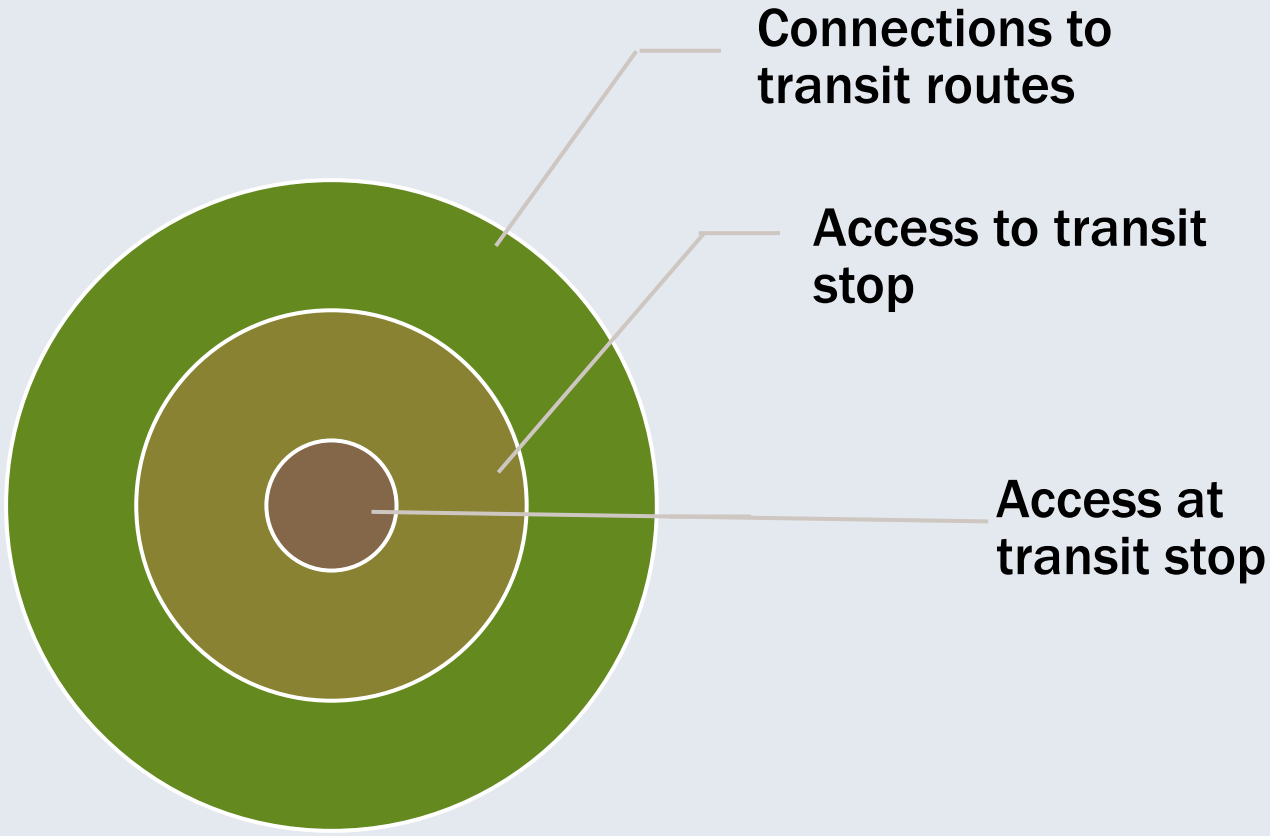
TRANSFER ACTIVITY

- Understand passenger travel patterns and the effect on pedestrian paths

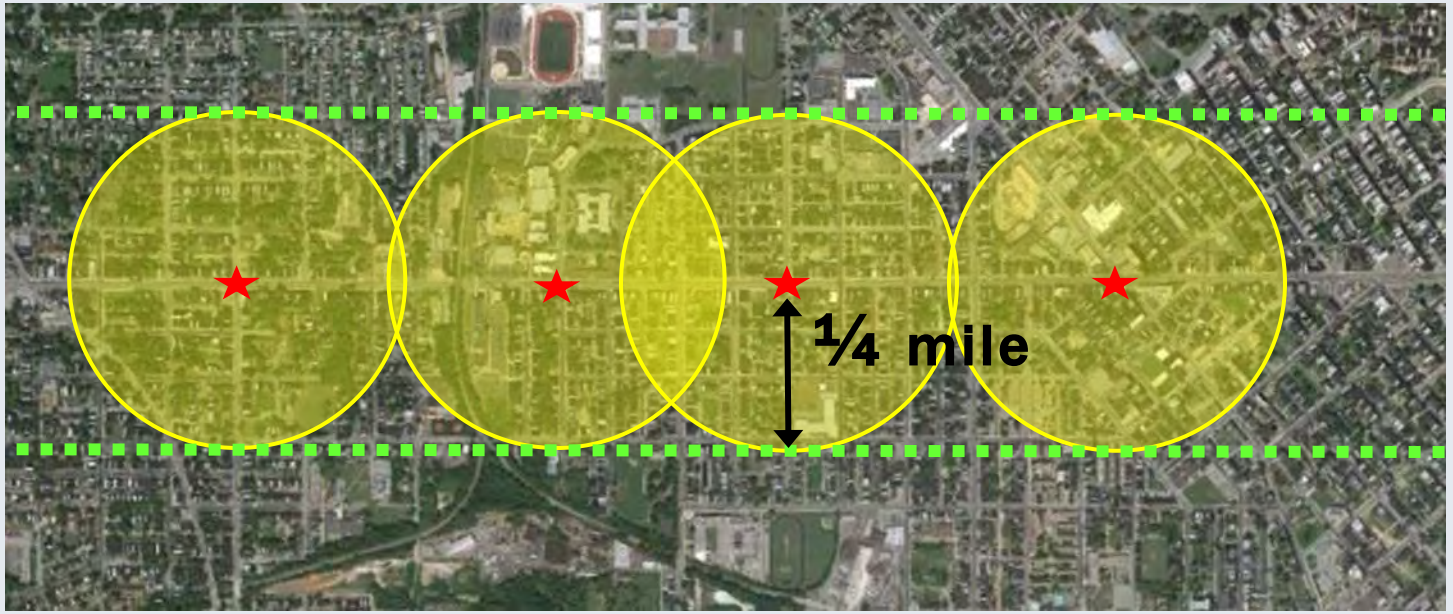
Source: RTD Denver

ACCESS TO TRANSIT

- Access to transit exists on multiple levels:



CATCHMENT AREA

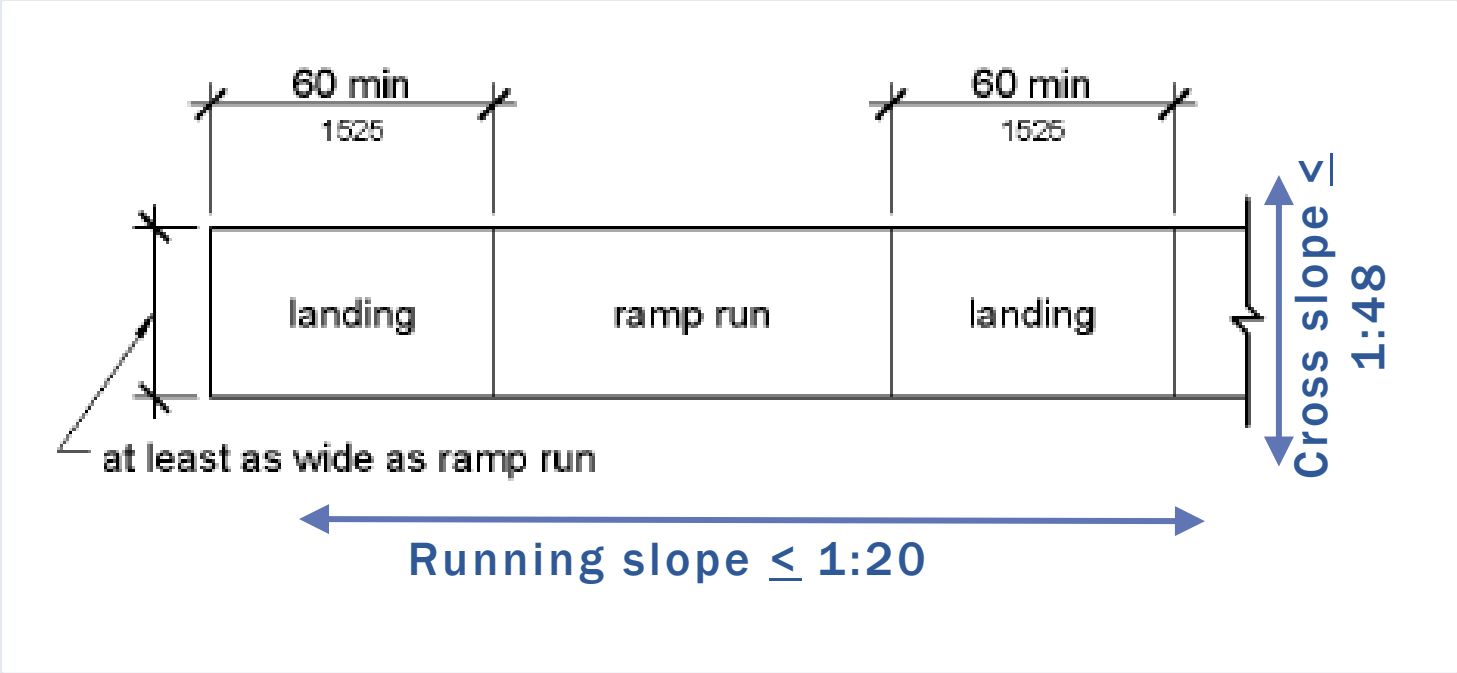


- Bus Stop
- Bus Stop Catchment Area
- Corridor Catchment Area

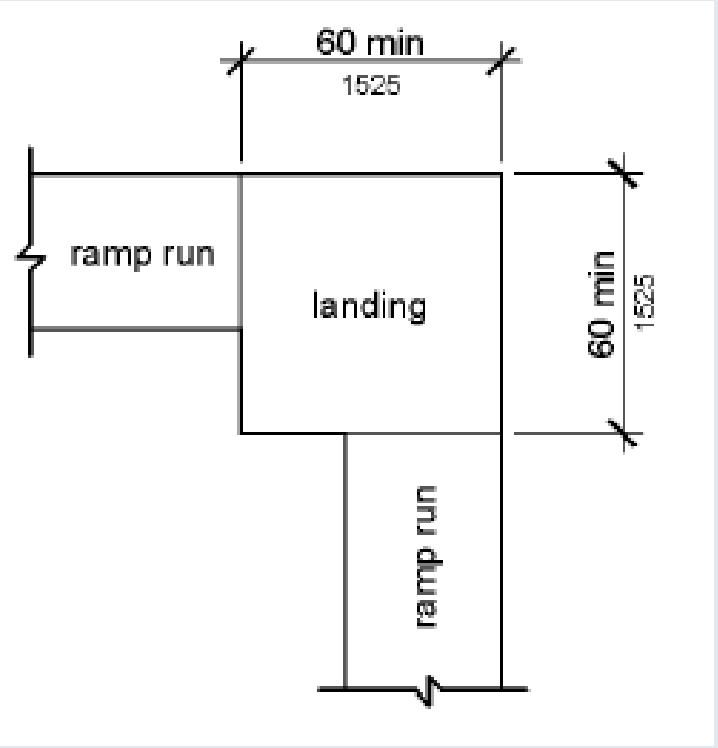
ADA COMPLIANCE

ACCESSIBILITY

ADA Standards – Ramps

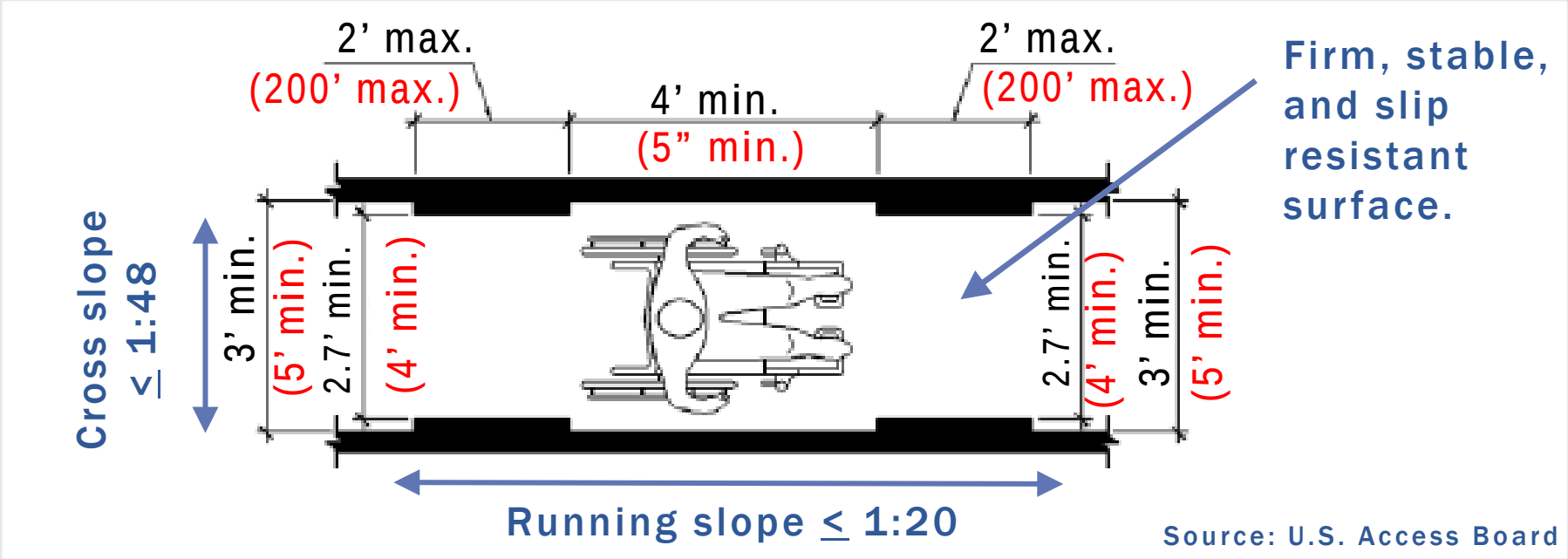


Change in direction:



ACCESSIBILITY

- ADA Standards – Accessible routes



Minimum width:

- 36” (2.7’) for a maximum length of 2’.
- Within public right-of-way: 48” (4’) for a maximum length of 200’.
- *Passing zones must be provided (3’ or 5’ within public right-of-way).*

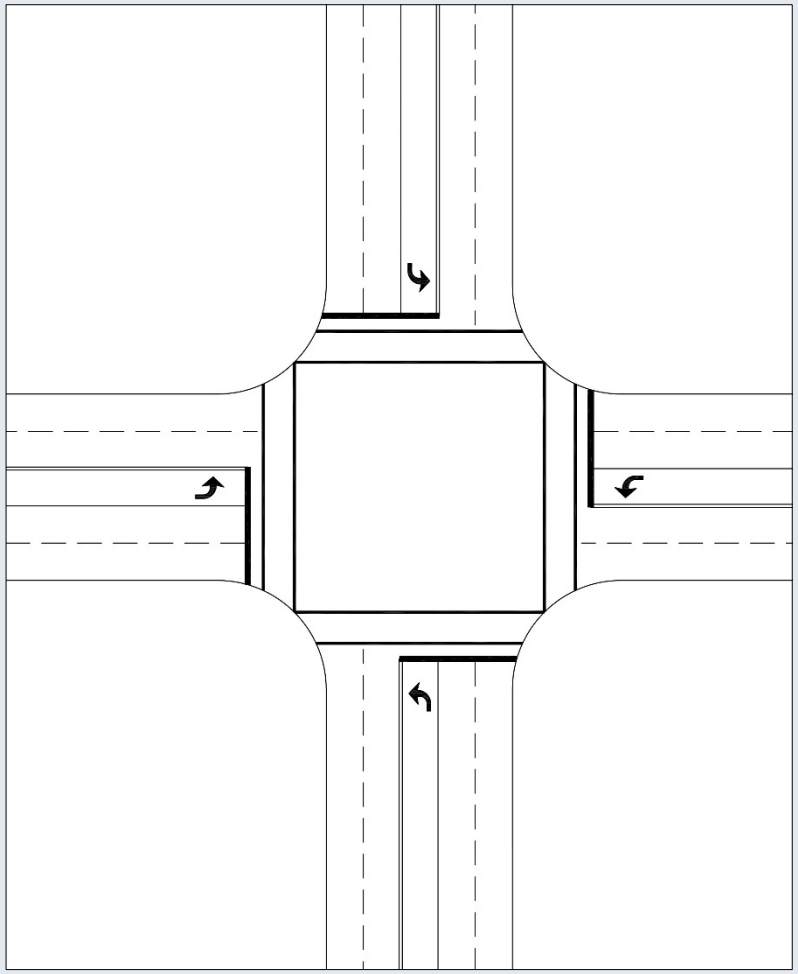
RESOURCES

- Pedestrian Safety Guide for Transit Agencies (FHWA, 2008)
- Complete Streets Local Policy Workbook (Smart Growth America 2013)
- PEDSAFE
- Design Documents
  - Stop location and design
- Planning documents
  - Corridor studies
  - System plans
    - Transit Development Plans
    - Long-range Transit Plans

PEDSAFE

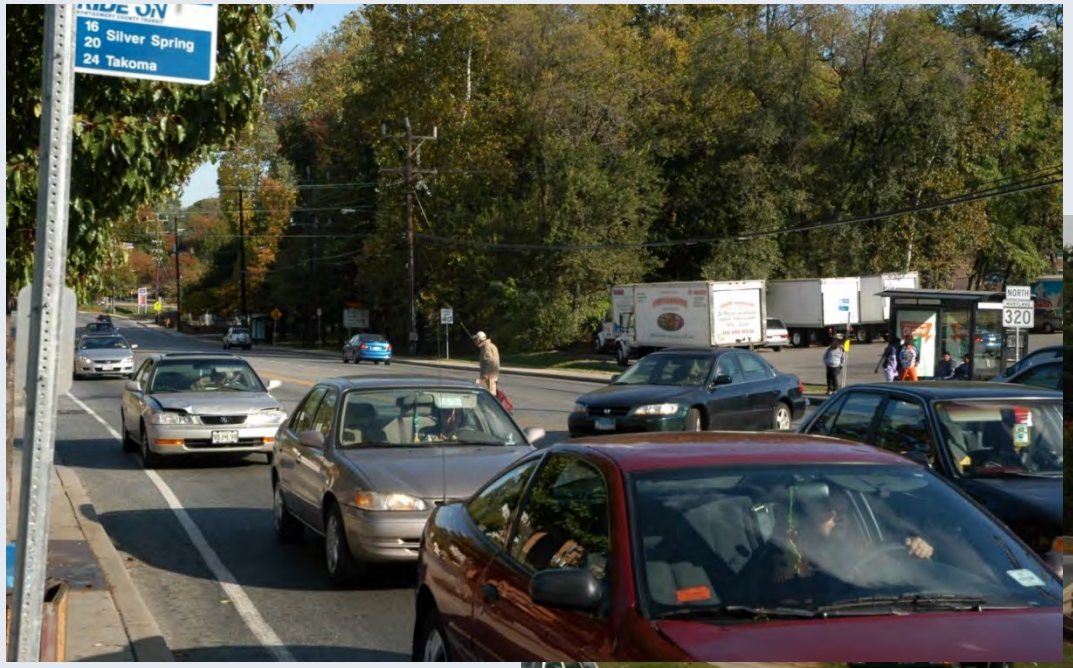
LOCATING BUS STOPS

- At intersections, consider traffic conditions:
  - Transfers
  - Proximity of pedestrian crossing facilities
  - Geometry (bus access and vehicle access)
  - Driveways



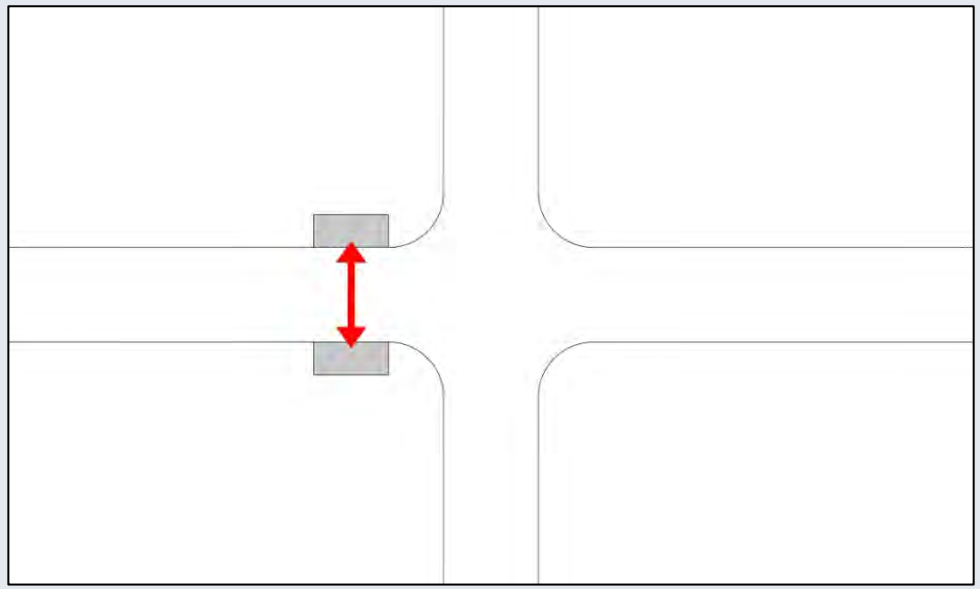
BUS STOP LOCATIONS

- Key Elements: Bus rider destination and transfers

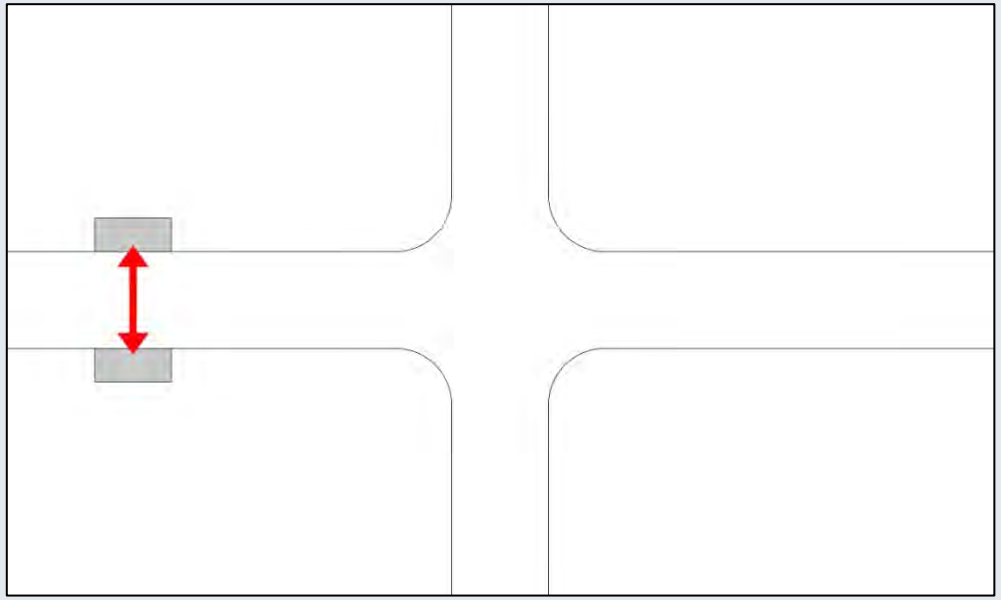


BUS STOP LOCATIONS

- Locating the bus stops to the intersections would encourage crossings at the intersection.

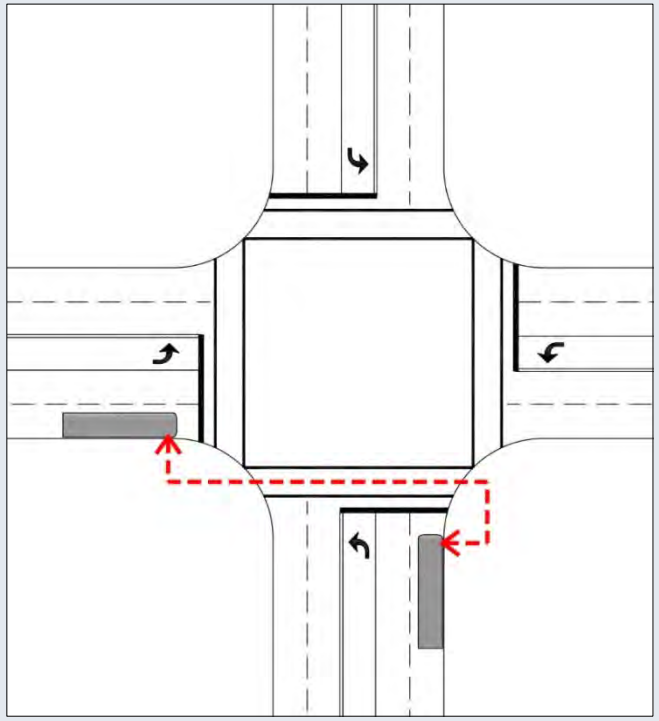


- Mid block bus stops may create false demand and encourage mid-block crossings

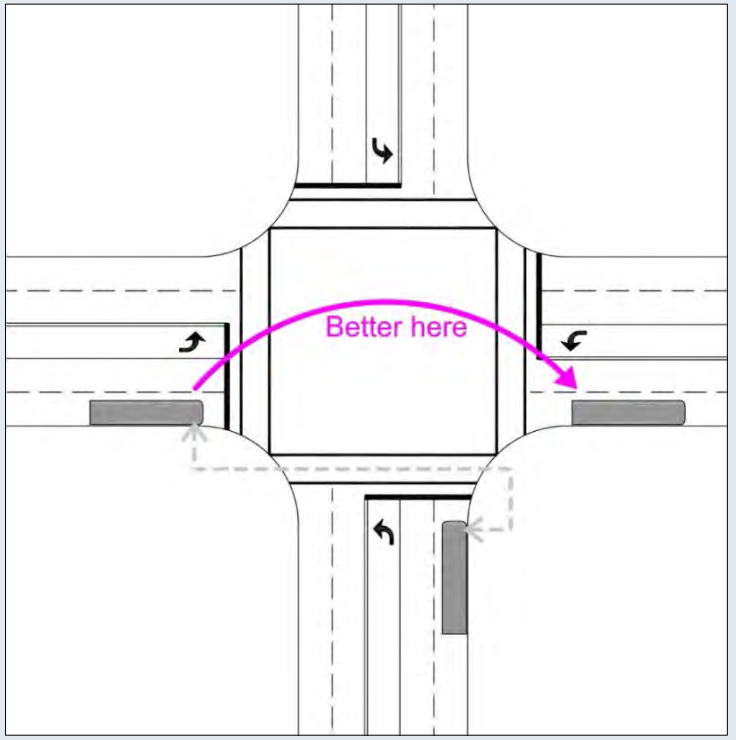


BUS STOP LOCATIONS: TRANSFERS

- This bus transfer location forces pedestrians to cross the street.

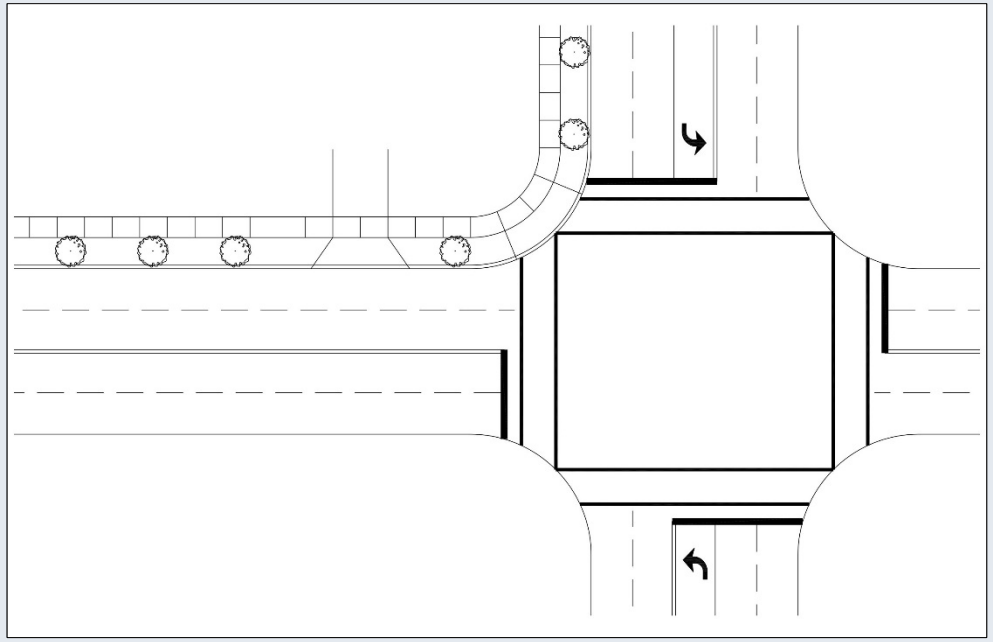


- The bus transfer location would be better in the same quadrant of the intersection.



BUS STOP LOCATIONS: DRIVEWAYS

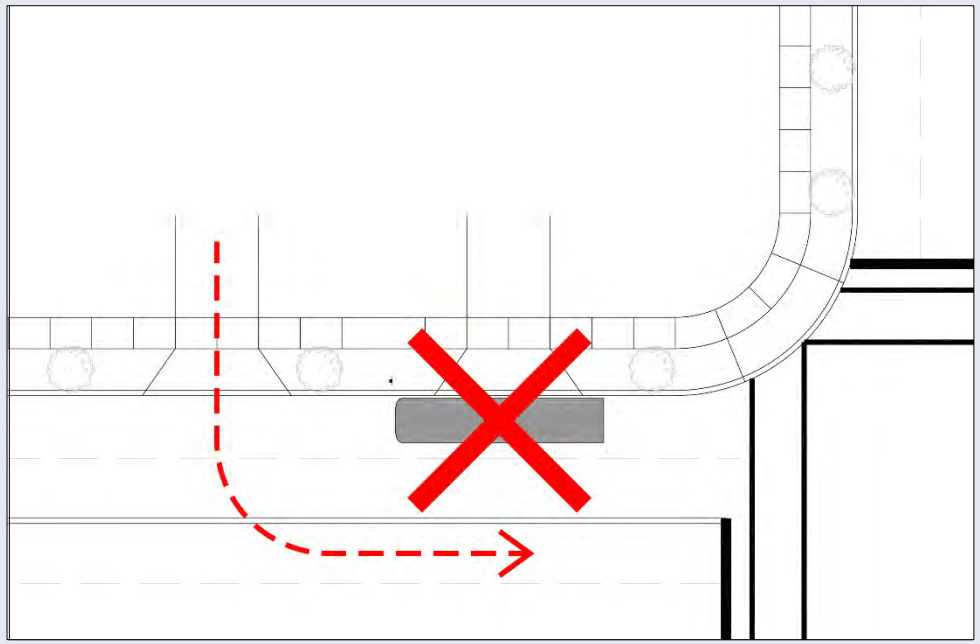
Driveways



- Driveways are common along roadways in urban areas.
- Placement of bus stop should avoid driveway entrances.

BUS STOP LOCATIONS: DRIVEWAYS

Driveways



- In some instances, driveways may be unavoidable.
- Need to consider possible driveway movements and sight distance considerations.

WHAT IS YOUR TAKE AWAY?

- Crossings
- Lighting
- Transit

QUESTIONS