DESIGNING IN CONTEXT OF COMPLETE STREETS
WHAT TYPE OF CROSSING WOULD YOU INSTALL?
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
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
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
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)

<table>
<thead>
<tr>
<th>Roadway Type (Number of Travel Lanes and Median Type)</th>
<th>Vehicle ADT ≤ 9,000</th>
<th>Vehicle ADT &gt;9,000 to 12,000</th>
<th>Vehicle ADT &gt;12,000 to 15,000</th>
<th>Vehicle ADT &gt;15,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 30 mph</td>
<td>35 mph</td>
<td>40 mph</td>
<td>≤ 30 mph</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35 mph</td>
<td>40 mph</td>
<td>35 mph</td>
</tr>
<tr>
<td>Two lanes</td>
<td>C/1</td>
<td>C/1</td>
<td>C/1</td>
<td>C/1</td>
</tr>
<tr>
<td>Three lanes</td>
<td>C/1</td>
<td>C/1</td>
<td>C/1</td>
<td>C/1</td>
</tr>
<tr>
<td>Multilane (four or more lanes with raised median)</td>
<td>C/1</td>
<td>C/2</td>
<td>C/2</td>
<td>C/2</td>
</tr>
<tr>
<td>Multilane (four or more lanes without raised median)</td>
<td>C/1</td>
<td>C/2</td>
<td>C/2</td>
<td>C/2</td>
</tr>
</tbody>
</table>

**Table 1: Total Pedestrian Delay – Treatment Selection Guidance**

<table>
<thead>
<tr>
<th>Speed</th>
<th>Motorist Compliance</th>
<th>Low (&lt; 1.3 ped-hrs)</th>
<th>Medium-Low (≥ 1.3 to &lt; 5.3 ped-hrs)</th>
<th>Medium-High (≥ 5.3 to &lt; 21.3 ped-hrs)</th>
<th>High (≥ 21.3 ped-hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 35 mph</td>
<td>Consider Marking Crosswalk</td>
<td>Consider Supplemental Treatments</td>
<td>Move to Step 4</td>
<td>Move to Step 4</td>
<td></td>
</tr>
<tr>
<td>&gt; 35 mph</td>
<td>Consider Supplemental Treatments</td>
<td>Consider Supplemental Treatments</td>
<td>Move to Step 4</td>
<td>Move to Step 4</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 16:** Example scenario using the “Speed Limit 35-35 mph – Crossing Distance 24 – Pedestrian 1” chart from Appendix C to determine crosswalk treatment type. Example shows a Medium-high delay between 5.3 and 21.3 ped-hrs.

Nevada DOT 8 /14/14

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

2009 MUTCD Section 3B.16
MUTCD Sec. 2B.11 and Figure 2B-2

R1-5b
STOP
HERE
FOR
PEDESTRIANS

R1-5c
STOP
HERE
FOR
PEDESTRIANS

R1-5
HERE
TO
PEDESTRIANS

R1-5a
HERE
TO
PEDESTRIANS
CROSSING THE ROAD: MEDIAN AND ISLANDS

Crossing island at marked crosswalk - same principle:
Breaks long complex crossing into two simpler crossings
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
Bollards, planters, & other fixed objects may be placed at the back of curb to protect pedestrians and prevent vehicles from driving onto the sidewalk.
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
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.
Informational Report on Lighting Design for Midblock Crosswalks

FHWA-HRT-08-053

April 2008

Available at

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

CONSIDER TREE EFFECTS
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

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

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

Primary Agencies
- Transit Agency
- Roadway Agency

Core Areas
- Ridership
- Transit Facilities
- Roadways
- Crashes

Transit vs. DOT Responsibility:

DOT Responsibility

Transit Stop

Transit Route

Transit Responsibility
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
• 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 exists on multiple levels:

- Access at transit stop
- Access to transit stop
- Connections to transit routes
- Access at transit stop
CATCHMENT AREA

- Bus Stop
- Bus Stop Catchment Area
- Corridor Catchment Area
ADA COMPLIANCE
ACCESSIBILITY

- ADA Standards – Ramps

Running slope ≤ 1:20

Cross slope ≤ 1:48
ADA Standards – Accessible routes

- Running slope < 1:20
- Cross slope < 1:48
- Firm, stable, and slip resistant surface.

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).

Source: U.S. Access Board
RESOURCES

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

The bus transfer location would be better in the same quadrant of the intersection.
Driveways are common along roadways in urban areas.

Placement of bus stop should avoid driveway entrances.
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