Bicycle & Pedestrian Safety: Getting to Vision Zero

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@tooledesign
 Principle #1: It’s all about SPEED
“Addressing the issue through law enforcement alone often leads to temporary compliance at a significant cost. A more permanent way to reinforce the need to reduce speed is to change the look and feel of the road by installing traffic calming treatments that communicate to drivers that the function of the roadway is changing.”

-- FHWA TechBrief: Traffic Calming on Main Roads Through Rural Communities
A Way to Design Streets that are Self-enforcing
Principle #2: Inclusive Design

We are All Pedestrians
Universal Design
Types of Bicyclists – City of Portland

- Interested but Concerned, 60%
- No Way No How, 33%
- Enthused and Confident, 6%
- Strong and Fearless, 1%

Strong & Fearless
Enthused & Confident
Interested but Concerned
Not Interested
Principle #3: Fatalities go down when use goes up

Comparing Bicycling to Work and Bicyclist Fatality Rates in Large Cities

Fatalities go down when use goes up

Comparing Walking to Work and Pedestrian Fatality Rates in Large Cities

Principle #4: Design for Pedestrians First, then Bicyclists
A crash modification factor (CMF) is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site.

http://www.cmfclearinghouse.org
Principle #6: National Design Resources
Resources

PBIC: www.walkinginfo.org
FHWA: safety.fhwa.dot.gov
NHTSA: nhtsa.dot.gov
ITE: www.ite.org
AASHTO/NCHRP: safety.transportation.org
Principle 7: It’s Federal Policy

“The Department will promote the development of multimodal networks which include interconnected pedestrian/and or bicycle transportation facilities that allow people of all ages and abilities to safely and conveniently get where they want to go.”

- USDOT, Sept 2014

“The treatments described reflect typical situations; local conditions may vary and engineering judgment should be applied.”
Outline

Engineering
  • **Data Collection**
  • Walking Along the Street
  • Walking Across the Street
  • Intersection Geometry
  • Signals
  • On-Street Bicycle Facilities

Land Use & Site Design

Education & Enforcement

Performance Measures

Principles of Collaboration
Types of Safety Projects

1. Spot Locations (individual intersections and non-intersections)
2. Corridors (½ mile to 5 or more miles in length)
3. Targeted Areas (neighborhood, business district, or large area where pedestrian crashes are high)
4. Entire Jurisdictions (addressed through system-wide changes)
Types of Safety Projects: Spot Locations

EG: Single intersection with high crash rate
Types of Safety Projects: Corridors

Example: Long corridor with high crash rate

- No sidewalks
- Random midblock xings
- Dispersed land uses
Corridor Solutions Are Repeatable
Corridor Solutions Are Repeatable
Types of Safety Projects: Entire Jurisdiction

- Example: Lack of ped heads at signals
Plot crashes on a map: Area-wide problem
Plot crashes on a map: Area-wide problem
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Shourn is improve safety for all users

• For pedestrians: a place to walk
• 10 TO 15% OF ALL CRASHES: CMF = 0.3 (CRF = 70%)
Sidewalk Widths

- 5 feet necessary for two people to walk comfortably side by side or to pass each other; 6’ preferred
• Answer: Pedestrians walk in street, or cross twice
Driveways - Good Engineering Invites Right Use
Curb Zones Matter

- Why the curb zone matters: Mountable curbs are inappropriate on local streets
Sidewalks Need Buffers

4 Types of Buffers
- Planting strip
- Parked cars
- Bike Lane
- Furniture Zone
• Sidewalks define an urban street
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Why are marked crosswalks provided

1. To indicate to pedestrians where to cross
2. To indicate to drivers where to expect pedestrians
3. At mid-block locations, crosswalk markings legally establish the crosswalk.
Safety research - Findings

Three Significant Variables
1. Speed
2. Number of Lanes
3. ADT

Median Crossings
1. Significant crash reduction
2. Cut number of lanes in half
3. Reduces ADT by half
Crosswalk installation recommendations

<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; 12,000–15,000</th>
<th>Vehicle ADT &gt; 15,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Speed Limit**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤ 48.3 km/h (30 mi/h)</td>
<td>56.4 km/h (35 mi/h)</td>
<td>64.4 km/h (40 mi/h)</td>
<td>≤ 48.3 km/h (30 mi/h)</td>
</tr>
<tr>
<td>Two lanes</td>
<td>C</td>
<td>C</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>Three lanes</td>
<td>C</td>
<td>C</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>Multilane (four or more lanes) with raised median***</td>
<td>C</td>
<td>C</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Multilane (four or more lanes) without raised median</td>
<td>C</td>
<td>P</td>
<td>N</td>
<td>P</td>
</tr>
</tbody>
</table>

C = Compliant
P = Possibly compliant
N = Not compliant. Markings should not be installed without additional safety treatments
Challenge – Criteria not met

Zegeer Study – Obligation to get pedestrians safety across the street
Crosswalk Markings

‘Standard’ Markings
- Locations with positive traffic control
- Less preferred at uncontrolled locations

High Visibility Markings
- Uncontrolled Locations
- School Crossings (residential streets)
Challenges
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Education & Enforcement
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Principles of Collaboration
Larger Curb Radii
Increase the Exposure Time

Smaller Curb Radii
Reduce Turning Speeds
Small corner radii allow two ramps, shortest crosswalks, direct travel paths
Single ramp reduces crosswalk setback but lengthens crosswalk
Crosswalks at shortest crossing = longer walking distance

Right & left-turning drivers don’t see crosswalk
Guidance for walk plus clearance: Calculate time from pushbutton (or 6’ from curb) to curb on other side at 3’/sec

60’ crosswalk + 6’ = 66’ total; @ 3’/sec = 22 sec walk plus ped clearance

Note: pushbutton is considered the departure point for older pedestrians and people in wheelchairs.
3. Don’t choose larger design vehicle than necessary

Bus makes turn several times an hour
Minimize curb radius

4. Where appropriate, let trucks use 2nd lane
Right-Turn Slip Lane: Design for Pedestrians

Old Way

Wide Angle

40°

High speed, head turner = low visibility of pedestrians

New way

Tighter angle

55 to 60 degree angle between vehicle flows.

40°

Slow speed, good angle = good visibility of pedestrians
Here’s what pedestrians are expected to do

Will she wait?

Is crossing 15 lanes safer than crossing 5 lanes?
Should we add a marked crosswalk?

OF COURSE
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Permissive Left Turns

Pedestrians cross at same time as left-turning car;
Drivers turning left on a green ball don’t look for pedestrians.
Pedestrians cross after left-turning car, with thru-traffic; Pedestrian and car not in conflict

MUTCD Sec. 4D.19
Protected/permissive Left Turns

Pedestrians cross after most left-turning cars (protected phase); Pedestrian and remaining cars are in conflict (permissive phase)
1. Provide protected-permissive phasing by default, but revert to protected-only when pedestrian button is pushed or based on time of day

2. Flashing Yellow Arrow (details on the next slide)
Flashing left yellow arrow during steady green ball warns drivers: yield to pedestrians and oncoming vehicles
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Bicyclist and bicycle lane basics

- Allow cyclists to choose operating speed
- Preferred over shared lanes/wide outside lanes
- Bicyclists prefer bicycle lane continuity
- Still sensitive to adjacent traffic volumes and speeds
Bicycle lane widths

Optional Normal Solid White Line

Normal Solid White Line

Width Varies
Parking Lane
7 ft (2.1 m) minimum
(8 ft [2.4 m] desirable)

5–7 ft
(1.5–2.1 m)
Bike Lane

Travel Lanes

5–7 ft
(1.5–2.1 m)
Bike Lane

Width Varies
Parking Lane
7 ft (2.1 m) minimum
(8 ft [2.4 m] desirable)

On Street Parking

Normal Solid White Line

5 ft
(1.5 m)
Bike Lane

Travel Lanes

4 ft min.
(1.2 m)
Bike Lane

Parking Prohibited
Drainage considerations with curbside bike lanes

• Useable width of 4 feet is recommended

• Drainage grates
  – Reduce effective width of bike lane
  – Use bicycle compatible grates

• Widen bike lane or relocate grate if the clear bike lane operating space falls below 4 feet
Designs to Reduce Dooring

Wider Bike Lanes

Wider Parking Lanes
Designs to Reduce Door Crossing

Buffered door zone

Parking “Tees”
Solid lane lines vs dotted

- Solid lane lines discourage crossing or merging
- Dashed lane lines encourage crossing or merging
- Consider state and local laws for motorists turning at intersections
Green Colored bicycle Lanes

- Guide incorporates Green Lane FHWA interim approval
  - [http://mutcd.fhwa.dot.gov/resources/interim_approval/ia14/ia14grnpmbiketl](http://mutcd.fhwa.dot.gov/resources/interim_approval/ia14/ia14grnpmbiketl)

**Memorandum**

**Subject:** INFORMATION: MUTCD – Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14)

**From:** Jeffrey A. Lindsey
Associate Administrator for Operations

**To:** Federal Lands Highway Division Engineers
Division Administrators

**Purpose:** The purpose of this memorandum is to issue an Interim Approval for the optional use of green colored pavement in marked bicycle lanes and in extensions of bicycle lanes through intersections and other traffic conflict areas. Interim Approval allows interim use, pending official rulemaking, of a new traffic control device, a revision to the
Green Colored bicycle Lanes

- Guide incorporates Green Lane FHWA interim approval

...in marked bicycle lanes...extensions of bicycle lanes through intersections and other traffic conflict areas.

Purpose: The purpose of this memorandum is to issue an Interim Approval for the optional use of green colored pavement in marked bicycle lanes and in extensions of bicycle lanes through intersections and other traffic conflict areas. Interim Approval allows interim use, pending official rulemaking, of a new traffic control device, a revision to the MUTCD.
Dotted lines through intersections
Dotted lines and Colored pavement

- Green can be dashed to match dotted lines
- Green can be utilized to silhouette standard MUTCD word and symbol markings
Bike Boulevards

Source: NACTO

10. Guidance for vertical traffic calming features:
   - Slopes should not exceed 1:10 or be less steep than 1:25.
   - Side slopes on tapers should be no greater than 1:6 to reduce the risk of bicyclists losing their balance.

Optional Features

12. Speed management may be implemented on a trial basis to gauge residents’ support prior to finalizing the design. Temporary speed humps, tables, and lumps are available. Temporary traffic calming should be used with caution as they can diminish residents’ opinions due to.

Depending on motor vehicle speeds, a bicyclist will be passed by a car going the same direction this many times during a 10 minute trip:

- 20 MPH
- 30% increase
Right Hook Countermeasure

Highlight Conflict Zone

- Green increases conspicuity and awareness of conflict area
- Green can be dotted to match dotted lines within merging area
Bicycle boxes

- Provide head start for bicyclists
- Improve bicyclists visibility at on-set of green signal
Solid Colored pavement - Driveways
Lane diets

- Narrow arterial lanes up to 10 feet acceptable - AASHTO.
- 10’ and 11’ travel lanes don’t increase crash rates in urban and suburban areas – NCHRP Project 17-26
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Principles of Collaboration
Connectivity creates a walkable street system by:
- Reducing walking distances;
- Offering more route choices on quiet local streets;
- Dispersing traffic – reducing reliance on arterials for all trips
Bringing Buildings closer to the Street

- Creates a street where drivers know to expect pedestrians
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Principles of Collaboration
• Goals of Education:
• Should be specific, measurable, and address identified problems
Educating Pedestrians

- Reach out to most vulnerable: children and seniors
Why Children and Seniors?

They are:

• Overrepresented in ped crashes
• More vulnerable in a crash
• Less likely to understand how to cross safely
• Less able to judge traffic or understand signals
Example: Maryland Statewide Education Curriculum

- Comprehensive, hands-on K-2 curriculum:
  - Series of lessons and skill training
  - Has reached over 7,000 students at 10 schools
Role of Law Enforcement Officers

• Teach safety
• Evaluate traffic concerns
• Provide police presence
• Monitor drivers and pedestrians
• Not “just hand out tickets”
When is Enforcement Effective?

- The 85% Concept
- The Six Week Concept
The 85% Concept

• If 85% of motorists are doing the wrong thing, then enforcement will do little
• If 85% of motorists are doing the right thing, then enforcement can effectively manage the other 15%
The 6-Week Concept

• Enforcement changes behavior for up to 6 weeks
• Behavior will return without additional enforcement
• Engineering and education needed for permanent change
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Performance Measures

- Pedestrian and Bicycle Trips
- Injury Crashes & Fatalities
- Street Counts
  - Transit, Pedestrian, Bike
- Widgets
  - Number of bike racks installed
  - Linear feet of sidewalk installed
- System Performance
  - Gaps in system
  - Barriers removed
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Stakeholder Roles

Responsibility for ROW

Users of ROW

Non-motorized
People of all ages and abilities
Pedestrians
Bicyclists

Motorized
Motorists (private vehicle)
Truck drivers
Transit agencies

Both
Transit riders

Adjacent property owners

State DOT
Local DOT

Public land
Residences
Commercial
Offices
Industrial
Overlapping Responsibilities

Planning/Developers | City/Property Owner | Traffic Engineering | City/Property Owner | Planning/Developers
Three Step Process to Citizen Empowerment
I. Presentation
II. Walkabout
III. Plan of Action
Questions?