**LEARNING OUTCOMES**

- Understand intersection design options and features
- Select appropriate design feature for a bikeway in a given context
KEY SAFETY FACTORS

- Speed
- Number of lanes
- Visibility
- Traffic volume & composition
- Conflict points
- Proximity
- Bike control
- Connectivity
Designing for Bicyclist Safety

SHARED-USE PATH CROSSINGS
SIDE-STREET CROSSINGS

<table>
<thead>
<tr>
<th>Adjacent Road Speed Limit (Mi/h)</th>
<th>Recommended Sidepath Separation Distance at Crossings</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25 mi/h</td>
<td>6.5 ft (2.0 m)</td>
</tr>
<tr>
<td>35–45 mi/h</td>
<td>6.5–16.5 ft (2.0–5.0 m)</td>
</tr>
<tr>
<td>≥ 55 mi/h</td>
<td>16.5–24 ft (5.0–7.0 m)</td>
</tr>
</tbody>
</table>

*Separation distance may vary in response to available right of way, visibility constraints and the provision of a right turn deceleration lane.*
MID-BLOCK CROSSING DESIGN PROCESS

1. Geometric alignment & terrain considerations
2. Roadway characteristics (lane, speed, volumes)
3. Evaluate sight triangles
4. Determine which leg has priority
5. Assess potential crossing treatments
SIGHT TRIANGLES
PATH YIELDS TO ROADWAY

- Varieties—See MUTCD Table 2C-4
- W11-15/W16-7P (optional)
- W11-15/W11-15P/W16-9p

R1-2
D0-1 is optional

R3-3
NO MOTOR VEHICLES

W11-15/W16-7p

5 ft (1.5 m)
8 ft (2.4 m)

100 ft (30 m)

ROAD NAME

5 ft (1.2 m)
8 ft (2.4 m)

Centerline as needed

Optional Path Markings

Shaved-Use Path

Crosswalk markings legally establish midblock pedestrian crossing
Crossing Countermeasures

- Advance warning signs
- Advance yield/stop line
- Raised island/crossing
- RRFB/PHB
BIKE “HAWK” PHB

- First installation Tucson, AZ
- “BIKES WAIT”/”BIKES OK”
Designing for Bicyclist Safety

INTERSECTION DESIGN
INTERSECTION DESIGN PRINCIPLES

- Reduce speed
- Minimize exposure to conflicts
- Communicate right-of-way priority
- Provide adequate sight distance
INTERSECTION CONFLICTS

- Typical conflicts for both pedestrians and motorists, plus:
  - Right-turn/thru movement
  - Weaving to left turn
LEFT-TURN CONFLICT
Shoulder not a travel lane
Modify shoulder striping
Opportunity to switch to shared lanes OR
Add bike lane thru intersection
Additional/all lanes are shared at intersection
HIGHLIGHT CONFLICT ZONE

Dotted Line Extensions
Shared Lane Markings
Colored Conflict Area
Elephant’s Feet
HIGHLIGHT CONFLICT ZONE
BIKE LANE THRU INTERSECTION
TWO-STAGE LEFT TURN BOX
TWO-STAGE LEFT-TURN QUEUE BOX

- Required design elements include:
  - Bicycle symbol
  - Turn or through arrow
  - Turn on red prohibition
  - Passive detection of bicycles
- Size to prevent conflicts
BIKE BOX

- Increase visibility
- Reduce signal delay for bikes
- Positioning for left-turn
- Prevent “right-hook” (except at onset of green)
- Groups bikes
Required elements:

- Advance stop bar
- Bike symbol
- RTOR prohibited
- Setback from crosswalk
- Countdown ped signal
- Yellow change & red clearance
SAFER SIGNALS FOR BICYCLISTS

- Bikes start-up and travel slower than cars
  - Differentiating bike detection to optimize signals
  - Set initial and gap times to accommodate bikes
- Leading Bike Interval
- Segregate Conflicting Movements
BICYCLE SIGNAL FACE

Application for:

- Bicyclist non-compliance
- Provide a leading or lagging bicycle interval
- Continue the bicycle lane on the right-hand side of an exclusive turn lane
- Augment the design of a segregated counter-flow
- Unusual or unexpected arrangements of the bicycle movement through complex intersections, conflict areas, or signal control.
BICYCLE DETECTION

- Buttons
- Loops
- Video
- Microwave
- Radar
- Infrared

Grand Prairie, Alberta
PUSH BUTTONS
PASSIVE DETECTION
BICYCLISTS AT ROUNDABOUTS
**MAKING ROUNDABOUTS WORK**

- Slow speeds
  - Deflection
  - Truck apron
  - NO BIKE LANES
- Simple
  - Single lane
  - NO BIKE LANES
- Splitter islands
- Escape ramps
Bike lane ends at splitter island

Bend, Oregon
Slower speeds and fewer conflict points
Slower speeds and fewer conflict points
Bend, Oregon

Bike lane begins
“PROTECTED” INTERSECTIONS
VISIBILITY AT CONFLICT POINTS

motorist’s view at conventional bike lane

motorist’s view at separated bike lane
VISIBILITY AT CONFLICT POINTS

protected intersection  conventional bike lane
PROTECTED INTERSECTIONS

1. Corner refuge island
2. Forward bicycle queuing area
3. Motorist yield zone
4. Pedestrian crossing island
5. Pedestrian crossing of separated bike lane
6. Pedestrian curb ramp
CHICAGO, IL
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