Countermeasure Strategies for Pedestrian Safety

Pedestrian Safety at Interchanges

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Today’s Presentation

- Introduction and housekeeping

- Audio issues?
  Dial into the phone line instead of using “mic & speakers”

- PBIC Trainings and Webinars
  www.pedbikeinfo.org/training

- Registration and Archives at
  pedbikeinfo.org/webinars

- PBIC News and updates on Facebook
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- Questions at the end
Countermeasure Strategies for Pedestrian Safety Webinar Series

Upcoming Webinars

Lighting Strategies for Pedestrian Safety
Tuesday, December 15 (1:00 – 2:30 PM Eastern Time)

Traffic Calming
Thursday, December 17 (1:00 – 2:30 PM Eastern Time)

Pedestrian Safety at Roundabouts
Wednesday, January 6 (1:00 – 2:30 PM Eastern Time)

To view the full series and register for the webinars, visit
www.pedbikeinfo.org/training/webinars_PSAP_countermeasurestrategies.cfm
WHERE DOES THE FREEWAY END?
Intersections of freeway ramp terminals at crossroads are the most critical components of an interchange.

- Challenge: balance mobility and safety of peds & bicycles with movement of vehicles.
Free-flow ramp movements can be very challenging for pedestrians to cross.

Photo Source: Mark Doctor, FHWA
Drivers do not expect pedestrians around interchanges

- There is safety in numbers; but pedestrian numbers are usually low around interchanges

After coming off freeway 45 mph appears to be a slow speed

- Provide visual cues

Discontinuous facilities

- Free-flowing entry and exit ramps

- Insufficient lighting

- Unmarked crossings

- Poor sight distance

- Long crossing distances
RESOURCES
10 Grade Separations and Interchanges
  10.1 Introduction and general Types of Interchanges
  To reduce conflicts between vehicles, pedestrians, or bicycles within interchanges, it is preferable to separate their movements. When separation of pedestrians and bicycle movements from vehicle traffic is not practical, each interchange site should be studied and alternate designs considered to determine the most appropriate arrangement of structures and ramps to accommodate bicycle and pedestrian traffic through and interchange area.
  10.9 Interchanges
  The accommodation of pedestrian and bicyclists also should be considered in the selection of an interchange configuration
GUIDING PRINCIPLES

• Provide bicycles and pedestrian facilities

• Design ramp geometries to encourage slower vehicle speeds until past crosswalk

• Locate the crosswalk at the location with the best visibility and before the point where vehicles begin to accelerate

• Crosswalks should be as short as possible
GUIDING PRINCIPLES

- Where bicyclists would travel between moving vehicles for more than 200 feet, install a buffer zone.
- Where bicyclists merge across a vehicle lane allow flexibility to transition when/where safe.
- Use a decision tool to select appropriate crossing treatments.
PEDESTRIAN & BICYCLE ACCOMMODATIONS
Apply Principles from DPS 101 & DPS 201

- Sidewalks or shoulders
  - Zone System when designing sidewalks

- Crosswalks
  - High visibility crosswalks
  - Optimal placement

- Advance stop/yield bars

- Signing
  - Florescent yellow-green for pedestrian warning signs
  - Rectangular Rapid Flash Beacon (RRFB)

- Pedestrian crossing islands
ZONE SYSTEM

Frontage

Sidewalk

Furniture

Curb
HIGH VISIBILITY CROSSWALKS
SIGNING
RAISED ISLANDS

Pedestrian pass through on channelization island

Photo Source: Mark Doctor, FHWA
SIGNING RRFB & CROSSING ISLAND
AVOID EXCESSIVE USE OF SIGNS
Choosing the best crosswalk placement where it’s not clear what’s most logical for the driver or the pedestrian:

3 choices:
- Most direct route
- Shortest crosswalk
- “Compromise” - midway solution
Driver can make turn at high speed

Pedestrian crosses long distance with back turned to traffic
Driver is accelerating, no longer expects crosswalk

Pedestrian must travel long distance to get to crosswalk
Driver is still making turn, can see the crosswalk

Pedestrian mustn’t travel too far to get to crosswalk; crosswalk is not too long
INTERCHANGE CASES

On-Ramps
Off-Ramps
DDIs
SPUIs
Roundabout
ON-RAMPS
TREATMENTS FOR ON-RAMP ENTERED FROM SHARED-THRU RIGHT LANE

- Optional “exit ramp” for bicyclists to use sidewalk
- Dashed bike lane before on-ramp lane
- Landscape buffer provided between sidewalk and bike lanes, including on the structure as feasible
- Ramp geometrics minimize speed for vehicles leaving the arterial
- Directional curb ramps with truncated domes, high visibility striping provided for all crosswalks
- Crosswalk located where speed is lowest and visibility is highest
- HOV Lane added downstream of crosswalk
TREATMENTS FOR ON-RAMP ENTERED FROM SHORT, SINGLE RIGHT LANE
TREATMENTS FOR ON-RAMP ENTERED FROM LONG, SINGLE RIGHT LANE
Advance yield limit line provided on dual lane crossing (advance stop bar if signalized). Bicyclists have option to use crosswalk (with ramps).

Raised (landscaped) buffer provided between bike lane and on-ramp lanes.
TREATMENTS FOR DUAL-LANE ON-RAMPS
WHAT’S MISSING?

RIGHT TURN LANE ADJACENT TO SHARED RIGHT-THRU
OFF - RAMPS
TREATMENTS FOR ARTERIAL ENTERED FROM STOP/MERGE (SPLIT RAMPS)
TREATMENTS FOR ARTERIAL ENTERED FROM STOP/MERGE (COMBINED RAMPS)
TREATMENTS FOR ARTERIAL ENTERED FROM FREE OFF-RAMP
BIKE LANE CROSSING DETAIL
In this configuration, ramps should be signalized. Bicycle detection and optional ramps accommodate bikes at the crosswalk.
Advance yield limit line is provided across dual lane ramp. Advance stop bar if signalized.
ENHANCING UNCONTROLLED CROSSWALKS
OFF RAMP SIGNING
HIGH SPEEDS, POOR VISIBILITY

FIGURE 2 Visibility problem at merging areas
- Flat angle = wide crossing & high-speed turns
- Tight angle = short crossing & slow speed turns
- Red arrow = old crosswalk
- Green arrow = new crosswalk

**BEFORE & AFTER**

Old ramp alignment
DESIGN DETAILS SLIP LANES W/ISLAND

Old Way

Wide Angle

High speed, head turner = low visibility of pedestrians

New way

Tighter angle

55 to 60 degree angle between vehicle flows.

Slow speed, good angle = good visibility of pedestrians
ALTERNATIVE INTERSECTIONS/INTERCHANGES INFORMATION REPORT

DIVERGING DIAMOND INTERCHANGE INFORMATION GUIDE
SINGLE POINT URBAN INTERCHANGES (SPUI)
“Dog Bone” Diamond

- Compared to signalized intersections, roundabouts require fewer lanes on the crossroad (no need for turn lanes) resulting in a narrower bridge

- Roundabouts can have either a true circular shape or a “raindrop” shape

- Raindrop-shaped islands eliminate direct U-turn movements (U-turns can be made by circulating around both roundabouts)
RETROFITTING EXISTING INTERCHANGE

Photo Source: Mark Doctor, FHWA
PROVIDING PEDESTRIAN PATHWAYS AS PART OF AN INTERCHANGE IMPROVEMENT PROJECT

West Vail, CO

Photo Source: Mark Doctor, FHWA
QUESTIONS?

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ALTERNATIVE INTERSECTIONS/INTERCHANGES INFORMATION REPORT

DIVERGING DIAMOND INTERCHANGE INFORMATION GUIDE (COMING LATE OCTOBER 2014)
WHAT IS A DIVERGING DIAMOND INTERCHANGE?

An interchange form that allows two directions of traffic on the crossroad to temporarily cross to the opposite side to gain access to and from the freeway more easily.
FHWA VIDEO ON HOW A DDI WORKS
Pedestrian facilities on the inside minimizes conflicts with left-turning traffic to and from the freeway and allows crossing the interchange in all directions (along the arterial and crossing the arterial).

For underpass DDIs, existing center bridge columns may dictate putting pedestrian walkways on the outside.
PEDESTRIAN – VEHICLE CONFLICT POINTS

Outside Walkway

Center Walkway
PEDESTRIAN PATH IN CENTER

Source: MoDOT
Very positive feedback from user surveys
Saves bridge width
May require structural capacity considerations
PEDESTRIAN PATH ALONG OUTSIDE

Source: MoDOT
PEDESTRIANS HAVE DIFFICULTY VIEWING IF THERE IS AN APPROPRIATE GAP IN APPROACHING TRAFFIC

Photo Source: Mark Doctor, FHWA
PEDESTRIAN’S LIMITED VIEW OF APPROACHING VEHICLES

Photo Source: Mark Doctor, FHWA

DDI – I-15 at American Fork, UT
Limited Sight Distance - use Pedestrian Signal

DDI – Kansas City, MO
SINGLE POINT URBAN INTERCHANGES (SPUI)
Advance crosswalk controlled with a signal or pedestrian hybrid beacon
Bike lanes have skip striping through the complex intersection.

Each stage is coordinated with the downstream signal in the same direction.
With most SPUIs there is never a phase when pedestrians can cross the urban arterial without conflict.

Solution 1: Two-step crossing (one step during vehicle phase 2 and the other during vehicle phase 3)  
NOTE: requires median refuge & Ped Signals

Solution 2: Nearby midblock signalized ped crossing, or nearby signalized intersection with crosswalks.
Vehicle phase 1
GETTING PEDESTRIANS ACROSS A SPUI

Vehicle phase 2
GETTING PEDESTRIANS ACROSS A SPUI

Vehicle phase 3
“Dog Bone” Diamond

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City of Carmel, Indiana
Photo Credit: American StructurePoint, Inc.  www.structurepoint.com
THE “PEANUT” INTERCHANGE
Thank You!

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  ▪ Downloadable/streaming recording and presentation slides

➔ Questions?
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