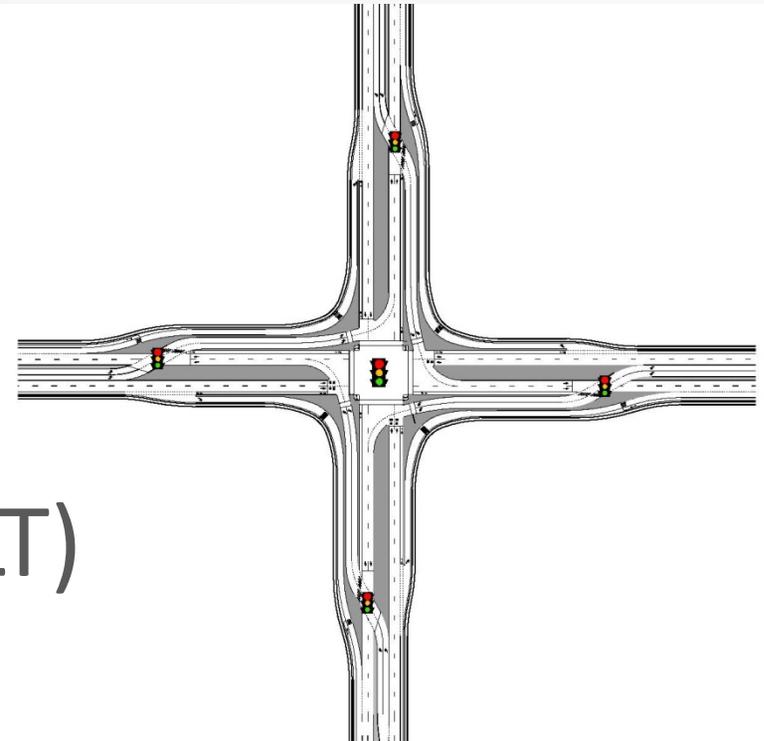


# Develop Alternative Intersection Guides

- Displaced Left Turn (DLT)
- Median U-Turn (MUT)
- Restricted Crossing U-Turn (RCUT)

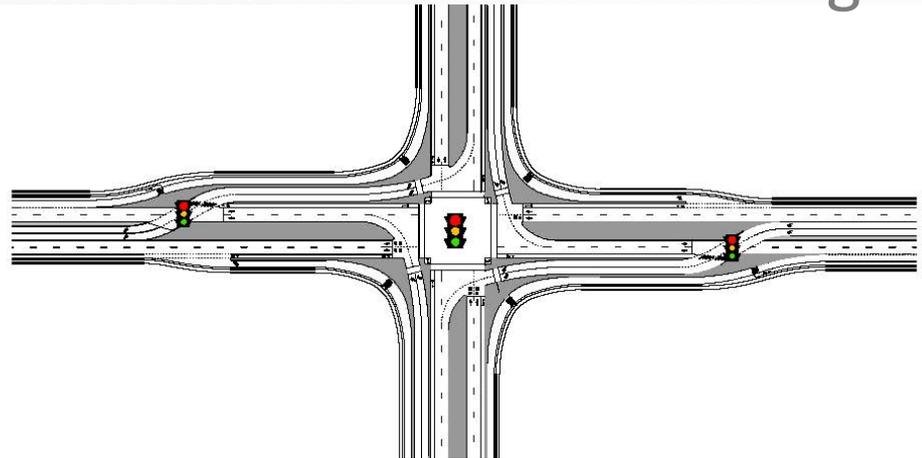


August 2014

# Presentation Outline

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- **Introduction**
- Project Background, Objectives, and Team
- Overview of Alternative Intersections
- Overview of Displaced Left-Turn
- Overview of Median U-Turn and Restricted Crossing U-Turn
- Additional Resources



# Introduction

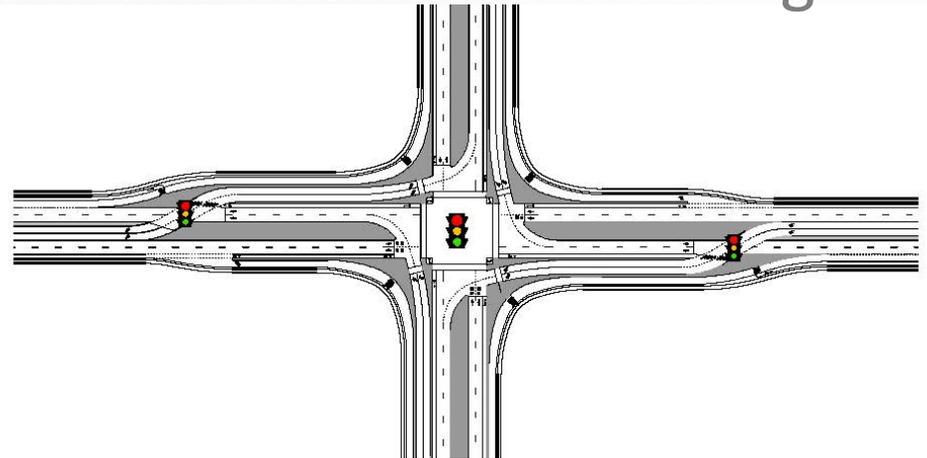
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- Today's Presenters
  - Jeff Shaw, FHWA
  - Pete Jenior, Kittelson & Associates, Inc.
  - Hermanus Steyn, Kittelson & Associates, Inc. (DLT author)
  - Dr. Joe Hummer, Wayne State University (RCUT author)
  - Jonathan Reid, Parsons Brinkerhoff (MUT author)
- Webinar Overview

# Presentation Outline

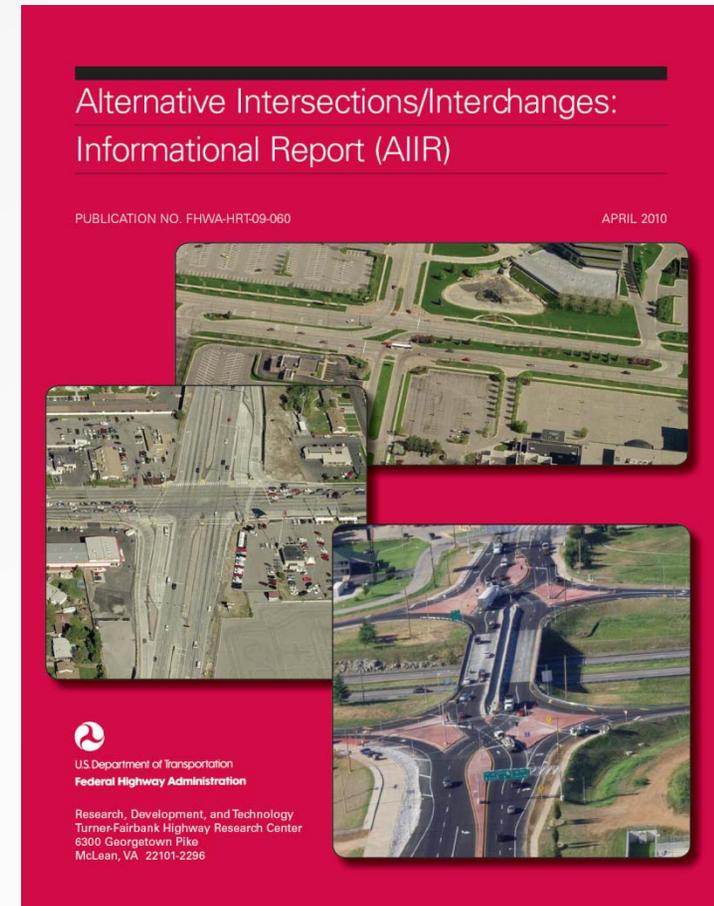
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- Introduction
- **Project Background, Objectives, and Team**
- Overview of Alternative Intersections
- Overview of Displaced Left-Turn
- Overview of Median U-Turn and Restricted Crossing U-Turn
- Additional Resources



# Project Background

- Past Alternative Intersections/Interchanges: Informational Report (AIIR)
  - Published by FHWA in 2010
  - Provided a summary of the range of intersection forms professionals could consider



# Project Background



- Every Day Counts (EDC) Initiative
  - Designed to identify and deploy innovation aimed at reducing the time it takes to deliver highway projects, enhance safety and protect the environment.
- For this project
  - Assisting efforts to bring renewed focus to alternative intersections
    - create easy to use guides and supplementary webinar materials
  - Foster a wider implementation of these EDC intersection and interchange designs by state highway and local road agencies,

## Project Objectives

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- Develop materials that will aid highway planners and designers
- Facilitate the deployment of four (4) Alternative Intersection designs:
  - Diverging Diamond Interchange (DDI)
  - Displaced Left-Turn Intersection (DLT)
  - Restricted Crossing U-Turn Intersections (RCUT)
  - Median U-Turn Intersection (MUT)
- Replace the 2010 AIIR information with current research and findings

# Project Objectives

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- Guide Outline – consistent for all Guides
  - Chapter 1 – Introduction
  - Chapter 2 – Policy and Planning
  - Chapter 3 – Multimodal Considerations
  - Chapter 4 – Safety
  - Chapter 5 – Operational Characteristics
  - Chapter 6 – Operational Analysis
  - Chapter 7 – Geometric Design
  - Chapter 8 – Signal, Signing, Marking and Lighting
  - Chapter 9 – Construction and Maintenance
  - Appendices

# Project Objectives

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- Focus of the Guides
  - Policy and planning considerations
  - Multimodal considerations
  - Public outreach materials and resources
  - Current safety research and operational practices
- While still providing
  - Geometric design guidance
  - Signals, signing and pavement marking details
  - Construction considerations

# Project Team

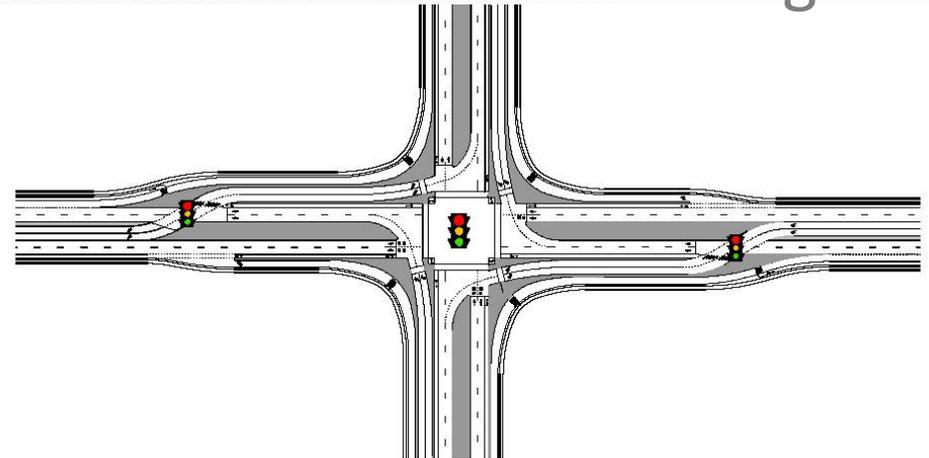
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- Overall Project Management
  - Federal Highway Administration
  - Virginia Tech Transportation Institute
  - Kittelson & Associates, Inc. (Brian Ray, Principal Investigator)
- Diverging Diamond Interchange
  - Dr. Bastian Schroeder
  - Chris Cunningham
- Displaced Left-Turn Intersection
  - Hermanus Steyn, Kittelson & Associates, Inc.
- Median U-Turn Intersection
  - Jonathan Reid, Parsons Brinckerhoff
- Restricted Crossing U-Turn Intersection
  - Dr. Joe Hummer, Wayne State University

# Presentation Outline

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- Introduction
- Project Background, Objectives and Team
- **Overview of Alternative Intersections**
- Overview of Displaced Left-Turn Intersection
- Overview of Median U-Turn and Restricted Crossing U-Turn Intersections
- Additional Resources



# Overview of Alternative Intersections

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- Provide potential to improve safety and reduce delay at a lower cost than traditional solutions
- Often unfamiliar to transportation practitioners due to limited existing applications
- Require specific planning and policy considerations for all users
- Create the need for public involvement and driver education

# Planning Considerations

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- Alternative intersection evaluations may vary depending on the stage of the project development process
- Planning level design evaluations may not require a detailed level of analysis
- Evaluations should be comprehensive enough to answer key project questions for each unique project context

# Pedestrian and Bicycle Accommodation

- Pedestrians may be required to cross multiple lanes with potential multi-stage crossings
- Some maneuvers through intersection are counterintuitive for pedestrians and bicycles
- Bicyclists are accommodated on the road or off-street in shared-use paths
- Evaluate trade-offs to address various user needs



# Stakeholder Outreach

- The implementation may require extensive public outreach and educational meetings to familiarize the public with the unusual geometry.
  - Outreach should be directed at all users

**THE THRU-TURN INTERSECTION (TTI)** will reduce delay and improve safety by redirecting left turns from the main intersection to nearby U-turn locations.

● TRAFFIC SIGNAL  
● PEDESTRIAN SIGNAL

U-turn location at 4015 West and Sams Blvd

**SCAN THIS QR CODE WITH YOUR SMART PHONE TO SEE AN ANIMATION OF HOW THE TTI WILL WORK.**

[udot.utah.gov/5400south](http://udot.utah.gov/5400south) >>

**Superstreet Intersection Design**

Poplar Tent Road Widening  
TIP Project U-3415

Progressive design to:

- Help improve safety
- Reduce travel time
- Reduce construction costs
- Reduce impacts on the environment

U-turns provide left turn and through movements for vehicles from side streets

No left turns or crossing traffic from side streets

**CONTINUOUS FLOW INTERSECTION**

## HOW TO NAVIGATE A CONTINUOUS FLOW INTERSECTION

UDOT is building a new type of intersection at 3500 South and Bangerter Highway. The Continuous Flow Intersection (CFI) will be under construction in the summer of 2007.

**STRAIGHT:** Proceed as you normally would but watch for another light just past the intersection. It's possible to encounter a red light here, which allows left turning cars to cross in front of you.

**RIGHT TURN:** Be sure to yield to traffic, cyclists and pedestrians. Make your turn, merge with traffic and keep on going.

**LEFT TURN (onto Bangerter Highway):** Stop, only a little further back. Merge lanes into an all new lane and make your left turn.

[www.udot.utah.gov/cfi](http://www.udot.utah.gov/cfi) | (877) 350-2346 | [cfi@utah.gov](mailto:cfi@utah.gov)

# Types of Alternative Intersections

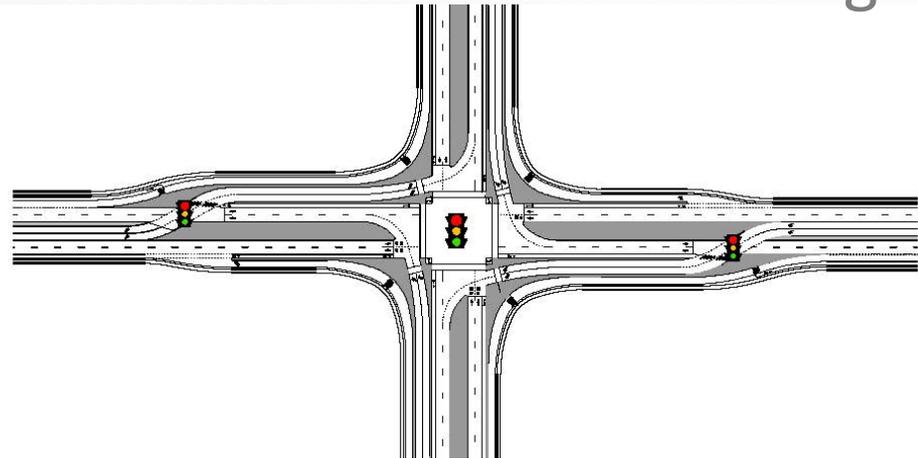
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- Displaced Left-Turn Intersection
  - Continuous Flow Intersection (CFI)
  - Crossover Displaced Left-Turn Intersection
- Median U-Turn Intersection
  - Median U-turn Crossover
  - Boulevard Turnaround
  - Michigan Loon
  - ThrU-Turn Intersection
- Restricted Crossing U-Turn Intersection
  - Superstreet Intersection
  - J-turn Intersection
  - Synchronized Street Intersection
- Diverging Diamond Interchange
  - Double Crossover Diamond (DCD)

# Presentation Outline

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- Introduction
- Project Background, Objectives and Team
- Overview of Alternative Intersections
- **Overview of Displaced Left-Turn Intersection**
- Overview of Median U-Turn and Restricted Crossing U-Turn Intersections
- Additional Resources



# Poll

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- Are there Displaced Left Turn intersections in your state?



# Displaced Left-Turn Intersection

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- Overview of Intersection Type
- Multimodal Considerations
- Safety Considerations
- Operations
- Geometric Design
- Signing, Striping and Lighting
- Construction

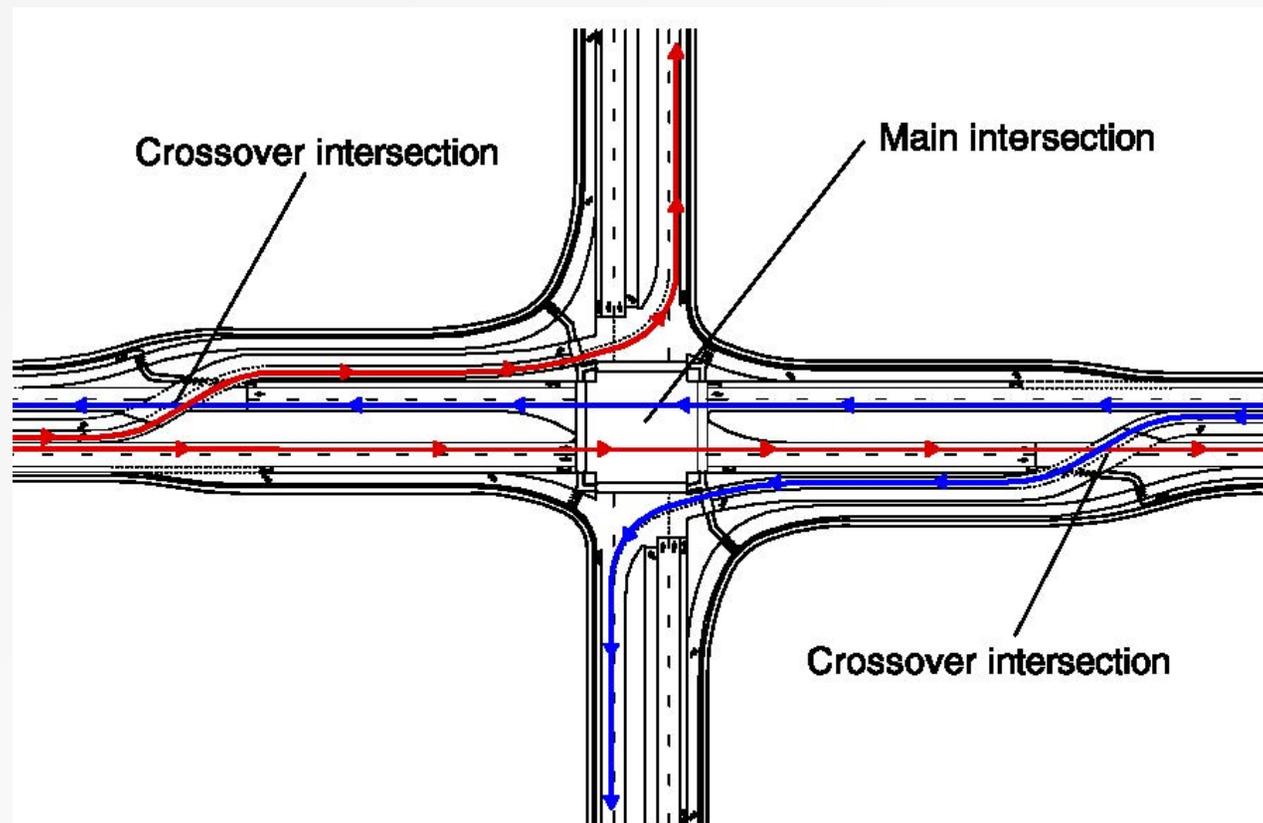
## Overview: Displaced Left-Turn Intersection

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- Any intersection form relocating one or more left-turn movements on an approach to the other side of the opposing traffic flow.
  - Allows left-turn movements to proceed simultaneously with the through movements
    - Eliminates the left-turn phase for this approach
  - Reduces the number of traffic signal phases and conflict points (locations where user paths cross)
    - Can result in improvements in traffic operations and safety performance
  - Green time can be reallocated to facilitate pedestrian crossings

# Overview: Displaced Left-Turn Intersection

- Four-legged DLT with displaced lefts on a major street

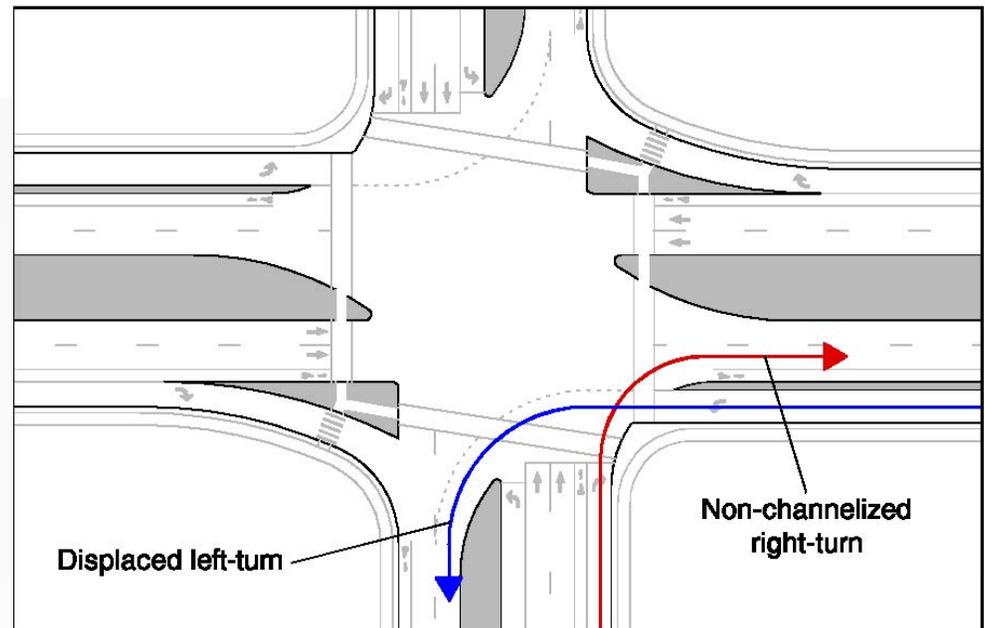
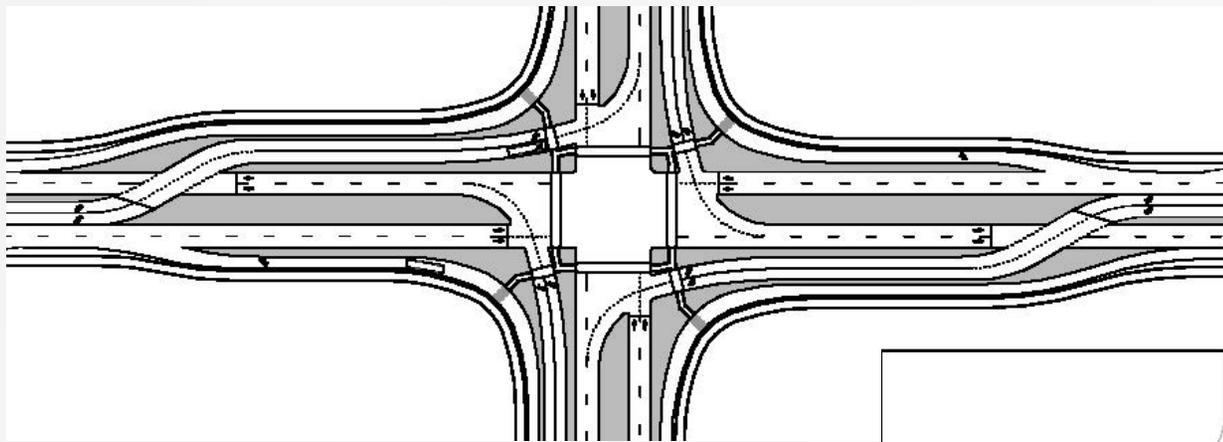


# Overview: Displaced Left-Turn Intersection

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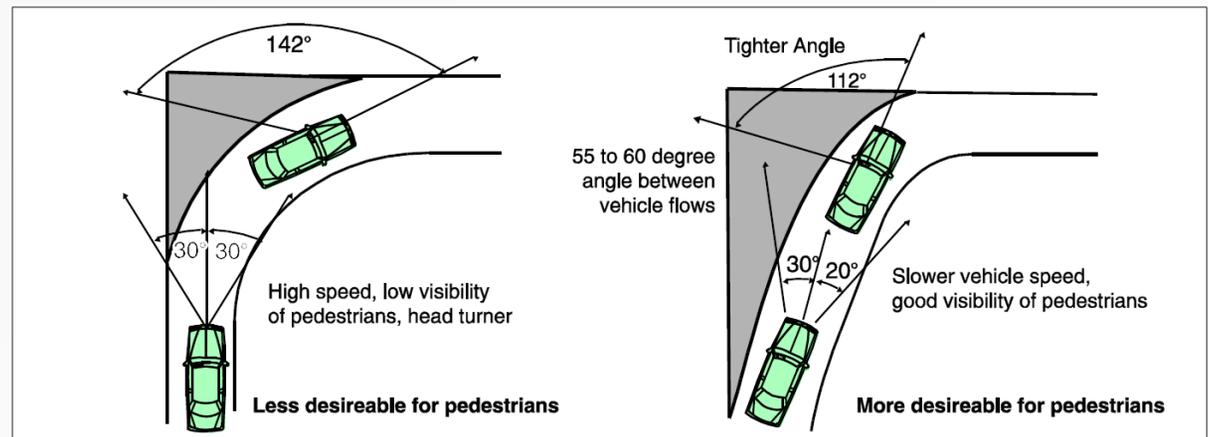
- Range of Configurations
  - Four-legged DLT intersection with four displaced lefts
    - With channelized right turns
    - Without channelized right turns
  - Four-legged DLT intersection with major street displaced lefts and channelized right turns
    - With channelized right turns
    - Without channelized right turns
  - Three-legged DLT intersection with major street displaced left
  - Three-legged DLT intersection with minor street displaced left

# With/Without Channelized Right Turns



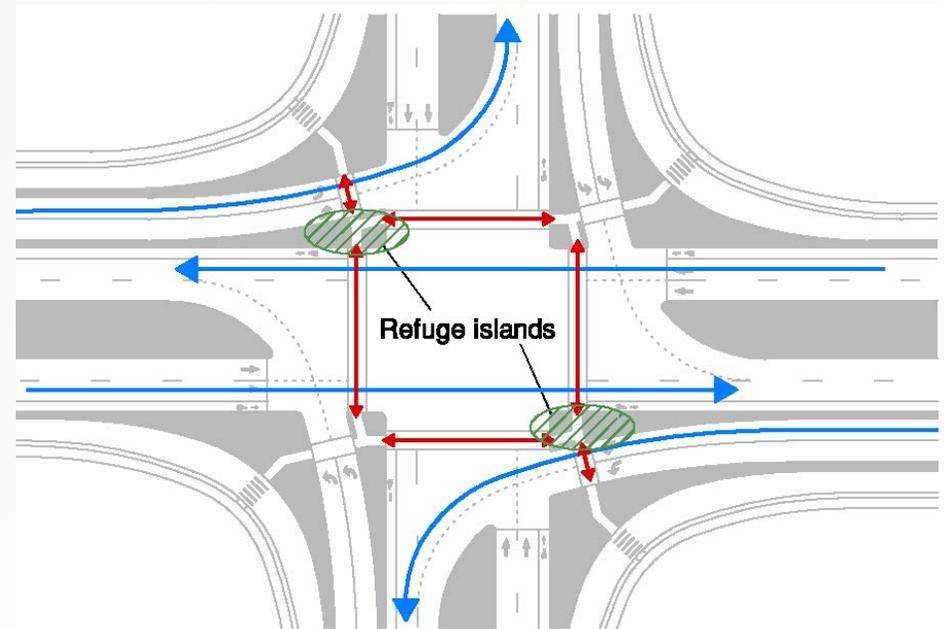
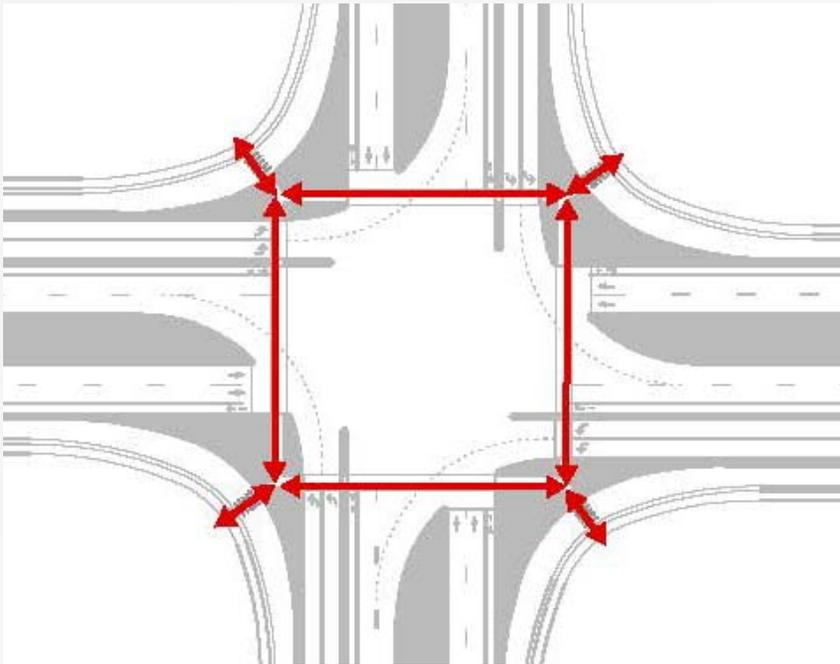
# Multimodal Considerations/Complete Streets

- Design elements
  - Width of roadway
    - Crossing distance for pedestrians
    - Exposure of bicyclists in conflict zones
  - Bus stop locations relative to natural walking paths
  - Unique movements
  - Large vehicles

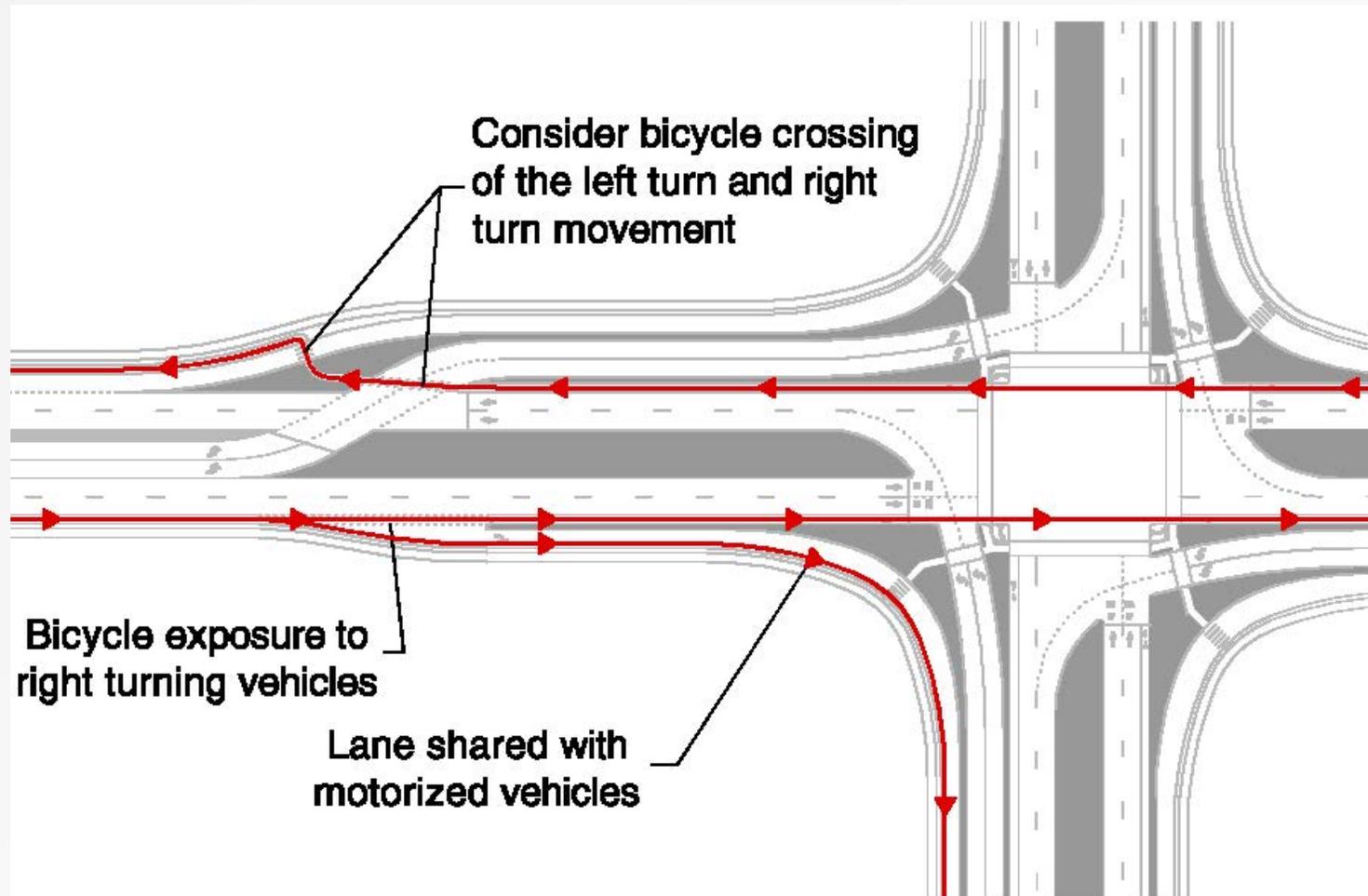


# Pedestrians

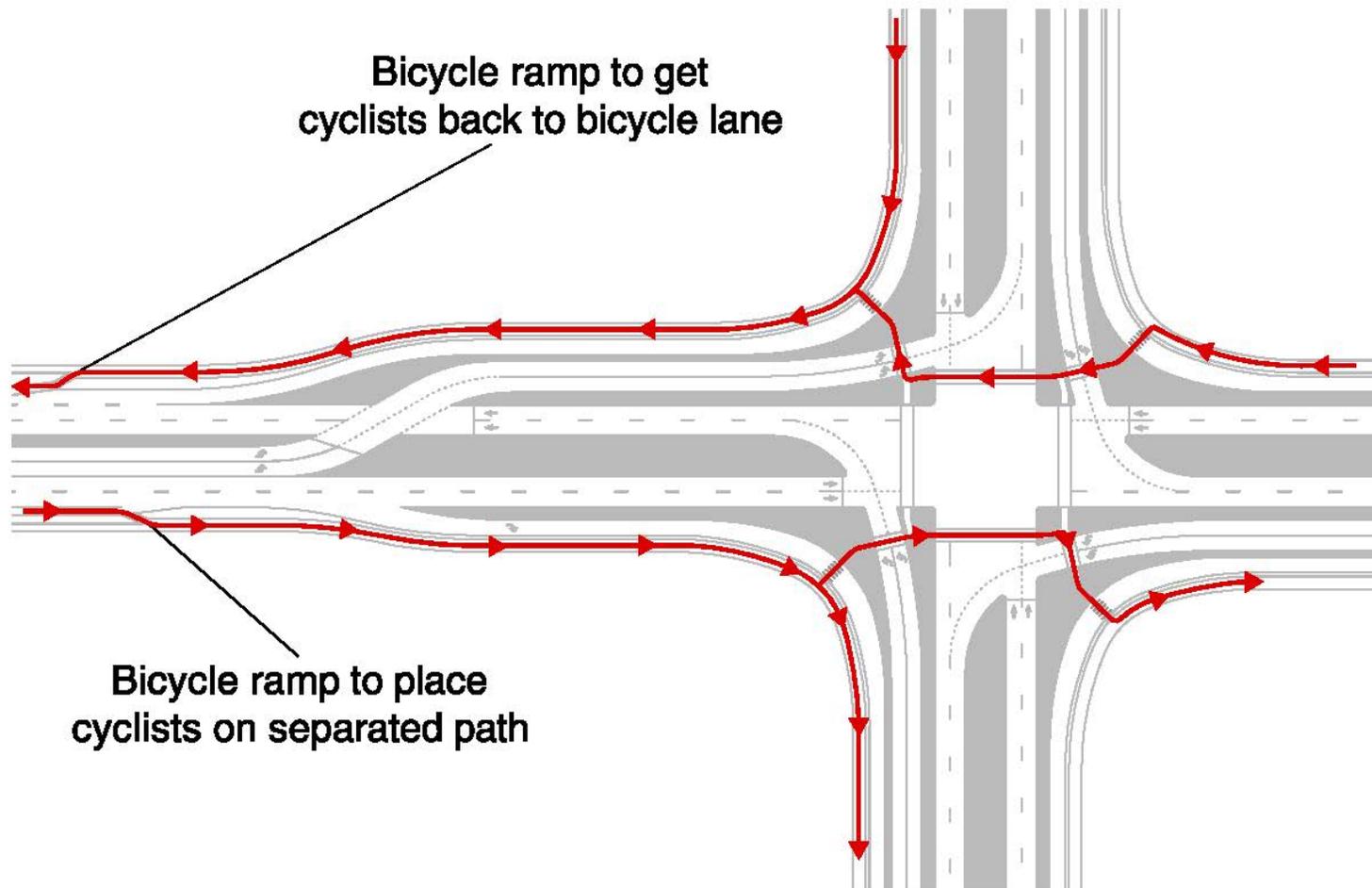
- Design and operational challenges



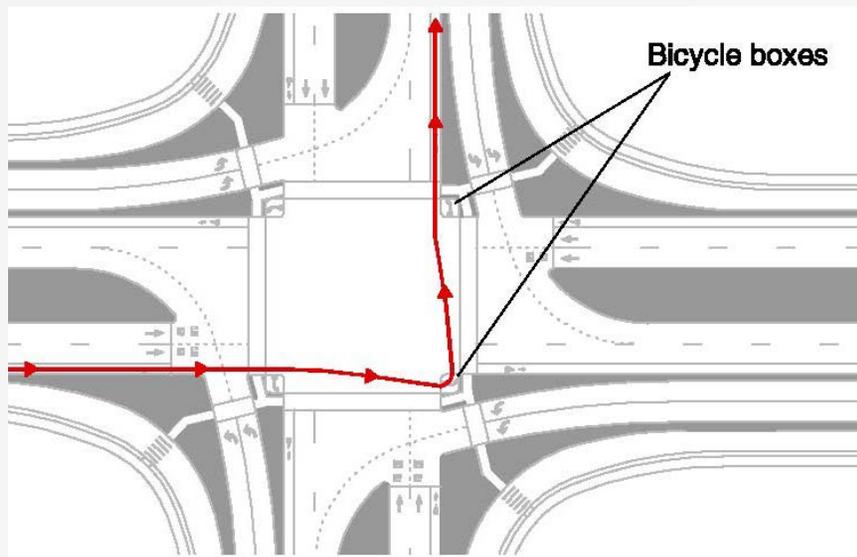
# Bicycles: On-Street Bicyclists



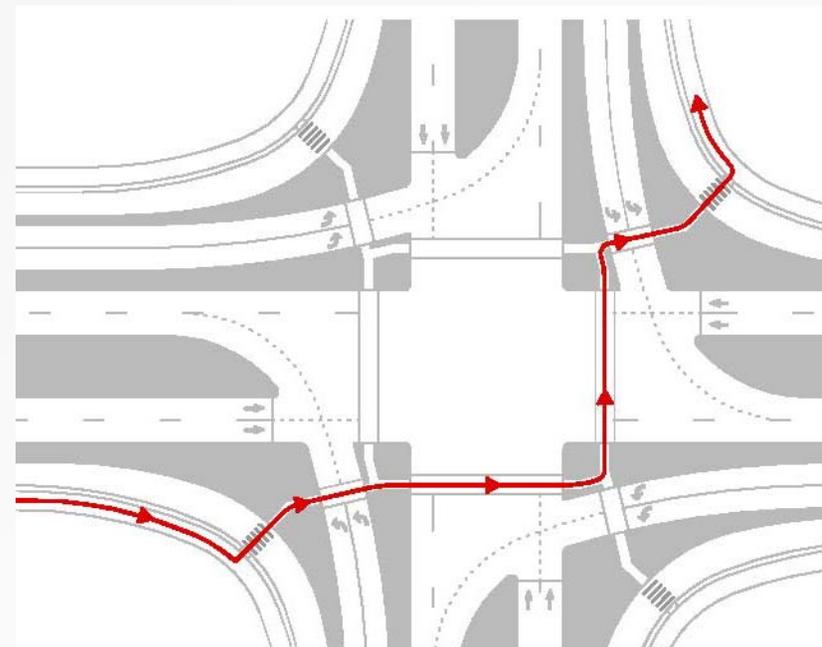
# Bicycles: Off-Street Bicyclists



# Bicycles: Bicycle Left-Turn



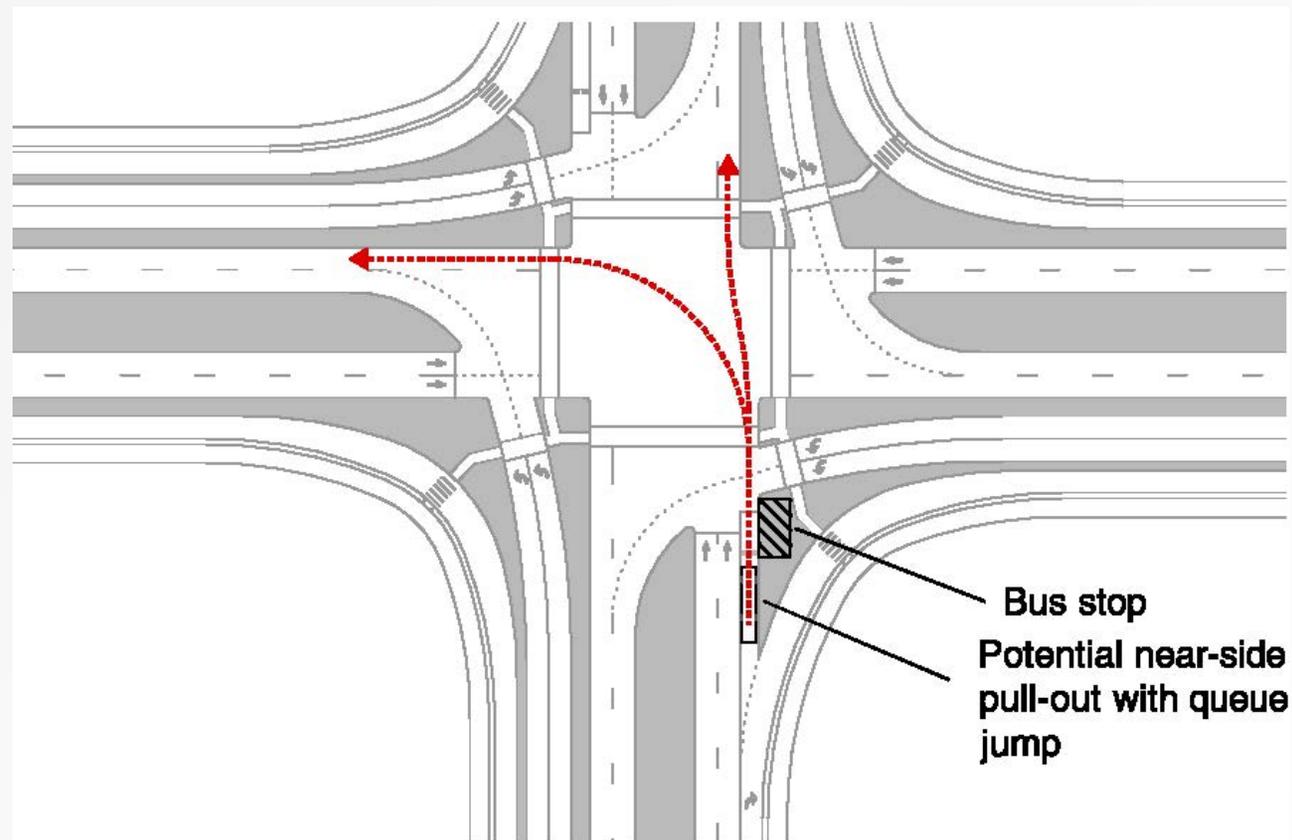
**On-Street Left: Bicycle Box**



**Off-Street Left: Share with Pedestrians**

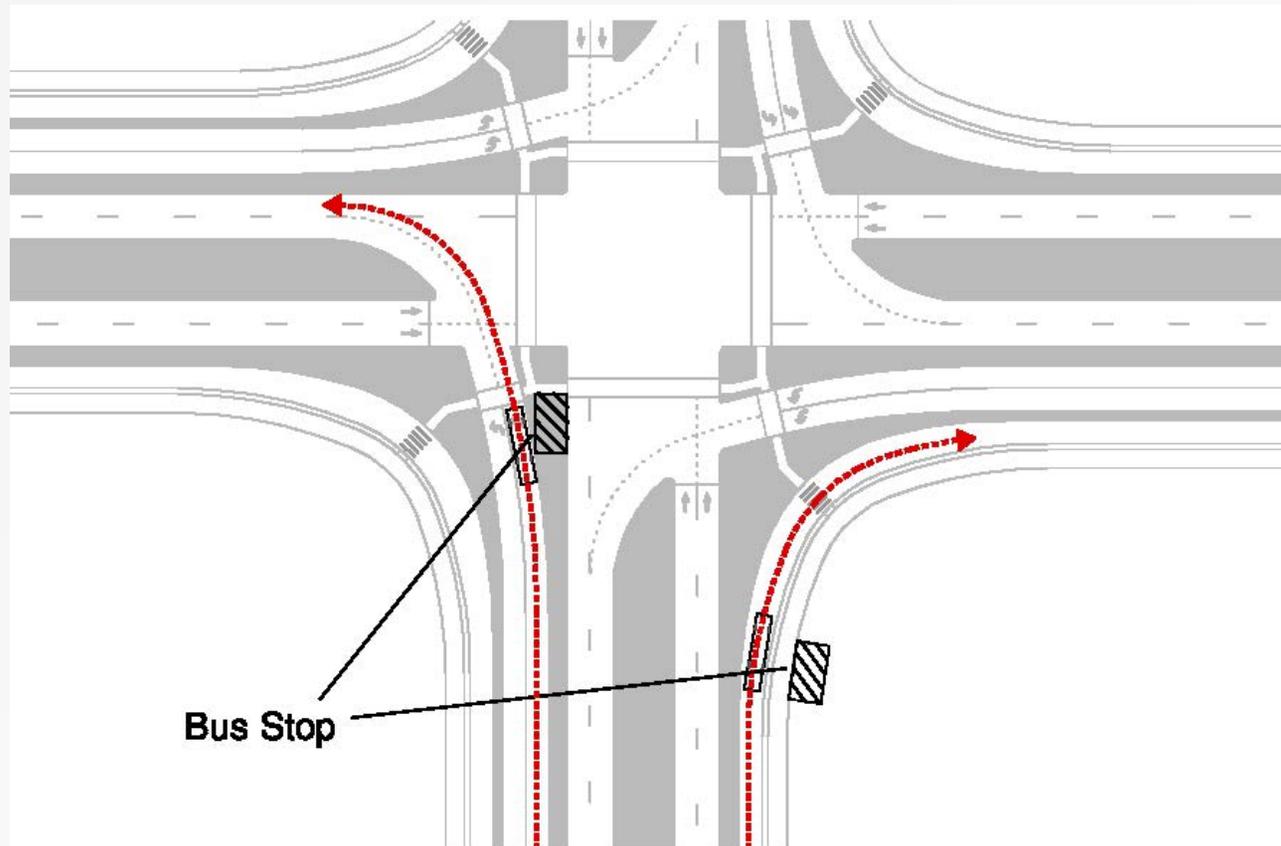
# Transit: Bus Pull-out

- Potential Queue Jump for Left/Through Buses



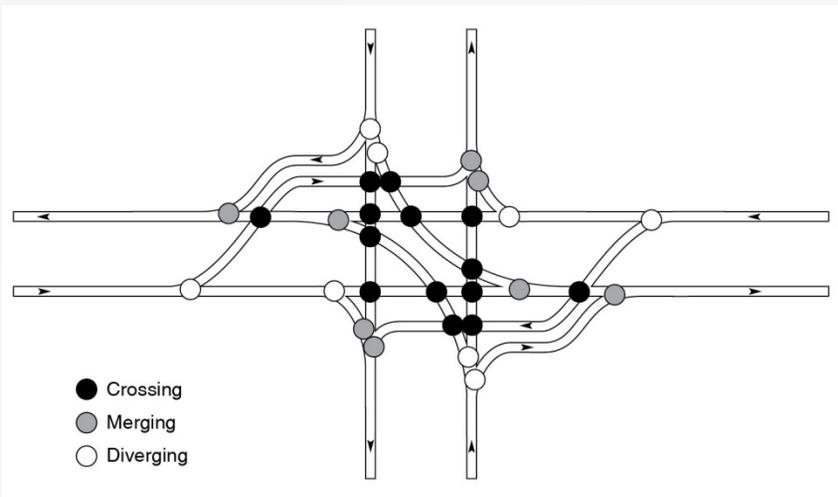
# Transit: In Travel Lanes Bus Stops

- Queuing behind stopped buses

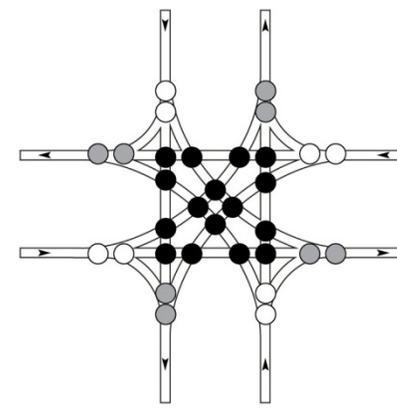


# Safety Principles

- There is limited documentation about the safety performance of DLT intersections
- Conflicts are correlated with collisions and are often used as a surrogate measure
- DLT Intersection Conflict analysis is shown below



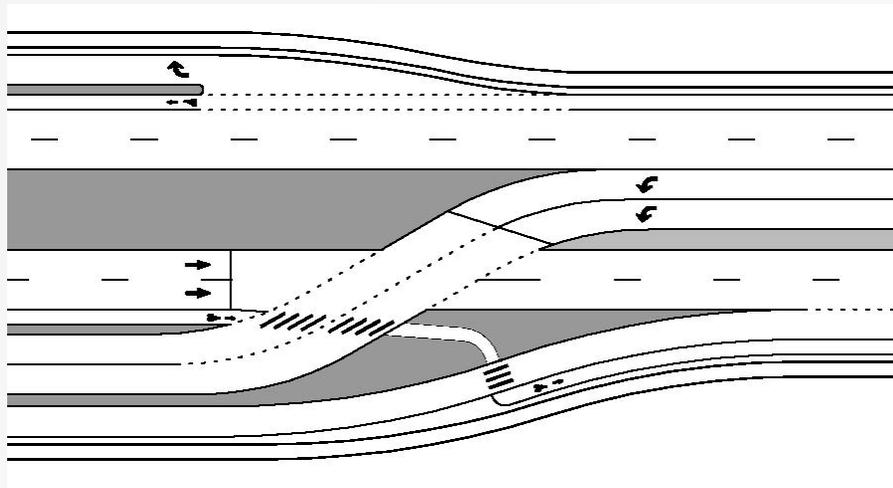
Partial DLT: 30 conflict points  
14 crossing, 16 merging/diverging



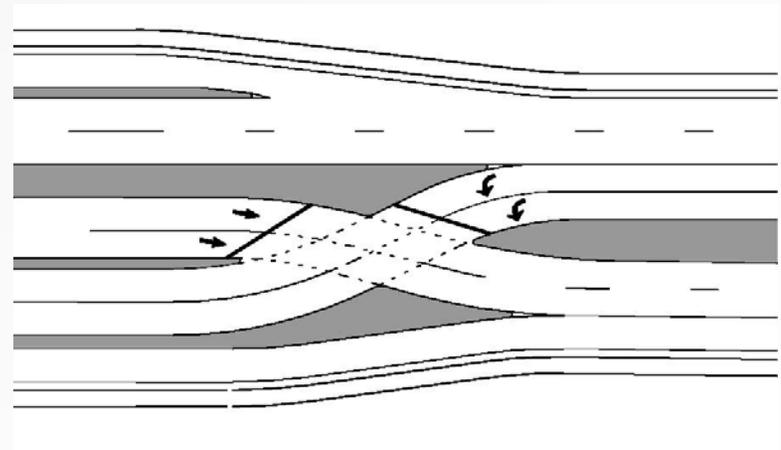
Conventional: 32 conflict points  
16 crossing, 16 merging/diverging

# Safety Concerns

- Driver unfamiliarity
  - Counterintuitive design features
  - Use appropriate design and signing to prevent wrong-way movement



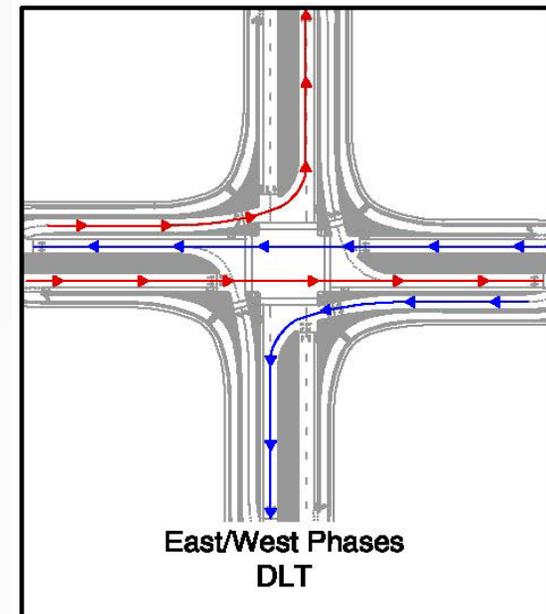
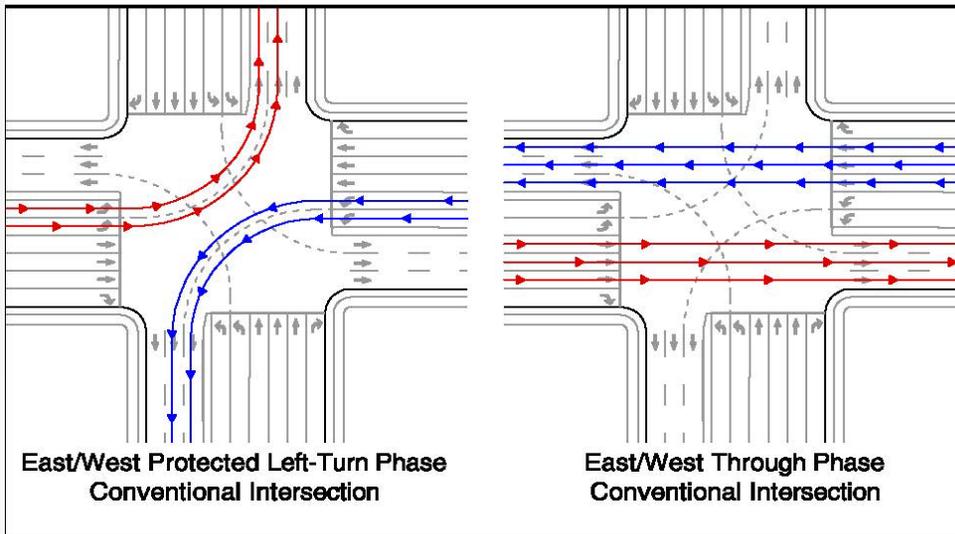
Desirable



Undesirable

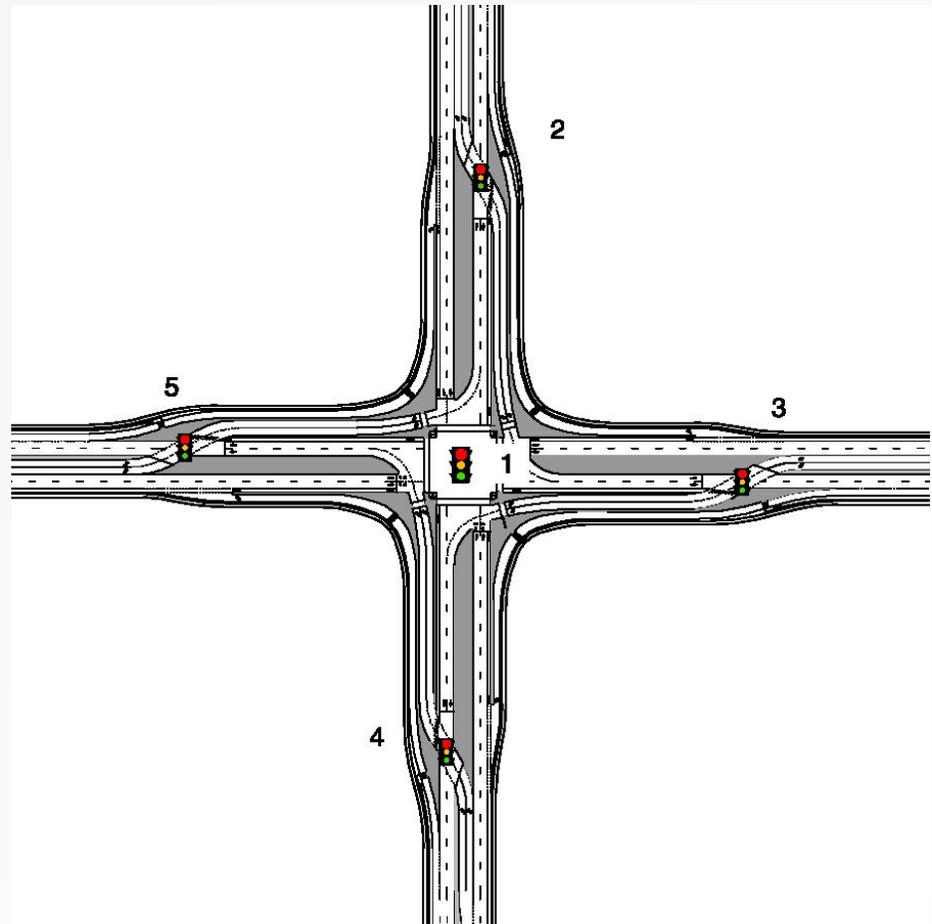
# Operational Principles

- DLTs usually implemented to maximize throughput
- Operational Benefit
  - allowing left turns to move concurrently with through traffic



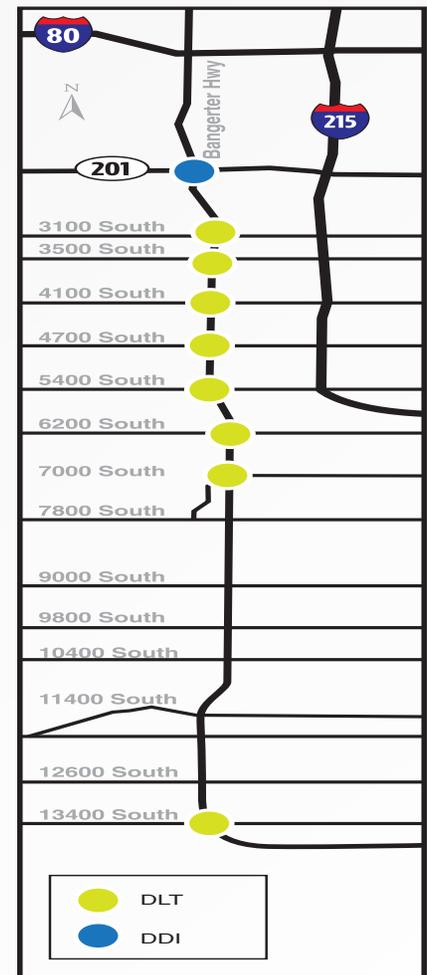
# Signal Phasing

- DLT can have up to 5 signalized intersections
  - 1 is the main intersection
  - 2 through 5 are the crossover intersections
- DLT intersections typically have shorter cycle lengths than similarly sized traditional intersections
  - Due to the reduced number of phases
  - and the need to reduce queue lengths between the closely-spaced intersections



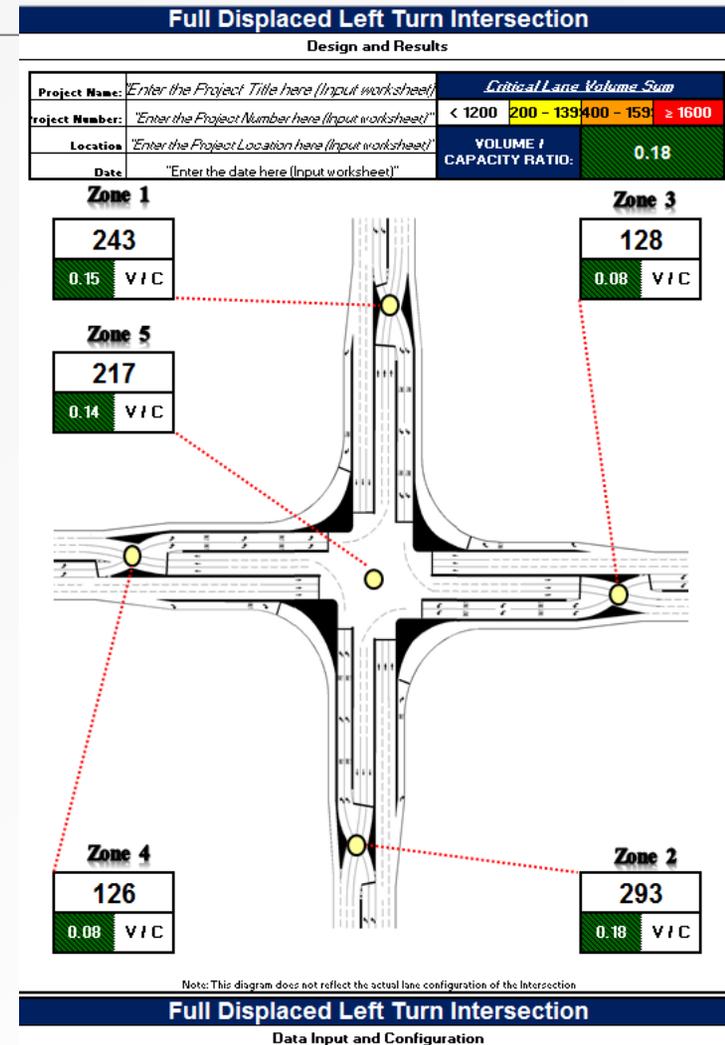
# System-wide Considerations

- Can be implemented as a corridor-wide treatment
- Fewer signal phases allow for longer green bands, improving signal coordination
- Bangerter Highway with 8 DLT intersections and one DDI

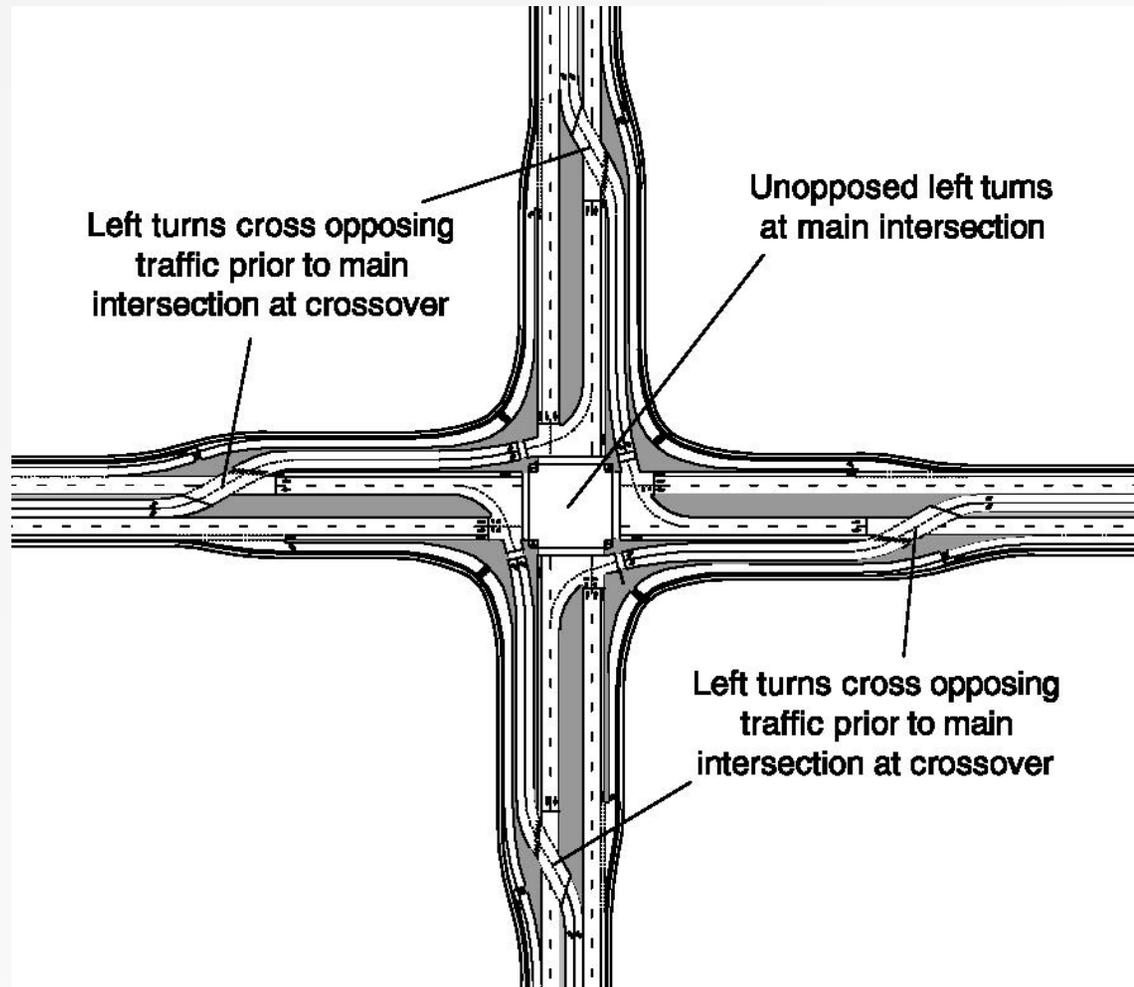


# Operational Analysis and Tools

- Planning-level Tools
  - Critical lane analysis
    - Cap-X
- HCM Analysis Methods
  - HCS, Synchro, Vistro
  - Limitations
    - Closely spaced intersections
    - Modeling unusual geometry; e.g., displaced left-turns
- Microsimulation

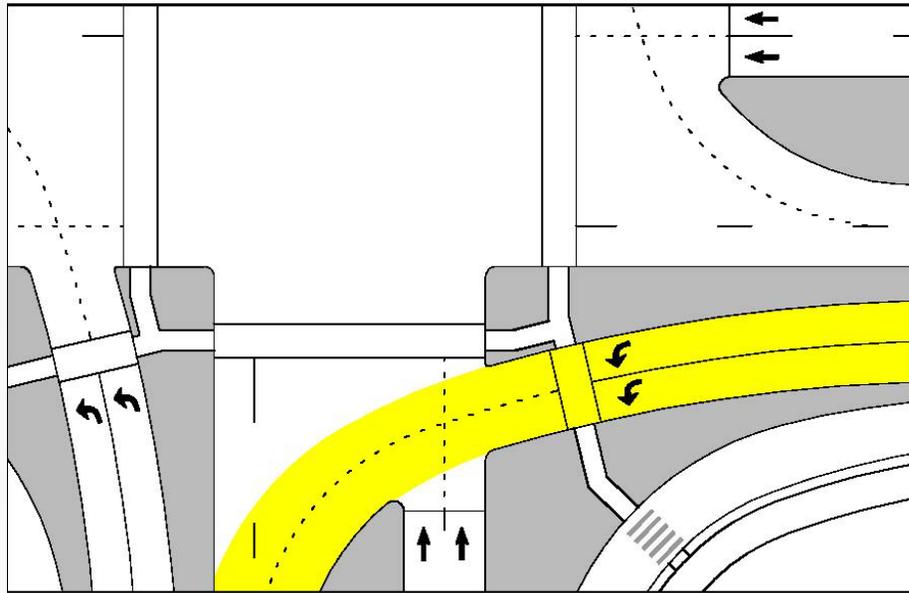


# Geometric Design



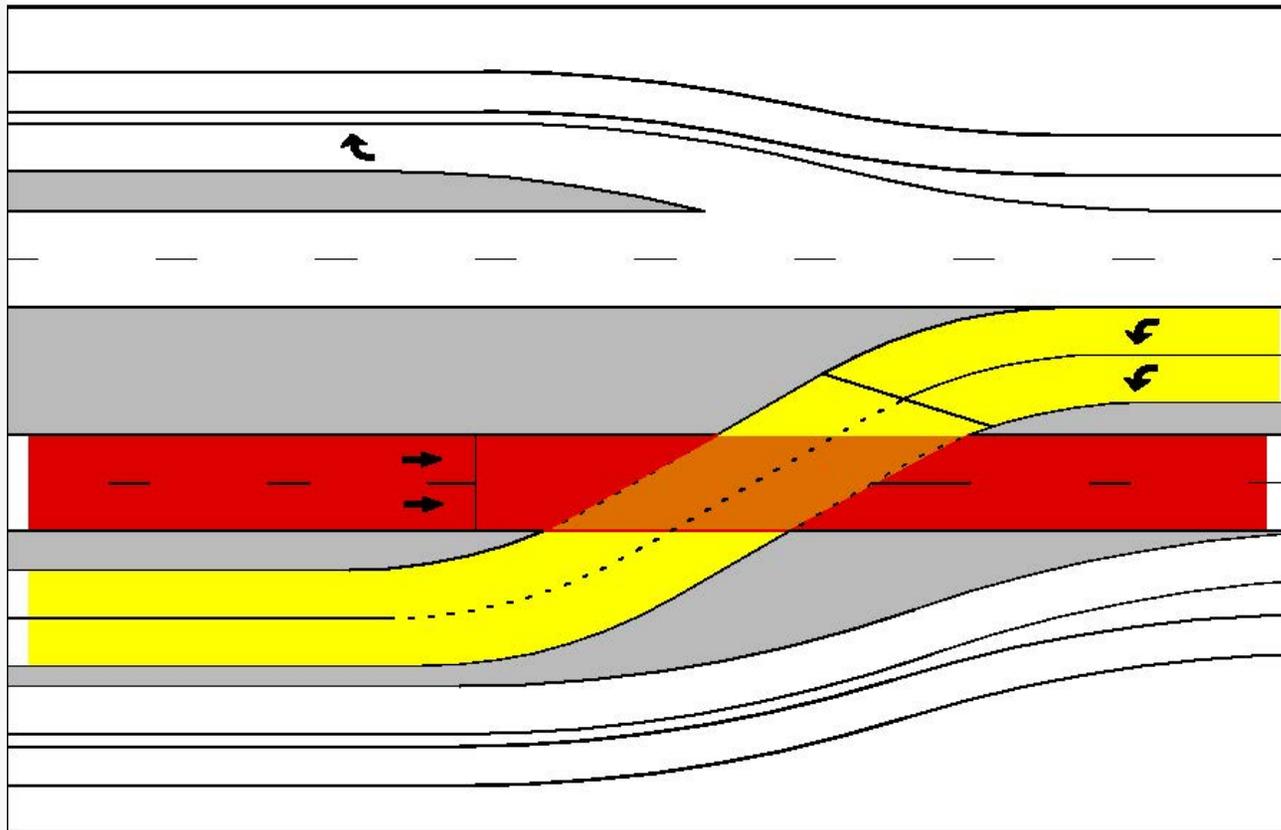
# Geometric Design Parameter and Principles

- Main Intersection
  - Unique displaced left-turns configuration
    - Accommodating pedestrians (refuge islands)
    - Appropriate turning paths



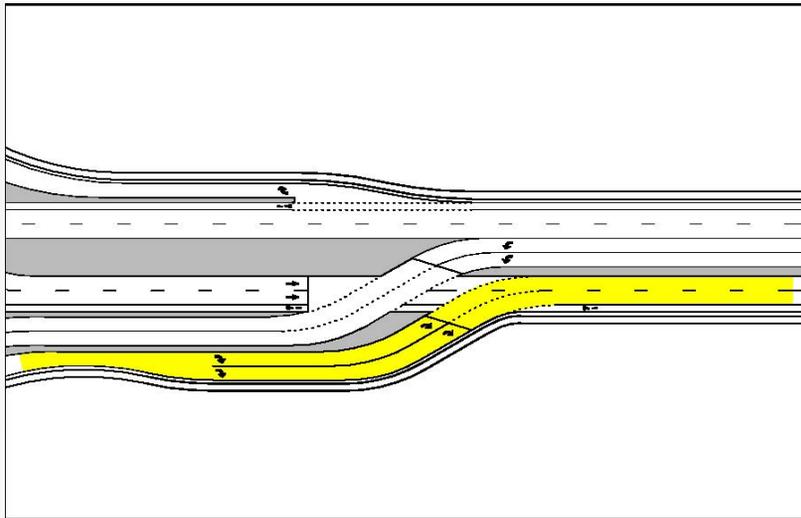
# Geometric Design Parameters and Principles

- Crossover Intersection Geometry

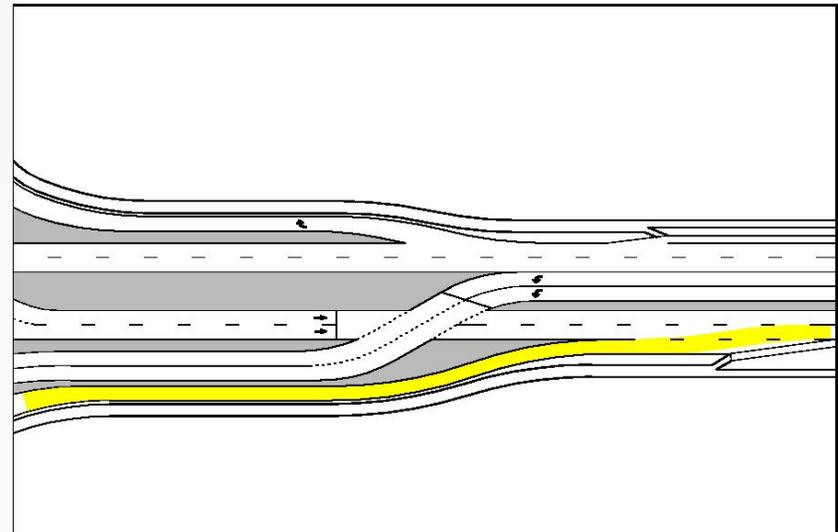


# Geometric Design Parameters and Principles

- Crossover Intersection
  - There are two ways to accommodate the geometry where the right-turn bypass lane joins the cross road through lanes:



**Signalized right-turn**



**Add lane with a downstream lane merge**

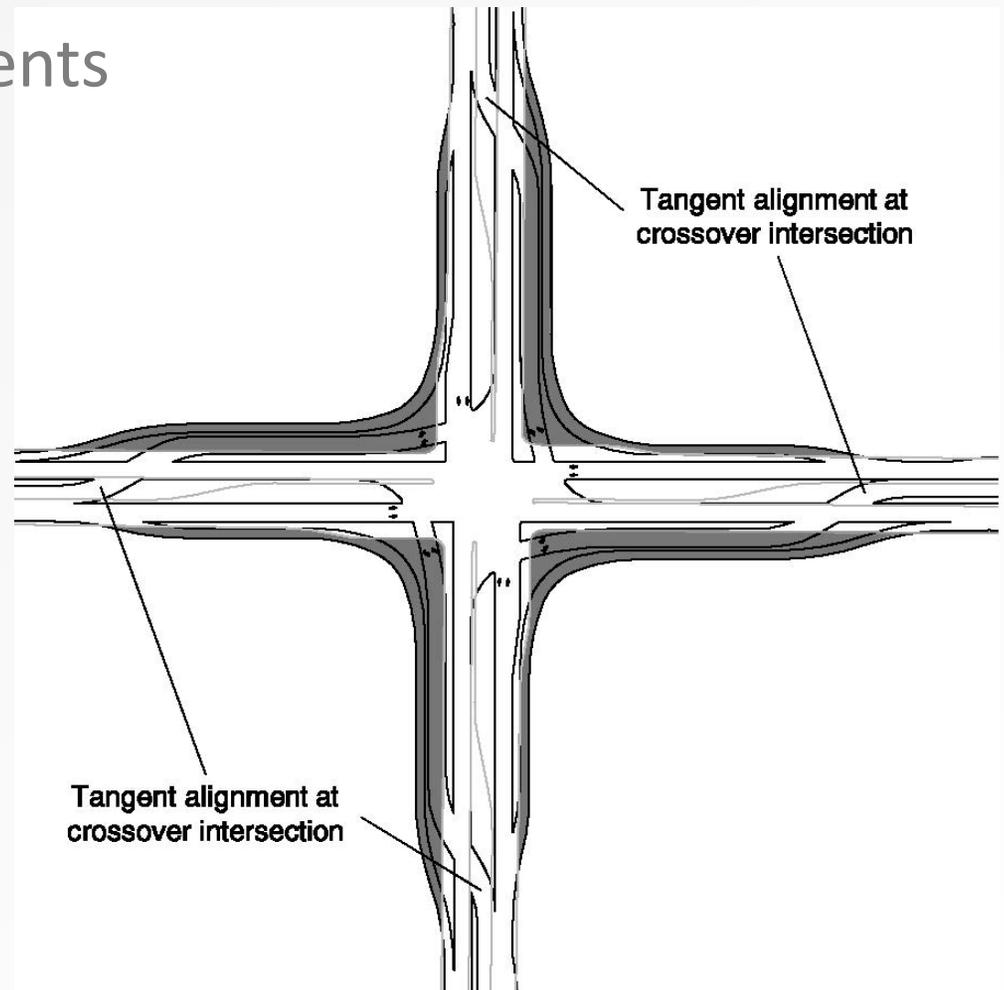
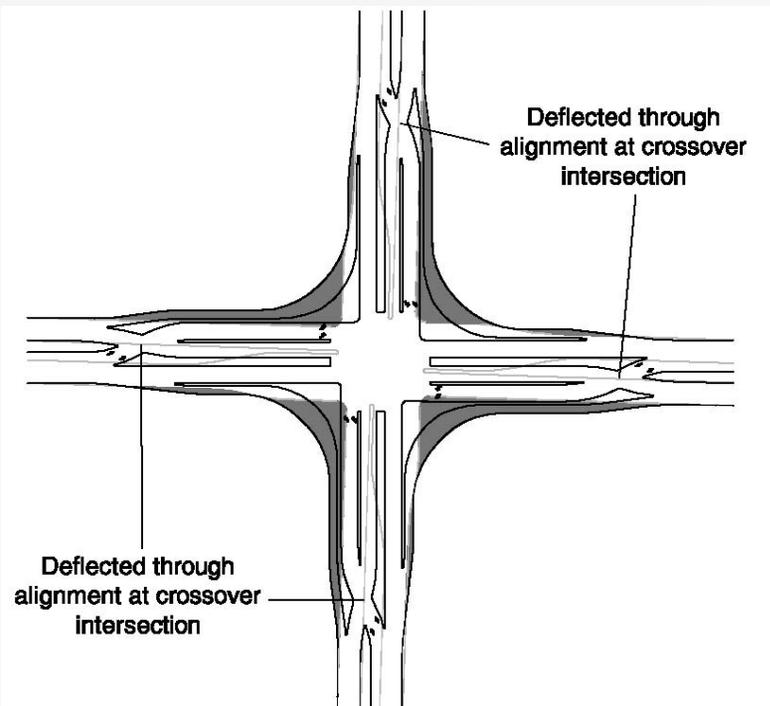
# Operational Effects of Geometric Design

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- Crossover Intersection
  - Traffic operations establishes initial clearance time for traffic signal
  - Entrance to left turn pockets is farther in advance than at conventional intersections
  - TRB paper presents deterministic model that minimizes DLT delay based on geometric spacing
  - NCHRP Synthesis 225: Left-Turn Treatments at Intersections—A Synthesis of Highway Practice describes several design features for DLT Intersections

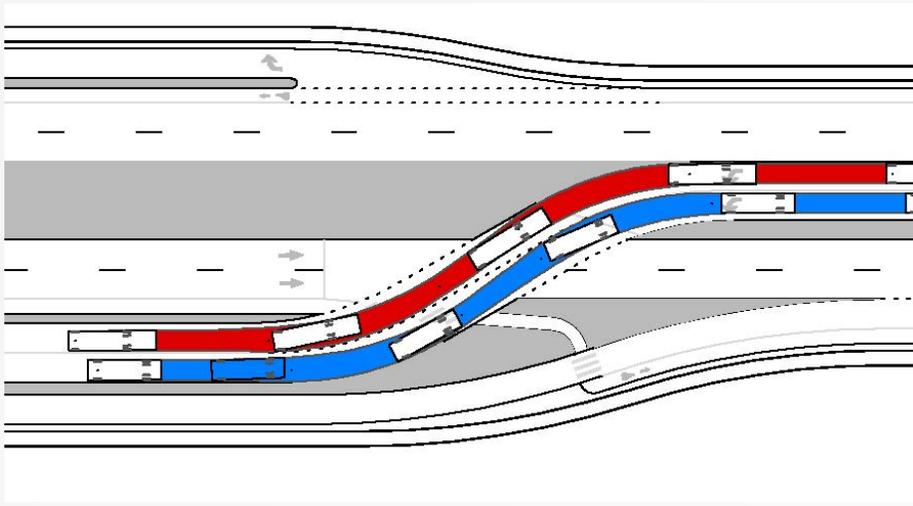
# Design Guidance

- Right-of-way Requirements
  - Tangent alignment vs. undesirable deflections

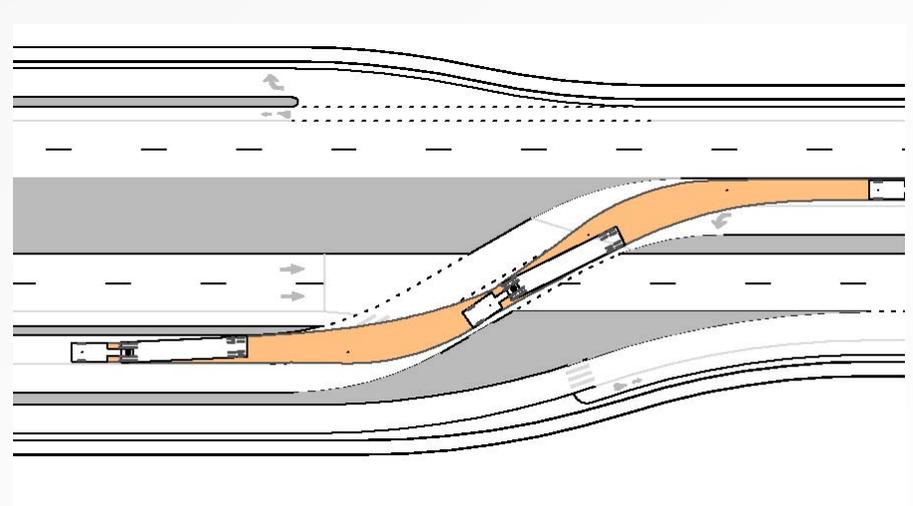


# Design Guidance

- S-curves through crossovers
  - Lane widths typically wider
  - Dual turns should accommodate the design vehicle



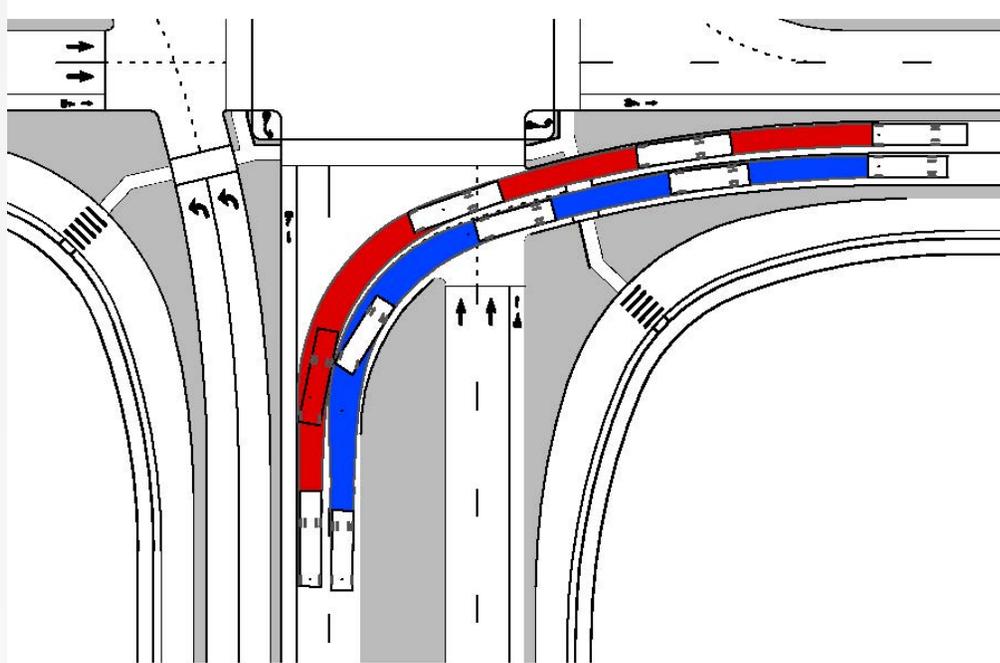
**Side-by-side crossover maneuver**



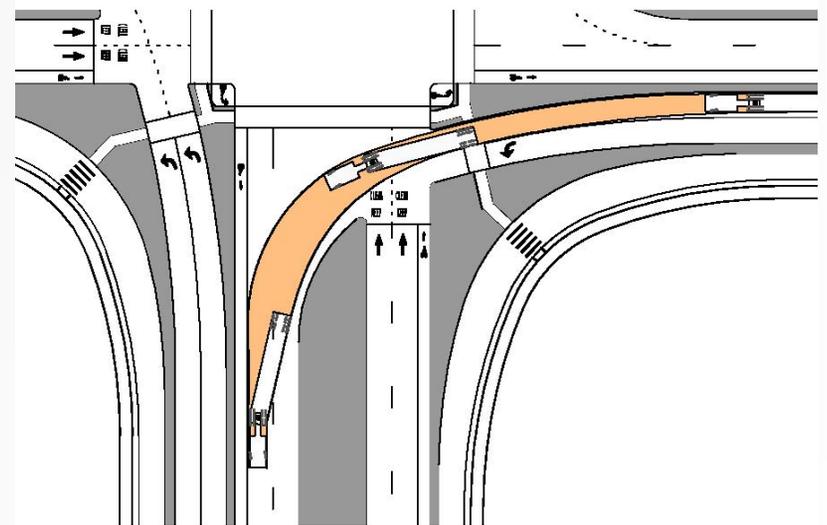
**Semi-truck maneuver at crossover**

# Design Guidance

- Dual left-turns at Main Intersection
  - Dual turns should accommodate the design vehicle



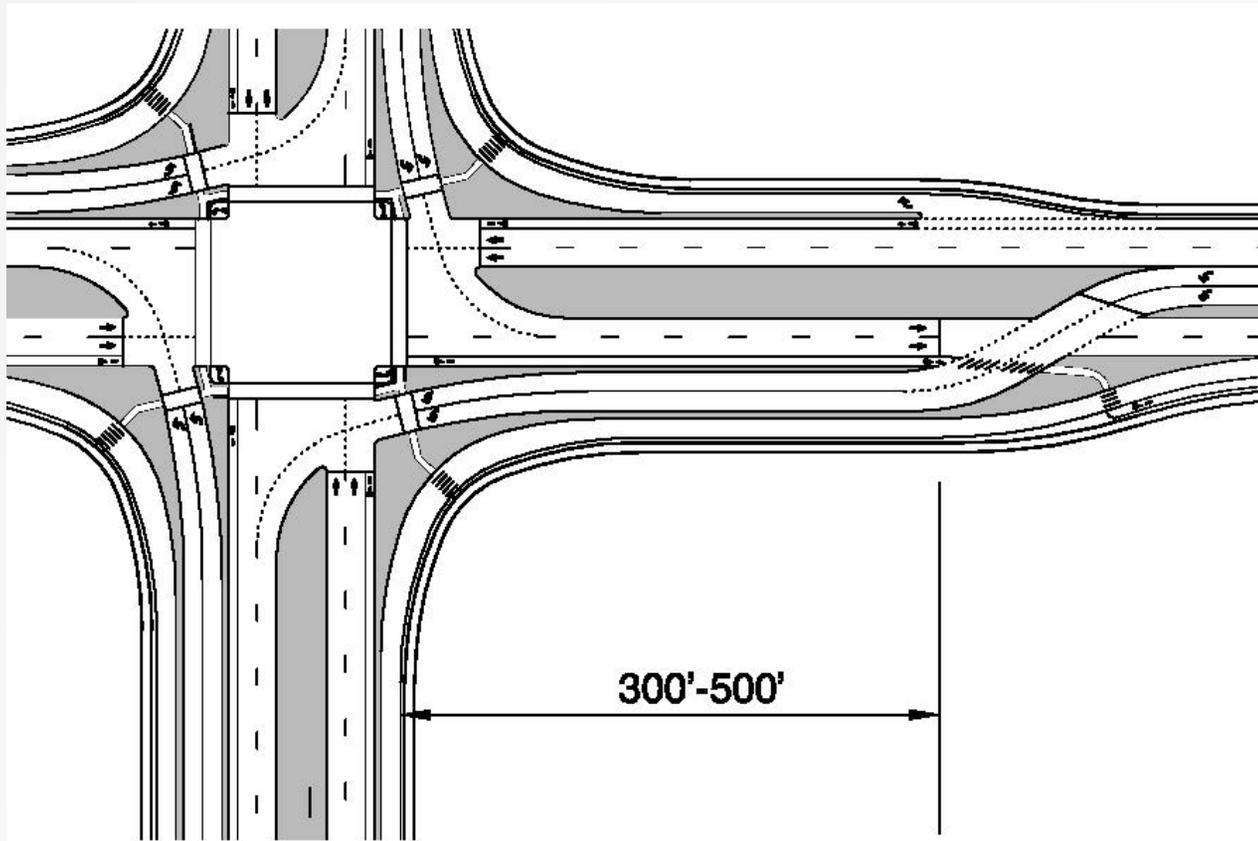
Side-by-side left-turn maneuver



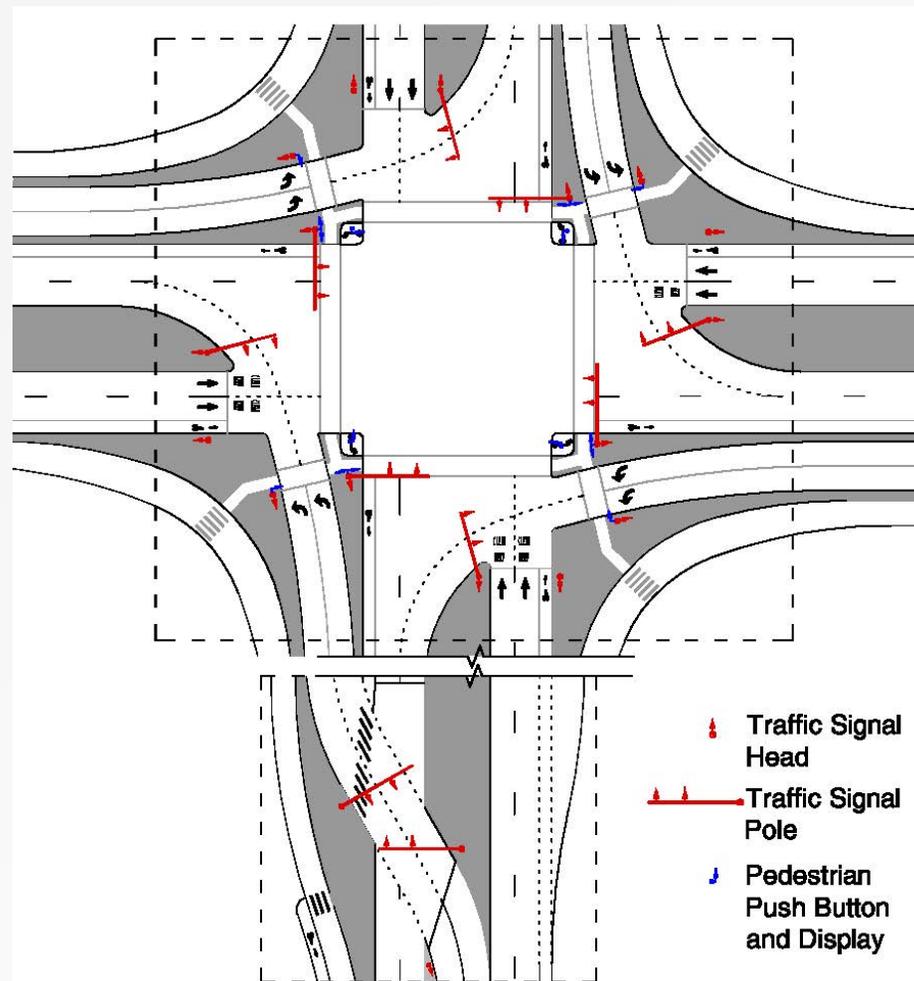
Semi-truck maneuver at crossover

# Design Guidance

- Intersection spacing



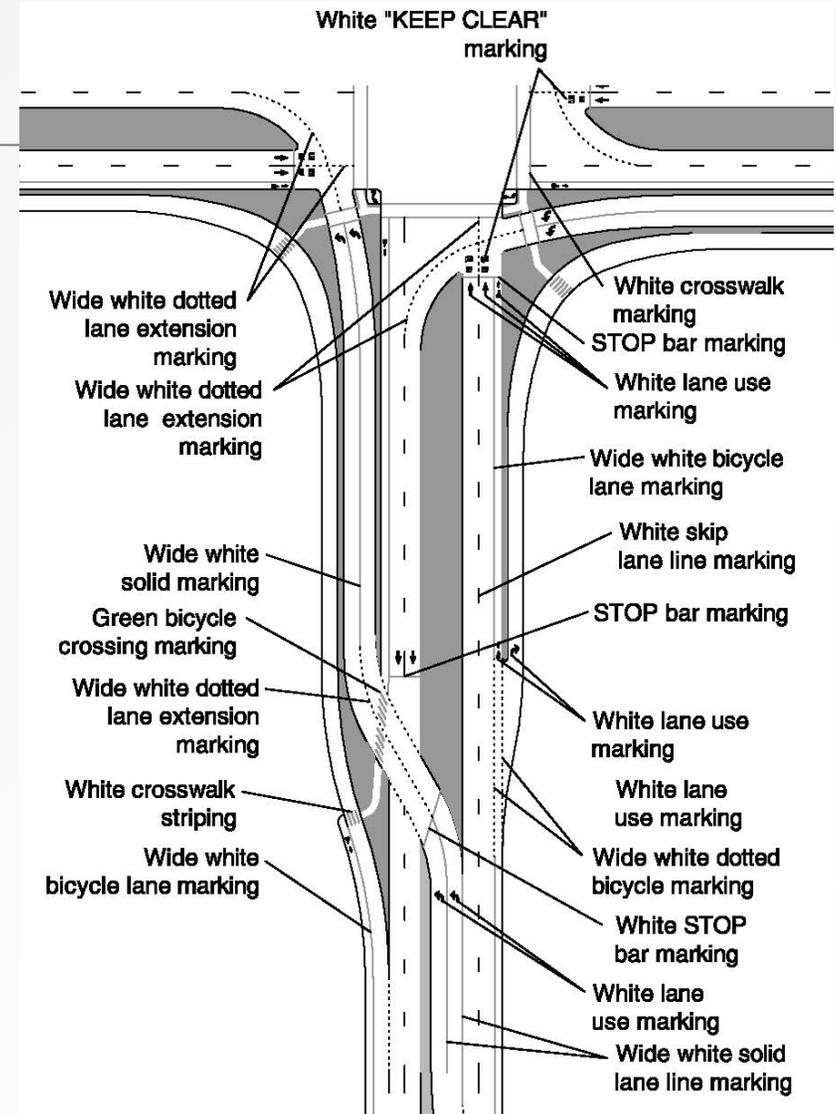
# Signals - Possible Signal Design Pole Layout





# Pavement Markings

- Prevent stop bar overrun
  - Placement of symbols
  - “STOP HERE ON RED” signs and/or nearside signals



# Lighting

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- Lighting standards and specifications
  - AASHTO's Roadway Lighting Design Guide
  - FHWA's Lighting Handbook
  - Illuminating Engineering Society of North America
    - [American National Standard Practice for Roadway Lighting](#)
- Lighting approach
  - Road functional and pedestrian conflict area classifications
  - Intersections lighting
    - [1.5 times roadway lighting or adding approaching roadways](#)

# Construction

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- Common options
  - Close entire intersection
  - Close one cross road at a time
  - Accommodate all movements during construction
- Operational analyses can help inform and guide decision making regarding staging sequence
- Coordination with stakeholders and explaining trade-offs between construction options

# Cost Estimates

- Review of previous projects



**Baton Rouge, LA**  
**\$4.4 million**  
**(bid price, incl. \$1.0 million for frontage roads)**



**West Valley City, UT**  
**\$7.5 million**  
**(total project cost)**



**Fenton, MO**  
**\$4.5 million**  
**(construction cost)**

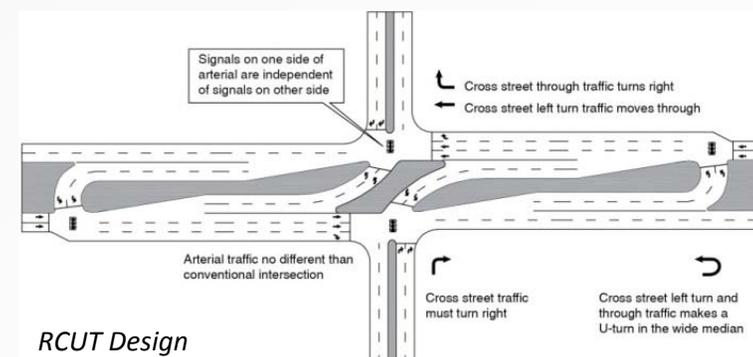
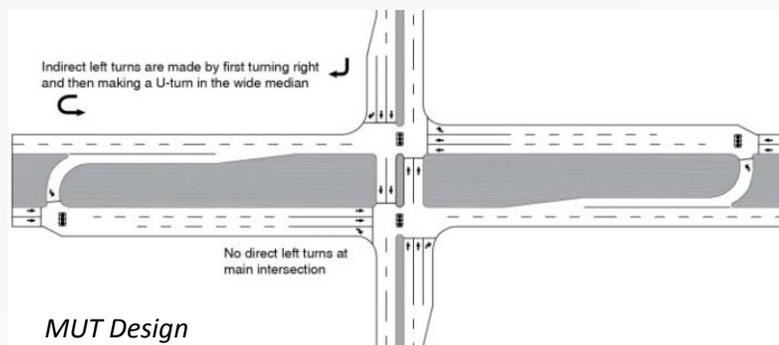
# Summary Advantages and Disadvantages

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- Advantages
  - Reduces number and severity of conflicts
  - Increases lane capacity by 30 to 70 percent
  - Reduced number of signal phases improves progression
  - Significant cost benefit over grade separation solution
- Disadvantages
  - Potential for wrong-way movements
  - Larger footprint than conventional intersection
  - Corner business access challenges
  - Longer pedestrian crossing distances and time
  - Additional sign and signal maintenance cost

# Presentation Outline

- Introduction
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- Overview of Displaced Left-Turn
- Overview of Median U-Turn/Restricted Crossing U-Turn
- Additional Resources



# Poll

---

- Are there Median U-Turn or Restricted Crossing U-Turn intersections in your state?



## Median U-Turn / Restricted Crossing U-Turn Intersections

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- Overview of Intersection Type
- Multimodal Considerations
- Safety Considerations
- Operations
- Geometric Design
- Signing, Striping and Lighting
- Construction

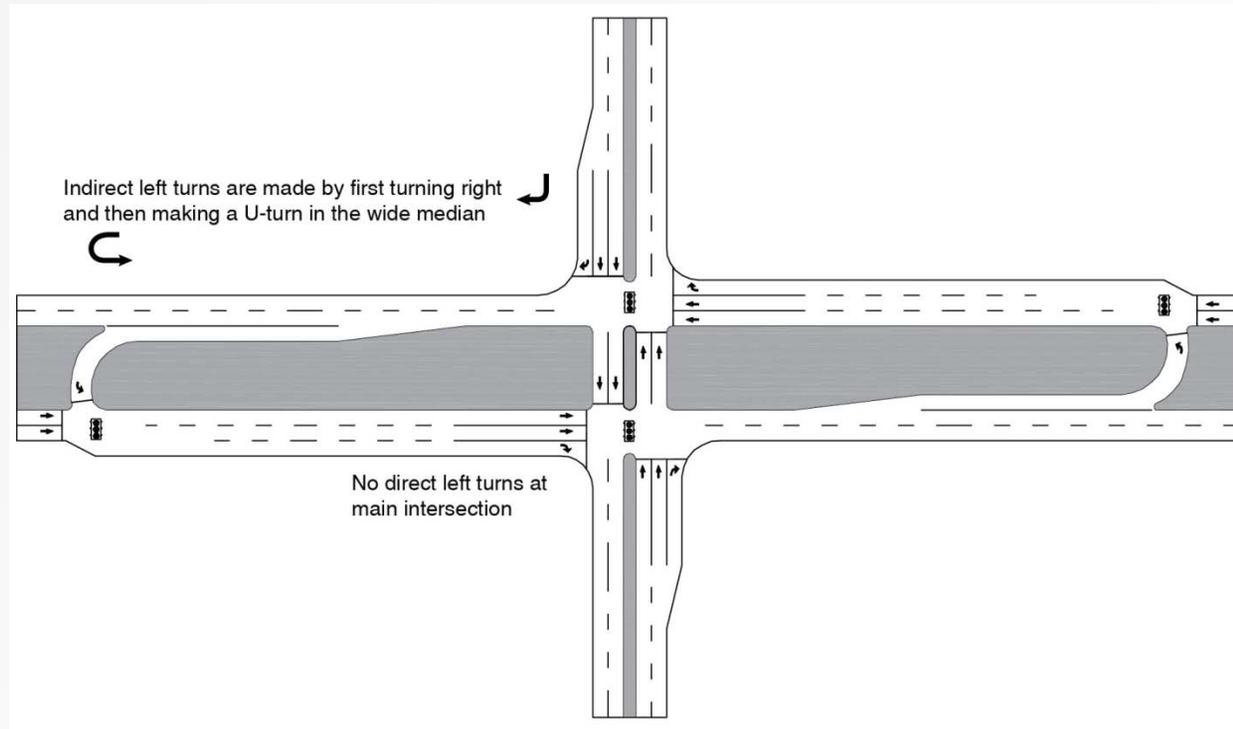
## Median U-Turn / Restricted Crossing U-Turn Intersections

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- Median U-Turn Intersection (MUT)
  - Replaces direct left turns at an intersection with indirect left turns using a U-turn movement in a wide median.
    - Eliminates left turns on both intersecting streets
- Restricted Crossing U-Turn Intersection (RCUT)
  - Replaces direct left turns and through movements at the cross street approaches with indirect left turns using a U-turn movement in a wide median.
    - Eliminates left-turns and through movements from cross streets
- Both types of intersections
  - Reduce the number of traffic signal phases and conflict points
  - May result in improved intersection operations and safety

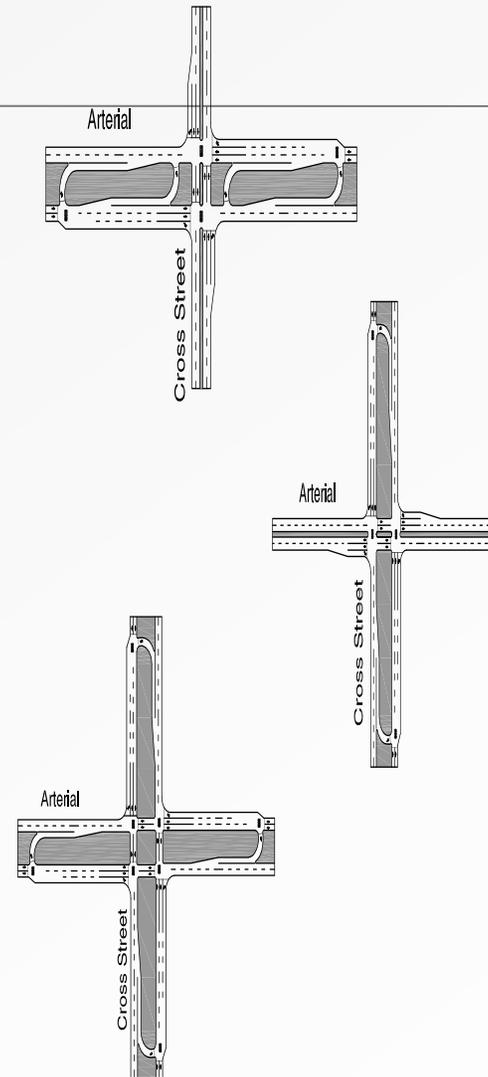
# Median U-Turn Intersection

- MUT with signals at the main intersection and two crossover locations
- MUT may also have signals at the main intersection but unsignalized crossovers



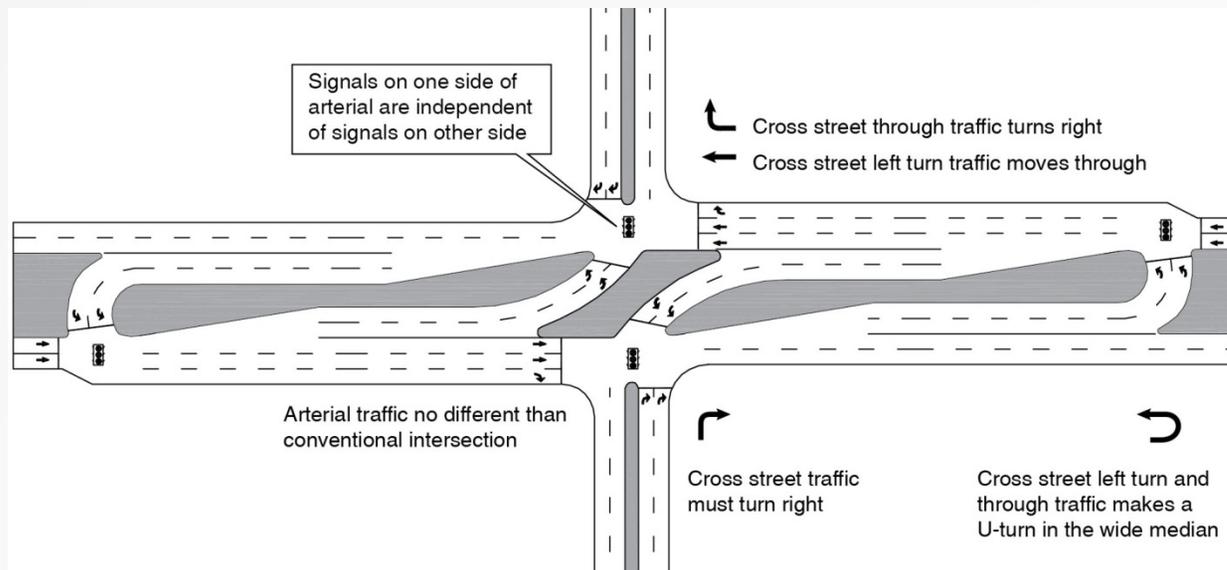
# Median U-Turn

- Design variations
  - Placing a stop-controlled directional crossover immediately prior to the primary intersection
  - Placing directional crossovers on the minor street to minimize major street median width and right-of-way requirements
  - Placing directional crossovers on both the major and minor street



# Restricted Crossing U-Turn Intersection

- Three types of RCUT intersections
  - Signalized (shown below)
  - Stop-controlled
  - Merge- or yield-controlled



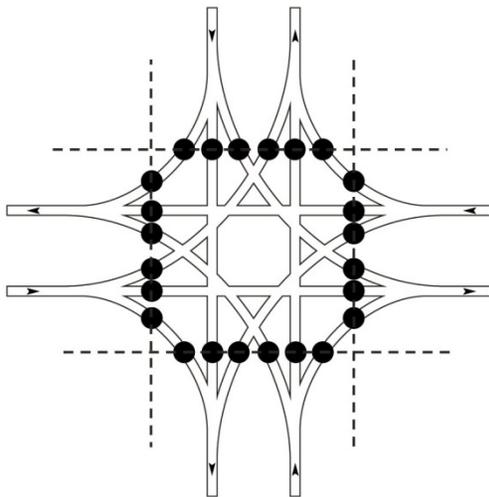
# Multimodal Design

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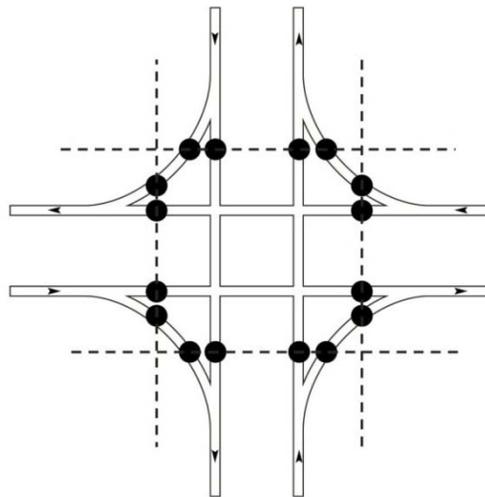
- Wide median on one or both roadway
  - Consider the challenge this may present to pedestrians and bicyclists
  - Provides unique transit opportunities
- Reduction in signal phases
  - Provides greater time for pedestrian and bike movements
  - Reduces delay for vehicle through movements
- Accommodations of Heavy Vehicles
  - Design U-turn crossovers for design vehicle
  - Consider weaving requirements
  - Consider location of bus stops

# Pedestrian-Vehicle Conflict Points

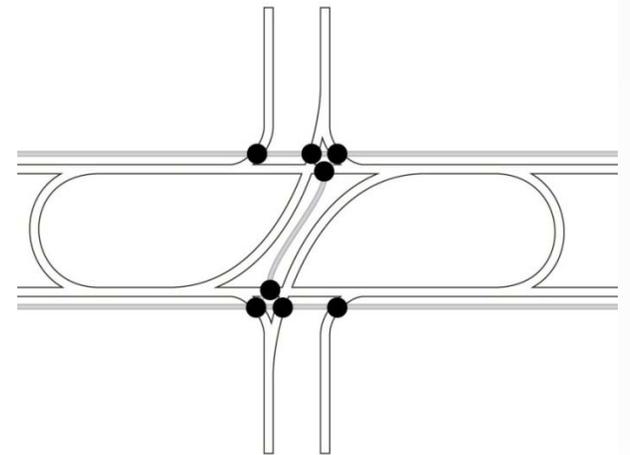
Conventional intersection:  
24 conflict points



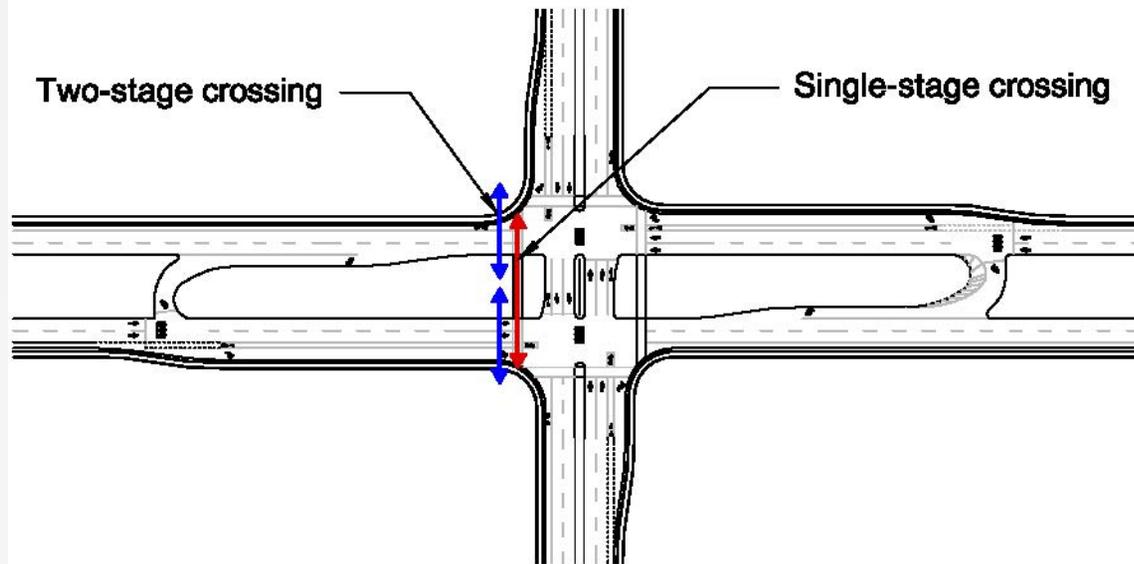
MUT intersection:  
16 conflict points



RCUT intersection:  
8 conflict points

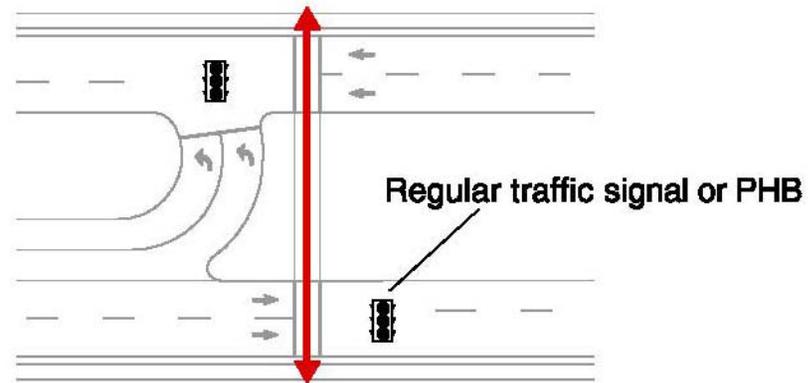


# MUT Pedestrian Movements

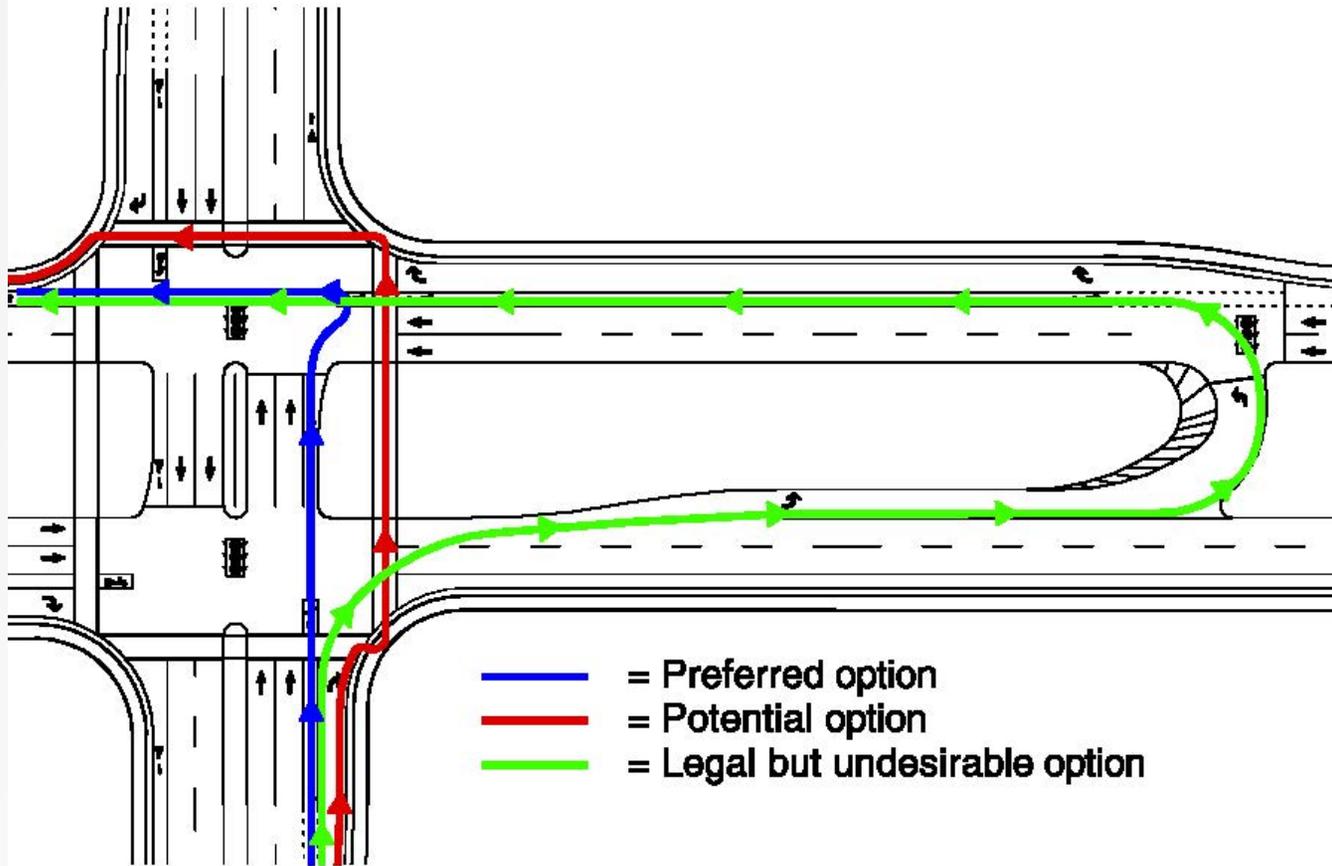


*Pedestrian Crossing Options*

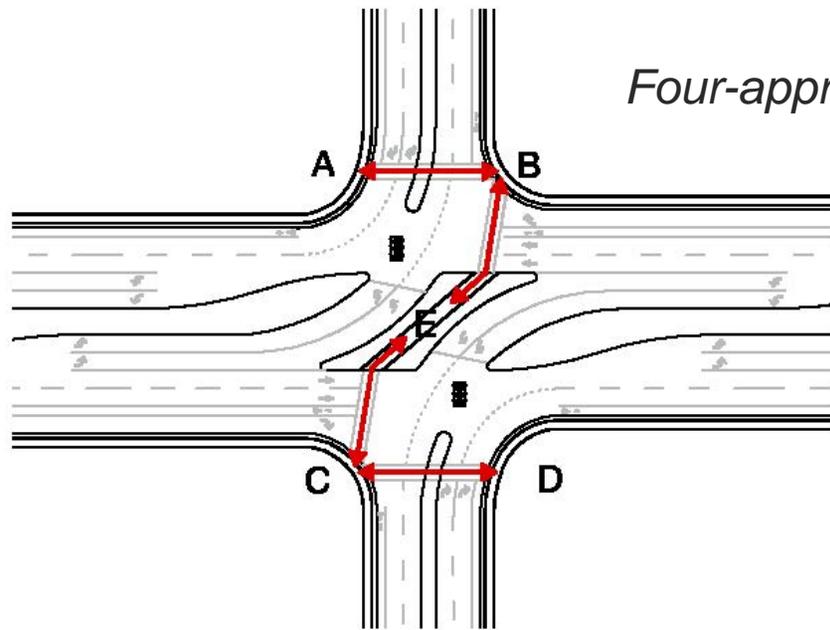
*Signalized mid-block crossing*



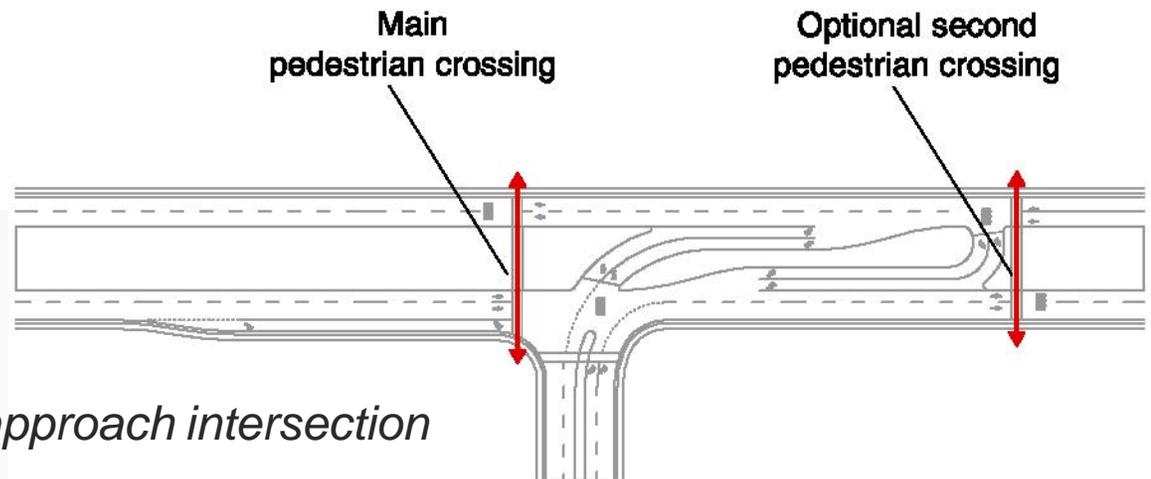
# MUT Bicycle Left Turn Options



# RCUT Pedestrian Movements

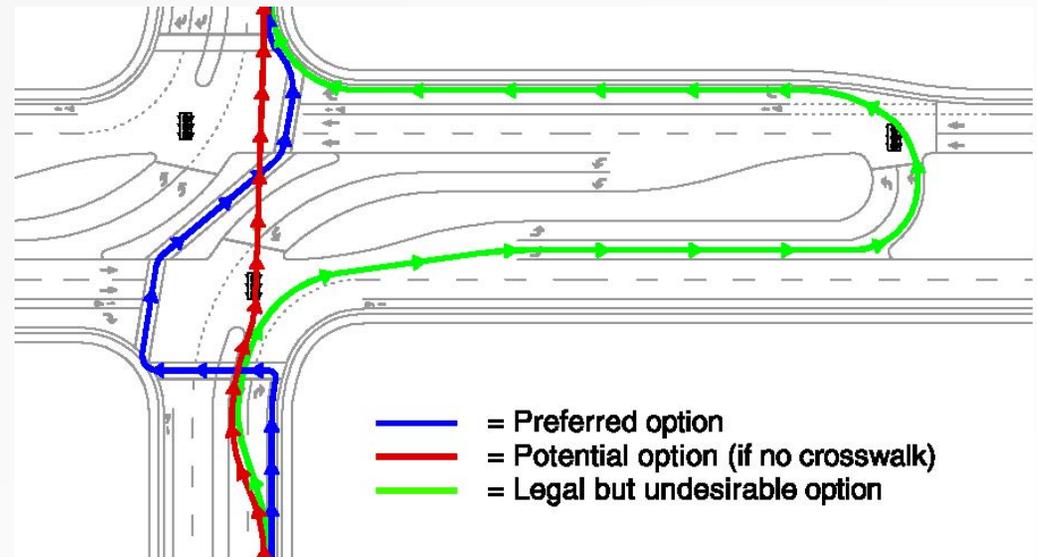


*Four-approach intersection*



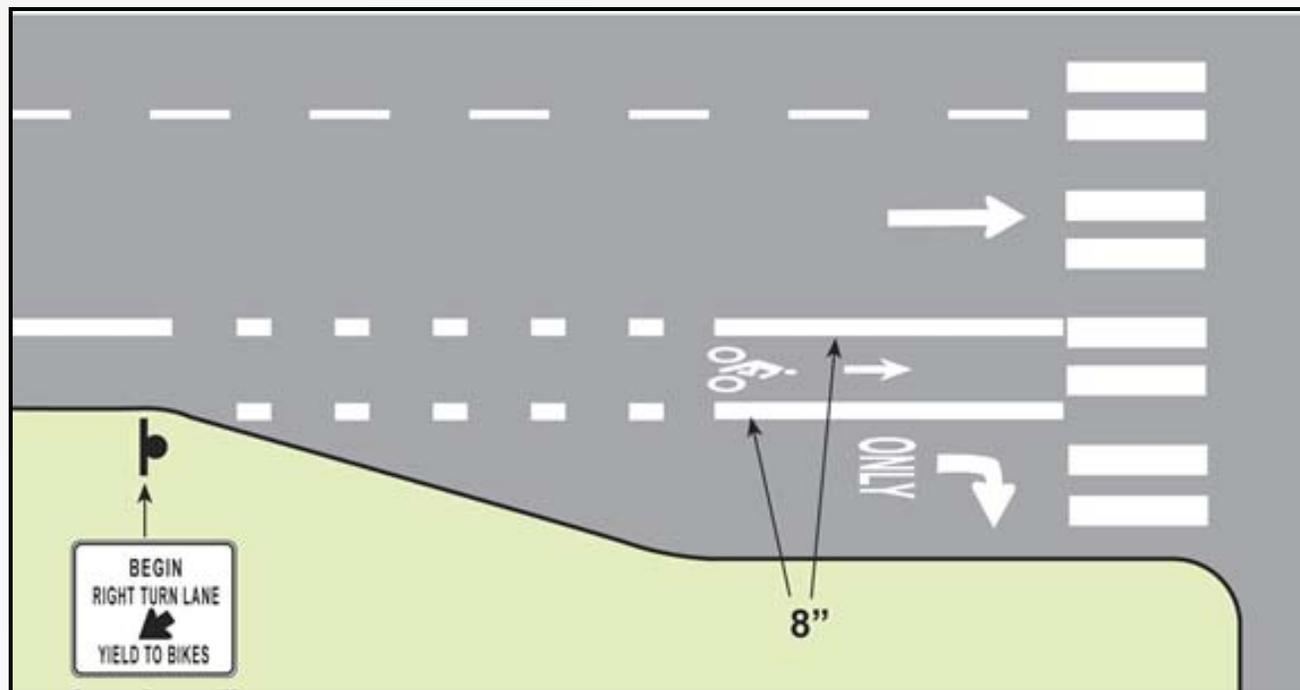
*Three-approach intersection*

# RCUT Minor Street Bicycle Through Options



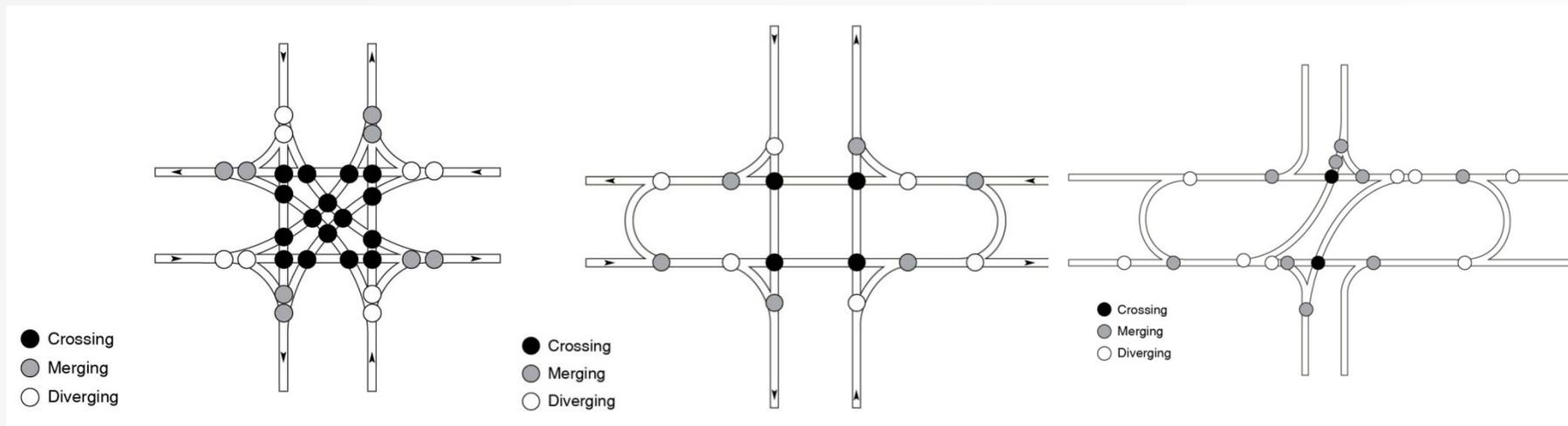
# Bicycles at MUT and RCUT Intersections

- Bicycles: On-street through movements



# Safety Principles: Conflict Points

- Reduces number of conflicts
- Type of conflicts are correlated with severity
  - Crossing more severe than merge/diverge
- Greater speed control and simplified driver decisions



Conventional intersection:  
32 conflict points

MUT intersection:  
16 conflict points

RCUT intersection:  
14 conflict points

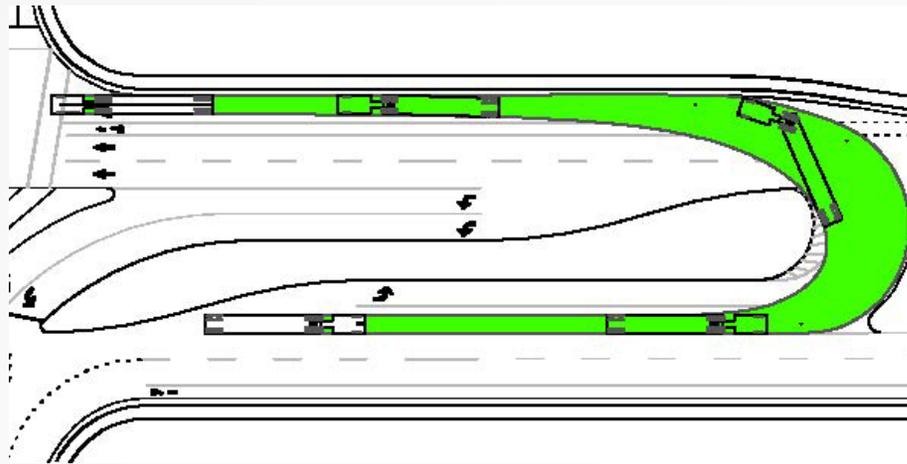
## Safety Concerns: Violating Left Turn Prohibitions

- There is no physical barrier to prohibit illegal left turns at MUTs
- Proper signing, marking, and geometric design are important factors in discouraging illegal left turn at the main intersection



# Safety Concerns

- Truck Navigation of Dual Lane Crossovers
  - Signage should direct large trucks to use outside U-turn lanes
  - Crossover design must anticipate heavy vehicle tracking through the crossover to eliminate path overlap with vehicles in the inner lane



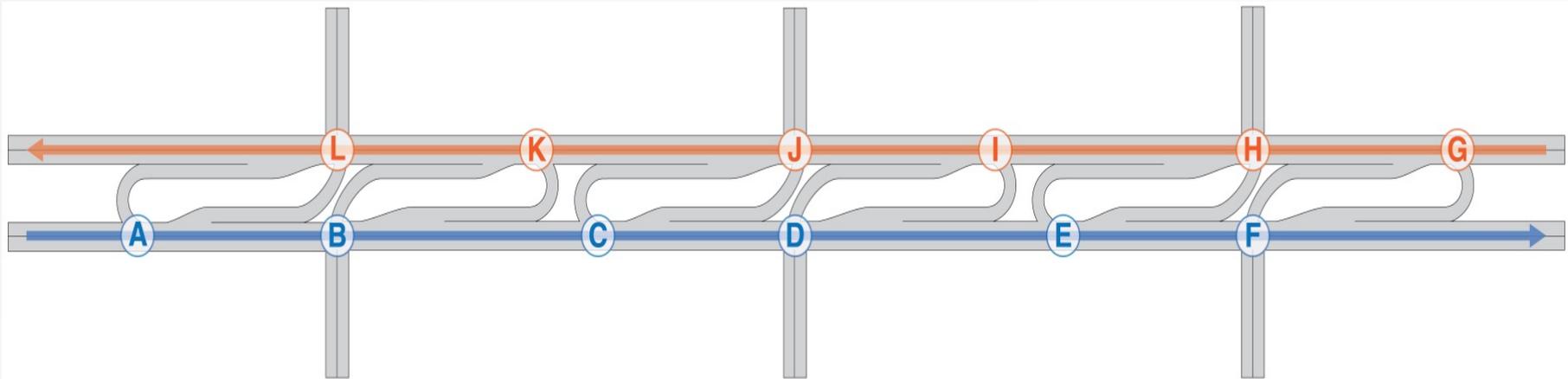
# Operational Considerations

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- Traffic operational benefits
  - Signal phases are reduced, thus shortening overall signal cycle lengths
- RCUT Intersections
  - Signals on one side can be independent of signals on the other side
  - Makes “perfect progression” possible
    - Both directions of main street can have progression band equal to smallest green time
    - At any speed—allowing speed control
    - With any signal spacing—providing flexibility in signal location
- MUT Intersections
  - Signals at main intersection only switch between 2 phases:
    - Main street through and right movements
    - Minor street through and right movements
  - Main and U-turn intersections coordinated to provide flow through both intersections
  - All left turns are made indirectly

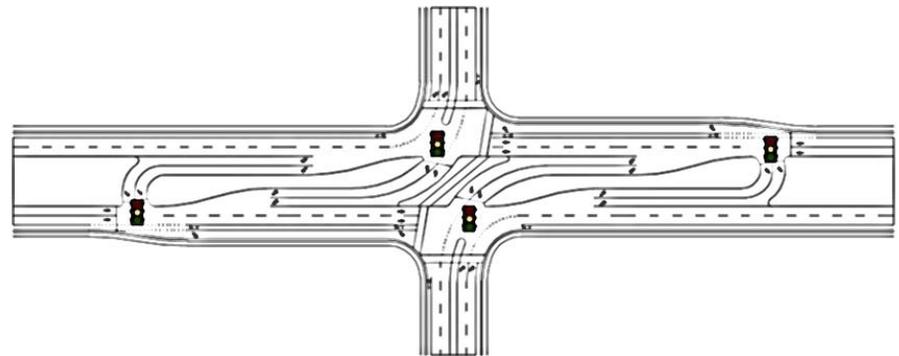
# RCUT Corridor Signal Coordination

- Each direction independent
- Equivalent to one-way couplet



# Operational Analysis

- Operational Analysis and Tools
  - Planning level analysis
  - Highway Capacity Manual (HCM) analysis
  - Microsimulation analysis
- Most important input data are the turning movement counts, which must be translated from conventional movements to the alternative movements of an RCUT or MUT intersection
- Factors in operations
  - U-turn Crossover Flow Rates
  - Signal Timings/Operations
  - Weaving
  - Queue Storage



# Geometric Design

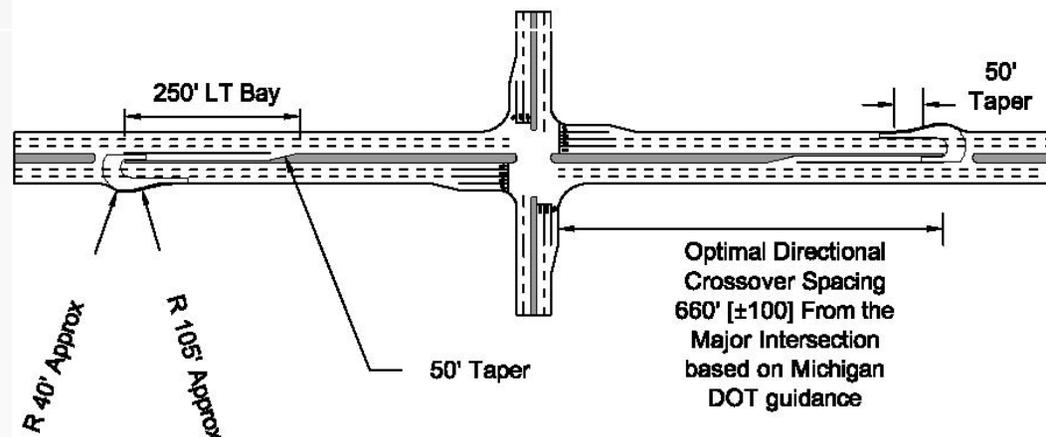
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- Design approach
  - Relationships/interaction between safety, operations, design
  - Understanding trade-offs of the physical, environmental and right-of-way constraints
  - Meet driver expectations
  - Numbers of lanes in crossovers
  - Distances from main intersection to crossovers
  - Median width or provision of loons
- Design Principles
  - Number of approaches
  - Number of through lanes
  - Intersection angle
  - Design vehicle - critical for U-turn crossover
  - Design speed - typical 15 mph for U-turn crossover
  - Sight distance - critical for U-turn crossover

# Design Guidance: U-turn Intersection Spacing

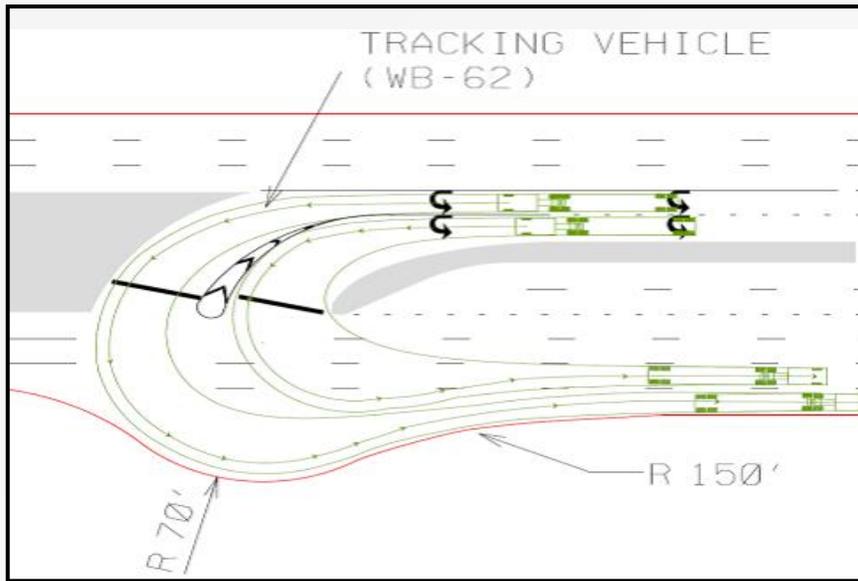
- Trade-off between queue storage and left turn travel distance
  - Short distance risks spillbacks into through lanes
  - Long distance risks motorist acceptance of design

| MUT   | RCUT   |
|---|--|
| <ul style="list-style-type: none"> <li>• Michigan DOT: optimal distance of 660 feet <math>\pm</math> 100 feet</li> <li>• AASHTO Green Book recommends range of 400 to 600 feet</li> </ul> | <ul style="list-style-type: none"> <li>• 400 to 800 feet for signal- or stop-controlled RCUT</li> <li>• Up to 2600 feet for merge-controlled RCUT</li> </ul> |

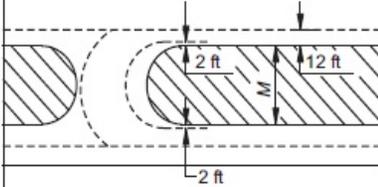
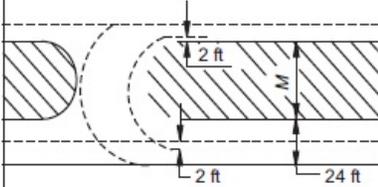
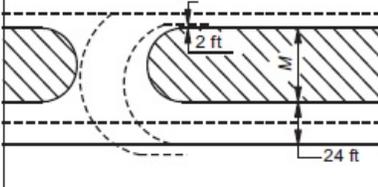


# Design Guidance—U-Turn Crossovers

- Loons can minimize median width
- Other treatments can also help u-turning vehicles, such as mountable curbs, strengthened shoulders, right turn lanes and bus stops.



# Design Guidance—Median Width

| Type of Maneuver         |   | U.S. Customary                                   |       |       |     |       |       |       |
|--------------------------|---|--|-------|-------|-----|-------|-------|-------|
|                          |   | M—Minimum Width of Median (m) for Design Vehicle |       |       |     |       |       |       |
|                          |   | P  | WB-40 | SU-30 | BUS | SU-40 | WB-62 | WB-67 |
|                          |   | Length of Design Vehicle (ft)                    |       |       |     |       |       |       |
|                          |   | 19   | 50    | 30    | 40  | 40    | 63    | 68    |
| Inner Lane to Inner Lane |    | 30   | 61    | 63    | 63  | 76    | 69    | 69    |
|                          |   | 18   | 49    | 51    | 51  | 64    | 57    | 57    |
| Inner Lane to Shoulder   |  | 8  | 39    | 41    | 41  | 54    | 47    | 47    |

- Median width is major factor in right-of-way width
- Designing turn bays back-to-back can reduce width

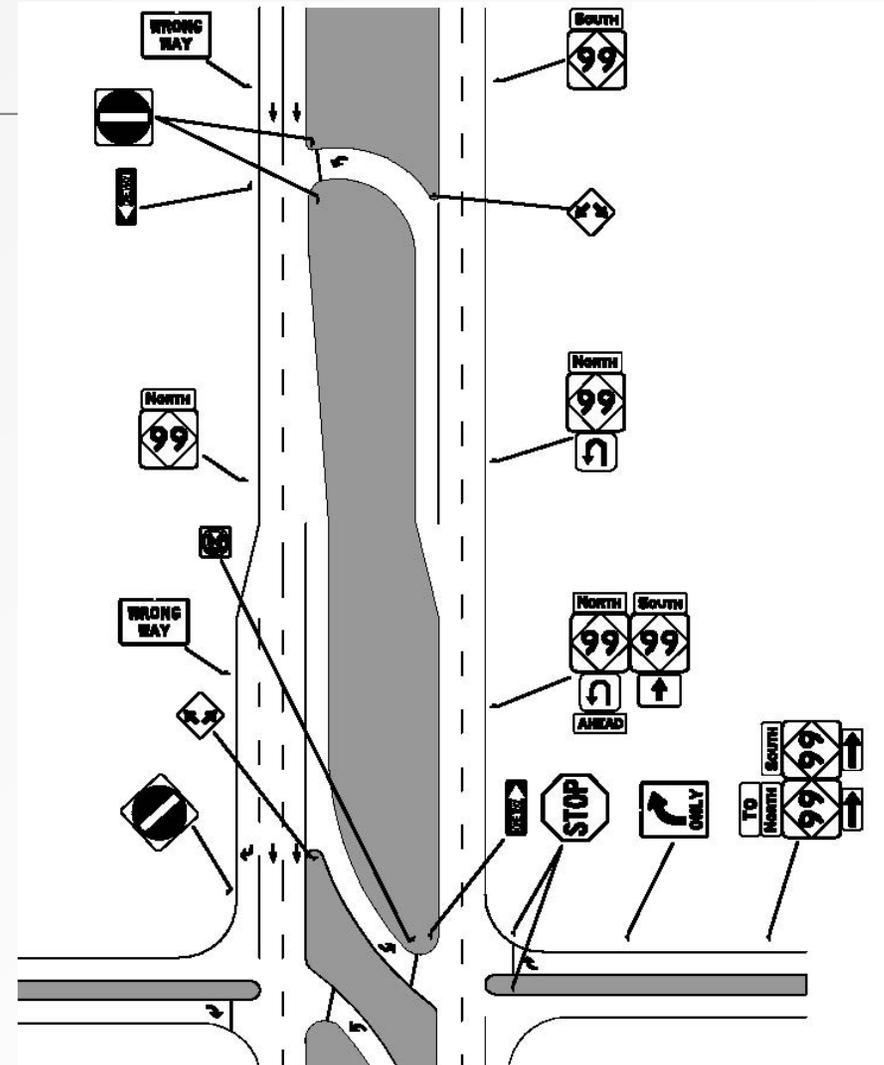
# Signals

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- Placement of signal poles and heads follow the same guidance as conventional intersection (provided in MUTCD)
  - Exception: no direct left-turn lanes are provided
  - Mast arms typically located opposite the U-turn crossover on the outside of the opposing major roadway lanes
  - Two signal heads must be used for thru traffic in U-turn crossover

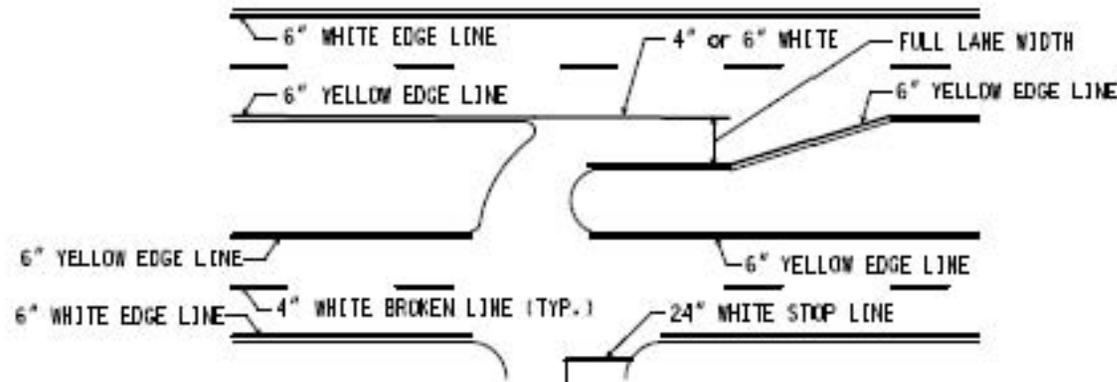
# Signing

- Special considerations:
  - Provide guide signing for the minor street left turn and through movements
  - Include devices to guide motorists to the optimum lane in a multilane minor street approach or in a multilane crossover
  - Provide signing for RTOR or LTOR prohibitions



# Pavement Markings

- Pavement markings at RCUT and MUT intersection generally follow same principles as conventional intersections
- MUTCD does not provide pavement markings guidance for U-turn crossovers
  - MDOT has developed pavement marking standards for U-turn crossovers in Michigan



Source: Michigan Department of Transportation *Geometric Design Guide 670*

# Lighting

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- Lighting standards and specifications
  - AASHTO's Roadway Lighting Design Guide
  - FHWA's Lighting Handbook
  - Illuminating Engineering Society of North America
    - American National Standard Practice for Roadway Lighting
- Lighting approach
  - Road functional and pedestrian conflict area classifications
  - Intersections lighting

# Construction

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- MUTCD principles and applications apply in constructing a RCUT or MUT intersection
- May require additional lanes to be added:
  - In center of major road for exclusive U-turn movements
  - To the right of the U-turn movements for thru movements
  - On the far right for right turning movements
- Widen symmetrically on both sides or perform all widening exclusively on one side, depending upon:
  - Geometric design
  - Project cost
  - Maintenance of traffic
  - Overall impact to adjacent land owners and the community if additional right-of-way must be purchased

# Cost Estimates for Recent MUT Projects



Legacy Drive at Preston  
Parkway, Plano TX  
Opened: July 27, 2010  
Cost: \$1.7M



Minuteman at 12300  
South, Draper, UT  
Opened: Nov 2011  
Cost: \$5.1M



Haggerty Connector, Novi  
MI (2-mile, 8-lane  
boulevard on new  
alignment including two  
MUT intersections)  
Opened: Nov 1, 2002  
Cost: \$21M

# Summary Advantages and Disadvantages

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- Advantages

- Reduces number and severity of conflicts
- Reduced signal phases and shorter cycle length
  - results in decreased intersection delay, congestion, and queuing
- Increases intersection capacity
- Allows for installation of additional midblock crossing pedestrian signals
- Significant cost benefit over grade separation solution

- Disadvantages

- Without special facilities, crossing bicyclists may have challenges
- Increases travel time and distance for movements that are redirected
- May require additional right-of-way for loons or wider medians
- Higher construction cost than conventional intersection due to additional pavement, signs, and signals

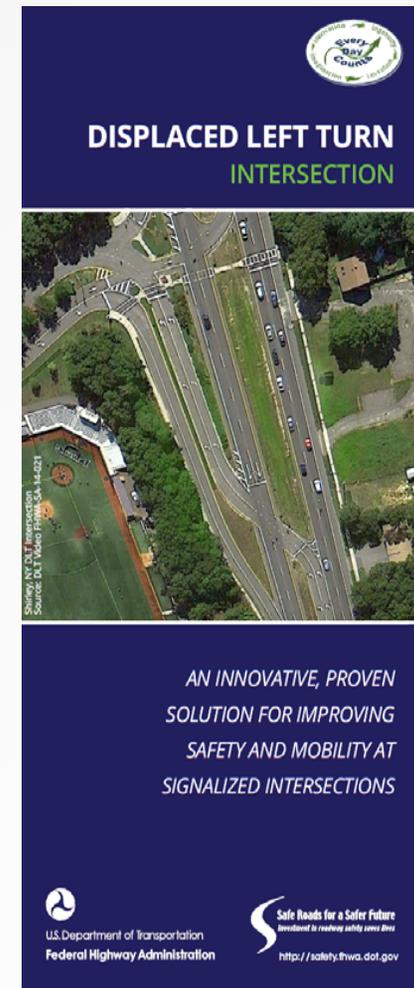
# Presentation Outline

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- Introduction
- Project Background, Objectives, and Team
- Overview of Alternative Intersections
- Overview of Displaced Left-Turn
- Overview of Median U-Turn and Restricted Crossing U-Turn
- **Additional Resources**

## Additional Information on Alternative Intersections

- FHWA created informational videos
  - FHWA YouTube channel  
<https://www.youtube.com/user/USDOTFHWA>
- FHWA has developed alternative intersection brochures
  - FHWA website  
<http://safety.fhwa.dot.gov>



## Questions

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Jeff Shaw, PE, PTOE, PTP

FHWA Office of Safety

Intersections Program Manager

jeffrey.shaw@dot.gov

(708) 283-3524

<http://safety.fhwa.dot.gov/>