# Innovative Intersections and Interchanges

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#### **Presentation Outline**

- Overview of Innovative Intersections
  - FHWA Every Day Counts Program
- Freight Accommodation at Roundabouts
- Introduction to Other Emerging Innovative Intersections
- Emerging Trends
- Questions



Content of this webinar was developed by Members & Friends of the TRB Intersections Joint Subcommittee



U.S. Department

of Transportation

Federal Highway Administration

## **Overview of Innovative Intersections**

## Mainstreaming Innovative Intersections Diverging Diamond Interchange (DDI)

Roundabouts

Source: FHWA

Media

urns







# Why Innovative Intersections?

# Intersections represent about $\frac{1}{4}$ of all traffic fatalities...

# ...and HALF of all severe crashes

Intersections are a major safety issue and may become bottlenecks along high volume roadways

Source: Mark Doctor, FHWA



## **Intersection Safety Facts**

- » Angle crashes account for over 40% of fatal crashes at intersections
- » Left turn crashes account for over 20% of fatal crashes at intersections



» Ped/Bike crashes account for 25% of fatal crashes at signalized intersections





## **Innovative Intersections Benefits**

### SAFETY

- Fewer and less severe conflict points
- Speed management benefits
- Significant crash reductions

## MOBILITY

- Synchronized movements
- Reduced delay and congestion
- Pedestrian and bicycle opportunities



## VALUE

- Less right-ofway impact
- Decreased capital and lifecycle costs
- Quicker construction
- Higher B/C



# Outreach & Education <u>http://www.youtube.com/USDOTFHWA</u>



#### FHWA Every Day Counts II Project Update

- KLS ENGINEERS & SPECIALIZED FREIGHT SOLUTIONS conducted outreach to standard and specialized carriers, pilot cars, and emergency responders.
- Technical oversight provided by ATA, SC&RA, OOIDA, State DOT Permit Officials and FHWA
- Goal is to avoid the negative feedback from the trucking industry as a lessons learned with the introduction and implementation of roundabouts
- Project scope covered each of the innovative intersection topic areas covered on the previous slides.
- Outreach: many states already have existing innovative intersections
  - Examples: MO, MN, NC, UT, VA and WI
- Feedback from EDC II outreach is being integrated into national design guidance to be used by state and local road agencies and their contract designers



#### **Example Sites (December 2016)**

### Median U-Turn Alternative Intersections and Interchange Signalized RCUT US Inventory (December 2016) Unsignalized RCUT $\diamond$ $^{\circ}$ 0 6 0 0 Google earth Data SID, NOAA, U.S. Navy, NGA, G 🖽 CO Image Landsat © 2016 Google © 2016 INEBI

Legend

**Diverging Diamond** 

Displaced Left Turn



#### **Freight Accommodation Fundamentals**

- Innovative intersections require similar considerations to conventional intersections
- Requirements vary by state, but principles are consistent.
  - Design Vehicle(s)
  - Check Vehicle(s)
  - Collaboratively determine the design and check vehicles with local agency, including how each vehicle is to be accommodated.
    - Identify the representative cross-section of vehicles that will use the intersection regularly.
    - Use software to check vehicle paths and refine geometry.



#### **Intersection Examples: Truck Aprons**



Google Earth image



#### **Supporting Freight Accommodation**

- Designate freight corridors to support planning for large vehicles and preserving OSOW routes.
- Establish standardized check vehicle packages for designated OSOW routes that are representative of the normal range of OSOW vehicle types for the state/region.
- Provide mechanism for designers to have access to historical permit data
  - Potential pit-fall: Is historical information representative of future uses?



#### Florence, KS

Source: Kansas DOT

#### ROUNDABOUTS







#### **Roundabout Inventory – Through 2014**

- Roundabouts currently operate in every state in the U.S.
- Over 25 years of US experience



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#### **Roundabout Design – Emphasis on Principles**

- Design checks performed to verify:
  - Slow and consistent fastest path speeds
  - Accommodation of design vehicles
  - Appropriate sight distance and visibility
  - Appropriate vehicle alignment and channelization
  - Appropriate features for pedestrian and bicycle users
- NCHRP Report 672 serves as FDOT's roundabout design guide





Source: NCHRP Report 672

#### **Oregon Example "Roundabout Rodeo"**

- Full-scale test in two locations
- Tested 18 truck/trailer combinations
  - Up to 130' in length
- All test vehicles made it through the roundabout



Source: Kittelson & Associates, Inc.



ODOT images: Total Length 113', Booster Trailer Length 90', Axle Width – 13.5'; & Tractor with 75' trailer and manufactured home load, Total Length=101', Load Width=14'



ODOT images: Tractor with 70' logging trailer and 102' long load, Total Length=112' and Tractor with 101' booster trailer, Total Length=125'



#### **Oversize Vehicles at Roundabouts**



#### Dolly rig at roundabout in Pennsylvania



#### Sample Strategies for OSOW at Roundabouts

- Wider Central Island Truck aprons
- Outside aprons (AKA "Blisters")
- Mountable splitter islands
- Removable signs for swept path.
- Bypass Treatment
- Central Island Cut Through





#### **Example: Olean, New York**

- Specialized Freight Solutions worked directly with roundabout designer to address freight accommodation for corridor accessing Dresser Rand/Siemens plant.
  - Mountable Center Island
  - Mountable Medians
  - Removable Signs.



#### Example: SR 44 at Grand Ave, Deland, FL





#### **Example: Mountable Aprons**



Courtesy of Kelli Owen (10)



#### **Example: Bypass Lanes (Marion County, KS)**





#### **Example: Advanced Left-Turn Movement** (Netherlands)



Bing Maps. Image courtesy of Simmons ©2013 Microsoft Corporation



Source: Kansas Roundabout Guide, 2<sup>nd</sup> Edition

#### **Example: Central Island Cut-Through**



Courtesy of Uroš Brumec and Brilon Werner



#### **Diverging Diamond Interchange (DDI)**



Source: Kansas DOT

Aerial Image Sources: Google Earth



#### **DDI Design Principles**

- Principles
  - Design vehicle
  - Design speed
  - Crossover design
  - Path alignment







Source: FHWA Diverging Diamond Interchange Informational Guide

#### **Restricted Crossing U-Turns (RCUT) Supersteets / J-Turns**







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**Traditional Divided Highway Intersection** 

### **Far-Side Right-Angle Collisions**





Source: FHWA and Gilbert Chlewicki; Talking Freight: Innovative Intersections webinar (September 21, 2016)

# **Accommodating Truck Movements**

Source: FHWA and Gilbert Chlewicki; Talking Freight: Innovative Intersections webinar (September 21, 2016)

#### **RCUT Intersection - Loon**

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







#### Median U-Turn (MUT)



#### Median U-Turn (MUT) – Left Turn from Major Road



Vehicles on the major street (or the street with the median) that want to turn left are directed through the main intersection to a U-turn movement at a downstream directional crossover (usually signalized), and proceed back to the main intersection to then turn right onto the minor street.

#### Median U-Turn (MUT) – Left Turn from Minor Road



Vehicles on the minor street that wish to turn left at the major street are directed to turn right, make a U-turn movement at the same crossover, and then proceed through the main intersection.



**Displaced Left-Turn (DLT) AKA Continuous Flow Intersection (CFI) Distinguishing Feature:** 

Left-turn movement (on one or more approaches) strategically relocated to the far-side of the opposing roadway via interconnected signalized crossover in advance of the main intersection



SR 30 and Summit Rd in Fenton, MO



Source: FHWA and Gilbert Chlewicki; Talking Freight: Innovative Intersections webinar (September 21, 2016)

#### **DLT – Dayton Ohio**



Aerial Image Sources: Google Earth



#### Rural DLT – Oxford, MS



Aerial Image Sources: Google Earth



#### **DLT Freight Accommodation**

- S-curves through crossovers
  - Lane widths typically wider
  - Dual turns should accommodate the design vehicle
  - Accommodating some trucks may require using both lanes (if that is a legal maneuver within the given jurisdiction).



#### Side-by-side crossover maneuver

Semi-truck maneuver at crossover

Source: FHWA Displace Left Turn Intersection Informational Guide

#### **Design Guidance**

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





#### Semi-truck maneuver at crossover

Side-by-side left-turn maneuver



#### **Emerging Issues**

- One and Done Efforts are sometimes made by the designers to reach out to one or two carriers have their equipment run through a built design or do a computer model and call it good.
  - Positive Appreciate the effort and carrier member's assistance
  - Negatives Are the vehicles a representative sample of all specialized vehicles that may use this corridor?
    - For example blades and bridge beams are not low boys/perimeters/dolly rigs/schnabels/platforms/ etc.



#### **Emerging Issues (Continued)**

- Concerns with continued use of 6 to 8 inch curbs and narrow single lane roundabout designs on major routes.
  - States have been working to identify routes historically used and have been receptive to outside discussions feedback and best practices.
- Local Roundabouts Last mile, near producers/receivers, port and rail (trans load) facilities
- Monotubes and other fixed overhead obstructions and poles in sweeps
  - Consider having signals on turn tables or arm swings (Port of Houston Federal Road)
- Utility coordination Raise wires over or bury wires under roadway when state comes in and reconstructs a roadway



#### What Can We Do?

- Carriers/shippers/receivers/Ports/Rail Terminals Alert SC&RA (Steven Todd)
- Permit officials let regional chairs know and they alert SC&RA



#### **Questions?**

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