INTERCHANGE SAFETY

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OUTLINE

- Wrong Way Movements
- Highway Safety Manual (HSM)
  - Crash Modification/Reduction Factors
- Diverging Diamond Interchange (DDI)
- Partial Cloverleaf Interchange
- TDOT Ramp Queue Program
WRONG WAY MOVEMENTS
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Vehicular movement along a travel lane in a direction opposing the legal flow of traffic on interchange access ramps.

(T. N. Tamburri and D. J. Theobald, 1965)
WRONG WAY MOVEMENTS

U.S. Statistics

- 3% of traffic accidents (NTSB, 2012)
- Fatality rates are 12 to 27 times greater than other types of crashes
- 360 lives are lost each year

WRONG WAY MOVEMENTS

Wrong Way Movements - 24 Hour Period

- 78% 6:00 a.m.-6:00 p.m.
- 22% 6:00 p.m.-6:00 a.m.

WRONG WAY MOVEMENTS

Contributing Factors at Interchanges:

- Alcohol impairment: 60%
- Time of day
- Age: 20 - 29
- Unclear direction
WRONG WAY MOVEMENTS

Typical Prevention Strategies-Countermeasures

- Traditional signage and pavement markings
- Reflective delineation
- Geometric design/modification
WRONG WAY MOVEMENTS

Traditional Signage and Pavement Markings

Legend
- Direction of Travel
- Wrong-Way Arrows
- Lane-Use Arrows
- Optional

Use stop line if STOP sign is installed

Notes: Modify as appropriate for multi-lane crossroads
WRONG WAY MOVEMENTS

Traditional Signage and Pavement Markings
WRONG WAY MOVEMENTS

Examples
WRONG WAY MOVEMENTS

Examples
WRONG WAY MOVEMENTS

Geometric Design/Modification Countermeasures

- Channelizing methods
- Decrease throat size
- Sharp angles or turns
- Offsetting
WRONG WAY MOVEMENTS
Geometric Design Countermeasures

I-40/385, Shelby County
WRONG WAY MOVEMENTS

Geometric Design Countermeasures

I-40/Canada Rd., Shelby County
WRONG WAY MOVEMENTS
Geometric Design Countermeasures

I-40/Charlotte Pike, Davidson County
WRONG WAY MOVEMENTS

Innovative Strategies- Countermeasures

• Intelligent Transportation Systems, ITS
• Additional signage mounted at lower heights
• Lighted signs or flashing beacons
WRONG WAY MOVEMENTS

Intelligent Transportation System Applications
WRONG WAY MOVEMENTS

Additional Signing
WRONG WAY MOVEMENTS

Pole mount and overhead illuminated signs

- Advantages- increased visibility at night and low cost solution, compared to ITS Applications
- Disadvantages- maintenance and effectiveness
OPEN THE FLOOR FOR DISCUSSION

• Personal Experiences?
• Specific Locations where Wrong Way Movements Occur
• Specific Locations of Geometric Design/Modification Countermeasures
HIGHWAY SAFETY MANUAL (HSM)

System Planning

Project Planning & Preliminary Engineering

Design & Construction

Operations & Maintenance
HSM Organization

- Human Factors & Fundamentals of Safety
- Crash Modification Factors
- Roadway Safety Management Process
- Predictive Methods
Crash Modification Factor (CMF)

- Multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site

\[
CMF = \frac{\text{Expected Average Crash Frequency with Site Condition } "b"}{\text{Expected Average Crash Frequency with Site Condition } "a"}
\]
CMFs in Practice

- Roadway Safety Management
- Road Safety Audits
- Development and Analysis of Alternatives
- Design Decisions and Exceptions
- Value Engineering
OPEN THE FLOOR FOR DISCUSSION

• Familiarity of the HSM
• Who Uses CMFs?
• Implementation?
DIVERGING DIAMOND INTERCHANGE (DDI)
Diverging Diamond Interchange (DDI)
Why Diverge?

- Traditional Diamond Interchange
  - 30 Points of conflict
- Limited sight distance
- Wrong way entry
Safety Benefits

• Reduction to 18 conflict points
• Improved sight distance at turns
• Decrease in Wrong way entry
• Limited driver confusion
• Shorter pedestrian crossings
I-40 @ SR-66 (Winfield Dunn Pkwy)
I-40, Exit 407 (Sevierville) DDI Project

- Work started on March 12, 2014
- Contract completion date of May 15, 2015
Full Cloverleaf
I-40 AND HIGHWAY 186 IN JACKSON, Exit 80

RAMPS
WEAVING
LAND USE
Partial Cloverleaf
SR-36 & SR-38, Washington County
Case Study of Deficiencies

- January 2004, field studies at 4 interchanges
  - 1 Partial Cloverleaf
- At night with technical & nontechnical personnel
- Existing in compliance with MUTCD standards
- Enhancement modifications implemented at 2 crossings
- 2008 – Reevaluation of interchange Safety features implemented at other Partial Cloverleaf Interchanges
Case Study Improvements

- Traffic Control
- Geometrics
- Enhanced Signage
- Enhanced Roadway Markings
Saundersville Rd @ Westbound Vietnam Veterans Blvd (SR-386) Off and On Ramps, Hendersonville
EXISTING INTERIM IMPROVEMENTS
EXISTING INTERIM IMPROVEMENTS
Proposed Low-Cost Safety Improvements

Saundersville Rd @ Westbound Vietnam Veterans Blvd (SR-386) Off & On Ramps, Hendersonville
Proposed Low-Cost Safety Improvements
Proposed Low-Cost Safety Improvements

Proposed Ramp Alignment

Existing Ramp Alignment
What Distance is Desirable Between Ramps in Order to Improve Safety?
TDOT RAMP QUEUE PROGRAM
Ramp Queue Program

- Guidelines of TDOT’s Ramp Queue Program
- Ramp Queue Project Example
  - Existing conditions
  - Issues of current ramp configuration
  - Proposed Improvements
Ramp Queue Program Guideline

TDOT’s guidelines in developing a Ramp Queue Study involves 2 Phases:

- **Phase 1:** Proof of the queue surpassing the beginning of the gore area in order to justify a Ramp Queue Study.
- **Phase 2:** Once proper justification is provided, a Ramp Queue Study will be developed.
I-65 Southbound Off Ramp to SR-253
I-65 Southbound Off Ramp to SR-253

- Ramp Issues
  - Queue reaches I-65S mainline during PM peak hour
  - Right & left turn lane storage
    - As a result, high volume of red light running at intersection
  - 1,800 ft Single Lane Ramp
I-65 Southbound Off Ramp to SR-253 Improvements

- Widen ramp to dual left and single right turn lanes for 750 ft of storage (retaining wall req’d for widening)
- Reconstruct concrete island to better identify appropriate direction of traffic flow
- Install new signal heads and new mast arm supports
- Update striping, signage, and improve intersection delineation
I-65 Southbound Off Ramp to SR-253

Queue length prior to proposed improvements

Queue length after proposed improvements

Estimated Cost: $940,000
OPEN THE FLOOR FOR DISCUSSION

- Specific Ramp Queue Locations?
- Recommendations for Mitigation Strategies?