Analysis and Methods of Improvement of Safety at High-Speed Rural Intersections

Tommy E. Nantung

Pavements, Materials & Construction Research Manager,

INDOT

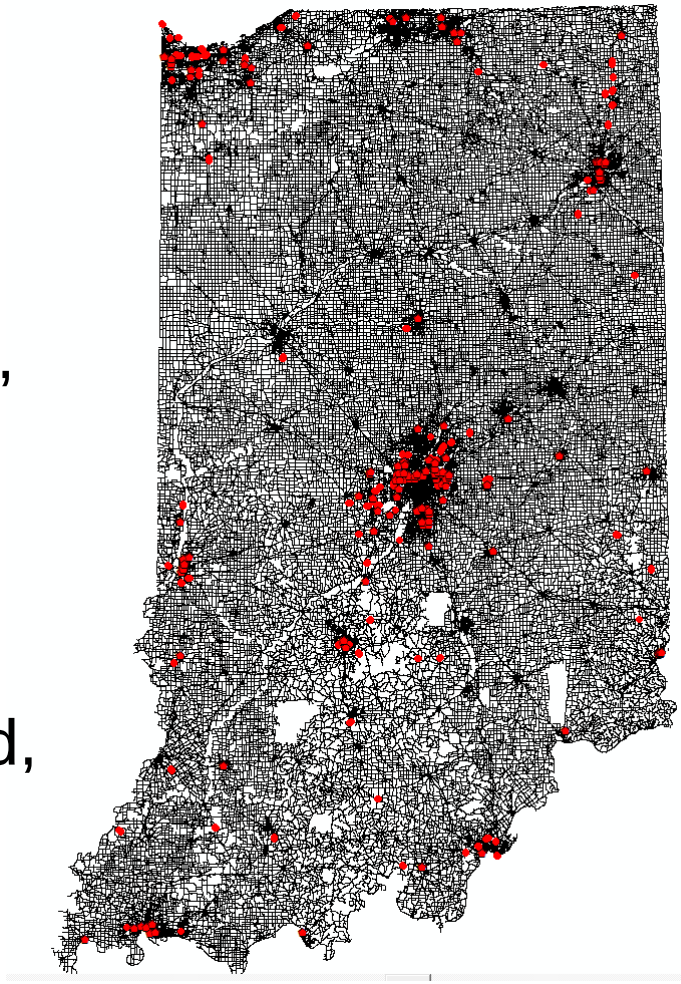
July 16, 2013

Introduction

- Researcher: Prof. Andrew Tarko
- Research Agency: JTRP – Purdue University
- Contact/links for more info: http://docs.lib.purdue.edu/jtrp/

Problem Statement

- Since 2006, INDOT systematically screens the Indiana road network for roads with safety needs.
- Many identified roads are two-way, stop-controlled intersections on high-speed, multi-lane rural roads.
- Some contributing design and human factors have been identified, while other factors awaited further investigation.



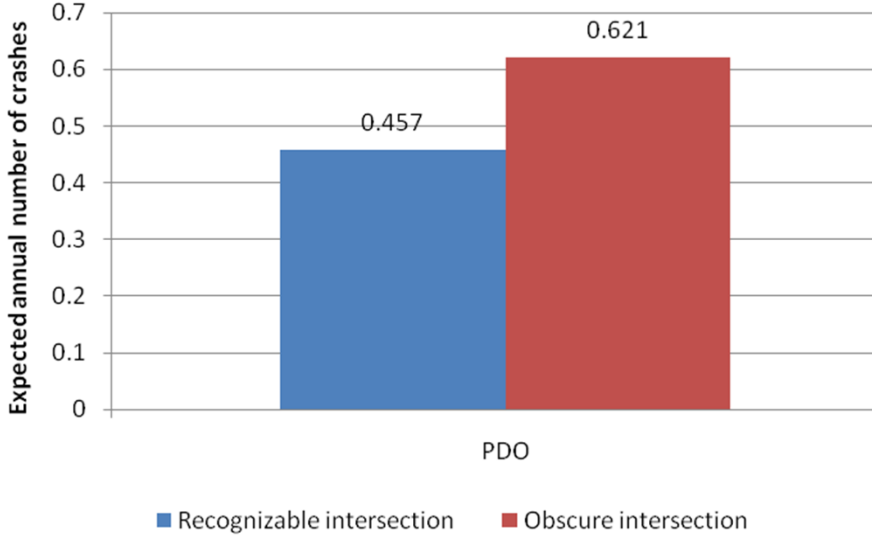
Research Performed

- Multivariate ordered probit models developed to identify safety factors at 553 Indiana intersections and 72 Michigan intersections.
- Estimated impacts of road characteristics on the frequency and severity of crashes.
- Recommendations of safety countermeasures made based on own results and research published by other authors.

Research Results

Identified safety factors

- Horizontal curves within the intersection vicinity
- Traffic volume on the major road
- Land use
- Population of the area surrounding the intersection
- The minor road functional class (traffic volume on minor road unknown)
- Nearby at-grade railroad crossings
- Intersection conspicuity to drivers on the major road
- Acceleration lanes for both left and right turns
- Median width
- Intersection angle
- Number of intersection legs Effect of Intersection Recognition on Expected Annual Number of Crashes

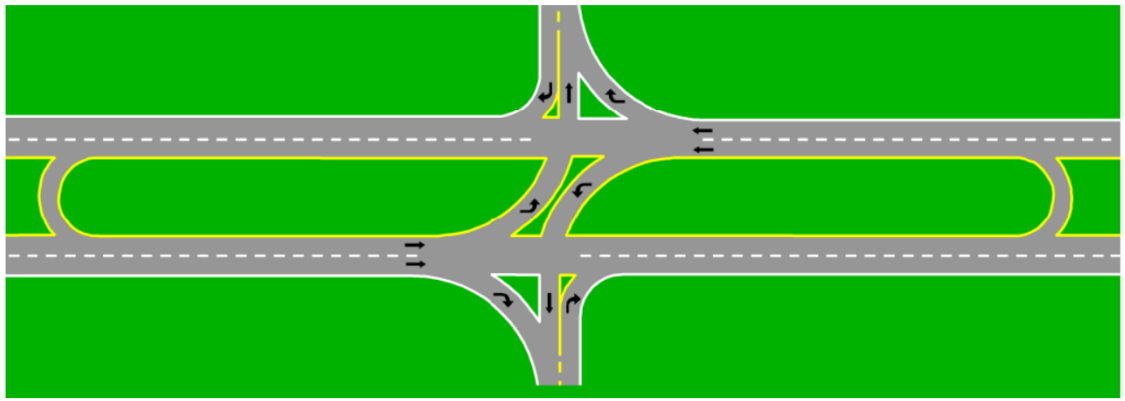


Effect of Intersection Recognition on Expected Annual Number of Crashes

Research Recommendations

New intersections

- Medians narrower than 80 feet with a parallel acceleration lane for vehicles turning left from the minor road.
- Intersections placed at a sufficient distance from horizontal curves and from at-grade railroad crossings.
- Solutions with indirect left-turn lanes (Michigan U-turns, J-turns) recommended.



Research Recommendations

Existing intersections with safety needs

- Median closure or restricting certain maneuvers
- Median acceleration lanes to allow a two-stage maneuver for left turns from the minor road
- Enhanced guide and warning signage to improve intersection conspicuity
- Road illumination


Advance warning sign in Indiana

- Installation of left- and right-turn bays on major road should be continued

Research Recommendations

Existing intersections with safety needs

- Recommended pilot studies in Indiana of advanced intersection collision avoidance systems, such as road-side dynamic signs warning drivers on the minor road about a short gap on the major road.

Example operation of the CICAS-SSA system illustrated in the Gorjestani et al. (2008)

Implementation Status

What has been/will be changed? (recommended, approved, or in place)

- Research is being implemented by:
  - Intersection Decision Guide - To provide practical guidance for the application of innovative intersection treatments
  - Design Treatments to limit left turns at the intersection under certain conditions (e.g. R-Cut, J-Turn, etc.)
  - Update of SHSP - calls for Systemic Project Type to improve driver recognition of two-way stop intersections.
  - Design recommendations to limit horizontal curves on high speed mainline roads though two-way stop intersections.

Implementation Strategy

How was/will change be institutionalized? (i.e. specification, policy, processes, training, legislation, etc.)

- Have drafted guidelines for practical means to aid implementation of recommendations of the research.
- Guidelines and Tools for Road Safety Assessments will include these countermeasures.
- INDOT is conducting statewide training this year on use of innovative intersection treatments and the Highway Safety Manual.
- Systemic projects under the Highway Safety Manual are being used to implement the research recommendations.

Value of Implementing the Research

- Crash Reduction Factors estimated with the statistical models (should be confirmed with before-after studies)

Geometry Improvement	KA	BC	O
Add a left-turn acceleration lanes at a four-leg intersection	68	90	86
Add a left-turn acceleration taper at a three-leg intersection		23	
Add a right-turn acceleration lane/taper	90[1)]		34
Remove the railroad crossing from major road		58	
Reduce the speed limit from 60 MPH to 55 MPH			25
Increase the intersection angle to make it at least 75 degrees			21
Widen the median to make it at least 80 feet wide			61
Make the intersection recognizable from the sufficient distance[2)]			27

[1)] Applies to three-leg intersections, [2)] 1.2 times the stopping distance

Return on Investment (optional)

What was the benefit vs. cost of research?

- Tools generated from this research are generally low cost and may be implemented quickly.
- While crash modification factors exist for many of the recommendations, before/after project analysis would be needed to understand the true cost effectiveness of the research.

Questions?

Contact information:

Tommy E. Nantung
tnantung@indot.in.gov
(765) 463-1521 ext. 248