IOWA DEPARTMENT OF TRANSPORTATION
RESEARCH news
Iowa Department of Transportation
BUREAU OF RESEARCH AND TECHNOLOGY ◆ SUMMER 2007

When are three lanes safer than four?

When do four- to three-lane conversions on urban roadways increase safety? After 15 conversion sites in cities across Iowa showed lower rates of traffic accidents (see table on page 2), city officials working with the Iowa Department of Transportation's (Iowa DOT) Office of Traffic and Safety decided to find out.

The Iowa DOT sponsored two projects at Iowa State University (ISU) to study safety impacts on four- to three-lane conversions. The first study was conducted by ISU's Center for Transportation Research and Education (CTRE), and the second was done by ISU's Department of Statistics.

CTRE did a classic before-and-after study using 10 years of crash data and compared it to annual crash trends on city streets and similar, unconverted roadways. The Department of Statistics used a Bayesian before-and-after analysis with monthly crash data and estimated volumes for all sites during a 23-year period (1982 through 2004). Both studies started with the same 15 conversion and comparison (unconverted) sites.

Generally, four- to three-lane conversions involve re-marking a four-lane, undivided urban roadway into three lanes—one through-lane in each direction with a two-way, continuous left-turn lane in the center. These studies looked at 15 corridors in Iowa where this conversion was implemented between 1993 and 2003. The conversion sites' traffic volumes ranged from 2,200 to 13,700 vehicles per day; the majority of these sites were located in smaller urbanized areas.

Two study methods produced similar results

- The classical study showed a 21 percent reduction in total crash frequency and 29 percent reduction in total crash rate when compared to overall city crashes. The Bayesian study showed that despite the fact both converted and comparison sites showed reductions in crashes, the converted sites' reduction in crashes was greater—resulting in a 25 percent reduction in crash density and 19 percent reduction in crash rate.
- When compared to crashes citywide, major injury crashes at the converted sites were reduced by 11 percent, minor injury crashes 30 percent and possible injury crashes 31 percent.

U.S. 34 study site in Osceola after conversion

Traditional safety and/or operational improvements for urban four-lane, undivided corridors include constructing a raised median or adding a fifth (center), two-way, left-turn lane. Both of these alternatives involve widening the roadway, which is costly and sometimes impractical. Converting four lanes to three with a center, left-turn lane may improve traffic operations and safety as effectively as traditional improvements at significantly less cost; however, each site should be evaluated thoroughly for successful application.

Conversion guidelines determine the feasibility of converting a four-lane, undivided roadway to a three-lane roadway on a case-by-case basis. From an operational viewpoint, a conversion is feasible when bi-directional, peak-hour volumes are less than 1,500 vehicles per hour (VPH), which typically translates to about 15,000 vehicles per day. For volumes more than 1,750 VPH, operations degrade, delays increase and conversion may not be accepted by drivers. Feasibility determination factors have been published in the CTRE report "Guidelines for the Conversion of Four-Lane, Undivided Roadways to Three-Lane, Two-Way, Left-Turn Lane Facilities," available at www.ctre.iastate.edu/reports/4to3lane.pdf. If a three-lane conversion is considered feasible, it should still be considered along with other alternatives within a detailed engineering study.

Lane conversions, *continued on page 2*

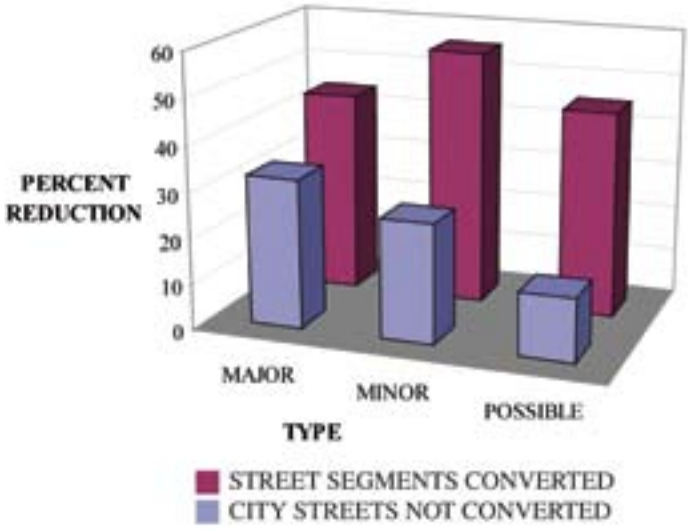
Lane conversions, *continued from page one*

Both study methods yielded similar results.

- Compared to crashes citywide at converted sites, major injury crashes were reduced by 11 percent, minor injury crashes 30 percent and possible injury crashes 31 percent.
- Crash frequency on the converted sites was reduced by about 24 percent—after accounting for the change in citywide crashes.
- Fewer people younger than 25 and older than 65 (two groups with traditionally higher crash risk) were involved in crashes.
- There were significantly fewer crashes related to left turns and stopping.

For information on four- to three-lane conversion research, contact Reg Souleyrette at 515-294-5453 or e-mail reg@iastate.edu.

Editor's note: *Information and images for this article were provided by ISU's CTRE Publications Group, including:* "Four-Lane to Three-Lane Conversions" *(Tech transfer summary), April 2006; and* "Three lanes really can be safer than four" *published in the May-June 2006 issue of Technology News, CTRE's bi-monthly newsletter. For more information visit www.ctre.iastate.edu/research/4laneto3lane.htm.*



Before and after comparison of injury crashes

Implementation benefits

- Potential for a 25 percent reduction in crash frequency per mile and a 19 percent reduction in crash rate
- A 34 percent reduction in the number of all injury crashes and lower severity of the crashes that occur
- Less involvement of age groups traditionally at risk—drivers age 25 and under, and 65 and older
- Significant reduction in the number of crash types related to left turns and stopped traffic

Description of conversion sites

City	AADT*	Population	Length	Land use
Storm Lake	7,333	10,076	1.41	Primarily commercial and industrial
Clear Lake	12,000	8,161	1.51	Mostly strip commercial with some residential remnants
Mason City	7,100	29,172	1.78	Primarily agricultural and industrial
Osceola	6,100	4,659	2.04	Residential, strip commercial and downtown
Manchester	11,200	5,257	.35	Downtown commercial
Iowa Falls	10,422	5,193	1.23	Industrial with some residential street access at one end
Rock Rapids	4,532	2,573	.35	Downtown commercial and office
Glenwood	6,313	5,358	1.09	Strip commercial, residential and transition between tthem
Des Moines	13,767	198,682	1.19	Mixed-residential and commercial
Council Bluffs	10,900	58,268	.20	Residential (few drives) and open space
Blue Grass	2,218	1,169	.72	Residential with commercial and industrial
Sioux Center	9,231	6,002	1.52	Single-residential through downtown commercial
Indianola	13,069	12,998	1.57	Strip commercial with some residential
Lawton	9,233	697	.64	Residential, access to side streets only
Sioux City	10,650	85,013	.77	Residential, access to side streets or alleys only

**AADT = annual average daily traffic (AADT and population data from year 2000)*

Iowa Traffic Safety Data Service

The Iowa Traffic Safety Data Service (ITSDS) provides the most readily available crash data analysis resources in Iowa. ITSDS was developed to fill the gap between the information safety data users can gather for themselves and what can be obtained from researchers using the latest in geographic information systems technology (GIS) developed by the Iowa Department of Transportation (Iowa DOT).

ITSDS is equipped to handle a wide variety of crash analysis requests. These include crash histories for specific areas, roads and/or intersections; fatalities and/or injuries; alcohol-related or cross-median crashes; seatbelt status or pedestrian crashes and weather-related conditions influencing crashes. Formats for data presentation include maps, diagrams and reports.

ITSDS is available to anyone who needs to examine crash data to make decisions regarding funding, improving roads, implementing enforcement, writing reports, designing presentations or increasing traffic safety awareness. Using the data and analyses provided by ITSDS, agencies can help reduce the number of crashes in their jurisdictions.

The following groups and individuals may submit data requests to ITSDS:

- State, county and local engineers
- University researchers
- Law enforcement agencies
- Advocacy groups
- Concerned citizens
- Students
- Others who can raise awareness of traffic safety in their communities
- Media

Technology at work

Michael Ring, P.E., principal traffic engineer for the city of Des Moines, requested an analysis of crash frequency and types along a specific section of Aurora Avenue—a four-lane, undivided roadway on Oct. 21, 2002, from the ITSDS. An analysis was completed three days later.

Comparing the resulting crash data tables and maps containing "before" data from similar Iowa corridors that experienced reductions in the number of crashes and severity after being converted to three-lane roads with center turn lanes, a decision was made by the city to convert the Aurora Avenue segment. The project will begin later this summer.

For information, contact Michael Ring at 515-283-4973 or MPRing@dmgov.org.

ITSDS is sponsored by ISU, ISU's Center for Transportation Research and Education (CTRE), the Iowa DOT, and Governor's Traffic Safety Bureau. ITSDS is located at CTRE, 2711 South Loop Drive, Suite 4700, Ames, Iowa 50010. For information call 515-294-8103 or visit www.ctre.iastate.edu/itsds/index.htm.

ctre Center for Transportation Research and Education

Iowa Department of Transportation

Iowa State University

Governor's Traffic Safety Bureau

Crash analysis tools updated with 2006 crash data

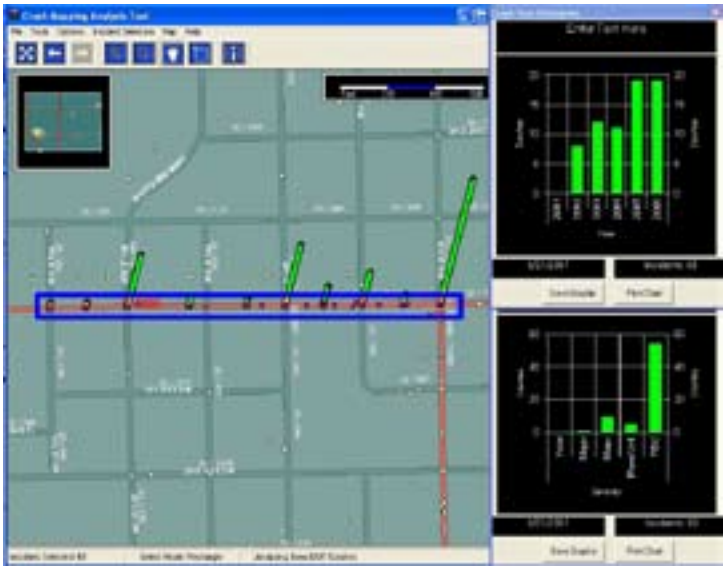
By Tim Simodynes, P.E., Iowa DOT

The 2006 crash data is available for use with either of Iowa's crash analysis software programs—Safety Analysis, Visualization and Exploration Resources (SAVER) and Crash Mapping Analysis Tool (CMAT). Both programs provide free GIS-based access to crash data for all public roads in Iowa.

SAVER is a more robust software and includes 1996-2006 crash data. SAVER also requires use of ArcView 3.2 or 3.3 software. CMAT includes 2001-2006 crash data.

To request software, data or training for SAVER, contact Michael Pawlovich, Iowa DOT's Office of Traffic and Safety at Michael.Pawlovich@dot.iowa.gov or 515-239-1428.

To request software, data or training for CMAT, contact Iowa DOT's consultant Bob Schultz, Customized Management Services, at rlspc@schultzgroup.org or call 515-984-6589.



Screen capture of CMAT 3.6 with 2001-2006 crash data.

Iowa roundabouts *safety comes full circle*

by Hillary N. Isebrands, P.E., Transportation Engineer

Modern roundabouts made their debut in Iowa in 1999, and the unofficial count is nearing two dozen roundabouts on Iowa streets and roadways. More and more Iowa jurisdictions are interested in incorporating modern roundabouts into their roadway networks to improve safety and efficiency at intersections.

Coralville

Modern roundabouts should not be confused with old-style rotaries that are often seen on the East Coast, such as DuPont Circle in Washington, D.C. or neighborhood traffic calming circles. Although these are all circular intersections, each have functional and design characteristics that make them operate differently.

Traffic in a modern roundabout travels counterclockwise around the central island, and all approach vehicles are deflected to the right with a splitter island and must yield to any traffic within the circulatory roadway. Neighborhood traffic circles often do not have entry deflection and are primarily used as a traffic-calming device. Old-style rotaries are often much larger in diameter with less entry deflection and higher speeds, and use stop signs or traffic signals to assign right of way for traffic on the approaches.

The safety benefits and intersection efficiency of modern roundabouts contributed to the increase in the number of modern roundabouts constructed across the U.S., although internationally, these benefits have been utilized for decades. Several before-and-after safety studies of modern roundabouts in the U.S. have shown a reduction in the total crashes near 40 percent and reductions near 80 percent for injury and fatal crashes ("Safety Effects of Roundabout Conversions in the U.S.; Empirical Bayes Observational Before and After Study," B. Persaud, et. al., 2001, and "NCHRP Report 572; Roundabouts in the U.S.," L. Rodegerdts, 2007). These statistics are also consistent with international data.

Iowa transportation agencies are including modern roundabouts as an additional tool in their intersection toolboxes at many different locations. They are found in urban and suburban settings. Next year, the first rural roundabout is anticipated to be constructed at Black Hawk County Road V-49 (Raymond Road) and Iowa 281 intersection.

School in North Liberty

Currently, the Iowa DOT's Office of Traffic and Safety has funded a project to prepare and publish planning and design guidelines for modern roundabouts. The planning guidelines should be published in the fall of 2007, with the design level guidelines to follow. The guidance is based on the 2000 Federal Highway Administration (FHWA) *Roundabouts: An Informational Guide* and supplemented with current state of the practice from other states in the U.S. and abroad. An Iowa DOT roundabout task force has spearheaded this initiative. Additionally, the *Iowa Driver's Manual* will soon be updated to provide driving instructions for single-lane and multi-lane roundabouts.

From a national perspective, efforts are underway to update the FHWA guide with current U.S. roundabout research (i.e. *NCHRP 572: Roundabouts in America*) and state-of-the-art practice. The National Committee on Uniform Traffic Control Devices (NCUTCD) has also recently approved updated roundabout signing and pavement marking language to be included in the next edition of the *Manual on Uniform Traffic Control Devices* (MUTCD). These changes can be found on the NCUTCD Web site, www.NCUTCD.org. Both of these documents are anticipated to be published in 2009.

Although roundabouts are not the panacea for all intersection issues, the increased interest and success of modern roundabouts and ongoing efforts to update and improve roundabout guidance has provided agencies with another viable intersection alternative to improve the safety and operations at intersections.

For more information about roundabouts, contact Hillary Isebrands (hillaryi@iastate.edu) at Iowa State University.

Editor's note: *Photos were provided by Hillary Isebrands.*

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For more information, see www.operationsresearch.dot.state.ia.us/reports/reports.html or call Mary Starr at 515-239-1590.

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