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Expressway crash data tell an interesting tale

Tom Maze, CTRE transportation engineer and ISU professor of civil engineering

An ISU study indicates that the overall severity of crashes at most rural expressway intersections (where traffic on the minor, or "side," road is controlled with stop signs) has less to do with the volume of traffic on the expressway than with the volume of traffic on the minor road.

Background

An expressway is a multi-lane, divided highway where most intersections are at grade. The typical intersection on a rural expressway is a two-way, stop-controlled (TWSC) intersection where a two-lane roadway meets a four-lane expressway.

Converting two-lane highways to expressways has become a popular improvement in Iowa and many other states. Expressways are now the fastest growing component in the nation's highway system.

The reasons seem obvious: With fewer interchanges than interstate highways, expressways are less expensive to construct, yet support similar traffic speeds and capacities and, where there are fewer than five access points per mile, have similar safety records.

The study

Still, relatively little is known about the specific safety performance of expressways.

A recent study of expressway segments in Iowa and Minnesota (described in the January–February 2004 issue of Technology News) found that, as traffic volumes increase, crash rates and crash severity also increase.

Now Tom Maze, professor of civil engineering at ISU, is studying the relative impact on crash rates of traffic volumes on both the major (expressway) and minor (two-lane, side) roadways, and of intersection geometry (median width, presence of turning lanes, and other features). The study is sponsored by the Iowa DOT, Office of Traffic and Safety, and funded by the Iowa Traffic Safety Fund Program.

Maze and his team examined five years of crash data (1996–2000) for 644 Iowa TWSC expressway intersections. Many of the intersections were very low volume, and 155 of them were with gravel roads.

The data

First, researchers examined intersection crash rates, crash fatality rates, and crash severity rates relative to traffic volumes on minor roadways.

- Crash rate is the total number of crashes divided by millions of entering vehicles (MEV).
- Fatal crash rate is the total number of fatal crashes divided by hundred million entering vehicles (HMEV).
- The crash severity index assigns a weight of 5 to fatal crashes, 4 to major injury crashes, 3 to minor injury crashes, 2

to possible injury/ unknown crashes, and 1 to property-damage-only (PDO) crashes.

Figure 1 shows crash and crash fatality rates plus crash severity index rates averaged over five years, stratified by increasing traffic volumes on the minor roadways.

All three rates increase with minor roadway traffic volumes. This indicates that crashes are occurring more frequently and becoming more severe as traffic increases on the side roads.

Second, researchers examined crash types (head-on, right-angle, rear-end, etc.) relative to both major and minor roadway traffic volumes. (Right-angle crashes tend to be the most severe. They happen when drivers on the minor roadway fail to select an adequate gap between vehicles when crossing the expressway.)

Figure 2 illustrates that as minor roadway traffic volumes increase, the percentage of right-angle crashes increases.

Interestingly, as Figure 3 illustrates, traffic volume on the expressway itself does not seem to have an impact on crash type.

Another look at the data

To examine this trend another way, Maze and his team looked at 20 TWSC expressway intersections with the 10 best and 10 worst safety performance records. (These were identified by comparing statistically modeled crash-severity rates for the intersections to actual crash-severity rates.)

Table 1 shows average traffic volumes for minor and major roadways at the 10 highest-severity intersections and the 10 lowest-severity intersections.

Table 1. Average Daily Traffic on Approaches of High- and Low-Severity TWSC Expressway Intersections

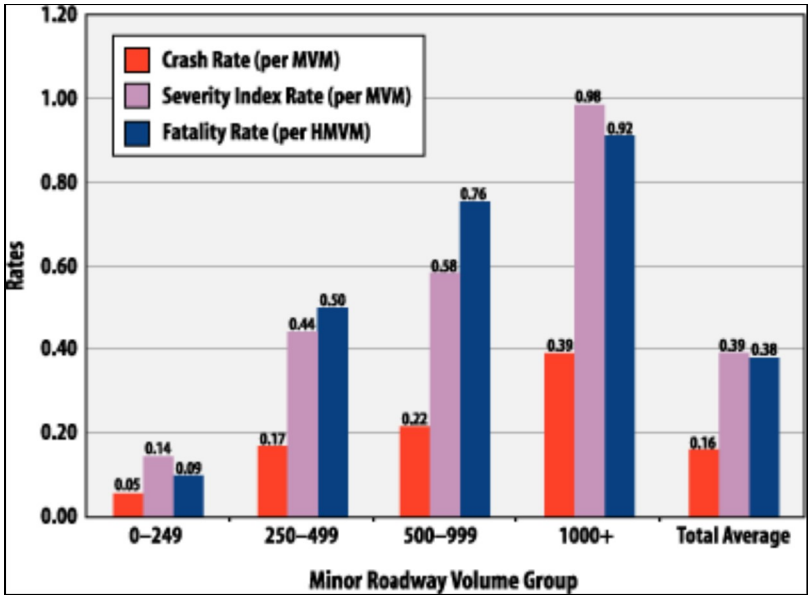

Figure 1. Crash, Severity Index, and Fatality Rates of Rural Expressways by Minor Roadway Volume

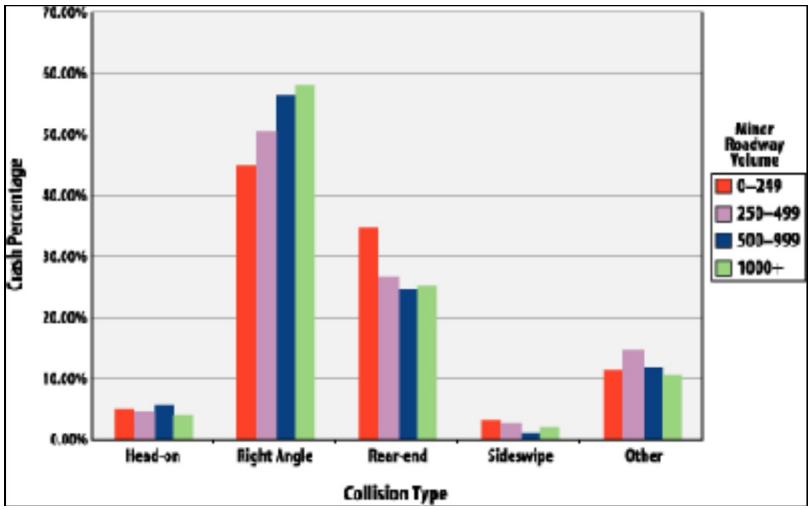

Figure 2. Crash Type by Minor Roadway Volume (without PDO Crashes)

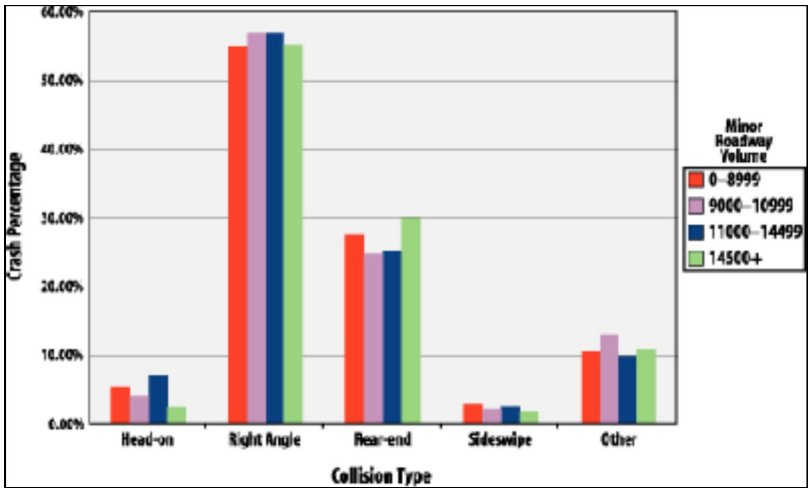

Figure 3. Crash Type by Major Roadway Volume (without PDO Crashes)

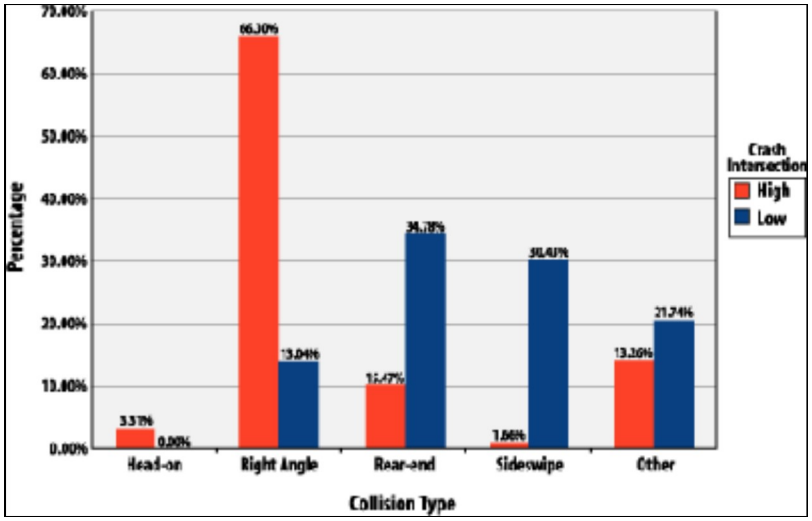

Figure 4. Crash Type Distributions for High and Low Crash-Severity Intersections

	Avg Traffic Volume (ADT) on Major Road (Expressway)	Avg Traffic Volume (ADT) on Minor Road
Low Crash-Severity Intersections	20,360	424
High Crash-Severity Intersections	11,490	2,300
Avg for all intersections with at least 1 crash	10,840	1,362

As expected, at intersections with low crash-severity ratings, average traffic volumes on the minor roadways were low—well below the overall average. And at intersections with high crash-severity ratings, average traffic volumes on the minor roadways were well above the overall average.

It was a surprise, however, that the low crash-severity intersections were on the highest volume rural expressways in Iowa.

Figure 4 illustrates the difference in crash type distribution between high crash-severity and low crash-severity intersections. The high crash-severity intersections have a very high involvement of right-angle crashes (66 percent), while the low crash-severity intersections have a low involvement of right-angle crashes.

Conclusions

The most problematic TWSC expressway intersections are those with high minor roadway traffic volumes (2,000 vehicle per day or more), or where minor roadway volumes are highly peaked. A typical example is a rural commuter route to an urban job center.

Other potentially problematic intersections include those

- where side-road drivers' ability to judge gaps in traffic is hindered by horizontal or vertical curves on the expressway.
- with commercial development (gas stations, convenience stores, fast food, etc.), where additional turning movements and higher volumes create more opportunity for crashes.

How does this affect roadway design?

See the follow-up article in the next issue of Technology News.

For more information

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