Low-Cost Safety Improvements for Rural Intersections

Introduction

The slowing, stopping, crossing, and turning of traffic at intersections represents potential vehicle conflicts, which may result in crashes at local and rural intersections. More than 80 percent of rural intersection fatalities occur at unsignalized intersections.[1,2] Furthermore, rural unsignalized intersections often have high-speed approaches, which contributes to the increased severity of any crashes that do occur.

The most severe crash type at unsignalized intersections is a right-angle crash, which typically occurs when two vehicles approaching at a perpendicular angle collide due to one vehicle failing to stop or yield the right-of-way. Out of every 100 reported angle crashes at unsignalized intersections, it is estimated that between 1 to 3 fatalities and 5 to 15 serious injuries result. Therefore, it is important that local and rural road owners understand and know how to identify both the safety concern and the types of countermeasures that address unsignalized intersection crashes.

Rural Intersection Characteristics and Identifying Opportunities

Intersections along rural roadways and intersections owned by local road agencies often have the following characteristics:

- Low traffic volumes on minor or all approaches;
- Unsignalized and mainly stop-controlled;
- Lack of turn lanes and lighting; and
- Skewed angle or limited sight distance.

Local and rural road owners need roadway information and crash data to help identify intersections with the potential for safety improvement. This information can come from sources such as project plans, aerial photos, and State or local crash databases populated by crash reports completed by law enforcement. If crash databases are not accessible, local and rural road agencies can often use the crash reports themselves, including the crash narrative descriptions, to identify certain risk factors and attributes, such as:

- Crash locations or approaches;
- Crash dates and times;
- Crash types and severity;
- Driver and vehicle characteristics;
- Environmental conditions; and
- Sequence of events and contributing circumstances.

Countermeasure Options

Rural intersection safety can be improved by implementing low-cost improvements that address sight distance, intersection recognition, visibility and conspicuity of traffic control devices, and roadway geometry issues. For example, adding or enhancing signs, pavement markings, delineators, channelizing islands, and flashing beacons at intersections can reduce crash risk. Sightlines should be evaluated with respect to vegetation and roadside features in order to establish adequate stopping and intersection sight distances. Intersections that are skewed (e.g., not perpendicular) may be modified to intersect at a more desirable angle (closer to 90 degrees) or controlled with regulatory signs or signals.

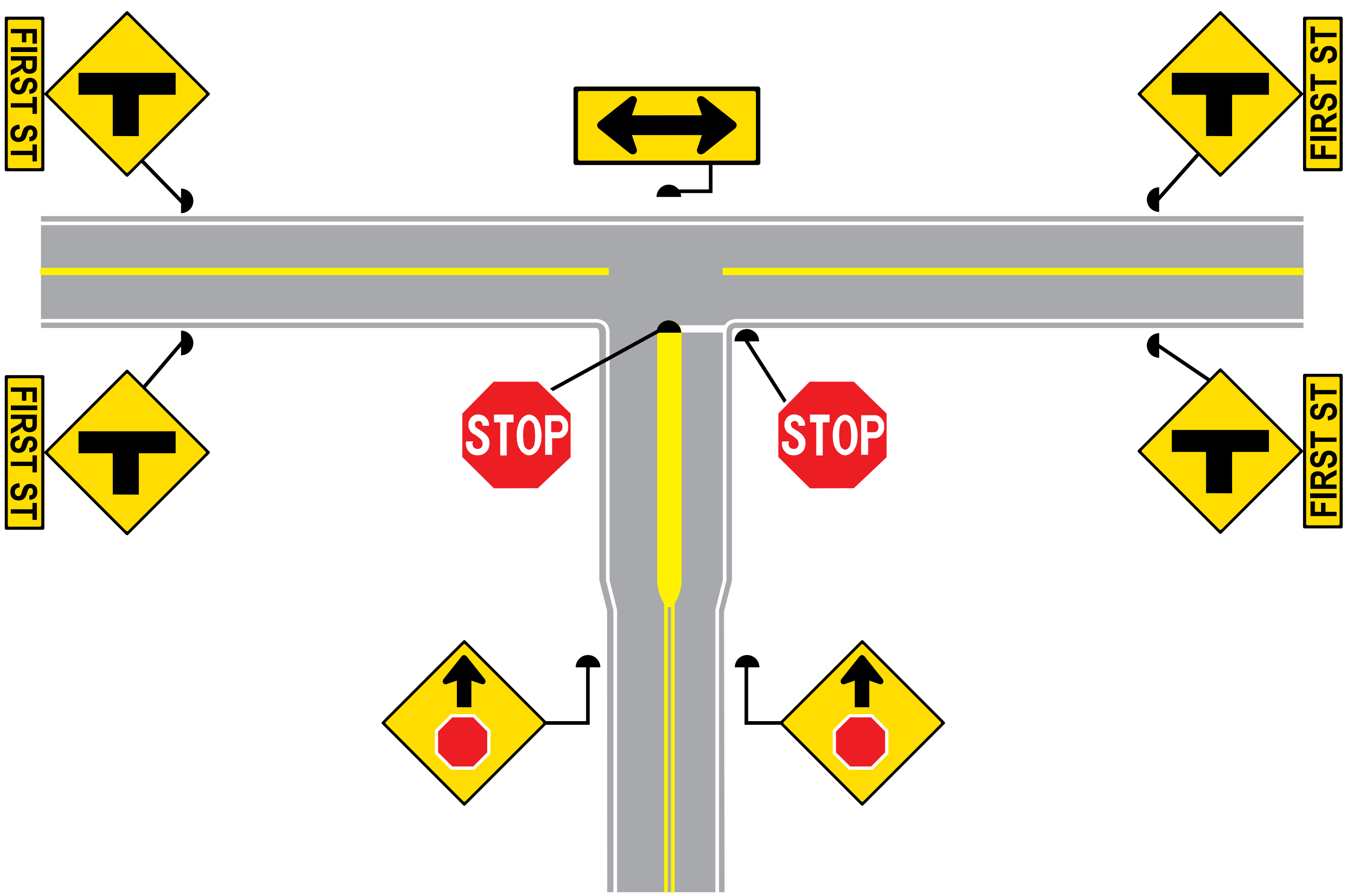
The Federal Highway Administration (FHWA) encourages agencies to consider the following treatments, either on a systemic basis or at spot locations, although the systemic approach may have a greater cumulative impact on reducing fatal and serious injury crashes. The table below shows treatments for stop-controlled intersections, the associated crash modification factor (CMF),[3] suggested crash thresholds in which the treatments should be applied, typical cost of implementation, and additional considerations. For example, the figure on the following page shows a basic set of sign and marking improvements that has the potential to reduce crashes by 30 percent.

Low-Cost Safety Treatments for Stop-Controlled Intersections

Countermeasure	Safety Issue Addressed	Crash Modification Factor	Typical Minimum Rural Crash Threshold (All Severities)	Additional Implementation Factors	Typical Implementation Cost Range per Intersection
Basic set of sign and marking improvements (as shown in Figure 3)	Recognition of stop-controlled intersection during day or night conditions	0.70	4-5 crashes in 5 years	None	$5,000 to $8,000
Either: a) flashing solar powered LED beacons on advance intersection warning signs and STOP signs, or b) flashing overhead intersection beacons	Recognition of stop-controlled intersection during day or night conditions	0.90 (0.87 for right angle crashes)	8-10 crashes in 5 years	None	$5,000 to $15,000
Dynamic warning sign which advises through traffic that a stopped vehicle is at the intersection and may enter the intersection. Dynamic warning sign activated by vehicle presence or excessive approach speed.	Limited sight distance as a result of geometry and/or vehicle speed	Unknown	10-20 crashes in 5 years	5 angle crashes in 5 years and inadequate sight distance from the stop approach	$10,000 to $25,000
Transverse rumble strips across the stop approach lanes in rural areas where noise is not a concern and running STOP signs is a problem ("Stop Ahead" pavement marking legend if noise is a concern)	Recognition of stop-controlled intersection	0.72 (transverse rumble strips) 0.85 (“Stop Ahead” pavement markings)	3 running STOP sign crashes in 5 years	Inadequate stopping sight distance on the stop approach	$3,000 to $10,000
Dynamic warning sign on the stop approach to advise high-speed approach traffic that a “stop” condition is ahead	Limited sight distance as a result of geometry or vehicle speed	Unknown	5 running STOP sign crashes in 5 years	Inadequate stopping sight distance on the stop approach	$10,000 to $25,000

Countermeasure	Safety Issue Addressed	Crash Modification Factor	Typical Minimum Rural Crash Threshold (All Severities)	Additional Implementation Factors	Typical Implementation Cost Range per Intersection
Extension of the through edge line using short skip pattern to assist drivers to stop at the optimum point	Recognition of stop location	Unknown	5 crashes in 5 years	Wide throat and observed vehicles stopping too far back from the intersection	Less than $1,000
Retroreflective strips on sign posts may increase attention to the sign, particularly at night	Recognition of stop-controlled intersection, especially at night	Unknown	5 crashes in 5 years	Sign visibility or conspicuity significantly degraded, particularly at night	Less than $1,000

Source: Federal Highway Administration, *Intersection Safety Implementation Plan Process*, November 2009. Available at: http://safety.fhwa.dot.gov/intersection/resources/intersaf_ipp0709/fhwasa10010.pdf



Examples of Basic Low-Cost Countermeasures for Stop-Controlled Intersections – Double Up Oversize Warning Signs, Double Stop Signs, Traffic Island on Stop Approach (if feasible), Street Name Signs, Stop Bars, and Double Warning Arrow at the Stem of T-Intersections

Resources

The following resources provide more details related to intersection safety:

Federal Highway Administration, Intersection Safety webpage: http://safety.fhwa.dot.gov/intersection/

Federal Highway Administration, Rural Intersection Resources webpage: http://safety.fhwa.dot.gov/intersection/rural/

In addition, the following publications can be consulted:

Federal Highway Administration, *Signalized Intersections: Informational Guide*, FHWA-SA-13-027 (Washington, DC: July 2013).
Available at: http://safety.fhwa.dot.gov/intersection/signalized/13027/fhwasa13027.pdf

Federal Highway Administration, *Intersection Safety: A Manual for Local Rural Road Owners*, FHWA-SA-11-08 (Washington DC: January 2011).
Available at: http://safety.fhwa.dot.gov/local_rural/training/fhwasa1108/index.cfm

Transportation Research Board, *NCHRP Report 500: Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Volume 12: A Guide for Reducing Collisions at Signalized Intersections,* National Cooperative Highway Research Program (TRB: Washington, DC, 2005).
Available at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v12.pdf

Transportation Research Board, *NCHRP Report 500: Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Volume 05: A Guide for Addressing Unsignalized Intersection Collisions,* National Cooperative Highway Research Program (TRB: Washington, DC, 2003).
Available at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v5.pdf

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[1] University of Minnesota, Center for Transportation Studies website, accessed February 4, 2014: http://www.its.umn.edu/Research/FeaturedStudies/intersections/

[2] Federal Highway Administration, *Intersection Safety: A Manual for Local Rural Road Owners,* FHWA-SA-11-08 (Washington DC: January 2011). Available at: http://safety.fhwa.dot.gov/local_rural/training/fhwasa1108/index.cfm

[3] A crash modification factor (CMF) is a measure of the safety effectiveness of a particular treatment or design element. A CMF less than 1.0 indicates that a treatment has the potential to reduce crashes, while a CMF greater than 1.0 indicates that a treatment has the potential to increase crashes. A CMF is determined by dividing the estimated number of crashes with a safety treatment by the estimated number of crashes without a safety treatment. For example, if an intersection experiences 10 crashes per year before a treatment is applied and 8 crashes per year after a treatment is applied, the CMF for the treatment is 0.8, netting a 20 percent reduction in crashes.