

12-2008

Best Practices for Low-Cost Safety Improvements on Iowa's Local Roads

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Recommended Citation

Sperry, Robert; Latterell, Jack; and McDonald, Thomas, "Best Practices for Low-Cost Safety Improvements on Iowa's Local Roads" (2008). *InTrans Project Reports*. 115.
http://lib.dr.iastate.edu/intrans_reports/115

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Best Practices for Low-Cost Safety Improvements on Iowa's Local Roads

Abstract

Many good maintenance practices are done routinely to ensure safe travel on low-volume local roads. In addition, there are many specific treatments that may go beyond the point of routine maintenance and in fact provide additional safety benefits with a relatively low price tag. The purpose of this publication is to try to assemble many of these treatments that are currently practiced in Iowa by local agencies into one, easy-to-reference handbook that not only provides some clarity to each treatment with photos and narrative, but also features references to agencies currently using that technique. Some strategies that are utilized by Iowa, other states, and are topics of research have also been included to allow the user more information about possible options. Even though some areas overlap, the strategies presented have been grouped together in the following areas: Signing and Delineation, Traffic "Calming," Pavement Marking and Rumble Strips/Stripes, Roadside and Clear Zone, Guardrail and Barriers, Lighting, Pavements and Shoulders, Intersections, Railroad Crossings, Bridges and Culverts, and Miscellaneous. The intention is to make this a "living" document, which will continue to be updated and expanded periodically as other existing practices are recognized or new practices come into being.

Keywords

Barriers (Roads), Best practices, Bridges and culverts, Clear zones, Flashing beacons, Guardrails, Handbooks, Highway safety, Improvements, Intersections, Lighting, Low volume roads, Maintenance practices, Pavements, Railroad grade crossings, Road markings, Road shoulders, Rumble strips, Traffic calming, Traffic signs

Disciplines

Civil Engineering

Comments

Please note: this report is part of the website Synthesis of Safety-Related Research <http://www.ctre.iastate.edu/research-synthesis/> which brings together a number of individual reports available in the InTrans collections in this repository.

Best Practices

for Low-Cost Safety Improvements
on Iowa's Local Roads

December 2008



U.S. Department of Transportation
Federal Highway Administration



Iowa Department
of Transportation

ctre

Center for Transportation
Research and Education

IOWA STATE
UNIVERSITY

Technical Report Documentation Page

1. Report No. CTRE Project 08-338 FHWA Project BPSG (383)		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Best Practices for Low-Cost Safety Improvements on Iowa's Local Roads				5. Report Date December 2008	
				6. Performing Organization Code	
7. Author(s) Robert Sperry, Jack Latterell, Tom McDonald				8. Performing Organization Report No.	
9. Performing Organization Name and Address Center for Transportation Research and Education Iowa State University 2711 South Loop Drive, Suite 4700 Ames, IA 50010-8664				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No.	
12. Sponsoring Organization Name and Address Federal Highway Administration Iowa Department of Transportation Office of Pavement Technology 800 Lincoln Way 400 7th Street S.W. Ames, IA 50010 Washington, D.C. 20590				13. Type of Report and Period Covered	
				14. Sponsoring Agency Code	
15. Supplementary Notes Visit www.ctre.iastate.edu for color PDF files of this and other research reports.					
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17. Key Words Iowa's local roads—low-cost safety improvements—low-volume roads—maintenance practices				18. Distribution Statement No restrictions.	
19. Security Classification (of this report) Unclassified.	20. Security Classification (of this page) Unclassified.	21. No. of Pages	22. Price NA		

Best Practices for Low-Cost Safety Improvements on Iowa's Local Roads

December 2008

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Printed in the United States of America, December 2008

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The preparation of this document was financed in part through funds provided by the Iowa Department of Transportation through its "Agreement for the Management of Research Conducted by Iowa State University for the Iowa Department of Transportation" and its amendments.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Iowa Department of Transportation.

Acknowledgements

Many thanks go to the FHWA, AASHTO, NACE, ATSSA, NCHRP, and all the individual state highway agencies and officials who continue to share existing and new ideas and findings to provide safer roads for the traveling public. Special recognition should be offered to the local agencies who have taken these pro-active steps in their jurisdictions to apply safety measures on those roadways. The goal of all is the significant reduction of highway crashes and deaths.

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Preface

Many good maintenance practices are done routinely to ensure safe travel on low-volume local roads, including the following:

- Replacing faded or damaged signs
- Restriping pavement markings regularly
- Cutting back foliage through curves and around signs
- Maintaining pavement edges and shoulders
- Maintaining adequate drainage

In addition, there are many specific treatments that may go beyond the point of routine maintenance and in fact provide additional safety benefits with a relatively low price tag. The purpose of this publication is to try to assemble many of these treatments that are currently practiced in Iowa by local agencies into one, easy-to-reference handbook that not only provides some clarity to each treatment with photos and narrative, but also features references to agencies currently using that technique. Some strategies that are utilized by Iowa, other states, and are topics of research have also been included to allow the user more information about possible options. Even though some areas overlap, the strategies presented have been grouped together in the following areas: Signing and Delineation, Traffic “Calming,” Pavement Marking and Rumble Strips/Stripes, Roadside and Clear Zone, Guardrail and Barriers, Lighting, Pavements and Shoulders, Intersections, Railroad Crossings, Bridges and Culverts, and Miscellaneous. Our intention is to make this a “living” document, which will continue to be updated and expanded periodically as other existing practices are recognized or new practices come into being. Therefore, anyone who has ideas and/or examples of additional information to be included is encouraged to send ideas to

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Crash Reduction Factors Included in this Handbook

The crash reduction factors (CRF) included in this handbook are defined as “the percentage crash reduction that might be expected after implementing a given countermeasure.” Although the source for these crash reduction factors is noted in the bibliography, the entire document includes a substantial amount of information about how the factors for the various countermeasures shown there were derived, their relative accuracy (if determined), and why some factors were not included. All this information will be of great value to users when searching for an appropriate CRF for their benefit/cost evaluations, and for that reason, it is recommended that potential users review the complete report before applying the numbers shown herein. (See <http://www.transportation.org/?siteid=35&pageid=1490>)

If an analysis is being done to satisfy a submittal requirement of another agency, potential users of the percentages shown need to verify for themselves that the factor(s) are indeed appropriate for their specific situations and currently in use by the reviewing agency.

When selecting appropriate countermeasure(s) for a specific location or condition, one should always first consider those that would keep more vehicles on (or from leaving) the highway. Once those have been considered, the focus can shift to that of minimizing the chances of the vehicle crashing into an object or overturning, if it does leave the highway. Finally, if the vehicle could easily go off the highway and has a great likelihood of crashing into an object or overturning, what countermeasures can be undertaken to reduce the severity of that crash?

1 Signing and Delineation

- 1-1 Use of 36 in. Signs on Paved Road ways (Warnings, Stop Ahead, and Stops)
- 1-2 Replacing Yield Signs with Stop Signs at Y Intersections
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Signing and Delineation

1-1 Use of 36 in. Signs on Paved Roadways (Warnings, Stop Ahead, and Stops)



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36 in. Stop sign at paved/paved intersection (photo courtesy of Grundy County)

Project Contact Information

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Garym@gccourthouse.org

Project Details

Program started: ~1998

(or miles) where this is applied: All paved roads in county

Comments: Easy to do a route or two at a time. Proper lateral placement needs to be considered when different radii are present at various paved intersections. Marshall County has also been using 36 in. Stop signs at all paved intersections for many years.

Potential benefit: 36 in. signs improve visibility, driver recognition, and compliance in areas where Stop sign running is a problem.

Cost of using innovation: Extra cost of sign (~60% higher)

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-2 Replacing Yield Signs with Stop Signs at Y Intersections



*Looking at Y intersection from center (left)
(photos courtesy of John Chaplin)*



Looking at Y intersection along one leg

Project Contact Information

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Keosauqua, IA 52565
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vbcoeng@netins.net

Project Details

Program started: ~2003

(or miles) where this is applied: Four sites in county

Comments: Van Buren County has increased the traveling public's safety on Y intersections by changing the signage from a Yield to a Stop, especially where visibility is limited.

Potential benefit: Replacing Yield signs with Stop signs can reduce driver confusion and indecision at certain troublesome intersections.

Cost of using innovation: Had Yield signs up already—cost is about the same.

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-3 Use of Chevrons (in Lieu of) Double Arrow for Extra Emphasis



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*View from distance
(photos courtesy of John Chaplin)*



Close up of sign

Project Contact Information

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Phone: 319-293-3663
vbcoeng@netins.net

Project Details

Program started: ~1995

(or miles) where this is applied: One site in the county

Comments: After years of replacing a standard double arrow sign multiple times per year, Van

Buren County replaced that device with the highly visible modified T-intersection signing made of six standard chevrons. County sign personnel report this assemblage has only been knocked down twice since it was replaced. Engineers had also used two similar devices previously in Kansas. Non-standard installations often can be approved as “experimental” by contacting the FHWA Division Office and DOT Office of Traffic and Safety.

Potential benefit: Replacing double arrow signs with multiple chevrons can result in better driver compliance at locations where the standard signing has not performed satisfactorily.

Cost of using innovation: Frame material and extra signs, —approximately \$200 for materials

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-4 Nighttime Sign Surveys



*Daytime view (top); Nighttime view (bottom)
(photo courtesy of Federal Highway Administration)*

Project Contact Information

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Project Details

Program started: ~2001

(or miles) where this is applied: All roads with signs

Comments: An annual survey is conducted in fall/winter. Reviewers decide if signs need to be rechecked, if they are OK, or if they need to be replaced. Monroe County has a similar program.

These photos exemplify the visual difference that a nighttime inspection can provide. The night survey is an allowable method of documenting retroreflectivity, a new requirement of a recent MUTCD revision. For more information, see http://safety.fhwa.dot.gov/roadway_dept/retro/

Potential benefit: Nighttime sign reviews will identify signs with less than adequate visibility, thus improving safety for all road users at night.

Cost of using innovation: Takes two persons and approximately one week

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-5 Flags on (Oversize) Stop (and/or Warning) Signs



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*View of flags on Stop sign
(photos courtesy of Bob Sperry)*



View of flags on warning signs

Project Contact Information

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Project Details

Program started: ~1985

(or miles) where this is applied: Specific locations

Comments: Easy to do a site or two at a time. Flags are used on newly paved/resurfaced roads and when new signs are placed. Story County also uses strategy for special emphasis.

Potential benefit: Placing flags on Stop and warning signs can provide better recognition and compliance with sign messages by drawing drivers' attention to these signs.

Cost of using innovation: ~\$25 each

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-6 Object Markers—Marking Hazards



Object markers at culvert hazards (photos courtesy of Bob Sperry)

Project Contact Information

Darren Moon, P. E.
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837 N Avenue
Nevada, IA 50201
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engineer@storycounty.com

Project Details

Program started: ~1988

(or miles) where this is applied: Specific sites around county

Comments: These Type III object markers are used to make the drivers aware of hazards that are close to the edge of the traveled way. They are used on both low-volume paved and gravel roads to warn of such potential hazards as culvert headwalls, steep drop-offs due to short drainage structures or erosion, bridge rails (especially those without approach guardrail), etc.

Potential benefit: Type III object markers can clearly define hazards and near-vertical drop-offs within the clear zone.

Cost of using innovation: ~\$30 each plus post

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-7 Delineators—Marking Alignment or a Hazard



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Single reflective and triple amber delineators and markers (photos courtesy of Bob Sperry)

Project Contact Information

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Project Details

Program started: ~1988

(or miles) where this is applied: Scattered locations in Story and Marshall counties

Comments: This variety of delineator types is being used to make the drivers aware of road alignment along hazards that are close to the edge of the traveled way and also to warn of such things as culvert headwalls and steep drop-offs due to short drainage structures or erosion. They may be used on both low-volume paved and gravel roads, providing excellent guidance in nighttime or winter driving conditions.

Potential benefit: Delineators are used to identify hazards outside the clear zone and also to clarify alignment along longitudinal ditch hazards, etc.

Cost of using innovation: Very low cost (~\$10 per post/delineator), yet effective for many purposes. However, they are not effective as substitutes for chevrons on curves.

Crash reduction factor (if applicable): Up to 11% for all crashes and up to 34% for run-off-road crashes

Signing and Delineation

1-8 Post-Mounted Delineators and Chevrons (Curves)



Guardrail and chevrons (photo courtesy of Bob Sperry)

Project Contact Information

Darren Moon, P. E.
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837 N Avenue
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engineer@storycounty.com

Project Details

Program started: 1980s

(or miles) where this is applied: Scattered locations in county

Comments: These types of delineation are used primarily on curves to give drivers a better awareness of the degree of sharpness of an approaching curve. Since the signs are placed through the curve, the guidance continues as the driver traverses the entire curve. These methods are not only effective during the day, but also effective for nighttime driving.

Potential benefit: Very effective strategy to reduce run-off-road crashes on curves.

Cost of using innovation: Chevron cost is approximately \$30 each plus post

Crash reduction factor (if applicable): Up to 35% for all crashes and up to 20% for fatal/injury crashes

Signing and Delineation

1-9 Large Advance Street Signing



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Advance street signs along paved route (photos courtesy of Bob Sperry)

Project Contact Information

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Project Details

Program started: ~2003

(or miles) where this is applied: On all paved roads for major (paved) intersections

Comments: This practice has proven very effective for those using country roads, delivery services, and elderly drivers and has received many positive comments from the public. Even with larger signs, placement guidelines need to be followed to provide the best possible visibility for the motorists.

Potential benefit: Properly placed oversize advance street signs allow adequate reaction time for drivers to safely maneuver turns at intersections.

Cost of using innovation: Approximately 75% more than conventional and requires extra post

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-10 Larger 8 in. Street Names Signs



Large street name signs (photos courtesy of Bob Sperry)

Project Contact Information

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Project Details

Program started: ~2004

(or miles) where this is applied: Project is in progress

Comments: Doing some each year, which allows to spread cost and manpower over longer period

Potential benefit: Larger street sign names make driver recognition much easier, thus minimizing distraction in route identification and turning movements.

Cost of using innovation: 50% more per sign than 6 in. signs

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-11 Adding Large Arrow Sign to Curve Warning



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Arrow in the distance at the center of the road (left) and closer view (right) (photos courtesy of Bob Sperry)

Project Contact Information

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Project Details

Program started: ~1988

(or miles) where this is applied: Most locations in county with 90 degree turn; use double arrow sign at T intersections

Comments: This additional sign provides the motorist with an extra visual warning of the impending curve, and the “duplication” provides the information even if the curve warning sign is knocked down.

Potential benefit: Increased driver awareness of not only the curve ahead, but also where it is located.

Cost of using innovation: ~\$100 with post

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-12 Flashing Beacons (Red)



Beacon provides excellent awareness of stop at night (photo courtesy of Bob Sperry)

Project Contact Information

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Project Details

Program started: 1990s

(or miles) where this is applied: Few sites at intersections of paved roadways

Comments: When Royce places a flashing light at an intersection, it is usually hung by cable over the road, as shown above. Availability of power close to the site is critical, although solar power is now making applications in remote locations more versatile.

Potential benefit: Higher placement of cable-hung flashing light provides better visibility for longer distance, especially for problem locations.

Cost of using innovation: Approximately \$1000, if power available, plus continued energy expense and maintenance costs

Crash reduction factor (if applicable): Up to 30% for all crashes

Signing and Delineation

1-13 Flashing Beacons (Yellow)



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*Warning beacon and sign(s) are an effective combination (photo courtesy of Tom McDonald)
(Formerly county road—now Iowa 415)*

Project Contact Information

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Project Details

Program started: 1980s at selected sites

(or miles) where this is applied: N/A

Comments: Although this photo was taken to show the flashing yellow lights, you can also note the difference in the reflective sheeting on the left (No Passing Zone) and right (Stop Ahead) signs.

Potential benefit: Flashing amber lights provide a much higher degree of visibility and driver awareness than static signing, especially in limited light conditions, including darkness.

Cost of using innovation: Highly dependent on availability of power at the site; although, new innovations in solar power are making these more feasible for remote locations.

Crash reduction factor (if applicable): Up to 30% for all crashes

Signing and Delineation

1-14 Solar-Powered Flashing Beacons (Red or Yellow)



Clinton (left), Dubuque (middle), and Washington County (right) (photos courtesy of Doug Pershall, Brown Traffic Products)

Project Contact Information

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Project Details

Program started: July 2007

(or miles) where this is applied: One Washington County location—at junction of quarry entrance/exit and W55 (right photo).

Other photos are alternate applications and locations.

Comments: These photos were taken to show the existing flashing yellow lights for emphasis on both caution and warning situations, as well as red light for stop application. They also may be used for general lighting on bridge sidewalks, pedestrian/bike paths, or as luminaries.

Potential benefit: Solar panels provide great versatility in locating flashers or light where no power source is readily available.

Cost of using innovation: ~\$2200 for flasher plus \$500 for software, if programming of unit is desired

Crash reduction factor (if applicable): Up to 30% for all crashes

Signing and Delineation

1-15 Utility Pole Delineation



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Simply adding a reflective tape to a pole or tree that cannot be removed may prevent a crash (photos courtesy of Jack Latterell, FHWA Office of Safety)

Project Contact Information

Project Details

Program started: Mostly utilized in cities

(or miles) where this is applied: Normally would be used on only those poles that are extremely close to the traveled way

Comments: Provides a visual awareness of both the alignment and the hazard. The perceived benefit/cost ratio for poles in clear zone is very high, but actual benefit and CRF are difficult to measure.

Potential benefit: Retroreflectivity of tape on poles in the clear zone increases driver awareness, especially in darkness.

Cost of using innovation: ~\$15 per pole

Crash reduction factor (if applicable): N/A

Signing and Delineation

1-16 Blinker Signs



Perimeter blinking lights provide additional emphasis (photos courtesy of Tapco Inc.)

Project Contact Information

Tapco Inc.
800 Wall Street
Elm Grove, WI 53122
Phone: 262-814-7000
Toll free: 800-236-0012
www.tapconet.com
www.tapcostore.com

Project Details

Program started: ~2006

Applications: New Stop sign locations, high incident intersections, rural roads.

Comments: Iowa installations in Davenport, Des Moines, Dubuque, Fort Dodge, Spencer,

LeClaire, Asbury, and Glenwood. Installs easily onto new or existing sign post; can be integrated into an ITS (Intelligent Transportation System); high intensity Day-Viz™ LEDS command attention day and night; can be programmed to operate continuously (24/7) or on solar time clocks, push-buttons, and/or motion (vehicle) detectors; propriety circuitry automatically adjusts light output for maximum visibility and battery efficiency; multiple signs can be synchronized; heightened driver awareness; increased visibility at high incident intersections.

Potential benefit: Provides special emphasis to signs where driver inattention has resulted in violations or problems in the past.

Cost of using innovation: Get cost from vendor

Crash reduction factor (if applicable): Up to 15% for all crashes

Signing and Delineation

1-17 Sign Sheeting Alternatives



www.ctre.iastate.edu/ltap



Eng Grade – HIP – DG3 Daytime



Eng Grade – HIP – DG3 Nighttime



EG – HIP Daytime
(photos courtesy of 3M Company)



EG – HIP Nighttime

Project Contact Information

Kyle Kovar
3M Company
W. Dodge Road #344
Omaha, NE 68114
Phone: 402-598-8527
Cell: 651-732-7996
kkovar@mmm.com

Project Details

Program started: Several sheeting developments in past 15-20 years

(or miles) where this is applied: Various types of sheeting are installed on signs in every local agency in Iowa

Comments: Because of the diverse alternatives available for sign sheeting and the range of costs of each, every agency needs to balance their sign needs for high visibility with the dollars they have to spend. Recently passed legislation introducing retroreflectivity requirements by the FHWA for signs in the future may require that balance to shift. See http://safety.fhwa.dot.gov/roadway_dept/retro/index.htm for more information.

Potential benefit: Higher grade sheeting provides much better visibility (and longer sign life) than others, increasing driver awareness and enhancing safety.

Cost of using innovation: Dependent on type of sheeting and quantity ordered—check with project contact

Crash reduction factor (if applicable): N/A

2 Traffic “Calming”

- 2-1 Summary of Treatment Effectiveness
- 2-2 Speed Displays
- 2-3 Lane Width Reduction with Channelizers
- 2-4 Speed Limit on Pavement
- 2-5 Pavement Marking with Convergent Chevrons
- 2-6 Shoulder Marking to Reduce Perceived Width of Traveled Way
- 2-7 Speed Humps or Tables
- 2-8 Optical Speed Bars for Speed Reduction
- 2-9 Optical Speed Bars (for Speed Reduction at Curves)
- 2-10 Red Painted Pavement Markings

Traffic “Calming”

2-1 Summary of Treatment Effectiveness



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Treatment	Range of changes from before to after data-collection periods		Cost	Maintenance	Most appropriate for
	85th % speed (mph)	% exceeding posted speed limit (mph)			
Transverse pavement markings	-2 to 0	-5 to 1% for ≥ 5 -9 to 0% for ≥ 10 -8 to 1% for ≥ 15 -7 to 2% for ≥ 20	\$	regular painting	community entrance
Transverse pavement markings with speed feedback signs	-7 to -3	-34 to -8% for ≥ 5 -22 to -16% for ≥ 10 -27 to -5% for ≥ 15 -21 to -1% for ≥ 20	\$\$\$	regular painting	community entrance
Lane narrowing using center island widening with pavement marking	-3 to +4%	-4 to 15% ≥ 15 -1 to 5% for ≥ 10 0 to 1% for ≥ 15 no change for ≥ 20	\$	regular painting	entrance or within community
Converging chevrons with “25 MPH” legend	-4 to 0	-31 to -4% ≥ 5 -16 to -3% for ≥ 10 -5 to -1% for ≥ 15 -2 to 0% for ≥ 20	\$	regular painting	community entrance
Lane narrowing using shoulder widening and pavement marking legend “25 mph”	-2 to 4	-21 to 14% ≥ 5 -6 to 26% for ≥ 10 -4 to 16% for ≥ 15 0 to 5% for ≥ 20	\$	regular painting	entrance or within community
Speed table	-5 to -4	-34 to -21% ≥ 5 -10 to -5% for ≥ 10 -1% for ≥ 15 no change for ≥ 20	\$\$	regular painting	within community
Lane narrowing with center island widening using tubular channelizers	-3 to 0	-32 to 1% ≥ 5 -20 to -4 % for ≥ 10 -20 to -1 % for ≥ 15 -12 to 1% for ≥ 20	\$\$\$	regular maintenance, channelizers often struck	within community
Speed feedback sign (based on one analysis period)	-7	-49% ≥ 5 -27% for ≥ 10 -6% for ≥ 15 -1% for ≥ 20	\$\$\$	regular maintenance	entrance or within community
“SLOW” legend	-2 to 3	-16 to 4% ≥ 5 -8 to 16% for ≥ 10 -2 to 18% for ≥ 15 0 to 17% for ≥ 20	\$	regular painting	entrance or within community
Entrance treatment using “35 MPH” legend with background	-9 to 0	-43 to 0% ≥ 5 -42 to 0% for ≥ 10 -23 to 1% for ≥ 15 -7 to 0% for ≥ 20	\$	faded quickly, regular painting	entrance or within community
- indicates a reduction in 85 th percentile speeds or % exceeding posted speed limit					
\$ under \$2,500 \$\$ \$2,500 to \$5,000 \$\$\$ \$5,000 to \$12,000					

Project Contact Information

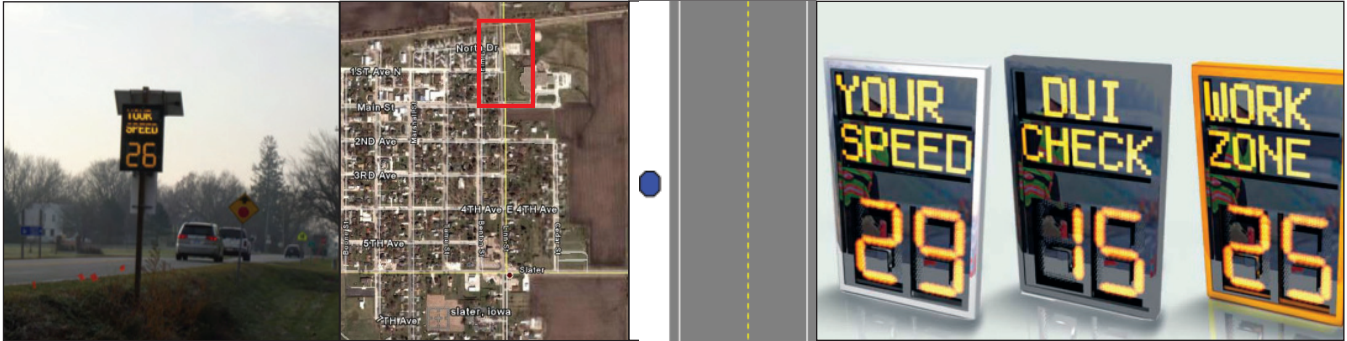
Dr. Shauna Hallmark
 Center for Transportation Research and Education (CTRE)
 2711 South Loop Drive, Suite 4700
 Ames, IA 50010-8664
 Phone: 515-294-5249
shallmar@iastate.edu

Project Details

Information on this study may be found at
<http://www.ctre.iastate.edu/reports/traffic-calming-rural.pdf>.

Traffic “Calming”

2-2 Speed Displays



*Speed display sign
(photos courtesy of
Shauna Hallmark)*

*Incoming southbound direction
in 25 mph zone*

Variable speed sign flashers

Project Contact Information

City Clerk

Slater City Hall
105 Greene Street
Slater, IA 50244
Phone: 515-685-2531
(also see research link)

Project Details

Program started: Reference research in 2006

(or miles) where this is applied: One location—North entrance to town on R38

Comments: This method of “Traffic Calming” and speed reduction was used on a road entering a small town; however, it also could be (and is) used by some around construction sites and for special events to make drivers aware of their speeds and encourage a slowing from normal highway speed. Information on this study may be found at <http://www.ctre.iastate.edu/reports/traffic-calming-rural.pdf>. Displays were effective but had a relatively high cost.

Potential benefit: Effective techniques can be used to slow drivers by utilizing visual or physical stimuli that create increased awareness of their speeds and thereby greater compliance with speed limits.

Cost of using innovation: \$2,000–\$11,000 per display

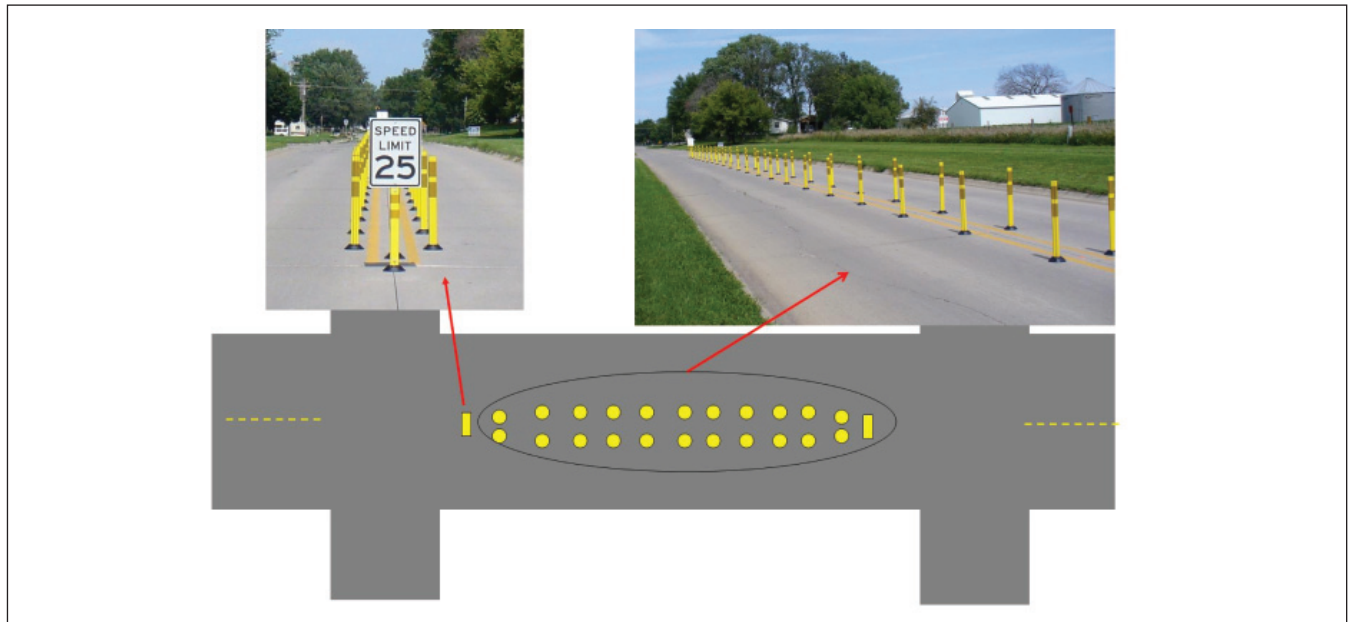
Crash reduction factor (if applicable): N/A

Traffic “Calming”

2-3 Lane Width Reduction with Channelizers



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Channelizer layout and photos (photos courtesy of Shauna Hallmark)

Project Contact Information

City Clerk

Slater City Hall
105 Greene Street
Slater, IA 50244
Phone: 515-685-2531
(also see research link)

Project Details

Program started: Reference research in 2006

(or miles) where this is applied: South entrance to town on R38

Comments: These longitudinal channelizers are able to withstand an impact with a vehicle. Their flexible structure allows them to quickly return to

their initial position. Repeated impacts, however, may take a toll on the delineators and they may eventually require some maintenance. One disadvantage of placing the delineators along the centerline is that wide trucks and farm machinery, which are common on rural Iowa roadways, may have difficulty maneuvering around them. The delineators also should not be placed so that they block driveways or cross-streets. Information on this study may be found at <http://www.ctre.iastate.edu/reports/traffic-calming-rural.pdf>.

Potential benefit: Effective techniques can be used to slow drivers by utilizing visual or physical stimuli that create increased awareness of their speeds and thereby greater compliance with speed limits.

Cost of using innovation: N/A

Crash reduction factor (if applicable): N/A

Traffic “Calming”

2-4 Speed Limit on Pavement



Speed limit pavement markings in Roland, IA (photo courtesy of Shauna Hallmark)

Project Contact Information

City Clerk

Roland City Hall
202 E Ash
Roland IA, 50236
Phone: 515-388-4861
(also see research link)

Project Details

Program started: 2006 Research Project

(or miles) where this is applied: In Roland, Iowa

Comments: On-pavement speed markings were used as part of the gateway treatment in Roland, Iowa, with a research project. In addition, use of

the message “SLOW” was utilized as part of this research project along one section of roadway in the vicinity of areas where pedestrians cross a state road through the community of Slater, Iowa. This method may be installed quickly at relatively low cost and produces no noise or impediment to traffic. For more information, see the following: <http://www.ctre.iastate.edu/reports/traffic-calming-rural.pdf>.

Potential benefit: Effective techniques can be used to slow drivers by utilizing visual or physical stimuli that create increased awareness of their speeds and thereby greater compliance with speed limits.

Cost of using innovation: Approximate cost of original or recurring pavement marking is \$25–\$50 per letter or number and \$100–\$200 per symbol.

Crash reduction factor (if applicable): N/A

Traffic “Calming”

2-5 Pavement Marking with Convergent Chevrons



www.ctre.iastate.edu/ltap



Aerial view of pavement chevrons (photo courtesy of Shauna Hallmark)

Project Contact Information

City Clerk

Roland City Hall
202 E Ash
Roland IA, 50236
Phone: 515-388-4861
(also see research link)

Project Details

Program started: Reference research in 2006

(or miles) where this is applied: East entrance to town on E18

Comments: Transverse pavement markings should be spaced with decreasing separation as

a roadway approaches a speed transition zone. This gives drivers the perception of moving too fast or speeding and encourages a reduction in speeds. Markings were found to be cost effective, but required maintenance and were not a factor in winter during snowfalls. Information on this study may be found at <http://www.ctre.iastate.edu/reports/traffic-calming-rural.pdf>.

Potential benefit: Effective techniques can be used to slow drivers by utilizing visual or physical stimuli that create increased awareness of their speeds and thereby greater compliance with speed limits.

Cost of using innovation: ~\$100–\$200 per marking

Crash reduction factor (if applicable): N/A

Traffic “Calming”

2-6 Shoulder Marking to Reduce Perceived Width of Traveled Way



Shoulder marking completed (photo courtesy of Shauna Hallmark)

Project Contact Information

City Clerk

Roland City Hall
202 E Ash
Roland IA, 50236
Phone: 515-388-4861
(also see research link)

Project Details

Program started: Reference research in 2006

(or miles) where this is applied: Several blocks through Roland on county road E18

Comments: Lane narrowing visually reduces the width of the traveled portion of a lane.

Narrowed lanes provide a feeling of constraint and cause drivers to reduce speed. Lanes can be either physically narrowed or visually narrowed by increasing the marked width portion of a shoulder or median. Visually narrowing lanes is accomplished by re-painting shoulder and median markings to widen the shoulder or median and decrease lane width. Information on this study may be found at <http://www.ctre.iastate.edu/reports/traffic-calming-rural.pdf>.

Potential benefit: Effective techniques can be used to slow drivers by utilizing visual or physical stimuli that create increased awareness of their speeds and thereby greater compliance with speed limits.

Cost of using innovation: Pavement marking costs only

Crash reduction factor (if applicable): N/A

Traffic “Calming”

2-7 Speed Humps or Tables



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30 mph speed table used in the CTRE study for residential traffic calming (photos courtesy of Shauna Hallmark)

Project Contact Information

City Clerk

Gilbert City Hall
Gilbert, IA 50105
Phone: 515-233-2670
(also see research link)

Project Details

Program started: Reference research in 2006

(or miles) where this is applied: Western entrance to town on county route E23

Comments: Speed tables are asphalt or rubber mounds that cover the full width of the roadway. Speed tables are essentially speed humps that have been modified with a flat top, thus reducing the disruption to vehicle operation. The flat top is typically long enough for the entire wheelbase of a passenger car to rest on. The ramps of the speed table are also sloped more gently than speed humps. Therefore, design speeds for speed tables are higher than for speed humps.

Speed tables are commonly being preferred over speed humps. This is in large part due to the delay of emergency service vehicles. Speed tables are less jarring and can allow larger emergency vehicles to cross with minimal disruption. Like speed humps, speed tables are designed according to the desired target speed. The target speed can be up to 45 mph. Speed humps/tables should not be placed near intersections. These may delay emergency service vehicles and may cause noise. They also may impact drainage and drivers may swerve to avoid them, impacting pedestrians and others. Information on this study may be found at <http://www.ctre.iastate.edu/reports/traffic-calming-rural.pdf>.

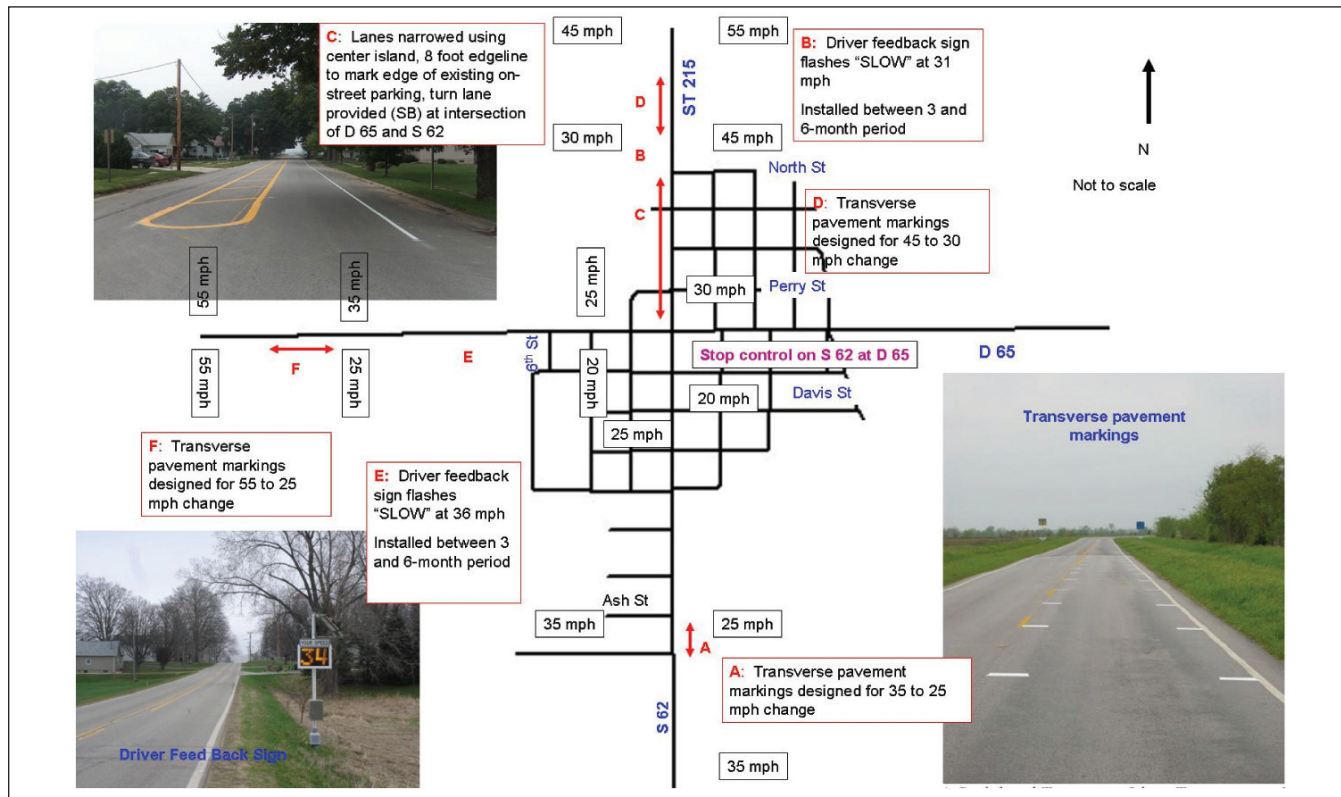
Potential benefit: Effective techniques can be used to slow drivers by utilizing visual or physical stimuli that create increased awareness of their speeds and thereby greater compliance with speed limits.

Cost of using innovation: \$3,000–\$4,000 each, depending on materials used

Crash reduction factor (if applicable): N/A

Traffic “Calming”

2-8 Optical Speed Bars for Speed Reduction



Layout details for traffic calming project (photos courtesy of Shauna Hallmark)

Project Contact Information

City Clerk

Union City Hall
308 Center Street
Union, IA 50258-7752
Phone: 641-486-2302
(also see research link)

Project Details

Program started: Reference research in 2006

(or miles) where this is applied: Placed on three approaches into town of Union, two county routes (S62 and D65), and one state route (IA 215)

Comments: The transverse markings appeared to be moderately effective in decreasing

vehicle speeds directly downstream of the markings for all three gateways, although none of the differences was large. Because other measures were introduced concurrently with these markings, one needs to refer to the entire study for specific detail. Addition of flashing signs for speed or SLOW notification increased performance considerably. Information on this study may be found at <http://www.ctre.iastate.edu/reports/traffic-calming-rural.pdf>.

Potential benefit: Effective techniques can be used to slow drivers by utilizing visual or physical stimuli that create increased awareness of their speeds and thereby greater compliance with speed limits.

Cost of using innovation: Minimal for pavement markings, but would need to be redone annually because of winter snow/ice removal

Crash reduction factor (if applicable): N/A

Traffic “Calming”

2-9 Optical Speed Bars (for Speed Reduction at Curves)



www.ctre.iastate.edu/ltap



*Optical speed bars used to reduce vehicle speed
(photo courtesy of Virginia Department of Transportation)*

Project Contact Information

Virginia DOT

Project Details

Program started: N/A

(or miles) where this is applied: N/A

Comments: Although tried and unproven as a “calming” technique, this strategy may be most effective where vehicles traveling at high speeds are required to slow down for curves or other

conditions. As the spacing between the bars is reduced around the curve, the driver senses increased speed and slows down instinctively. The length of pavement marking segment and the spacing between bars are dependent on the amount of speed reduction desired.

Potential benefit: Effective techniques can be used to slow drivers by utilizing visual or physical stimuli that create increased awareness of their speeds and thereby greater compliance with speed limits.

Cost of using innovation: Pavement marking costs only

Crash reduction factor (if applicable): N/A

Traffic “Calming”

2-10 Red Painted Pavement Markings



East entrance after treatments were installed (left) and west entrance treatment illustrating fading of pavement markings at nine-month data collection period (right) (photos courtesy of Shauna Hallmark)

Project Contact Information

City of Dexter Clerk
911 State Street
Dexter, IA
Phone: 515-789-4210

Project Details

Program started:

(or miles) where this is applied: N/A

Comments: The main road thru Dexter is county road F-65, which is an asphalt-paved two-lane roadway. Some sensitive areas near F-65 include an elementary school, a park, and a metal fabrication plant just outside the west city entrance. When speeds in rural communities are problematic, traffic calming provides a potential solution. The surface treatments were selected

after confirming that the measures did not violate guidelines set forth by the Manual on Uniform Traffic Control Devices (MUTCD). In addition to red markings with 35 mph, an eight-inch edgeline was painted along the sets of treatments.

Potential benefit: Effective techniques can be used to slow drivers by utilizing visual or physical stimuli that create increased awareness of their speeds and thereby greater compliance with speed limits.

Cost of using innovation: N/A

Crash reduction factor (if applicable): The treatments were effective in reducing speeds at all three of the locations where they were tested. The effectiveness varied over time. Nine months after installation, the effectiveness of the treatments appeared to decrease, most likely due to the fact that the markings had faded over time. The treatments were re-painted and the effectiveness increased again at the twelve-month data collection period.

3 Pavement Marking and Rumble Strips/Stripes

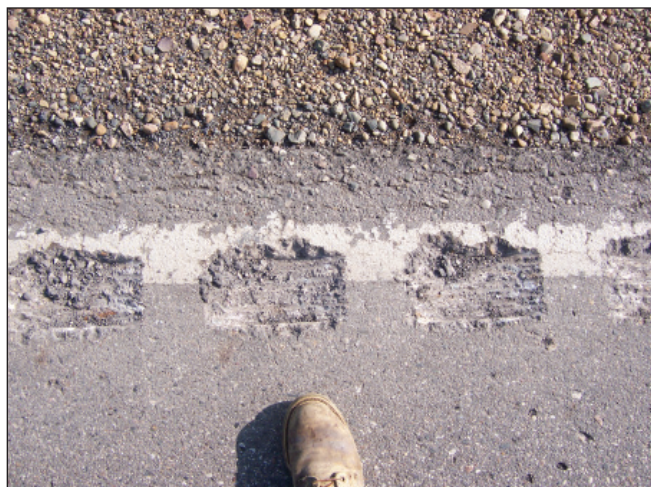
- 3-1 Rumble Striping (Research project in 2008)
- 3-2 Rumble Striping on New PC Overlay Project
- 3-3 Painted Edgelines on Two-Lane Paved Roads
- 3-4 Wider Longitudinal Pavement Markings (Edgelines)
- 3-5 Milled in Centerline Pavement Markings
- 3-6 Shoulder and Edgeline Rumble Strips
- 3-7 Centerline Rumble Strips
- 3-8 Advance Rumble Strips for Stop Signs on Paved Roadways
- 3-9 Curve Advance Warning on Pavement

Pavement Marking and Rumble Strips/Stripes

3-1 Rumble Striping (Research project in 2008)



www.ctre.iastate.edu/ltap



After milling (left) and with paint applied (right) (photos courtesy of Bob Sperry)

Project Contact Information

Tom McDonald, P. E.
Safety Circuit Rider, CTRE
2711 S. Loop, Suite 4700
Ames, IA 50010-8664
Phone: 515-294-7311
tmcdonal@iastate.edu

Project Details

Program started: ~ 2008 (research)

(or miles) where this is applied: Six locations in five counties

Comments: A research project was undertaken by CTRE researchers Shauna Hallmark and Tom

McDonald in the spring of 2008 to install and then follow up and report on the life and effectiveness of painted edge lines after a winter and after several years for effect on crash reduction. Further information may be obtained on the following website, <http://www.ctre.iastate.edu/research/detail.cfm?projectId=1594879152>, which will be updated periodically. The final report is not due until fall 2010.

Potential benefit: This strategy is especially useful to counter run-off-road crashes in problem areas and curves where no paved shoulder exists.

Cost of using innovation: High initial cost as research price involved equipment modification, short strips, a lot of travel between sites, and painting the same day; average bid is approximately \$58/sta.

Crash reduction factor (if applicable): N/A

Pavement Marking and Rumble Strips/Stripes

3-2 Rumble Striping on New PC Overlay Project



After milling (left) and with paint applied (right) (photos courtesy of Linn County)

Project Contact Information

Steve Gannon, P. E.
Linn County Engineer
1888 County Home Road
Marion, IA 52302-9753
Phone: 319-892-6400
Steve.Gannon@linncounty.org

Project Details

Program started: September 2008; this project is complete except for payment

(or miles) where this is applied: On curves (inside and outside) along 4.2 mile project

Comments: The county discussed how this process went and suggested floating the rumble strip during paving operation. This would allow for

adjusting the rumble strip to match the transverse joints and would reduce the damage to the new pavement caused by the operation. Our project included paving a 4 ft shoulder with longitudinal joint at the edge of the 24 ft pavement. The contractor had difficulty controlling the rumble strip alignment and had several blowouts between the rumble strip and the edge joint at the shoulder line. Placing the rumble strip in plastic concrete would eliminate this problem.

Potential benefit: The combination of two-foot paved shoulders with rumble stripes provides more recovery area (and time) following driver alert by the noise from passing over the stripes.

Cost of using innovation: The contract price for the rumble strip was \$75 per station, and the durable pavement marking was \$37 per station. This may be a bit high because there were only 52 stations of rumble strip to place.

Crash reduction factor (if applicable): N/A

Pavement Marking and Rumble Strips/Stripes

3-3 Painted Edgelines on Two-Lane Paved Roads



www.ctre.iastate.edu/ltap



Recently applied markings (photos courtesy of Bob Sperry)

Project Contact Information

Darren Moon, P. E.
Story County Engineer
837 N Avenue
Nevada, IA 50201
Phone: 515-382-7355
engineer@storycounty.com

Project Details

Program started: ~1978

(or miles) where this is applied: All paved roads in county—often omitted on sealcoat roads

Comments: Edge lines are used to delineate the path of a roadway for drivers. They are

especially helpful in the nighttime for guidance. Several studies have been conducted in the past, consistently showing impressive reductions in fatalities and crashes. The MUTCD provides guidelines and warrants for use of edge lines, especially for higher volume roadways. On many of Iowa's two-lane rural roads, they are normally provided, but are subject to engineering judgment on low-volume roads.

Potential benefit: Driver guidance and awareness of roadway edge location and geometry is greatly enhanced for both daytime and nighttime travel.

Cost of using innovation: 2008 cost varies, but normally it is approximately \$4–\$7 per station for maintenance striping contracts.

Crash reduction factor (if applicable): Up to 3% for both injury and PDO crashes

Pavement Marking and Rumble Strips/Stripes

3-4 Wider Longitudinal Pavement Markings (Edgelines)



*Roadway with 4 in. edge line
(photos courtesy of Federal Highway Administration)*



Roadway with 8 in. edge line

Project Contact Information

Unknown—see Bibliography #4, p. 9

Project Details

Program started: N/A

(or miles) where this is applied: N/A

Comments: A wide (8 in.) edge line provides a stronger visual guide. Although this strategy has been found to be an effective tool, it should not be used on pavements less than 20 ft in width, as motorists may move too far left—into conflict with oncoming traffic. Six-inch paint stripes are being used on some DOT projects as well.

Potential benefit: Better visibility and awareness of roadway edge location and geometry is a good safety enhancement for run-off-road crashes, especially if older drivers are involved.

Cost of using innovation: Additional width cost of paint—approximately additional \$2.50–\$3.00 per station for 8 in. line compared to normal 4 in. With ice blade usage in winter, annual re-painting might be required to maintain effectiveness, which would increase the long-term cost of this strategy; therefore, some agencies widen the edge lines only at curves and other higher potential crash locations.

Crash reduction factor (if applicable): Listed CRFs show same data for 4–6 in. lines and no gain for 8 in. width.

Pavement Marking and Rumble Strips/Stripes

3-5 Milled in Centerline Pavement Markings



www.ctre.iastate.edu/ltap



Milled in centerline pavement markings (photo courtesy of Tom McDonald)

Project Contact Information

Mary Kelly, P. E.
Cerro Gordo County Engineer
2716 South Federal Avenue
Mason City, IA 50401
Phone: 641-424-9037
MKelly@co.cerro-gordo.ia.us

Project Details

Program started: Summer 2005

(or miles) where this is applied: 8.25 miles between US 65 and town of Grouse

Comments: Paint performance has been excellent and periodic retroreflectivity readings are done by the DOT twice a year to monitor and quantify its performance. We have done a similar thing on another job this summer where

we actually had a bid item for the grooves cut. (The recent development of 3M's All Weather Paint (AWP) may make this procedure even more appealing. Although the cost of this product is slightly over twice the cost of conventional paint, it performs well in rain and even under a film of water.) With ice blade usage in winter, annual re-painting should not be required to maintain effectiveness, which would increase the long-term cost of this strategy.

Potential benefit: Long-term performance from pavement markings can be a good countermeasure for lane departure crashes, especially when used in combination with other strategies.

Cost of using innovation: Milling and high performance paint cost was \$19.25 per sta. in 2005. In this summer's project, the milling was contracted separately for \$10.55 per sta.

Crash reduction factor (if applicable): N/A

Pavement Marking and Rumble Strips/Stripes

3-6 Shoulder and Edgeline Rumble Strips



Shoulder rumble strips (photo courtesy of Jack Latterell)

Project Contact Information

DOT location—US 6 in Johnson County—East of Iowa City

Project Details

Program started: State DOT initiated this program several years ago and the practice has become almost routine on their projects with shoulders.

(or miles) where this is applied: N/A

Comments: Excellent strategy for run-off-road crash mitigation, but most county routes do not have paved shoulders for installation. Hopefully, the rumble striping research and other installations included herein on local agency roads will prove to be effective and viable second choices.

Potential benefit: The noise and vibration created by these rumble strips makes this an excellent strategy for lane departures to the right.

Cost of using innovation: ~\$1600 per mile

Crash reduction factor (if applicable): Up to 13% for all crashes and 18% for fatal/injury crashes

Pavement Marking and Rumble Strips/Stripes

3-7 Centerline Rumble Strips



www.ctre.iastate.edu/ltap



Centerline and shoulder rumble strips (photo courtesy of Jack Latterell)

Project Contact Information

DOT Location—US 34 in Union County

Project Details

Program started: 2005

(or miles) where this is applied: 14 miles

Comments: Centerline rumble strips can be very effective for reducing crashes involving crossing

the centerline. The DOT is still evaluating benefits/costs.

Potential benefit: The noise and vibration created by these rumble strips makes this an excellent strategy for centerline crossover crashes and lane departures to the left.

Cost of using innovation: ~\$800 per mile

Crash reduction factor (if applicable): The installation of centerline rumble strips on a two-lane roadway can lead to a 14% reduction in all crashes and up to a 55% percent reduction in head-on crashes.

Pavement Marking and Rumble Strips/Stripes

3-8 Advance Rumble Strips for Stop Signs on Paved Roadways



Advance rumble strips on PCC approach (photo courtesy of Bob Sperry)

Project Contact Information

Darren Moon, P. E.
Story County Engineer
837 N Avenue
Nevada, IA 50201
Phone: 515-382-7355
engineer@storycounty.com

Project Details

Program started: ~1988

(or miles) where this is applied: On most paved roads in Story County approaching a Stop sign at an intersection with another paved road

Comments: The grooves or strips are normally milled into the pavement surface (either PC concrete or AC concrete) after the pavement is in place. Because the strips tend to lose depth (and effectiveness) under repetitious heavy loads, concrete panels are often installed at the rumble strip locations before they are milled in to provide a longer life for the strips.

Potential benefit: This strategy is very effective for reducing crashes due to Stop sign running.

Cost of using innovation: ~\$2000 per set of three approach panels

Crash reduction factor (if applicable): N/A

Pavement Marking and Rumble Strips/Stripes

3-9 Curve Advance Warning on Pavement



www.ctre.iastate.edu/ltap



PennDOT curve advance marking (photos courtesy of Federal Highway Administration)

Project Contact Information

Pennsylvania DOT

Project Details

Program started: N/A

(or miles) where this is applied:

Comments: Several other states have used the curve arrow alone, without the bars and “SLOW” message.

Potential benefit: Additional emphasis with pavement marking warning can help reduce lane departure crashes on curves.

Cost of using innovation: N/A

Crash reduction factor (if applicable): N/A

4 Roadside and Clear Zone

- 4-1 Mowing Entire ROW (Paved Roads)
- 4-2 Mowing/Clearing Railroad ROW (with permission)
- 4-3 Safety Dikes (Ramps) at T Intersections
- 4-4 Flattening Slopes of Entrances and Drives
- 4-5 Maintenance Shouldering/Flattening Slopes
- 4-6 County Entrance Slope Survey Data from Iowa DOT
- 4-7 Removal of Hazard(s) in Clear Zone
- 4-8 Utility Pole Relocation

Roadside and Clear Zone

4-1 Mowing Entire ROW (Paved Roads)



www.ctre.iastate.edu/ltap



Flat and level terrain (left) and a typical county road (right) (photos courtesy of Bob Sperry)

Project Contact Information

Dennis Osipowicz, P. E.
Lee County Engineer
933 Avenue H
Fort Madison, IA 52627
Phone: 319-372-2541
denniso@LeeCounty.org

Project Details

Program started: 2004

(or miles) where this is applied: ~156 miles of ACC & PCC roads

Comments: Although Lee County began their program of mowing full roadsides mainly to keep the brush down and to improve visibility, members of the public came to them with thanks for helping to reduce the animal crashes. Lee County uses 4 mowers AFTER August 1st. Boone County also uses this program.

Potential benefit: Increased visibility provides more reaction time, thereby reducing animal crashes, and the absence of tree hazards reduces crash severity, when they do occur.

Cost of using innovation: Usually mow or spray anyway—no increase

Crash reduction factor (if applicable): N/A, but should reduce animal crashes and severity

Roadside and Clear Zone

4-2 Mowing/Clearing Railroad ROW (with permission)



Visibility at skewed crossing (left) and looking south (right) (photos courtesy of Bob Sperry)

Project Contact Information

John Goode, P. E.
Monroe County Engineer
10 Benton Avenue E. #6
Albia, IA 52531
Phone: 641-932-7123
jgoode@monroecoia.us

Project Details

Program started: ~1998 with Appanoose Co. railroad (1 train a week)

(or miles) where this is applied: Four crossings

Comments: Due to the fact that the rail line involved had only one train a week and a skewed intersection made it potentially unsafe for vehicular traffic, the railroad and the county engineer agreed that the road crew could work on the railroad ROW to clear brush for better visibility. The public greatly appreciates improved sight distance.

Potential benefit: Additional advance warning of a train approaching is made possible by providing better driver visibility.

Cost of using innovation: Mowers are out anyway—minimal after first clearing

Crash reduction factor (if applicable): N/A

Roadside and Clear Zone

4-3 Safety Dikes (Ramps) at T Intersections



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Entrance provides safety ramp at T intersection (photo courtesy of Bob Sperry)

Project Contact Information

Darren Moon, P. E.
Story County Engineer
837 N Avenue
Nevada, IA 50201
Phone: 515-382-7355
engineer@storycounty.com

Project Details

Program started: Late 1980s when DOT volunteer program started

(or miles) where this is applied: Most all T intersection locations

Comments: This has been a very simple and inexpensive program to participate in. Utilizing much of the dirt that was (and is) created from our maintenance ditching practices, safety dikes at T intersections were installed for only the cost of culverts, shaping, and re-seeding. Those that did not require culverts were done first, so our expenses were minimal and our safety efforts could be seen by the public.

Potential benefit: Building ramps at T intersections provides a safe slope for descent for those drivers who either miss the warning signs or run a Stop sign.

Cost of using innovation: Cost of required culvert if incorporated with normal ditch cleaning maintenance.

Crash reduction factor (if applicable): N/A

Roadside and Clear Zone

4-4 Flattening Slopes of Entrances and Drives



Additional culvert provided to flatten entrance slopes (photo courtesy of Bob Sperry)

Project Contact Information

Robert J. Kieffer, P. E.
Boone County Engineer
201 State Street
Boone, IA 50036
Phone: 515-433-0530
engineer@co.boone.ia.us

Project Details

Program started: Late 1980s when DOT volunteer program started

(or miles) where this is applied: Many paved road locations were done early, then later flattened in conjunction with projects and for new entrances as they were required.

Comments: This has been a very simple and inexpensive program to participate in. Although this photo is along a recent grading/shouldering project, the county has utilized much of the dirt that is collected by standard ditching practices to flatten the slopes at entrances and drives. Those that did not require culverts were done first so expenses were minimal and our safety efforts could be seen by the public.

Potential benefit: Flattened slopes are especially effective in reducing crash severity at locations where lane departures are a problem.

Cost of using innovation: Minimal—hauling, shaping, and re-seeding; culvert expense at locations with existing (or needed) culverts.

Crash reduction factor (if applicable): N/A

Roadside and Clear Zone

4-5 Maintenance Shouldering/Flattening Slopes



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Work in progress on Buchanan County local road (photos courtesy of Brian Keierleber)

Project Contact Information

Brian Keierleber, P. E.
Buchanan County Engineer
1511 1st St E
Independence, IA 50644-3123
Phone: 319-334-6031
engineer@co.buchanan.ia.us

Project Details

Program started: N/A

(or miles) where this is applied: N/A

Comments: County does much of their own shouldering on road projects.

Potential benefit: The addition of shoulders and flattening slopes is a very good countermeasure for areas of lane departure crashes.

Cost of using innovation: Unknown

Crash reduction factor (if applicable): Up to 42% for injury crashes (slope dependent)

Roadside and Clear Zone

4-6 County Entrance Slope Survey Data from Iowa DOT



Before (left) and after (right) (photos courtesy of Bob Sperry)

Project Contact Information

LeRoy Bergmann, P. E.
Secondary Roads Engineer
Iowa DOT
800 Lincoln Way
Ames, IA 50010
Phone: 515-239-1506
LeRoy.Bergmann@dot.iowa.gov

2008 survey summary of Iowa counties:

- Started 1989
- 137,187 total county entrances on paved roads
 - 51,462 dry; 84,709 pipe
- 19,219 flattened or removed by February 2004
- 24,904 flattened or removed by February 2008
 - 12,281 dry; 12,623 pipe

Project Details

Program started: 1989

(or miles) where this is applied: Information is updated annually by DOT with information provided by counties

Comments: This strategy has proven to be a very popular and effective program in the entire state. Although the number of improvements made varies with individual counties, most have made significant progress in making their roadways safer using this strategy.

Potential benefit: Flattened slopes throughout the state by way of a voluntary compliance program ARE making Iowa's roads more forgiving to errant drivers.

Cost of using innovation: N/A

Crash reduction factor (if applicable): N/A

Roadside and Clear Zone

4-7 Removal of Hazard(s) in Clear Zone



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Removal of hazard(s) in clear zone (photos courtesy of Jack Latterell)

Project Contact Information

Jim George, P. E.
Dallas County Engineer
415 River Street
Adel, IA 50003
Phone: 515-993-4289
jgeorge@co.dallas.ia.us

Project Details

Program started: Many counties

(or miles) where this is applied: Varies

Comments: Removal of hazards in the clear zone should always be considered first; however, if it is not possible, then look at other possible mitigation strategies, such as shielding or delineation. This practice has been a priority

in Iowa for several years, and legislation was enacted in 2006 which clarified responsibilities. An ad hoc committee of the Iowa County Engineer's Association has developed (and is distributing) some standardized sample forms and "tools" that can be used by individual counties in the process of making their roads safer. The successful process can be very slow and politically challenging, but the rewards to the traveling constituents are great, as well as to those involved in the process.

Potential benefit: Removal of hazards from the clear zone can eliminate, or at the least greatly reduce, crash severity resulting from lane departures.

Cost of using innovation: N/A

Crash reduction factor (if applicable): Up to 38% for all crashes for removal from clear zone; less for widening existing clear zone.

Roadside and Clear Zone

4-8 Utility Pole Relocation



Poles moved back to ROW line (photo courtesy of Bob Sperry)

Project Contact Information

Robert J. Kieffer, P. E.
Boone County Engineer
201 State Street
Boone, IA 50036
Phone: 515-433-0530
engineer@co.boone.ia.us

Project Details

Program started: With construction projects

(or miles) where this is applied: In conjunction with grading projects where additional strip right-of-way must be acquired to accommodate new cross section.

Comments: Normally, relocation of utilities from existing right-of-way limits to new expanded right-of-way limits has been done at no cost, providing adequate notice has been given to the utility company. As the utility company's cost of that relocation work has inflated in recent years, the question of who should pay those costs continues to be re-evaluated. Early communication is strongly recommended with the utility company during the planning and preliminary design stages of a project.

Potential benefit: Striving to maintain utility poles and guy wires as far away from the clear zone as possible provides the highest degree of safety for lane departure crashes.

Cost of using innovation: Dependent on utility type and initial position of lines.

Crash reduction factor (if applicable): Up to 44% for all crashes, depending on width of clear zone.

5 Guardrail and Barriers

- 5-1 Reflective Tape on Guardrail
- 5-2 Reflective Paint on Guardrail
- 5-3 Roadside Cable Barrier
- 5-4 Roadside Beam Guardrail
- 5-5 High Tension Cable Guardrail (Medians)

Guardrail and Barriers

5-1 Reflective Tape on Guardrail



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Additional emphasis to alignment provided here (photos courtesy of Iowa DOT)

Project Contact Information

Tom Welch, P. E.
Iowa DOT Safety Engineer
800 Lincoln Way
Ames, IA 50010
Phone: 515-239-1267
Tom.Welch@dot.iowa.gov

Project Details

Program started: N/A

(or miles) where this is applied: On IA 212 between Belle Plain & Marengo

Comments: This treatment has been used and found to be very effective when placed on guardrail on a bridge approach and especially in a horizontal curve.

Potential benefit: This visual treatment provides the driver with additional awareness and reaction time when approaching an area of changing alignment and/or physical width restriction.

Cost of using innovation: N/A

Crash reduction factor (if applicable): N/A

Guardrail and Barriers

5-2 Reflective Paint on Guardrail



Reflective paint on guardrails (photos courtesy of EZ Liner Industries [top] and Bob Sperry [bottom])

Project Contact Information

Doug Julius, P. E.
Sioux County Engineer
P.O. Box 17
Orange City, IA 51041
Phone: 712-737-2248
dougj@siouxcounty.org

Project Details

Program started: Trial Application in fall 2007

(or miles) where this is applied: On B30 just west of K22 plus another Sioux County bridge

Comments: This treatment option has also been used and found to be very effective when placed on guardrail on a bridge approach and especially in a horizontal curve. EZ Liner Industries of Orange City applied paint and beads to these guardrails in the fall of 2007 as an experimental trial. Although they are still in the evaluating stage, county engineer Julius believes that it has been and will be a very effective and economical safety strategy.

Potential benefit: This visual treatment provides the driver with additional awareness and reaction time when approaching an area of changing alignment and/or physical width restriction.

Cost of using innovation: Not yet priced for commercial work

Crash reduction factor (if applicable): N/A

Guardrail and Barriers

5-3 Roadside Cable Barrier



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Cable guardrail for embankment area (left) and at curve location (right) (photos courtesy of Tom McDonald)

Project Contact Information

Winnebago County Engineer
126 South Clark
Forest City, IA 50436
Phone: 641-585-2891
dreisetter@wctatel.net

Project Details

Program started: 2008

(or miles) where this is applied: Spot locations

Comments: The cable guardrail provided in the left photo helps protect drivers from run-off-road crashes at a high embankment area. In the right photo, a cable guardrail is at a location where the horizontal alignment changes and run-off-road incidents are more likely. This technique is also used in Story County.

Potential benefit: This strategy provides driver protection for lane departures to avoid leaving the road or hitting an immovable hazard near the clear zone, including embankments and water bodies.

Cost of using innovation: ~\$3950

Crash reduction factor (if applicable): Up to 63% for outside curve

Guardrail and Barriers

5-4 Roadside Beam Guardrail



Guardrail along embankment to edge of lake (photo courtesy of Bob Sperry)

Project Contact Information

Darren Moon, P. E.
Story County Engineer
837 N Avenue
Nevada, IA 50201
Phone: 515-382-7355
engineer@storycounty.com

Project Details

Program started: Early 1980s

(or miles) where this is applied: Various locations around a county lake maintained by the Conservation Board. Beam guardrail was installed for protection soon after lake was constructed and before trees along edge had matured.

Comments: Can be costly to maintain if impacted and can cause snow drifting in winter.

Potential benefit: This strategy is used where lane departure crashes, especially involving large vehicles, are a problem and at sites that would result in more severe damage.

Cost of using innovation: N/A

Crash reduction factor (if applicable): Up to 7% for all crashes

Guardrail and Barriers

5-5 High Tension Cable Guardrail (Medians)



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HTC protection of bridge pier (photo courtesy of Bob Sperry)



I-35 from bridge overpass (photo courtesy of Ryan Pettit)

Project Contact Information

Tom Welch, P. E.
Iowa DOT Safety Engineer
800 Lincoln Way
Ames, IA 50010
Phone: 515-239-1267
Tom.Welch@dot.iowa.gov

Project Details

Program started: Summer 2008

(or miles) where this is applied: Various locations along Interstates I-80 and I-35 to minimize/eliminate cross-median crashes.

Comments: Photos show double segments because they are at a bridge location. Typical installation is on one side only. Maintenance effects need to be determined. The high tension cable guardrail does not allow U turns by enforcement or maintenance forces. Several states have used it very successfully in the past few years. See report from Washington State DOT, <http://www.wsdot.wa.gov/projects/cablebarrier/Report2008>.

Potential benefit: HTC guardrail is highly effective for hazard (pier) protection and as a countermeasure for median crossover crashes.

Cost of using innovation: N/A

Crash reduction factor (if applicable): Up to 92% for head-on crashes and up to 29% for injury crashes.

6 Lighting

- 6-1 Destination Lighting
- 6-2 Intersection Lighting

Lighting

6-1 Destination Lighting



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Day (left) and night (right) photos (photos courtesy of Bob Sperry)

Project Contact Information

Darren Moon, P. E.
Story County Engineer
837 N Avenue
Nevada, IA 50201
Phone: 515-382-7355
engineer@storycounty.com

Project Details

Program started: ~1995

(or miles) where this is applied: Intersections that include two paved roads

Comments: Although this destination lighting does not provide total illumination of the

intersection (as at major state highway locations), it does provide a visual guide for nighttime travel and usually increased visibility for the signs in that area. Most counties that are allowed to pay a monthly rental charge (such as a “yard light” for homeowners) choose to do this rather than the more expensive option of having a fully metered light. It is easy to do a light or two at a time (highest priority first). Grundy County has these installed at every intersection that includes two paved roads.

Potential benefit: The illumination these lights provide is a good countermeasure along paved routes at locations where nighttime crashes involve Stop sign running or a failure to yield.

Cost of using innovation: Installation ~\$250–\$750; monthly maintenance ~\$8–\$15 a month

Crash reduction factor (if applicable): N/A

Lighting

6-2 Intersection Lighting



Breakaway base closeup (photo courtesy of Iowa DOT)

Project Contact Information

DOT – Polk County site

Project Details

Program started: Mostly DOT

(or miles) where this is applied:

Comments: Use breakaway or slip base in clear zone (as shown above).

Potential benefit: Breakaway bases add a greater degree of driver protection where lighting poles must be located near the clear zone.

Cost of using innovation: N/A

Crash reduction factor (if applicable): N/A

7 Pavements and Shoulders

- 7-1 Adding 2 ft of Additional Paving at Curves
- 7-2 Recycling (4 in.) and Resurfacing (3 in.) at 24 ft Width and Marking Pavements at 22 ft Width
- 7-3 Skid Resistant Treatments and Overlays
- 7-4 Safety Edge Attachment for ACC Paving

Pavements and Shoulders

7-1 Adding 2 ft of Additional Paving at Curves



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Additional shoulder begins before and carries through curve (photos courtesy of Bob Sperry)

Project Contact Information

Kurt Bailey, P. E.
Polk County Engineer
NE 14th Street
Des Moines, IA 50313
Phone: 515-286-3705
kbailey@co.polk.ia.us

Project Details

Program started: ~1980s

(or miles) where this is applied: Most routes have minimum of additional 2 ft on curves.

Comments: As Polk County's safety awareness and subsequent program began, adding 2 ft wide strips to the inside and outside of horizontal curves was one of the first initiatives undertaken. This helped to achieve the desired effect of minimizing run-off-road crashes on curves. The practice has continued through the years, increasing to three additional feet and then to continuous shoulders on many projects.

Potential benefit: Providing additional shoulder width, especially on horizontal curves, is a good counterstrategy for lane departure to the right and swerving crashes at those locations.

Cost of using innovation: Cost of additional asphalt, if adequate roadbed exists.

Crash reduction factor (if applicable): Up to 16% for all crashes

Pavements and Shoulders

7-2 Recycling (4 in.) and Resurfacing (3 in.) at 24 ft Width and Marking Pavements at 22 ft Width



Photos show additional paved foot for errant vehicles (photos courtesy of Bob Sperry)

Project Contact Information

Royce Fichtner, P. E.
Marshall County Engineer
E Church Street
Marshalltown, IA 50158-4915
Phone: 641-754-6343
rfichtner@co.marshall.ia.us

Project Details

Program started: 2005

(or miles) where this is applied: 11.5 miles
(some trenched in for widening)

Comments: As Cold In-Place Recycling
for asphalt has become very popular as a

rehabilitation technique, Marshall County has begun recycling a 12 ft lane width (standard milling head width) and then resurfacing the full 12 ft; however, by repainting the edge line back at the old 11 ft lane width, the need for edge maintenance for drop-offs is negligible, and they have allowed an extra solid foot of travel way for those vehicles that might have strayed slightly off the roadway.

Potential benefit: Providing additional shoulder width, on straight segments and on horizontal curves, is a good counterstrategy for lane departure to the right and swerving crashes at those locations.

Cost of using innovation: Normally, about 190 tons/mile—two sides

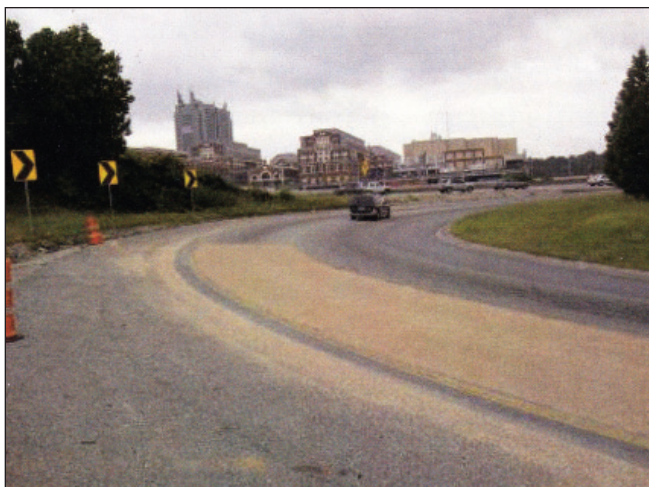
Crash reduction factor (if applicable): Up to 12% for all crashes

Pavements and Shoulders

7-3 Skid Resistant Treatments and Overlays



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Photos of road (left) and close-up (right) (photos courtesy of FHWA)

Project Contact Information

See bibliography #4, p. 47

Project Details

Program started: N/A

(or miles) where this is applied: N/A

Comments: Many counties have attempted to increase the skid resistance on some of their highways that have high number of wet-weather accidents. In addition to the standard sealcoat applications (sometimes with special cover aggregate) that are used for temporary improvement, several commercial products are available. One of these that has been introduced to the DOT, but not yet used, is Tyregrip.

Potential benefit: Increasing skid resistance is an effective countermeasure for crashes occurring in wet conditions.

Cost of using innovation: N/A

Crash reduction factor (if applicable): Up to 30% for fatal/injury crashes

Pavements and Shoulders

7-4 Safety Edge Attachment for ACC Paving



Close-up of safety edge in place on paver (left) and 30° edge slope (right) (photos courtesy of FHWA)

Project Contact Information

Todd Kinney, P. E.
Clinton County Engineer
1900 N 3rd, PO Box 2957
Clinton, IA 52733
Phone: 563-244-0564
tkinney@clintoncountyiowa.com

The safety wedge shoe is a special edging device that asphalt paving contractors can install on new or existing resurfacing equipment to shape the safety edge.

Project Details

Program started: N/A

(or miles) where this is applied: N/A

Comments: Clinton County had their asphalt contractor use this edging device on a project in late September. The county also worked with the FHWA to set up an open house for all interested agencies to view the workings and results.

Potential benefit: This device provides a 30° traversable slope on the outside of asphalt resurfacing. When exposed by the development of edge rutting, that slope allows safe reentry to the lane by a vehicle that has begun to depart the lane.

Cost of using innovation: FHWA currently has a wedge shoe to lend to contractors, IF it is available.

Crash reduction factor (if applicable): N/A

8 Intersections

8-1 Offset Right-Turn Lane

8-2 Roundabouts

Intersections

8-1 Offset Right-Turn Lane



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Looking NE along IA-137 (left) and looking SW along IA-137 (right) (photos courtesy of Ryan Pettit)

Project Contact Information

John Goode, P. E.
Monroe County Engineer
10 Benton Avenue E. # 6
Albia, IA 52531
Phone: 641-932-7123
jgoode@monroecoia.us

Project Details

Program started: Built 2005

(or miles) where this is applied: This site only

Comments: This offset right-turn lane was constructed as a part of a “RISE” economic development project and was designed to accommodate right-turning traffic (at full growth level) for an ethanol plant near Eddyville. In this wintertime picture, the function is not very clear, but the purpose is to move turning traffic from the line of vision for vehicles at the intersecting road Stop sign and thus reduce potential broadside crashes for entering traffic.

Potential benefit: Offset turn lanes are an excellent countermeasure for intersection accidents involving turning movements because of the increased visibility they provide the drivers.

Cost of using innovation: ~\$250,000

Crash reduction factor (if applicable): N/A

Intersections

8-2 Roundabouts



Roundabout in Coralville, Iowa (Photo by Coralville Engineering Department 2003)

Project Contact Information

Scott Larson, P. E.
Assistant City Engineer
1512 7th Street
Coralville, IA 52241
Phone: 319-248-1700
utilitybilling@cicoralville.ia.us

Project Details

Program started: Built 2002; success of the first roundabout cleared the way for the construction of three more in the past three years, with more planned.

(or miles) where this is applied: Four locations

Comments: The benefits of building a roundabout at what was previously an awkward

Y intersection were immediately evident when it opened to traffic. Vehicle speeds through the intersection were greatly reduced and the peak-hour delays have dropped significantly. Non-peak performance is also outstanding when compared to all-way stop or signal-controlled intersections. For 20+ hours each day, traffic is basically free flowing in all directions.

Potential benefit: This intersection design provides traffic control without stops, increasing volume capacity and minimizing turning conflicts.

Cost of using innovation: This roundabout was part of a much larger \$1.5 million street improvement. There were cost savings by using a roundabout instead of widening for left-turn lanes and installing traffic signals, but a majority of those savings were put back into substantial streetscaping of the roundabout since it was the city council's desire for it to be a significant gateway in this part of the city.

Crash reduction factor (if applicable): N/A

9 Railroad Crossings

- 9-1 Channelizers for Lane Guidance and at Railroad Crossings
- 9-2 Medians at Railroad Crossings
- 9-3 Stop Signs at Railroad Crossings

Railroad Crossings

9-1 Channelizers for Lane Guidance and at Railroad Crossings



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*Longitudinal channelizers at railroad crossings reduce gate violations
(left photo courtesy of Peter Speer)*



(right photo courtesy of Bob Sperry)

Project Contact Information

Nevada City Administrator

Nevada City Hall
1209 6th Street
Nevada IA 50201
Phone: 515-382-5466

Project Details

Program started: Spring 2006; Quiet Zone is in effect July 15, 2006.

(or miles) where this is applied: Major street crossings with Union Pacific Railroad

Comments: Longitudinal channelizers are delineators that are commonly used to direct vehicles and prevent particular movements. Depending on where the channelizers are used, they may be between 18 in. and 36 in. tall, spaced about 32 in. apart, and may be yellow or

orange in color. The photos above show yellow channelizers being used to separate traffic movements at railroad crossings.

The ability of longitudinal channelizers to reduce speed, however, is not well documented. The majority of research regarding these devices pertains to use at highway–railroad grade crossings. These delineators (right photo) have been placed along the centerline of the roadway, extending about 100 ft from the railroad gates, to dissuade motorists from driving around the crossing gates ahead of an oncoming train.

Potential benefit: The visual guidance provided by these delineators helps drivers stay in the intended lane, both in areas of high speed and where lane changing is strongly discouraged.

Cost of using innovation: N/A

Crash reduction factor (if applicable):

Effectiveness factor = 0.75 (49CFR, Part 222, Appendix A, paragraph 3)

Railroad Crossings

9-2 Medians at Railroad Crossings



Looking N towards the railroad on 10th Street (photo courtesy of Bob Sperry)

Project Contact Information

Nevada City Administrator

Nevada City Hall
1209 6th Street
Nevada, IA 50201
Phone: 515-382-5466

Project Details

Program started: Built 2008

(or miles) where this is applied: This site only

Comments: This median has been placed along the centerline of the roadway, extending about 100 ft from the railroad gates, to dissuade motorists from driving around the crossing gates ahead of an oncoming train.

Potential benefit: The physical and visual guidance provided by these median segments help drivers stay in the intended lane where lane changing is strongly discouraged.

Cost of using innovation: ~\$2,500 for materials and labor to install

Crash reduction factor (if applicable):
Effectiveness factor = 0.80 (49CFR, Part 222, Appendix A, paragraph 3)

Railroad Crossings

9-3 Stop Signs at Railroad Crossings



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Note that railroad is very close to roads intersection (photo courtesy of Jack Latterell)

Project Contact Information

Jim Hyde, P. E.
Worth County Engineer
1000 Central Ave
Northwood, IA 50459
Phone: 641-324-2154
engineer@worthcounty.org

Project Details

Program started: N/A

(or miles) where this is applied: N/A

Comments: Although a few counties have placed Stop signs at all crossings in their counties, most use them selectively where limited sight distance or other traffic concerns occur. Yield signs could also be used for this purpose and would not require a legal stop when no train was approaching.

Potential benefit: A stop condition at a site which requires additional bending and stretching for a driver's proper review is an excellent countermeasure for car/rail crashes or near misses.

Cost of using innovation: \$75 for sign (plus post, if separate one is used)

Crash reduction factor (if applicable): N/A

10 Bridges and Culverts

10-1 Guardrail at Culvert Ends

10-2 Guardrail at Bridge Ends

Bridges and Culverts

10-1 Guardrail at Culvert Ends



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Guardrail provides protection from drop-off hazard (photo courtesy of Bob Sperry)

Project Contact Information

Darren Moon, P. E.
Story County Engineer
837 N Avenue
Nevada, IA 50201
Phone: 515-382-7355
engineer@storycounty.com

Project Details

Program started: 1980s

(or miles) where this is applied: N/A

Comments: Length of required guardrail depends on dimensions of culvert end (or other hazard) being shielded.

Potential benefit: Guardrail provides drivers protection from protruding roadside hazards along roadways that cannot be removed.

Cost of using innovation: \$7,000–\$10,000 per side

Crash reduction factor (if applicable): Up to 27% for all crashes

Bridges and Culverts

10-2 Guardrail at Bridge Ends



Approach guardrail on typical bridges (photos courtesy of Bob Sperry)

Project Contact Information

Robert J. Kieffer, P. E.
Boone County Engineer
201 State Street
Boone, IA 50036
Phone: 515-433-0530
engineer@co.boone.ia.us

Project Details

Program started: 1970s

(or miles) where this is applied: Most bridges on the Federal Aid Route, as required by current standards at the time of construction

Comments: Note that these photos both show recent installations with guardrail, but they are different due to required standards. Current standards require guardrail on all federally funded bridges—at all four corners on collector routes and at approach corners on local, unless a design exception to omit the guardrail can be justified by current criteria and is approved.

Potential benefit: Bridge guardrail can provide life-saving protection from direct impacts with concrete abutments, as well as keep errant drivers from leaving the road over the embankment.

Cost of using innovation: \$3,000–\$4,000 per corner

Crash reduction factor (if applicable): Up to 22% for all crashes and up to 90% for fatal crashes

11 Miscellaneous

11-1 Crash Study Methodology

11-2 Resource Allocation Strategy

11-3 Creating Positive relationships with Law Enforcement

Miscellaneous

11-1 Crash Study Methodology



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Reference: Bibliography # 1, p. 33

Because of the large number of roads under each agency's jurisdiction and the fact that bringing them all up to present day design standards is impossible, local agencies are looking for the best way to spend their limited funds. Many entities choose to review potential project sites by evaluating crash histories, identifying above-average crash occurrences or patterns, and applying as many low-cost safety improvements (including those listed in this handbook) to those sites to address as many safety concerns as practical. The process of a common crash study includes six basic steps, as follows:

- 1) Identify those sites with potential safety problems. Consider the following:
 - Deficient or inadequate road geometry, including width, grades, alignment and sight distance
 - Lack of passing opportunities due to limited sight distances or heavy oncoming traffic volumes
 - Traffic conflicts due to turns at intersections and drives
- 2) Characterize the crash experience at those locations. Consider the following:
 - Number and types of crashes *
 - Review of crash report forms *
 - Preparation of collision diagrams, if applicable *
 - Field visits

*A reminder that the Iowa DOT is able to provide not only the crash data and the CMAT (or SAVER) program (with training) for a local agency's use in these endeavors, but also specific detailed crash reports, analysis (by sorting), and diagrams, both with their own staff (see <http://www.iowadot.gov/traffic/sections/safety.htm>) and also thru the Iowa Traffic Safety Data Service at CTRE (<http://www.ctre.iastate.edu/services.htm#itsds>).

- 3) Characterize field conditions. Investigate, observe, and identify the following:
 - Physical condition of the site
 - Geometrics
 - On-site observation timed to correspond with the safety concern
 - Take photographs to document geometric or operational problems for later review
 - Develop condition diagrams
 - Obtain traffic volumes, speeds, and vehicle classification counts

- 4) Identify contributing factors and appropriate countermeasures:
 - Detailed investigations of crashes
 - Review of site plans
 - Site visits
 - Review of other related transportation engineering studies and technical literature
- 5) Assess countermeasures and select the most appropriate:
 - Identify all possible countermeasures, including doing nothing
 - Identify combinations of countermeasures
 - Identify practical limitations and restraints
 - Identify the potential effect of each alternative
- 6) Implement countermeasures and evaluate effectiveness:
 - FHWA has developed detailed evaluation procedures – See references # 9-13
 - Other recommended evaluation procedures
 - Before-and-after study with control sites
 - Before-and-after study without control sites
 - Comparative parallel study (side by side with similar road section)
 - Before, during, and after study (this is considered the most desirable of the four above)

Miscellaneous

11-2 Resource Allocation Strategy



www.ctre.iastate.edu/ltap

Reference: Bibliography # 5

Limited funding mechanisms for needed and cost-beneficial safety improvements (and often even maintenance needs) normally force agencies to consider many things in addition to the aforementioned benefit/cost ratios previously discussed. Certainly, risk management must be considered, as sometimes the most cost-beneficial projects are NOT the same ones where the most risk exposure lies for an entity.

The final decision of how much of and where an agency's financial resources are to be made is sometimes more political than analytical, but many tools are available and presented in this NCHRP report.

More often than not, small agencies do not have the time or the staff to carry out a full analysis like this, but it is very important that they review and fully evaluate those potential projects which are considered for funding. The agencies need to be able to justify narrowing decisions and final recommendations to policy makers and constituents using logical and well-conceived methods.

Staff at the Offices of Local Systems and/or Traffic and Safety at the Iowa Department of Transportation or Center for Transportation Research and Education at Iowa State University are available for assistance and advice.

Miscellaneous

11-3 Creating Positive Relationships with Law Enforcement

During the crash study process described earlier, little was mentioned about consulting with others in regard to the evaluation of crash experience, field site conditions, identifying contributing factors, and planning appropriate countermeasures to the safety performance of a particular area. However, experienced highway authorities realize that the engineering perspective is indeed just that! A perspective! We know that we can not (at least can not afford to) “design out” all of the crash-producing factors that are involved with crashes. There are many other types of factors that must also be identified and improved if we expect significant positive results for our low-cost safety improvement applications.

One of the oldest methods of reviewing other crash history perspectives has been to review crash sites and other potential problem areas and to discuss details with law enforcement officers and area landowners. Their observations and sometime opinions may be valuable sources of information for gaining insight into the REAL problems at your site. This relationship with law enforcement personnel is best utilized if it is constantly cultivated so that both entities feel encouraged and supported by the other to share information about what road safety problems they are seeing and feeling. Although the goal would be to verbally discuss issues when fresh in one’s mind, short monthly (or weekly) meetings, sometimes over coffee or breakfast, are a great start. In the event of serious safety problems, a field visit together can often produce more results than a discussion in an office.

As these relationships grow, many other safety venues will open up, as the community notes the “safety sense” of the highway authority and law enforcement. Add some local media coverage and promotional advertisements, and you may soon have a variety of people involved and might wish to create a safety consortium to let all contribute to the advancement of highway safety utilizing their own unique skills. These persons along with your original partner, the law enforcement officer(s), are the perfect basis for performing road safety assessments or audits, as they are called. For more information, see <http://safety.fhwa.dot.gov/rsa/>.

What is the final result? A more forgiving and safer road system, an informed and safety-conscious public, and a much larger group of persons who take responsibility and have pride in the road system they have helped improve.

Bibliography



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- 1 American Traffic Safety Services Association. *Low Cost Local Road Safety Solutions*. Fredericksburg, VA: American Traffic Safety Services Association, Revised March 2006.
- 2 Wilson, Eugene M., *Roadway Safety Tools for Local Agencies*. NCHRP Synthesis 321. Washington, DC: Transportation Research Board, 2003.
- 3 Mahoney, Kevin M., Frank Julian, and Harry W. Taylor, Jr., *Good Practices: Incorporating Safety into Resurfacing and Restoration Projects*. FHWA-SA-07-001. Washington, DC: Federal Highway Administration, December 2006.
- 4 McGee, Hugh W. and Fred R. Hanscom., *Low Cost Treatments for Horizontal Curve Safety*. FHWA-SA-07-002. Washington, DC: Federal Highway Administration, December 2006.
- 5 Harwood, D. W., Kohlman Rabbani, E. R., Richard, K. R., McGee, H. W., and G. L. Gittings. *Systemwide Impact of Safety and Traffic Operations Design Decisions for 3R Projects*. NCHRP Report 486. Washington, DC: Transportation Research Board, 2003.
- 6 Shauna Hallmark, Peterson E., Fitzsimmons E., Hawkins N., Resler J., and Tom Welch. *Evaluation of Gateway and Low-Cost Traffic-Calming Treatments for Major Routes in Small Rural Communities*. Report TR-523. Washington, DC: Federal Highway Administration, October 2007. <http://www.ctre.iastate.edu/reports/traffic-calming-rural.pdf>.
- 7 Hallmark, S. *Evaluation of Rumble Stripes on Low-Volume Rural Roads in Iowa*. In progress. <http://www.ctre.iastate.edu/research/detail.cfm?projectID=1594879152>.
- 8 Goodell-Grivas, Inc. *Highway Safety Evaluation: Procedural Guide*. FHWA-TS-81-219. Washington, DC: Federal Highway Administration, US Department of Transportation, November 1981.
- 9 Robertson, H.D., J.E. Hummer, and D.C. Nelson. *Manual of Transportation Engineering Studies*. Washington, DC: Institute of Transportation Engineers, 1994.
- 10 Council, F.M., Reinfurt, D.W., and B. J. Campbell. *Accident Research Manual*. FHWA/RD-80/016. Washington, DC: Federal Highway Administration, US Department of Transportation, February 1980.
- 11 Hauer, E. *Observational Before-After Studies in Road Safety*. Tanytown, NY: Peragamon/Elsevier Science Inc., 1997.
- 12 Latham, F.E., and J.W. Trombly. *Low Cost Traffic Engineering Improvements: A Primer*. FHWA-OP-03-078. Washington, DC: Federal Highway Administration, April, 2003. http://ops.fhwa.dot.gov/publications/low_cost_traf/low_cost_traf.pdf.
- 13 Federal Highway Administration. *Toolbox of Countermeasure and Their Potential Effectiveness for Roadway Departure Crashes*. FHWA-SA-07-013. Washington, DC: Federal Highway Administration, September, 2007. <http://www.transportation.org/?siteid=35&pageid=1490>.
- 14 Lindley, Jeffrey A. *ACTION: Consideration and Implementation of Proven Safety Countermeasures*. Memorandum. Washington, DC: Federal Highway Administration, US Department of Transportation, 2008.

