



Center for Transportation
Research and Education

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RESEARCH PROJECT TITLE

Safety Benefits of Paved Shoulders

SPONSORS

Iowa Department of Transportation
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The Midwest Transportation Consortium provided funding for a graduate research assistant assigned to this project.

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IOWA STATE UNIVERSITY
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Safety Benefits of Paved Shoulders

tech transfer summary

Paved shoulders can help accommodate non-motorized vehicles, allow errant vehicles to recover, and effectively reduce crash numbers.

Objectives

The Iowa Department of Transportation (Iowa DOT) requested this study to quantify the benefits and safety performance of various paved shoulder designs on several traffic and roadway types.

Problem Statement

According to a 2003 report from the National Cooperative Highway Research Program, single-vehicle run-off-road (ROR) crashes are the most common type of fatal passenger vehicle crashes in the United States. In Iowa, ROR crashes in 2006 accounted for 9% of total crashes, 32.6% of total fatal crashes, 36% of all rural crashes, and more than 61.8% of rural fatal crashes.

In addition to their other roles in highway design, paved shoulders are one possible countermeasure for ROR crashes. Iowa adopted a paved shoulder policy for higher volume roads in 2004, but diverse paved shoulder types had been used for many years earlier. While several studies have indicated that paved shoulders effectively reduce crashes (and provide other benefits), a limited number of studies quantify the crash reduction benefits for various paved shoulder types.



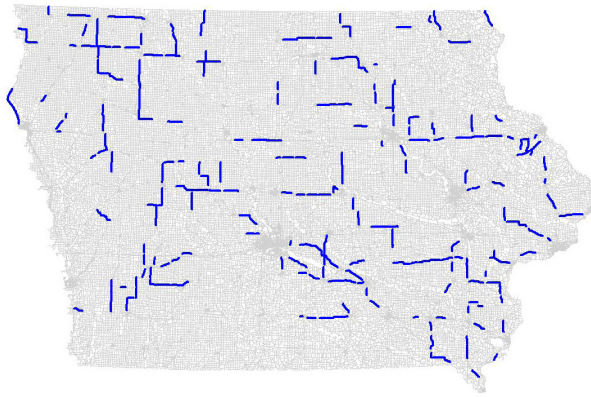
Earth shoulder



Fully paved shoulder

Research Methods

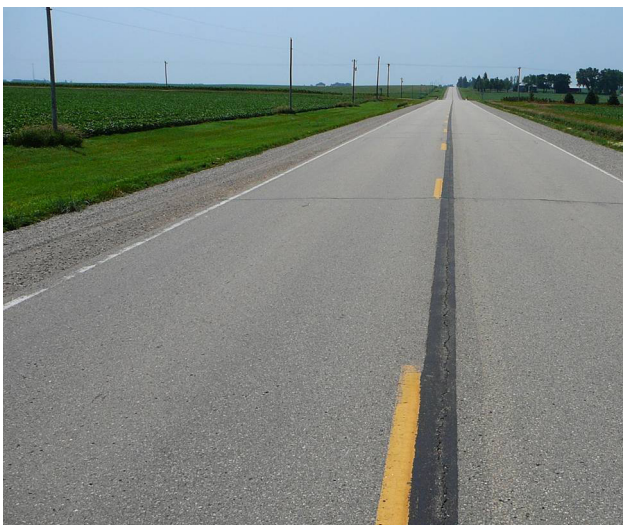
The research primarily involved a before-and-after crash analysis of various non-Interstate Iowa roadways where paved shoulders have been installed. A paved shoulder was defined as a shoulder with at least 1 ft of paved material beyond the painted edge line. The analysis covered 220 roadway segments, including 77 control sections without paved shoulders and 143 test sections with paved shoulders.



Locations of 220 segments used for analysis

A generalized linear model (GLM) was used to investigate the relationship between paved shoulder implementation and crash reduction. The response variable was monthly crash frequency. Other variables included traffic volume, segment length, season, presence of rumble strips, shoulder width, and presence of a divided median.

In addition, two surveys assessed the subjective opinions of field maintenance and law enforcement personnel regarding paved shoulders.



Two-lane highway with unpaved shoulders

Key Findings

- Most maintenance personnel felt that paved shoulders help reduce maintenance costs. Most law enforcement personnel felt that paved shoulders reduce ROR crashes and improve safety during traffic stops.
- Roadway sections with paved shoulders had fewer crashes in the period after installation than either the control sections or the pre-installation test sections.
- Season was significant for predicting the number of total monthly crashes; a higher number of crashes occurred in winter and fall than in spring and summer.
- The presence of rumble strips, paved shoulder width, unpaved shoulder width, and the presence of a divided median correlated with a decrease in crashes.
- The actual impact of paved shoulders depends on several other variables, such as installation year and paved shoulder width.
- When the expected total crash numbers are compared before and after installing paved shoulders for several scenarios, the expected number of monthly crashes in the after period drops by around 4.6%.

Implementation Benefits

It is generally accepted that paved shoulders are important for highway design, as they provide recovery space for errant vehicles and lateral support for the pavement structure. In addition, paved shoulders help accommodate non-motorized and slow moving vehicles and provide operational benefits. This study has quantified the safety benefits that paved shoulders can bring to a roadway.



Two-lane highway with fully paved shoulders