iRAP Road Attribute Risk Factors

Shoulder Rumble Strips

This factsheet describes the road attribute risk factors used in the iRAP methodology for Shoulder Rumble Strips. Shoulder Rumble Strips (also referred to as raised profile edge lines or audible edge lines) can be used to delineate the edge of paved roads. As well as providing visual delineation, Shoulder Rumble Strips can also be heard and felt by drivers and riders.

About risk factors

Risk factors, sometimes called crash modification factors (CMF), are used in the iRAP Star Rating methodology to relate road attributes and crash rates. Risk factors (or CMF) are described by the Crash Modification Factor Clearing House as follows:

> *A crash modification factor (CMF) is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site.*
>
> *For example, an intersection is experiencing 100 angle crashes and 500 rear-end crashes per year. If you apply a countermeasure that has a CMF of 0.80 for angle crashes, then you can expect to see 80 angle crashes per year following the implementation of the countermeasure (100 x 0.80 = 80). If the same countermeasure also has a CMF of 1.10 for rear-end crashes, then you would also expect to also see 550 rear-end crashes per year following the countermeasure (500 x 1.10 = 550).*

Related documents

This factsheet should be read in conjunction with:

- *Star Rating Roads for Safety: The iRAP Methodology.*
- *Safer Roads Investment Plans: The iRAP Methodology.*
- *Star Rating and Investment Plan Coding Manual.*
- *Road Safety Toolkit (*http://toolkit.irap.org*).*

Risk factors

Risk factors by road attribute category, road user type and crash type

Shoulder rumble strips	Vehicle occupant, motorcyclist, bicyclist and pedestrian run-off
Not present	1.25
Present	1.0

Selection of risk factors

Turner et al. (2012) found that in 13 studies, the presence of Shoulder Rumble Strips was associated with an average of 21% reduction for all crashes and 40% for run-off road crashes, though the latter assessed to be of a low level of confidence due to the wide spread of crash reduction factors.

Background research and model development

Lynam (2012) explained the research background to the values used in version 2.2 of the iRAP model. There is conflicting evidence on the effect of these measures. Elvik and Vaa (2004) suggest Shoulder Rumble Strips can reduce crash frequency by 30% although EuroRAP Swedish representatives suggest raised edge markings are thought to result in a maximum of 15% crash reduction. Some US states (FHWA, 2006) report very large reductions in run-off fatalities after introducing rumble strips. Harwood (1993, quoted in Ogden, 1996) concluded that Shoulder Rumble Strips installed along extended sections of roadway generally reduced the rate of run-off crashes by 20% or more. Torbic et al. (2009) provide the numbers that are provided in the AASHTO Highway Safety Manual. Their research shows reduction in run-off road crashes on different types of road varying between 11% and 51%.

Turner et al. (2009) said that there is a large amount of research on the effect of Shoulder Rumble Strips and argued that the research results are fairly consistent. Based on their review of this topic (particularly using Agent et al. (1996); Baas et al. (2001); Cairney (1996); Corben et al. (1996); and Shen et al. (2004) they concluded that casualty crashes reduce by around 23% from the use of this treatment.

KiwiRAP uses a relative risk of 0.85 which equates to a crash reduction of 15% (New Zealand Transport Agency, 2009).

Risk factors in earlier versions of the iRAP model

Shoulder rumble strip	Vehicle occupant run-off	Motorcyclist run-off
None	1.0	1.0
Present	0.8	0.8

Primary references

The following publications are the primary references used in the selection of the iRAP road attribute risk factors. A complete list of citations is available in: *iRAP Road Attribute Risk Factors: Full Reference List.*

Elvik, R, Hoye A, *Vaa, T, and Sorensen, M. (2009)*. The Handbook of Road Safety Measures, Second Edition (2009) Emerald Group Publishing Limited. ISBN 978-1-84855-250-0.

Lynam, D (2012). Development of Risk Models for the Road Assessment Programme. RAP504.12 and TRL Report CPR1293, Published by iRAP and TRL and available at: http://www.trl.co.uk and at http://www.irap.org.

Mak, K. and Sicking, D. (2003). *Roadside Safety Analysis Program – Engineer's Manual.* Transportation Research Board (TRB) National Cooperative Highway Research Program (NCHRP) Report 492. ISBN 0-309-06812-6.

Turner, B. Steinmetz, L., Lim, A. and Walsh, K. (2012). *Effectiveness of Road Safety Engineering Treatments.* AP-R422-12. Austroads Project No: ST1571.

Turner, B., Affum, J., Tziotis, M. and Jurewicz, C. (2009). *Review of iRAP Risk Parameters*. ARRB Group Contract Report for iRAP.

Turner, B., Imberger, K., Roper, P., Pyta, V. and McLean, *J. (2010). Road Safety Engineering Risk Assessment Part 6: Crash Reduction Factors*. Austroads AP-T151/10. ISBN 978-1-921709-11-1.

University of North Carolina Highway Safety Research Center and U.S. Department of Transportation Federal Highway Administration (2013). *Crash Modification Factors Clearing House*: http://www.cmfclearinghouse.org/.

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