iRAP Road Attribute Risk Factors

Skid Resistance / Grip

This factsheet describes the road attribute risk factors used in the iRAP methodology for Skid Resistance/Grip. This attribute records the general characteristics of the road surface with regard to grip. Formally, it relates to the force developed when a tire that is prevented from rotating slides along the pavement surface (Highway Research Board, 1972).

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

Skid resistance/grip	Vehicle occupant		Motorcyclist		Pedestrian	Bicyclist	
	Run-off and intersection	Head-on LOC	Run-off and intersection	Head-on LOC	Crossing	Along	Run off
Sealed - adequate	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sealed - medium	1.4	1.4	1.6	1.6	1.4	1.6	1.6
Sealed – poor	2.0	2.0	2.5	2.5	2.0	2.5	2.5
Unsealed - adequate	3.0	3.0	4.0	4.0	3.0	4.0	4.0
Unsealed - poor	5.5	5.5	7.5	7.5	5.5	7.5	7.5

LOC: loss of control.

Selection of risk factors

Typically, roads with low skid resistance and grip have increased crash rates. Risk factors used by iRAP are based on the Australian review below, with extrapolation for unsealed roads based upon the expectation that unsealed roads in an adequate condition have a crash rate about 3 times higher than adequate sealed roads and that unsealed roads in unsealed condition a rate about 5.5 times higher. Turner et al (2010) found that "The values from the BTE and Davies et al. studies were similar. A crash reduction factor of 35% was recommended for urban environments. Further work is required to establish a figure for rural roads."

Risk factors for Skid Resistance/Grip (Turner et al, 2010)

Study	Year	Country	Environment	Reduction
Elvik and Vaa	2004	Netherlands	Friction increase of 0.1 from a baseline of 0.5 or lower Friction increase of 0.1 from a baseline of 0.6 Friction increase of 0.1 from a baseline of 0.7	Wet roads 40%, All roads 10% Wet roads 25%, All roads 6% Wet roads 15%, All roads 4%
Davies et al.	2005	NZ	Friction <0.3 to Friction >= 0.5	37% reduction in casualty crashes
BTE	2001	Australia	Urban Rural	37.5% casualty crashes 26.7% casualty crashes (not statistically significant)
Meuleners et al.	2005	Australia		10.1% casualty crashes (non significant)

Relevant general conclusions from the 3rd International Surface Friction Conference, Workshop on the Decade of Action, Monday May 16th 2011 (Australia) indicate:

The majority of problems from poor skid resistance will be picked up by targeting further investigation of sites with visually poor skid resistance. iRAP's video-based approach is appropriate to needs and moving to machine-based collection of skid resistance is not warranted at this stage.

- Where skid resistance is very poor (fully flush surface) and either straight line braking demand is high (such as at intersections or crossings) or if there is poor alignment, then significant crash reductions are possible.
- Likelihood risk is assumed to be 20% greater for motorcyclists than for vehicle occupants.

Background research and model development

Earlier versions of the iRAP methodology did not include a specific attribute of skid resistance or grip but, it did include Road Condition, an attribute referring to gross deterioration such as potholes.

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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