FDOT State Safety Office
Crash Reduction Analysis System Hub (CRASH)
Information Guide

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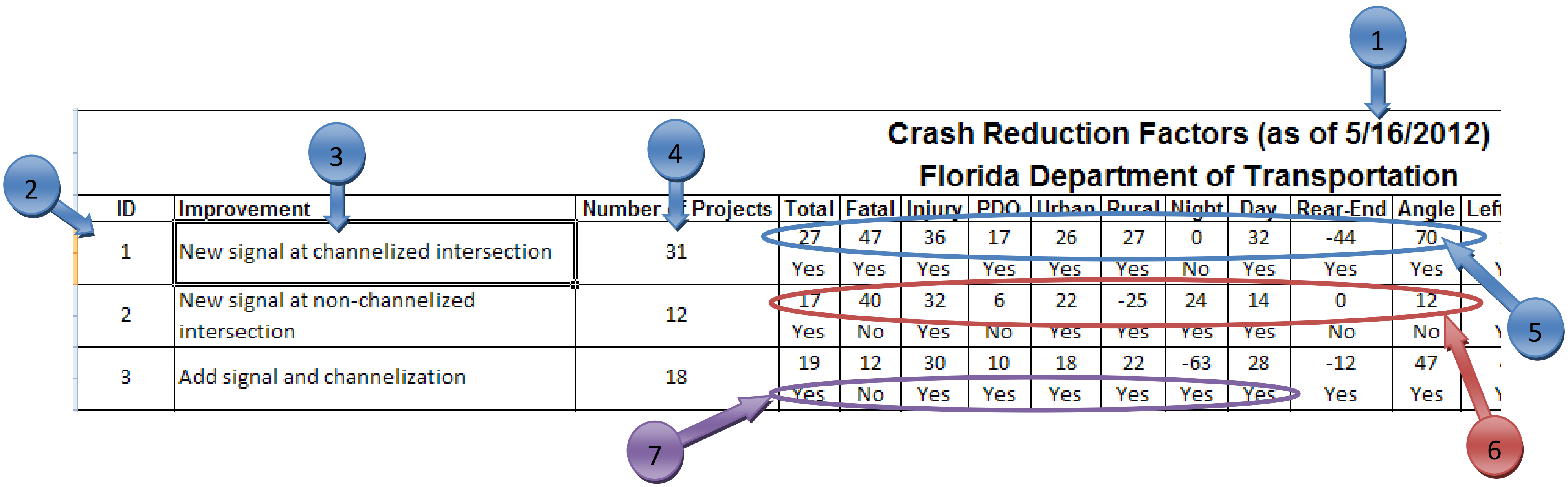
Contents

Crash Reduction Factors Spreadsheet

FDOT Safety Office Crash Reduction Analysis Safety Hub (CRASH) program is a safety improvement tools used by FDOT to conduct benefit-cost analyses and calculate crash reduction factors (CRF). Users are able to lists and download the CRF onto an Excel spreadsheet with the following:

1. As of Date: Date of spreadsheet creation and extraction from the Crash Reduction Analysis Safety Hub (CRASH) program.
2. ID: Improvement Type (countermeasure) identification reference number.
3. Improvement: Improvement Type (countermeasure) description.
4. Number of Projects: Number of projects existing in the database for the corresponding improvement type.
5. Total, Fatal, Injury… (Heading): Crash occurrence type that are selected for evaluation and used for CRF calculation.
6. Crash Reduction Factor: Factors generated by the CRASH program that are used to estimate the effects the corresponding countermeasure has on the crash occurrence type.
7. Statistical Significance ("does is meet the minimum reduction threshold 'yes' or 'no'?"): "Yes" represents that the CRF percentage (absolute value) is equal or higher than the minimum significant percent reduction; and "No" represents the CRF percentage (absolute value) that is lower than the minimum significant percent reduction.



Crash Reduction Factors (as of 5/16/2012)
Florida Department of Transportation

ID	Improvement	Number of Projects	Total	Fatal	Injury	PDO	Urban	Rural	Night	Day	Rear-End	Angle
1	New signal at channelized intersection	31	27	47	36	17	26	27	0	32	-44	70
			Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
2	New signal at non-channelized intersection	12	17	40	32	6	22	-25	24	14	0	12
			Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	No
3	Add signal and channelization	18	19	12	30	10	18	22	-63	28	-12	47
			Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Project Evaluation and Selection Method in CRASH

The selection of project locations for safety improvements in CRASH is based on the benefit-cost analysis. In general, the selected project locations should have the highest benefit-cost ratios and these ratios should be at least greater than one. The estimated benefit for a specific project is calculated as the estimated number of crashes that can be prevented as a result of the project implementation, multiplied by a cost-per-crash value. The estimated crash reduction is in turn estimated as the number of crashes before project improvement multiplied by a crash reduction factor (CRF) for the specific type of project being evaluated. The estimated cost, on the other hand, includes such costs as right-of-way (ROW), structure, signal/signing, etc., with consideration for lifecycle and interest rate. Both the estimated benefit and estimated cost are annualized before they are used to calculate the final benefit-cost ratio.

CRF Estimation

CRFs in CRASH are estimated based on the so-called before-and-after method. This method simply estimates a CRF as follows:

$$\text{CRF} = \frac{\text{Crash Rate Before - Crash Rate After}}{\text{Crash Rate Before}} \times 100$$

The crash rates for both before and after the implementation of a project are calculated as:

$$\text{Crash Rate} = \frac{\text{Total Number of Crashes}}{\text{Exposure}}$$

where the “Exposure” is usually calculated in million vehicle miles (MVM) of travel, as follows:

$$\text{Exposure} = \frac{\text{Project Section Length in Miles} \times \text{Mean ADT} \times \text{Years} \times 365\text{ Days}}{1{,}000{,}000}$$

Thus, the complete formula for calculating a crash rate becomes:

$$\text{Crash Rate} = \frac{\text{Total Number of Crashes} \times 1{,}000{,}000}{\text{Number of Days} \times \text{ADT} \times \text{Project Section Length in Miles}}$$

For an intersection or spot improvement, the intersection influence area, typically taken as the ±0.05 miles from the center of an intersection (i.e., 0.1 mile), is treated as the project section length. However, this influence area may take on other numbers depending on the type of safety improvement project.

Each crash record would typically include the corresponding average daily traffic (ADT). Therefore, an approximation of the mean ADT can be calculated as:

$$\text{Mean ADT} = \frac{\text{Summation of Individual ADTs Associated with each Crash}}{\text{Total Number of Crashes}}$$

CRF Estimation Example

CRFs are generally calculated based on multiple projects in which the same types of project improvements were applied. CRASH recommends the use of a minimum of five historical projects for CRF estimation. A warning is provided when the number of historical projects falls below five.

To illustrate how a CRF is calculated based on multiple projects, statistics for a two-project example are summarized in the before-and-after tables below:

Before Statistics:

Project	**1**	**2**	**Total**
Total Crashes	332	160	492
Project Section Length	2.3	1.9	
Mean ADT	15,836	13,523	
Study Period	3	3	
Exposure	39.822	28.135	67.957

After Statistics:

Project	**1**	**2**	**Total**
Total Crashes	174	113	287
Project Section Length	2.3	1.9	
Mean ADT	15,638	15,630	
Study Period	3	3	
Exposure	39.384	32.518	71.902

For the 332 accidents associated with Project #1 before project implementation, the mean ADT can be calculated as follows:

$$\text{Mean ADT} = \frac{14{,}935 + 14{,}935 \ldots + 16{,}040 + 17{,}794}{332} = 15{,}836$$

The corresponding exposure can then be calculated as follows:

$$\text{Exposure} = \frac{\text{Project Length} \times \text{Mean ADT} \times \text{Years} \times 365\ \text{Days}}{1{,}000{,}000} = \frac{2.3 \times 15{,}836 \times 3 \times 365}{1{,}000{,}000} = 39.822$$

The exposure for Project #2 is calculated in the same fashion. Total exposure is then calculated by summing the exposures from both projects. The “before” crash rate is calculated by dividing the total number of crashes before project implementation by the total exposure from both projects, as follows:

$$\text{Crash Rate Before} = \frac{492}{67.957} = 7.240$$

The “after” crash rate is similarly calculated:

$$\text{Crash Rate After} = \frac{287}{71.902} = 3.992$$

The CRF for the specific type of improvement project for total crashes can then be calculated as:

$$\text{CRF} = \frac{\text{Crash Rate Before - Crash Rate After}}{\text{Crash Rate Before}} \times 100\% = \frac{7.240 - 3.992}{7.240} \times 100\% = 45\%$$

CRFs for specific crash type or crash severity can be similarly calculated by including only the specific types of crashes in place of the total number of crashes above.

Test of Significance

The Poisson Comparison of Mean Test is used to determine if the crash reduction is statistically significant (i.e., significantly better, significantly worse, or no significant change). The formula for the Poisson Test based on a 95% confidence level is applied as follows[1]:

$$R = \left(\frac{2.326\sqrt{b - 0.16} - 0.35}{b} \right) \times 100$$

where

R = Minimum significant percent reduction, and
b = Total number of crashes before project implementation.

A CRF is said to be significant when its percentage is equal or higher than R. When a positive CRF (i.e., a project is expected to reduce crashes) is greater than R, it is said to be “significantly better”. On the other hand, when the absolute magnitude of a negative CRF (i.e., a project is expected to increase crashes) is greater than R, it is said to be “significantly worse”. A CRF is said to result in “no significant change” if its absolute magnitude is less than R.

A project type would typically be considered for potential safety improvement at a location when its overall CRF is expected to cause significant crash reduction. However, there are cases when it is desirable to trade a reduction in more severe types of crashes as a result of a project improvement type for an increase in the total number of crashes.

Multiple Improvements at Single Project Locations

Multiple types of project improvement are often applied to a project location. In this case, a composite CRF that reflects the total crash reduction is calculated. CRASH uses the following commonly used formula to calculate the composite CRF:

$$CRF = CRF_1 + (1 - CRF_1)CRF_2 + (1 - CRF_1)(1 - CRF_2)CRF_3 + \ldots$$

where

CRF = Overall composite CRF,
CRF_1 = CRF for the first project improvement,
CRF_2 = CRF for the second project improvement, and
CRF_3 = CRF for the third project improvement.

[1] *Methods for Evaluating Highway Safety Improvements*, National Cooperative Highway Research Program (NCHRP) Report 162, Transportation Research Board, National Research Council, Washington, D.C., 1975.