



*Engineering Guide*

# Crash Analysis

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Crash analysis is an identification of hazardous (unsafe) intersections and corridors is very important to improve the safety of the transportation system for all users and to help allocate money toward needed improvements. A crash analysis is a reactive method to identify locations with a history of crashes exceeding what would normally be expected at a comparable location with similar characteristics.

## Crash.

A collision, whether between vehicles, pedestrians, bicyclists, and/or other members or the traveling public.

*The term 'crash' is preferred over 'accident' as an accident implies the collision could not be avoided or happened by chance. While not pointing fingers, crash leaves the cause of the impact to be determined.*

## Crash Density.

The number of crashes per year.

## Crash Severity.

The seriousness of a crash and its impact on drivers, occupants, or others in the area. Typically, sub-divided into five categories:

- **Fatal Crash, Type K.** Deaths occurred as a result of a crash.

- **Incapacitating Injury, Type A.** Injuries from the crash serious enough to prevent normal activity for at least 1 day (broken bones, etc.).
- **Non-Incapacitating Injury, Type B.** Injuries evident at the scene, but not serious enough to prevent normal activity (cuts, bruises, limping, etc.).
- **Possible Injury, Type C.** Non-visible injuries from the crash, but complaints of pain or momentary unconsciousness (headaches, etc.).
- **Property Damage, Type PD or PDO.** No injuries resulting from the crash.

## Observed Crash Rate.

The measured number of crashes controlling for exposure (traffic volume), distance (if a section), and time to allow an even comparison between locations. Typically presented as a crash number per one million entering vehicles (intersections) or one million vehicle miles travelled (sections or corridors).

## Critical Crash Rate.

A statistical threshold for screening a location to determine if the number of crashes is above the statistical range of crashes that could occur. Exceeding the Critical Crash Rate can be indicative of a safety concern or issue that requires mitigation.

## Critical Index.

The ratio of observed crash rate to the critical crash rate. A critical index exceeding 1.00 indicates a potential safety concern. A critical index of 1.00 or less indicates performance within expectations without deviation from statewide trends.

## Formulas.

### Intersection

Entering Volume	$(\text{Average Daily Traffic}_{\text{LEG1}} + \text{Average Daily Traffic}_{\text{LEG2}} + \dots) / 2$
Exposure	$\text{Number of Days} * \text{Entering Volume} / 1,000,000$
Crash Rate	$\text{Number of Crashes} / \text{Exposure}$
Critical Crash Rate	$\text{Statewide Ave} + K * \sqrt{(\text{Statewide Ave} / \text{Exposure}) + 0.5 \text{ exposure}}$
Critical Index	$\text{Crash Rate} / \text{Critical Crash Rate}$

### Section

VMT	$\text{Number of Days} * \text{Average Daily Traffic} * \text{Section Length}$
Exposure	$\text{VMT} / 1,000,000$
Crash Rate	$\text{Number of Crashes} / \text{Exposure}$
Critical Crash Rate	$\text{Statewide Ave} + K * \sqrt{(\text{Statewide Ave} / \text{Exposure}) + 0.5 / \text{Exposure}}$
Critical Index	$\text{Crash Rate} / \text{Critical Crash Rate}$

## Confidence Interval Factor (K)

- 2.576 for a 99.5% confidence interval, used for weighing the average crash rate
- 1.282 for a 90.0% confidence interval, used for weighing the average rate for fatal and type A crashes only (FAR)

## Key Link for Minnesota.

<http://www.dot.state.mn.us/stateaid/trafficsafety.html>

- **Minnesota Crash Mapping Analysis Tool (MnCMAT)** Data of crash information in Minnesota
- **Intersection Green Sheets.** Spreadsheet containing statewide averages for intersections, definitions, and a calculator to determine crash rate, critical crash rate, and critical index.
- **Section Green Sheets.** Spreadsheet containing statewide averages for sections, definitions, and a calculator to determine section crash rate, critical crash rate, and critical index.

## Intersection Characteristics Needed.

- **Traffic Control Device.** Traffic Signal, Stop Sign Controlled, Roundabout
- **Environment.** Urban, Suburban, City Bypass, Rural
- **Speed Limit.** Posted limit or 85th percentile
- **Total Entering Volume.** Daily traffic moving through the intersection

## Section Characteristics Needed (aka Corridor Characteristics Needed).

- **Length.** Total length in miles
- **Volume.** Daily volume on the section
- **Environment.** Urban, Suburban, Rural
- **Designation.** Freeway, Expressway, or Conventional
- **Number of Lanes.** Total lanes, each way, on the section
- **Median Type.** Not divided/No median, Barrier, Curb, or divided/depressed median

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