Identification of Hazardous Locations

1. Crash Statistics Overview
2. Identification of Hazardous Locations
3. Traffic Engineering Tool Box
4. Lessons Learned
5. Traffic Safety Resources

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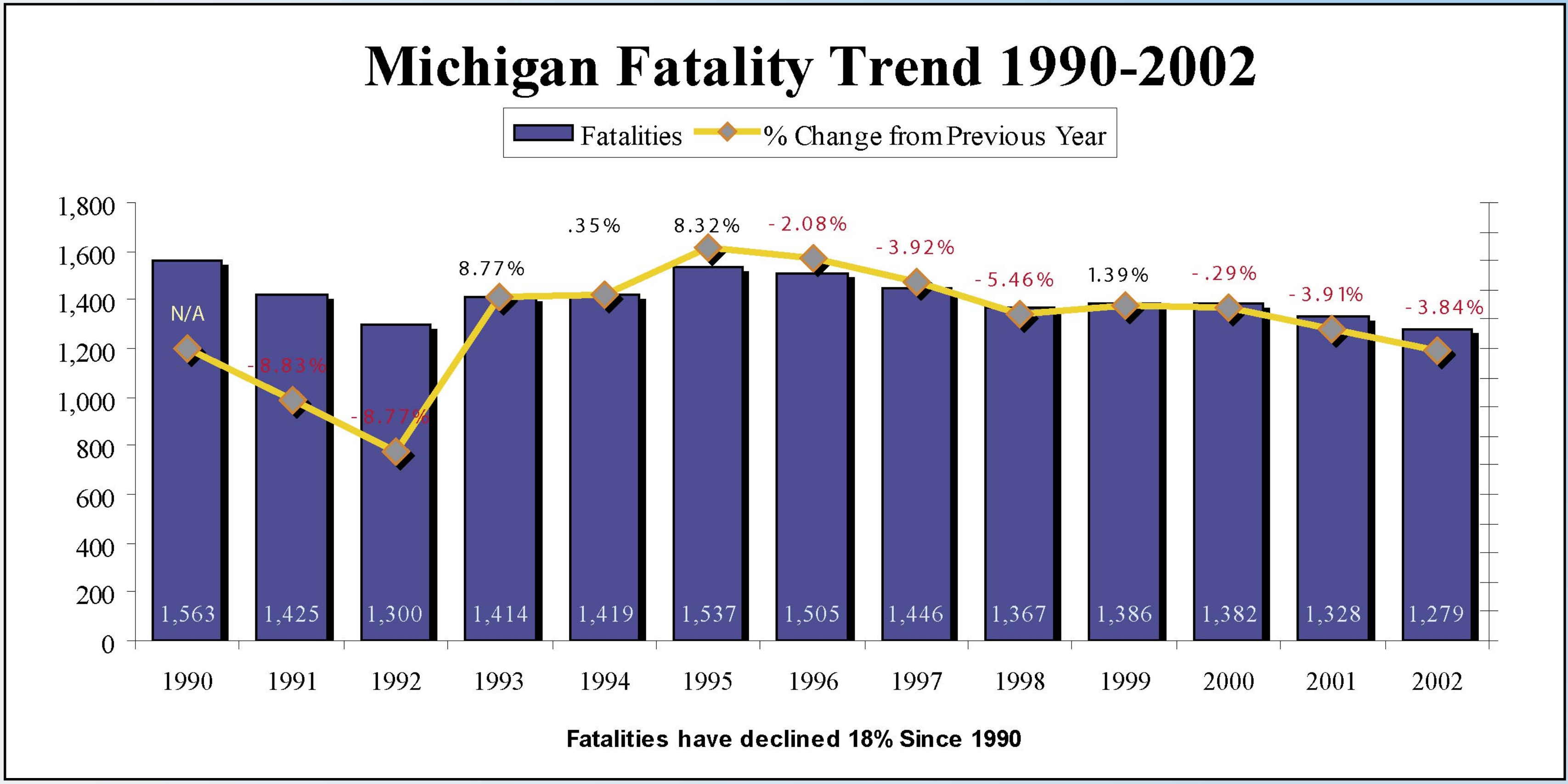
Why Monitor Traffic Safety?



- Safety has to be incorporated in transportation plans and organizations
- Understanding traffic crash characteristics can assist in prioritization and development of improvement projects
- Consideration of traffic crash safety issues is mandated by FHWA
- Monitoring traffic crash trends, patterns, concentrations . . . etc is good practice and is the ‘industry’ norm against which you will be evaluated

SOURCE: Michigan Office of Highway Safety Planning

Steps of a Typical Traffic Safety Analysis Program

2 BASIC COMPONENTS:

1. Training
2. Hazard ID and Analysis
   - Crash records, data base and safety objective
   - Initial System Overview (Problem Identification)
   - Supplemental Analysis
   - Develop Alternative Mitigative Strategies
   - Implementation
   - Post Improvement Evaluation Study

HIGHLIGHTS:

There are two basic components in a typical hazard identification program.

The first component involves providing training on key items which include:

- How to set up a records system.
- How to conduct inventories.
- Techniques for identifying problem locations.
- Analytical tools (spreadsheets, GIS, etc.).
- Basic traffic engineering and roadway design skills.
- Resources and Research

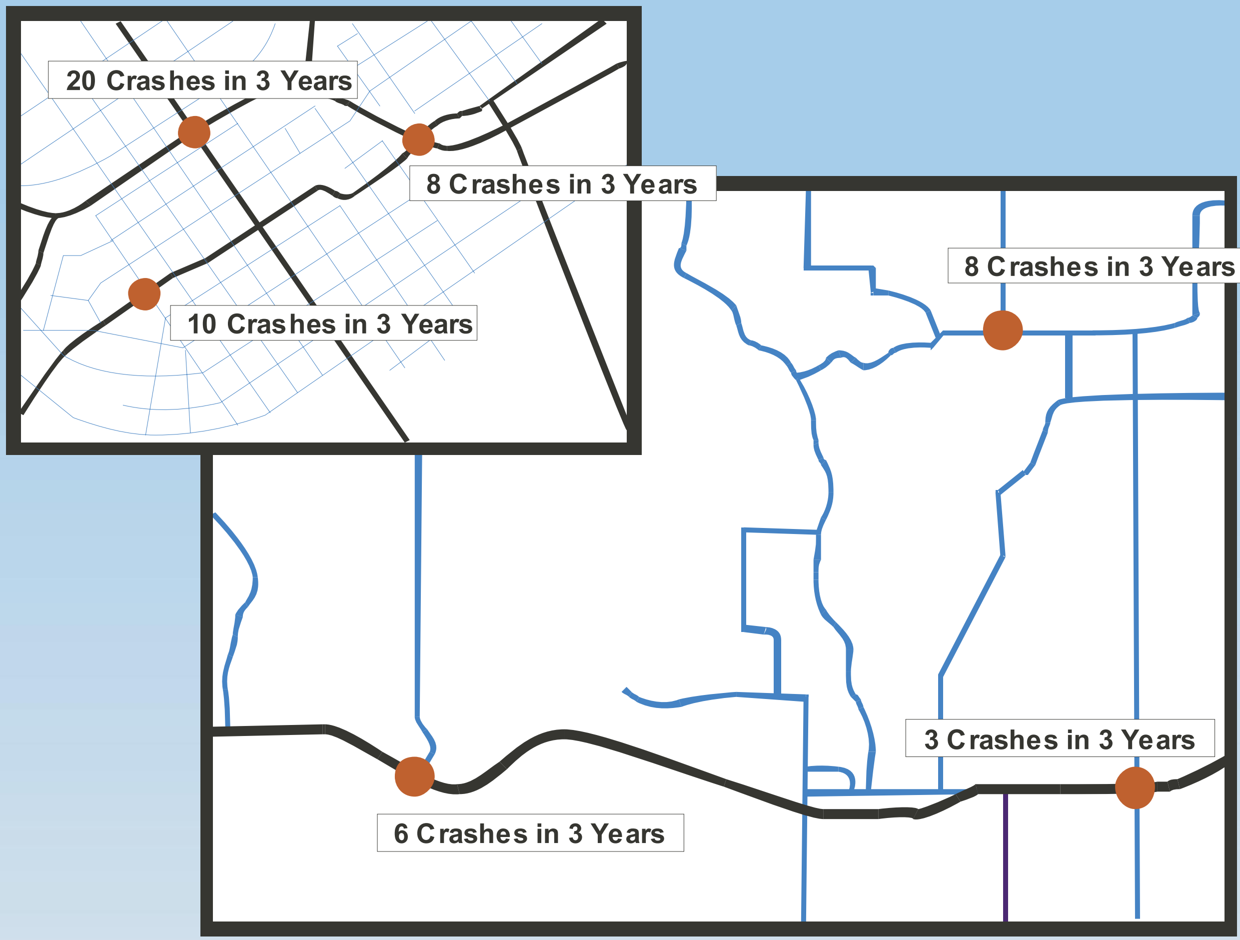
The second component is the hazard identification process, which consists of these key steps:

- Establish a crash records database and safety objectives
- Review the crash records, identify crash frequencies/rates, compare to your safety objectives, and identify potential problem locations.
- Supplemental analyses–field review, conflict analysis, safety audits.
- Develop alternative mitigative strategies, evaluate based on expected crash reduction, benefit-cost and feasibility, select the preferred alternative (which may be to do nothing), and document the process.
- Implementation
- The last step is critical (and frequently overlooked), and involves documenting the effectiveness of the selected strategy. This would typically include a before vs. after study and a statistical evaluation.
  The results of this step can then be used to modify the contents of the "Traffic Engineers Tool Box" and to guide future project development.

SOURCE: FHWA Highway Safety Improvement Program / SEMCOG Traffic Safety Manual

Basic Premise of Hazard Identification

- Crashes tend to be randomly distributed around a roadway system. With the exception of a few locations with clusters of crashes that are usually associated with high volumes of traffic or an adverse traffic control condition.
- The first objective of a highway safety program is to conduct an inventory of the road system to identify locations with correctable safety deficiencies. This inventory can consist of a review of roadway conditions and a tabulation of crashes on all intersections and roadway segments in the jurisdiction.
- Because of staff limitations and the size of roadway systems, most agencies screen their crash data to help focus their analytical efforts on locations that indicate a safety problem. No matter which screening technique is used, the goal is to find locations where crashes are occurring, and the crash pattern appears to be in some part correctable, due either to the number or the nature of the crashes.



SOURCE: FHWA Highway Safety Improvement Program / SEMCOG Traffic Safety Manual

Alternative methods for ID of Hazardous Location

Alternative Methods for Identifying Potentially Hazardous Locations

1. Number of Crashes annually is greater than X crashes per year
2. Crash Rate is greater than Y crashes per million vehicle miles annually
3. Critical Rate equals statistically adjusted Crash Rate to account for random nature of crashes.

There are three primary methods for identifying potentially hazardous locations:

1. Threshold analysis – crash frequency:
Arbitrary threshold values are chosen to screen out the locations at which fewer crashes are taking place. These thresholds could be expressed in number of crashes per year, (such as number of run-off road crashes, or number of injury crashes) for a given road unit such as per half mile, or per intersection.
This screening method is the most direct, in terms of screening out locations with fewer crashes. However, this method can be modified to use a tiered set of thresholds that reflect low, moderate and high volume traffic flow.

2. Threshold analysis – crash rate:
Thresholds can also be expressed as a percent - for instance, any location at which more than X % of the crashes occur at night, or more than Y % of the crashes occur on wet roads. Looking at the data in this way helps identify patterns in which particular crash types are occurring more often than the norm – such crash patterns often lend themselves to specific safety countermeasures.

3. Statistical analysis:
When crash data can be obtained on all or a large portion of the road system, it is possible to do comparative studies on crash rate and number for the individual road segments and intersections.
With this much data, road locations that exceed thresholds can be tested statistically to identify which high-crash locations are more likely to have reported high crashes due to chance vs. those that seem to evidence some continuing problem.

SOURCE: FHWA Highway Safety Improvement Program

Effect of Random Distribution of Crashes

The Concept of "Critical Crash Rate"

The technique that uses the critical crash rate is considered to be the best for identifying hazardous locations.

The critical crash rate accounts for the key variables that effect safety, including:

- The design of the facility
- The type of intersection control
- The amount of exposure
- The random nature of crashes

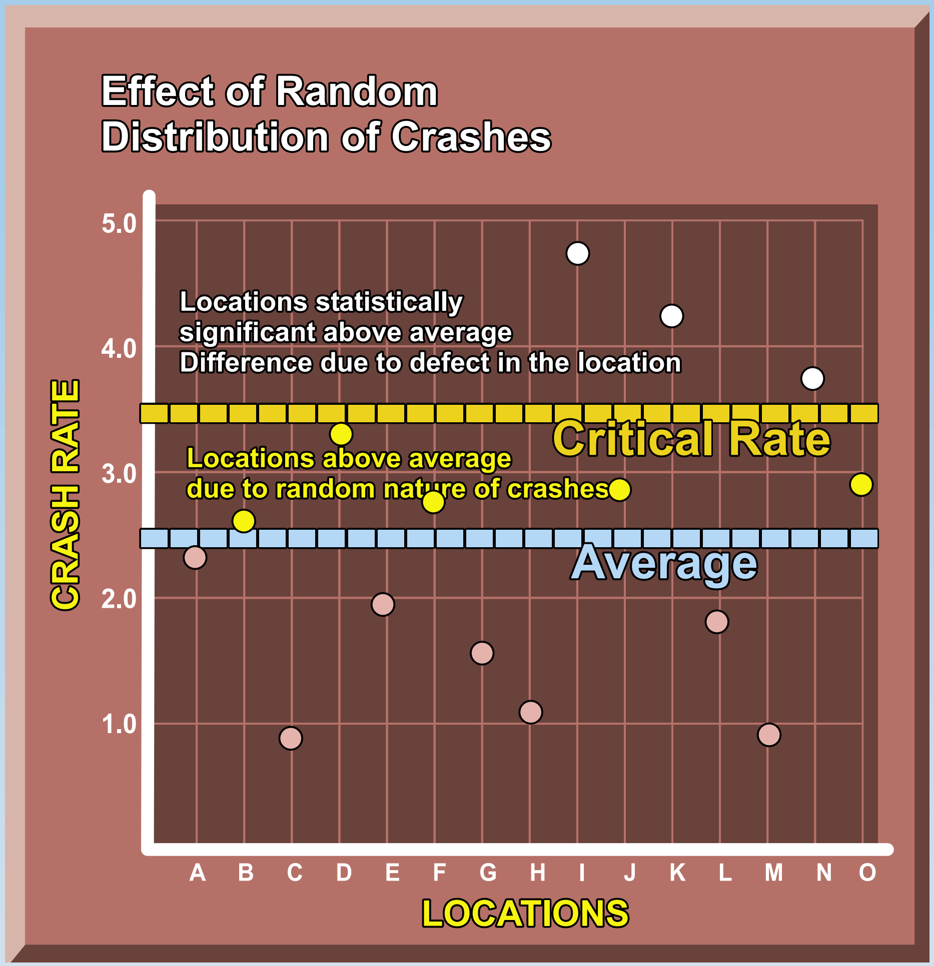
The concept suggests that any sample or category of intersections or roadway segments can be divided into three basic parts:

- Locations with a crash rate below the categorical average: these locations are considered to be SAFE because of the low frequency of crashes and can be eliminated from further review.

- Locations with a crash rate above the categorical average, but below the critical rate: these locations are considered to be SAFE because there is a very high probability (90-95%) that the higher than average crash rate is due to the random nature of crashes.

- Locations with a crash rate above the critical rate: these locations are considered to be UNSAFE and in need of further review because there is a high probability (90-95%) that conditions at the site are contributing to the higher crash rate.

The other primary advantage of using the critical crash rate is that it helps screen out the 90% of the locations that do not have a problem and focuses an agency's attention and resources on the limited number of locations that do have a documented problem (as opposed to a perceived problem)



Calculating Crash Rates

Intersection Rates:

$$\text{Rate per Million Entering Vehicles} = \frac{(\text{number of crashes})(1\text{ million})}{(\text{number of years})(ADT)(365)}$$

Segment Rates:

$$\text{Rate per Million Vehicle Miles} = \frac{(\#\text{ of crashes})(1\text{ million})}{(\text{segment length})(\#\text{ of years})(ADT)(365)}$$

Critical Rate: $R_c = R_a + K(R_a / m)^{1/2} - 0.5/m$

R_c = Critical Crash Rate
for intersections: crashes per MEV
for segments: crashes per MVM

R_a = System Wide Average Crash Rate by Intersection or Highway Type

m = Vehicle Exposure During Study Period
for intersections: ADT ($365/10^6$)
for segments: ADT ($365/10^6$) length

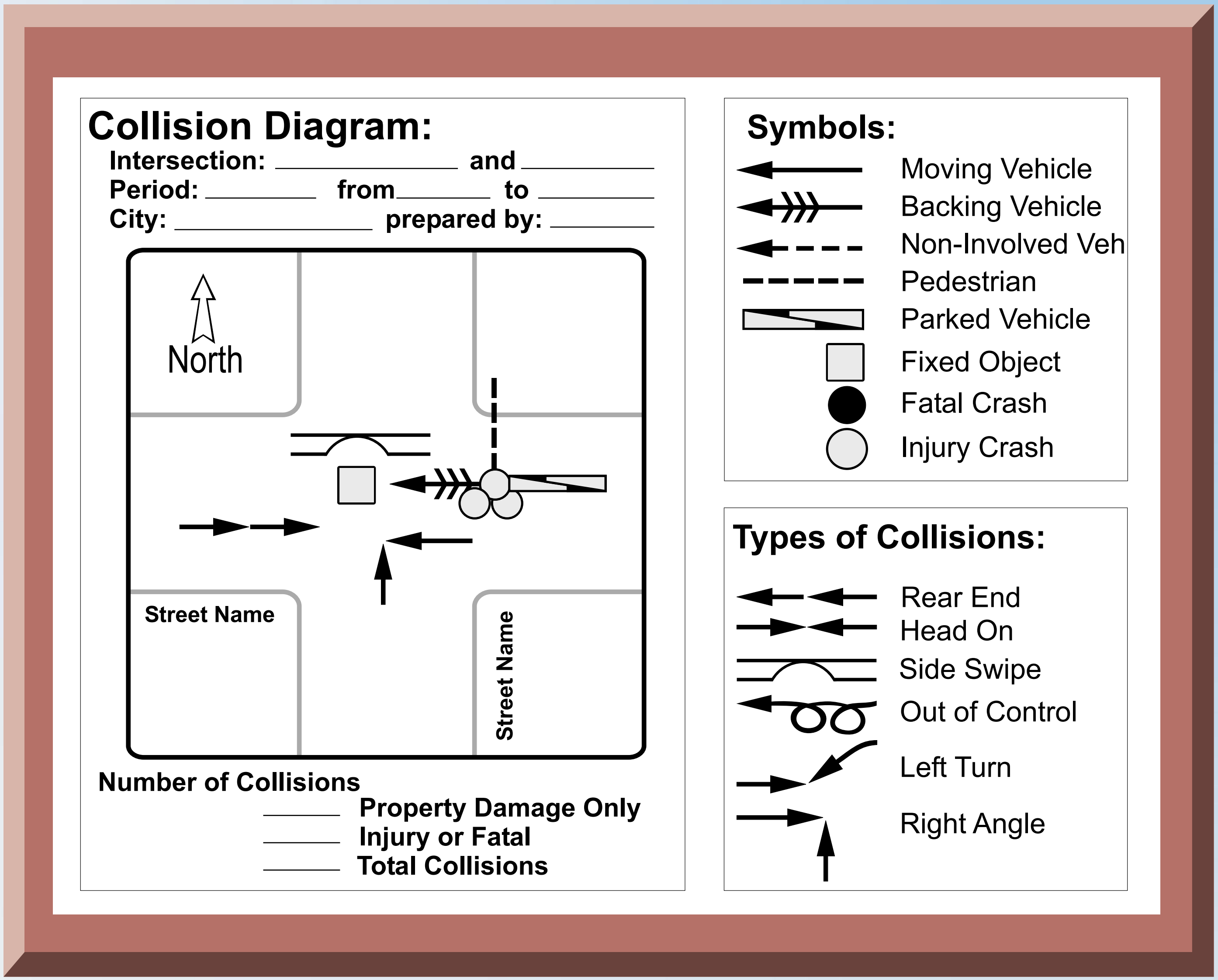
k = Constant based on Level of Confidence

Level of Confidence	0.995	0.950	0.900
k	2.576	1.645	1.282

- The number of crashes at any location is almost always a function of exposure. As the number of vehicles entering an intersection or the vehicle miles of travel along roadway segments increase the number of crashes also increase.
- The use of crash rates (crash frequency per some measure of exposure) accounts for this variability and allows for comparing locations with similar designs but different volumes.
- Intersection crash rates are typically expressed as the number of crashes per million entering vehicles.
- Segment crash rates are typically expressed as the number of crashes per million vehicle miles (of travel).
- The Critical Crash Rate is calculated by adjusting the systemwide categorical average based on the amount of exposure and a statistical constant indicating level of confidence.
- The critical rate increases as the volume decreases.
- The same formulas can be used to calculate fatality or injury rates or the rate at which any particular type of crash is occurring.
- A good rule of thumb is to use three years of crash data when available. More data is almost always useful, but increases the concern about changed conditions. Using only one or two years of data presents concerns about sample size and statistical reliability.

SOURCE: FHWA Highway Safety Improvement Program

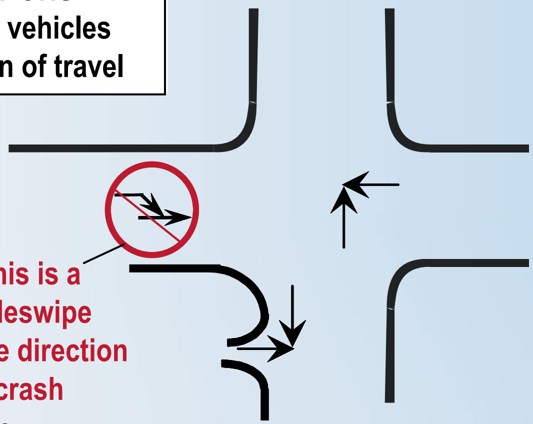
Typical Collision Diagram



SOURCE: Minnesota Traffic Safety Fundamental Handbook

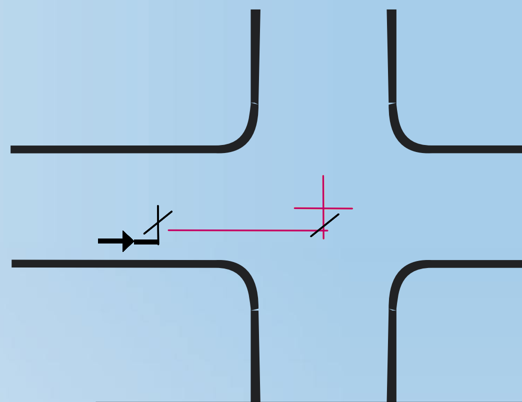
Crash Types

CRASH TYPE DESIGNATIONS
Consider the vehicles initial direction of travel

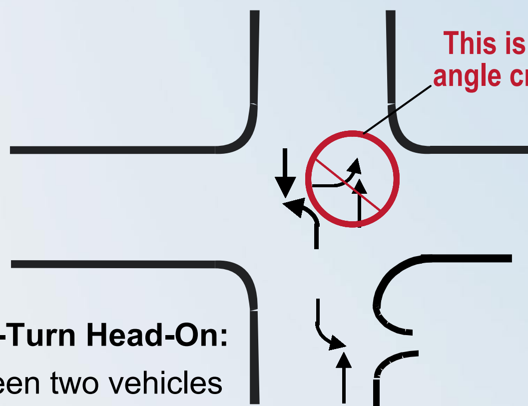


This is a sideswipe same direction crash

Right Angle : occurs between two vehicles initially traveling in **perpendicular** directions to each other



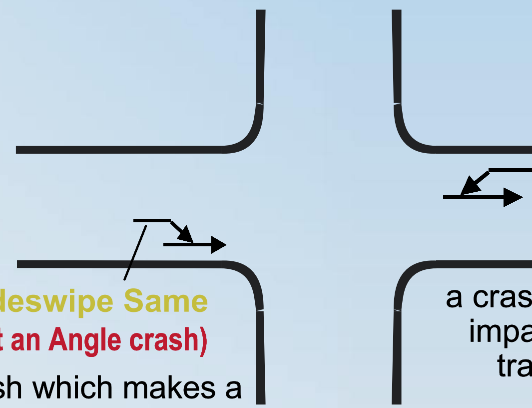
CRASH LOCATION
Should be referenced from the Centerline of the nearest intersection



This is an angle crash

Left-Turn Head-On:

occurs between two vehicles traveling in **opposite directions** one of which intends to turn left



Sideswipe Same
(Not an Angle crash)

a crash which makes a glancing impact between two vehicles traveling in the **same direction**

Sideswipe Opposite
(Not an Angle crash)

a crash which makes a glancing impact between two vehicles traveling in the **opposite direction**

Supplemental Analysis: More Detailed Crash Record

- After identifying hazardous locations, the next step is to conduct supplemental analyses in order to better understand the nature of the problem and to help develop appropriate mitigative strategies.
- A more detailed understanding of the problem is necessary to develop countermeasures. Traffic engineers need to know more about the particular problems at specific locations.
- The supplemental analysis of crash data involves comparing actual crash characteristics to expected characteristics and then looking for differences.
- It is important to remember that roads that are similar in design, with similar volumes and similar driver characteristics will operate in a similar manner and will probably have similar crash characteristics.