



Intersection Safety

An Online Continuing Education Course for Engineers

Course Number: T-3025

Credit: 3 Hours / 3 PDH / 3 CPD

Intersection Safety

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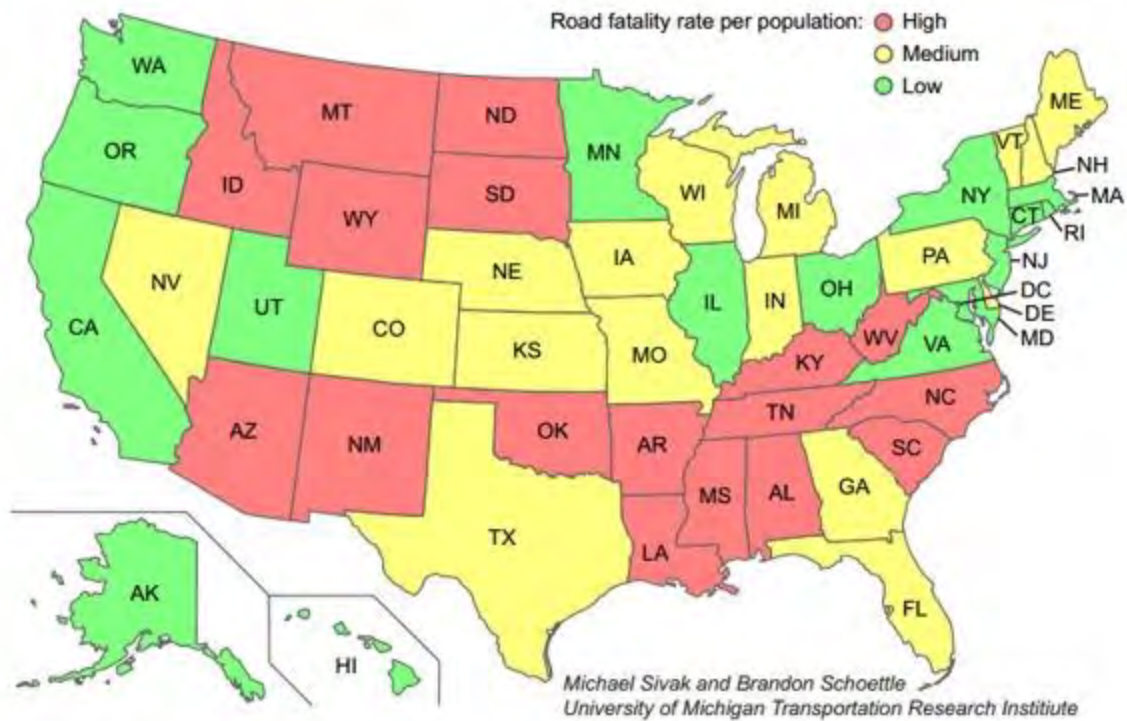
I. Introduction

Intersection Safety is an important issue because nationally there are:

- 3 million intersections
 - 2.7 million un-signalized intersections
 - 300,000 signalized intersections
 - 9,612 intersection fatalities per year
 - \$101 billion annual cost of intersection crashes

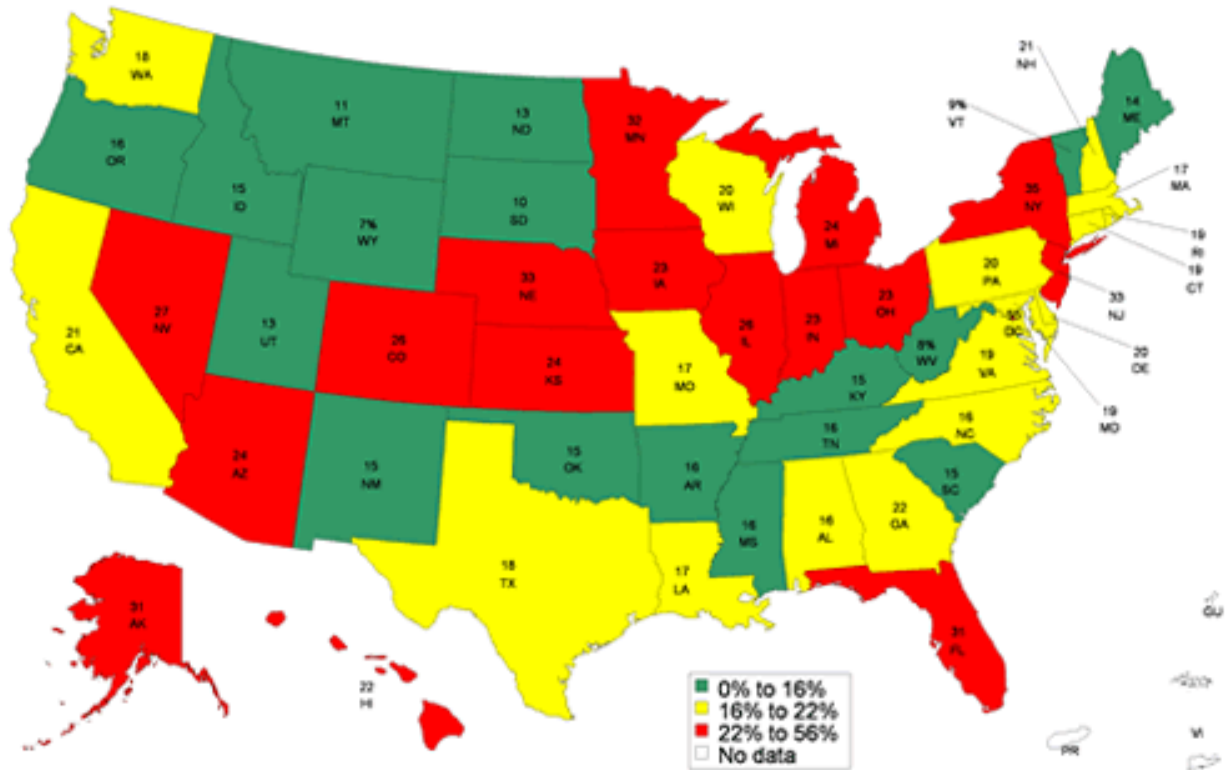
Despite improved intersection design and more sophisticated applications of traffic engineering measures, the annual toll of human loss due to motor vehicle crashes has not substantially changed in more than 25 years.

As seen in the following illustration, there were 17 states that had high road fatality rates per population. This represents 33% of the states.



Fatality rate from road crashes per population, 2013.

Intersection safety is a national, state and local priority. Intersections represent a disproportionate share of the safety problem. Thus, organizations such as the Federal Highway Administration (FHWA), Institute of Transportation Engineers (ITE), AASHTO, AAA and other private and public organizations are devoting resources to help reduce the problem. The following illustration shows the percentage of fatalities vs. crashes at intersections by state.



A. Intersection Crash Characteristics

Over the past two decades, urban intersectional vehicle crashes have increased 14%. A total of 55% of all urban vehicle crashes occur at intersections. Also, 23% of urban fatal crashes occur at intersections.

Over the past two decades, rural intersectional vehicle crashes have increased 5%. A total of 32% of all rural vehicle crashes occur at intersections. Also, 16% of rural fatal crashes occur at intersections.

The following table shows difference in the percentages of crash types between yield/stop and signalized intersections.

Type of Control	Accident Type – Percent of Total				Accident Rate (accidents per million entering vehicles)
	Rear-End	Angle	Sideswipe	Other	
Traffic Signal	43	37	12	8	1.26
Yield or Stop Sign	29	49	10	12	1.08

As the table shows, the rear end crashes increase at the signalized intersection (14% increase). However, these types of crashes are generally less severe. The angle crashes also decrease at a signalized intersection (12% decrease). These types of crashes are generally more severe. Thus, a signalized intersection can reduce the severity of the crashes.

B. Link Between Standards and Safety

Meeting design standards does not necessarily make a highway safe. Important features of highways are often not determined by standards.

- Nominal Safety is examined referring to compliance with standards, warrants, guidelines and sanctioned design procedures. Nominal safety devices can consist of advance warning signs and conventional road size.
- Substantive Safety is the actual crash frequency and severity for a highway or roadway. It is measured by actual frequency and severity. Substantive safety devices can consist of oversized signs, double placement of signs and yellow flashers with signs.



II. Human Factors

Both the number and severity of crashes are impacted by how an intersection is built and how it is operated. Design can reduce:

- Incidence of human error
- Chance of human error resulting in crash
- Severity of the consequences of crashes

Research indicates that driver error may account for approximately 90 percent of all crashes. While advances in automotive safety and highway design continue to improve, the one component that has not changed is the driver. Understanding how drivers and all roadway users interact within an intersection environment is fundamental to improve roadway safety and save lives.

To successfully execute a vehicle maneuver through an intersection, the driver must assimilate the information, decide and execute the desired action. One limitation is that humans are serial processors and the cognitive task-load at intersections can be quite large. Common items a driver must consider when approaching an intersection include:

- Monitoring and adjusting speed
- Maintaining lane position
- Being aware of other vehicles
- Attending to signals or signs
- Scanning for pedestrians/bicyclists
- Decelerating for a stop
- Searching for path guidance
- Selecting proper lane

Human Factor	Element Affected
Perception-reaction time	Stopping Sight Distance
Deceleration rate	Stopping Sight Distance
Pre-maneuver (distance to an unexpected condition)	Stopping Sight Distance
Gap acceptance	Stopping Sight Distance
Turning left or right from through traffic	Stopping Sight Distance
Crossing from stop	Stopping Sight Distance
Driver height of eye	Stopping Sight Distance
Pedestrian walk times	Stopping Sight Distance

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A. Driver Error

Perceptual failures account for a large portion of driver errors. Common driver errors for signalized intersections and unsignalized intersections include:

a. Signalized Intersections

- Not understanding whether to proceed or stop at a yellow signal indication (dilemma zone)
- Underestimating time to reach an intersection
- Underestimating time to make a smooth stop
- Failure to detect signal and proper lane assignment
- Misinterpreting guide sign information