

# What Elected Officials Need to Know About Traffic Safety (And What YOUR Constituents Expect YOU to Know!)

Student Workbook and Class Reference December 2008



Local Technical Assistance Program  
309 Dillman Hall  
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### The Elected Official As Decision Makers:

Elected officials are viewed by the public as “people of action.” On a daily basis, elected officials are forced to make numerous decisions that have significant impact on the community they represent. The public expects a skilled elected official to collect information, weigh the consequences, and make the best decision for their community. Because of the broad nature of decisions that elected officials face, they frequently find themselves working in areas outside their “comfort zone.” Traffic safety is one of those areas. There are even aspects of traffic safety that encourage a false sense of security for elected officials, such as:

- ❑ **Counterintuitive nature:** Many traffic safety decisions are counterintuitive. For example, installing a stop sign to control vehicle speed can actually increase vehicle speeds as drivers accelerate to “make up” lost time.
- ❑ **Roads viewed as “commonplace”:** The public has come to view roads as an ordinary, simple feature of the landscape. This desensitization to the subtle design features of a road and the complex relationships that exist within roadway infrastructure lead to the belief that good, safe roads are “simple.”
- ❑ **Roads are a public asset:** The vast majority of roads are in the public trust. Because of this, many people feel that they have an interest in deciding the operation and function of roads in their community, which is true to an extent. However, when the general public begins to dictate design and operation factors without an understanding of their impact, the chance is high that there will be negative consequence to safety.
- ❑ **Communicating with engineers:** Engineers are trained to make technically sound recommendations that are defensible, conservative and based on data. As part of this training, engineers depend on a “language” that is precise, full of jargon and esoteric. Many engineers do not view translating technical information to non-technical audiences as part of their job. This is common with people involved in technical fields. As a result, a barrier to communication can develop that separates engineers from non-technical audiences.

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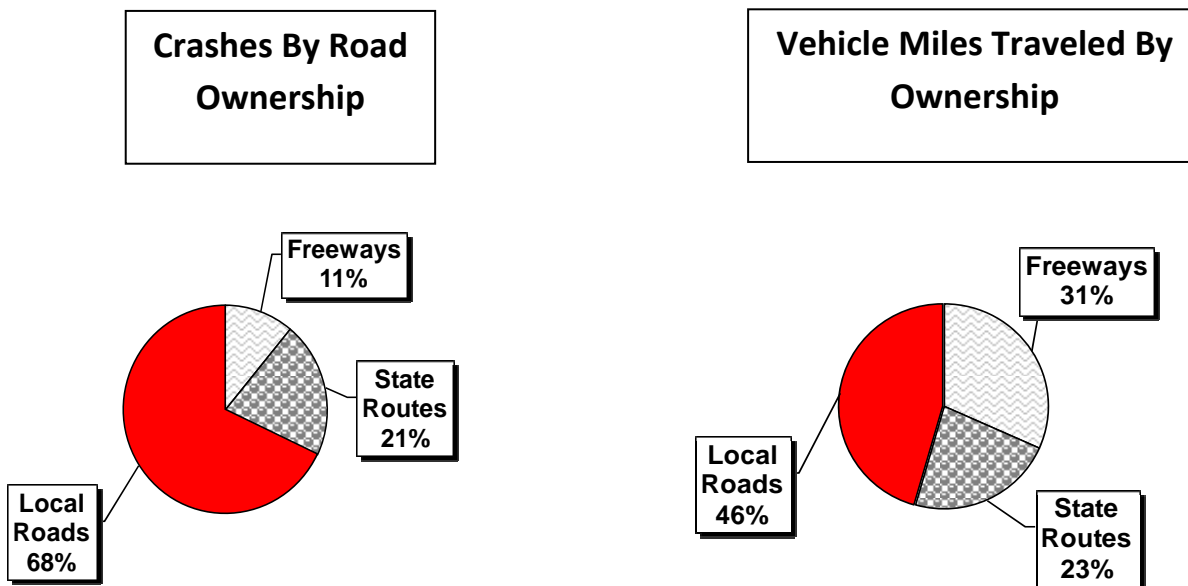
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## Where Do Most Crashes Occur In Michigan?

The majority of crashes occur on roads owned by Michigan's local governments (cities, villages and county road commissions). At first glance this seems to make sense because local governments own the vast majority of road mileage in the State. But when the number of vehicle miles traveled on local roads is considered, the number of crashes is disproportionately high.



## RESOURCES

 Michigan Crash Facts Report:  
Annual report detailing the crash experience on Michigan's public roads.  
<http://www.michigantrafficcrashfacts.org/>

 National Highway Traffic Safety Administration:  
Safety reports and materials on a variety of national traffic safety subjects.  
<http://www.nhtsa.dot.gov/>

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### Factors that may contribute to the number of crashes on local roads:

- Lane width:** State highways and freeways typically have wider lanes than the local roads. In addition many of these higher “functional class” roads also have wide paved shoulders. Research has shown that wider lanes and shoulders result in a decrease in the number of crashes, but may also lead to an increase in speeds—a different problem.
- Curve and grade geometry:** Contrary to state highways and freeways, local roads generally have more locations where geometric design exceptions have been made around curves and hills. Local roads often have sharper curves and steeper grades because the cost of correcting the geometric problem may not be feasible based on the number of vehicles that use the road.
- Signing and paint striping:** Generally speaking, local agencies do not have the budgets necessary to maintain signs and paint markings on local roads to the same level as higher functional class roads. In some cases, poor paint markings and a lack of signing can influence the number of crashes that occur.
- Roadside Obstructions:** Higher functional class roadways (freeways and highways) typically have a wide, relatively flat, clear area outside the driving lanes where drivers who run off the road can recover and get their vehicle back on the road or stop without causing a traffic crash. It is not uncommon for local roads to have little if any recovery area or to have obstructions directly adjacent to travel lanes.
- Number of driveways:** Research has shown that an increase in the number of crashes comes with an increasing number of driveways. Local roads are primarily for local property access, and as such, have a significant number of driveways. Higher functional class roads typically do not have as many driveways or have active “access management” programs to control driveway access.

### Factors that influence the number of crashes – all roads:

#### Driver Condition

- Reflexes – how quickly they can respond to a situation
- Attentiveness – Is the driver paying attention?
- Experience – Less experienced drivers are at an elevated crash risk
- Alcohol & drug use
- Driver aggressiveness – Aggressive or frustrated drivers take more chances or are more likely to drive beyond their limit of control

#### Human Factors

- Visibility – How well can an object be seen? Humans have a cone of vision 15° around the center of their focal point where items of interest will likely be noticed.
- Expectancy – Drivers use an understanding of past situations to lessen the mental workload of driving. For example, drivers in the Midwest expect that if they don’t see a stop sign at an intersection they can proceed without stopping. In Western states this is not always the case—there are many uncontrolled intersections without any signs or signals.

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- Consistency – When designs for roads and traffic control are applied consistently in the same situation, drivers have an easier time driving which results in fewer crashes.
- Workload – When a driver becomes overloaded with driving inputs they lose the ability to process information. An overloaded driver is actually impaired for a short period of time after the overload occurs. Overload situations include negotiating a complex, busy intersection. Overloaded drivers may also suffer from a temporarily reduced field of vision (tunnel vision).

### Vehicle

- Handling characteristics – Newer vehicles have improved handling characteristics that include reduced stopping distance due to anti-lock brakes, traction and skid control, and better cornering behavior. Older vehicles do not.
- Maintenance – Lack of vehicle maintenance such as poor brakes can lead to crashes, however the total percentage of crashes attributed to vehicle malfunction is very low – less than 5% of all crashes.


### Roadway

- Geometry – how roadway features are designed has a major impact on safety. Everything from the radius of a curve, or the grade that a road takes through a hill, to the slopes leading into and out of the ditches can influence traffic safety. Geometric features should be reviewed whenever major road work is planned or when there is a high incidence of crashes at a specific location.
- Maintenance – Upkeep of roadside features such as shoulders and signs can impact traffic safety.
- Surface condition – Maintaining a smooth, high friction road surface can reduce the incidents of traffic crashes.

### Environmental

- Rain / snow / fog

### RESOURCES:

-  Report on contributing factors of single vehicle crashes:  
<http://www-nrd.nhtsa.dot.gov/pdf/nrd-12/HS809664.pdf>

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### Roundabouts:

Standard “4-way cross” intersections have several safety issues that are not present in modern roundabouts.

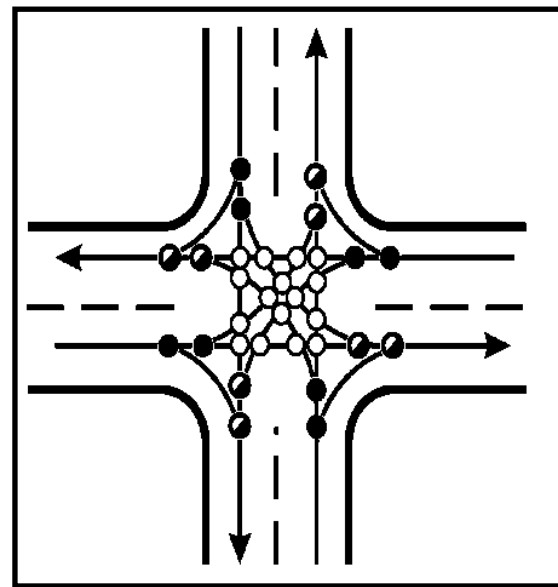
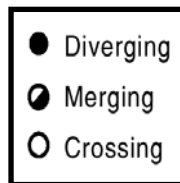
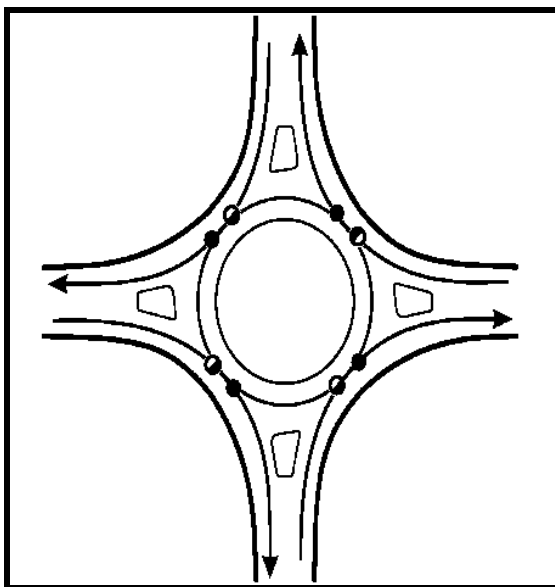
- ❑ Left Turning Movements: Left turning movements are a major factor in congestion at standard 4-way cross intersections. This is because the left turn movement prohibits all other straight through movements. Additionally left turn movements can subject the turning vehicle to collisions from all 3 other legs.
- ❑ Right angle crashes: Right angle crashes are the most severe type of crash and are the most likely to produce an injury or fatality.

### Conflict Points:

A conflict point is a location in an intersection where traffic from different directions crosses paths and where a collision could result. Designers try to increase safety by reducing the number of conflict points at intersections. A standard 4-way cross intersection has 32 vehicle conflict points, 16 of which are right angle conflicts. Roundabouts only have 8 conflict points and all of those are merging or diverging conflicts.

**Conflict Points: Roundabout**

**Conflict Points: 4-way Intersection**



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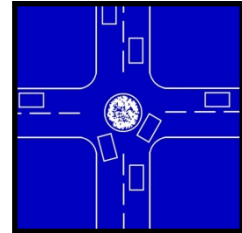
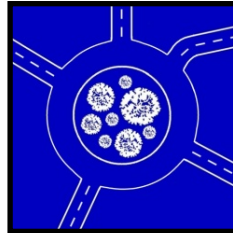
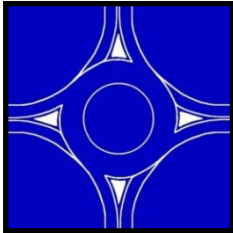
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### Modern Roundabouts Safety:

Roundabouts have been shown to reduce the number of crashes (29% to 50% fewer crashes) and the severity of crashes (30 to 73% fewer injury crashes) when compared to a signalized intersection.

### Circular Roadway Confusion:

Modern roundabouts are often confused with other types of circular roadways, such as rotaries and traffic circles. This confusion leads to objection if the general public has not used a modern roundabout, but has seen or heard about other types of circular roadways.



<u><b>Roundabout</b></u>	<u><b>Rotary</b></u>	<u><b>Traffic Circle</b></u>
<ul style="list-style-type: none"> <li>• Size: 100' to 200' dia.</li> <li>• Speed: 20 mph (single lane)</li> <li>• Crashes: infrequent</li> <li>• Traffic Control: Yield to enter</li> <li>• Center Island: No pedestrians; low vegetation only</li> <li>• Parking: Not allowed in circle</li> </ul>	<ul style="list-style-type: none"> <li>• Size: 400' dia. and up</li> <li>• Speed: 35 mph +</li> <li>• Crashes: frequently</li> <li>• Traffic Control: Circle yields</li> <li>• Center Island: Open to pedestrians and trees</li> <li>• Parking: Allowed in circle</li> </ul>	<ul style="list-style-type: none"> <li>• Size: 10' to 50' dia.</li> <li>• Speed: 10% less than standard intersection</li> <li>• Application: Traffic calming</li> <li>• Application: Low volume only</li> <li>• Space Required: Standard</li> <li>• Large Vehicles: Can be limited</li> </ul>

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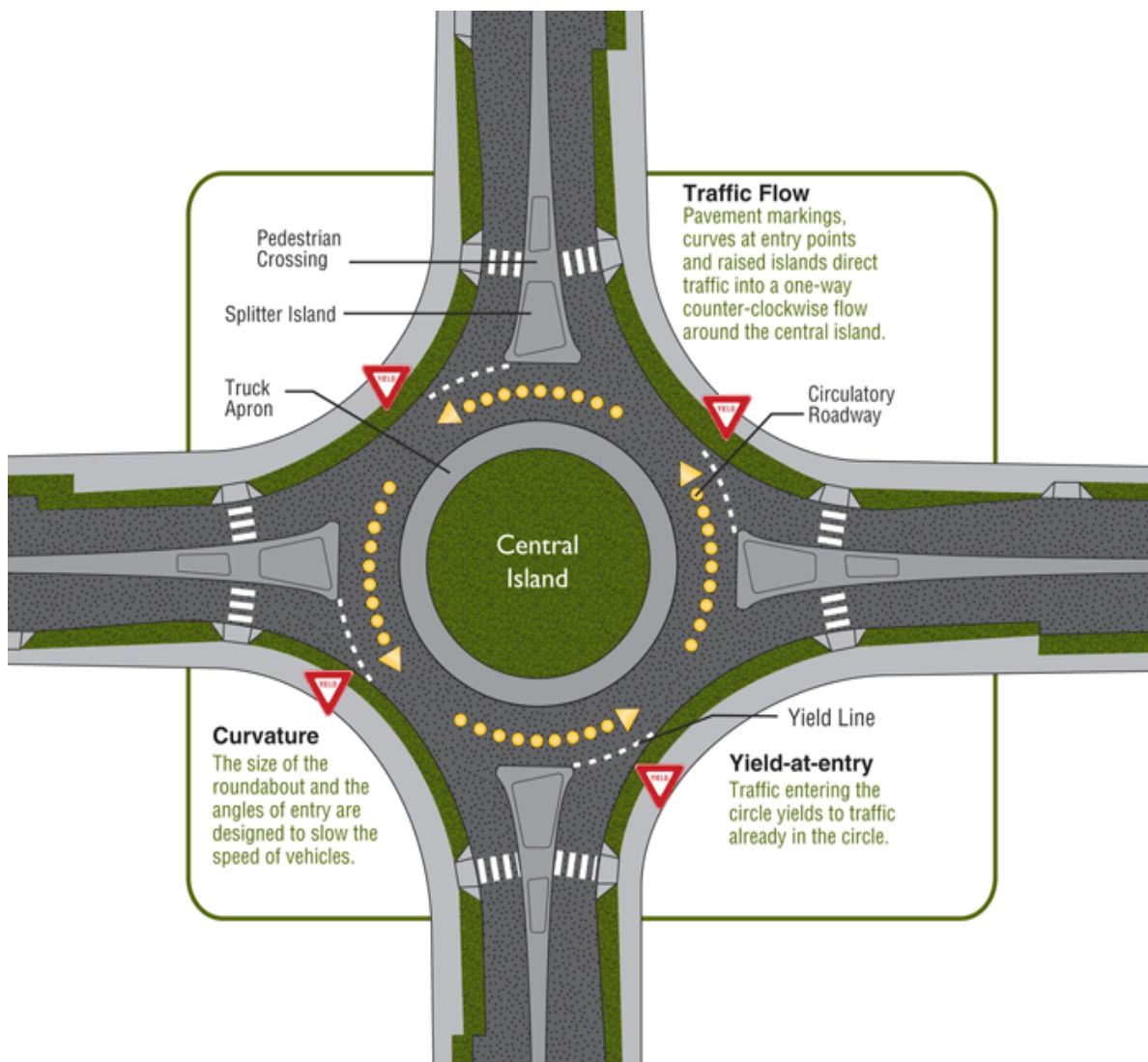
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## Design Features of a Roundabout:



Credit: Minnesota DOT Website <http://www.dot.state.mn.us/roundabouts/features.html>



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### Common Roundabout Misconceptions:

- 1) “Roundabouts restrict traffic” – Not true. Roundabouts can move as much or more traffic than a similarly sized signalized intersection.
- 2) “Roundabouts are dangerous and difficult to drive” – Not true. While drivers do take some time to become familiar with roundabout operation, roundabouts are safer than traffic signals.
- 3) “Roundabouts quickly become congested with just a moderate number of left hand turning movements” – Not true. Roundabouts, unlike signalized intersections, treat every turning movement with the same priority. Left turning movements do not influence roundabouts.
- 4) “Large trucks have difficulty traveling through roundabouts” – Not true. Large trucks can easily pass through appropriately designed roundabouts.
- 5) “Roundabouts cannot be used on high speed roads” – Not true. Traffic signals or stop signs, like roundabouts, require drivers to slow down to negotiate the intersection.

### RESOURCES:

-  Minnesota DOT Information page on roundabouts:  
<http://www.dot.state.mn.us/roundabouts/index.html>
-  Washington DOT- Information page on roundabouts:  
<http://www.wsdot.wa.gov/Projects/roundabouts/>
-  Iowa DOT – Info on rotaries, roundabouts and traffic circles:  
[http://www.iowadot.gov/roundabouts/roundabouts\\_design.htm](http://www.iowadot.gov/roundabouts/roundabouts_design.htm)
-  Iowa DOT – Myths about roundabouts:  
[http://www.iowadot.gov/roundabouts/roundabouts\\_myths.htm](http://www.iowadot.gov/roundabouts/roundabouts_myths.htm)
-  FHWA- Roundabout Information Guide:  
<http://www.tfhr.gov/safety/00068.htm>
-  FHWA – Research page on roundabouts:  
<http://safety.fhwa.dot.gov/intersections/roundabouts.htm>

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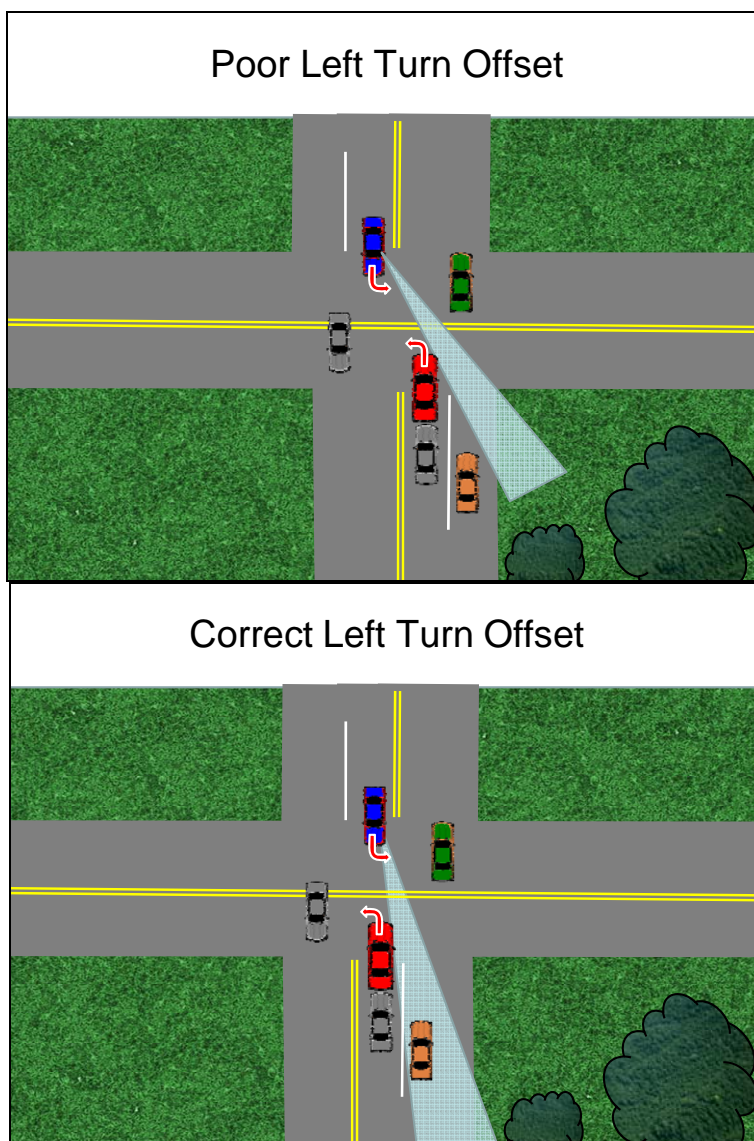
## Geometric Design Features And Safety

### **Approach Grade:**

The slope of a road leading into the intersection can influence traffic safety. Steep grades (over 6%) downhill can cause problems with drivers stopping, steep grades uphill can cause problems with drivers starting.

### **Left Turn Lane Offset:**

Ideally left turn lanes should be positioned directly across from each other. Simply changing a through lane to a dedicated turn lane without repositioning the lanes can lead to left turning vehicles blocking each other's view of oncoming cars that have the right of way to pass straight through.



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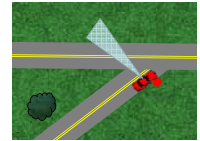
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### Skew Intersections:

Intersections that intersect at angles above 61 degrees are a safety concern because the driver's range of sight of oncoming cars is limited.



### Offset Intersections:

Intersections that have an offset in the opposite legs can be an operational and safety concern. The offset legs can cause vehicles to back up as drivers attempt to make left hand turns. In some cases a "left hand lock" may occur, where the queues from each lane can block left hand turns from the opposing lane.



### Horizontal Curves:

Horizontal curves should be designed for the design speed of the road. A curve that is too "sharp" for the design speed can be unsafe, unless posted with an advisory reduced speed limit.

### Compound Horizontal Curves:

Curves in a road should only have one continuous radius. Compound curves are curves with more than one radius—the curve gets tighter as you travel through it. These curves cause problems for drivers because they can be fooled into believing they are traversing at a safe speed until the curve turns more sharply—they need to brake or lose control.

### Stopping Sight Distance:

Stopping sight distance is the distance along a road from which a driver can identify a 3.5 foot tall target. The 3.5 foot target corresponds to the 90<sup>th</sup> percentile for vehicle heights allowing for enough of the vehicle to be viewed. When the stopping sight distance is shorter than the distance required to stop a vehicle at the posted speed limit (including reaction time), an unsafe condition can result.

### Intersection Sight Distance:

The distance a driver can see from a stopped position at an intersection is referred to as the intersection sight distance. A safe intersection sight distance allows the driver to make a determination of whether it is safe to proceed through the intersection. Safe intersection sight distance varies depending on the traffic control and the intended direction of travel by the stopped vehicle.

### Crashworthy:

An object is deemed to be "crashworthy" if it can pass crash testing that demonstrates it will not cause an undue risk to an occupant of a vehicle impacting the object. The National Cooperative Highway Research Program (NCHRP) 350 standards are used to determine crashworthiness. Common objects that are not crashworthy are trees, boulders, stone walls, reinforced sign supports, reinforced mailbox posts, etc.

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### Clear Zones:

Roads are designed with clear zones—areas that should be free from non-crashworthy objects adjacent to the road. The clear zone depends on the speed of traffic and type of road. At a minimum the clear zone is between 7 to 10 feet from the edge of the traveled way for local roads without curbs. The clear zone gives drivers that depart the roadway an area to regain control or stop the vehicle without impacting a fixed object or encountering a non-recoverable slope.

### Access Control:

The number and type of driveways can significantly influence the number of crashes that occur on urban streets. Access control—the act of managing access points to roads—can help to insure that unsafe conditions don't exist.

### RESOURCES:

-  NCHRP 350 report of crashworthy devices:  
[http://safety.fhwa.dot.gov/roadway\\_dept/road\\_hardware/nchrp\\_350.htm](http://safety.fhwa.dot.gov/roadway_dept/road_hardware/nchrp_350.htm)
-  FHWA website on clear zones:  
<http://www.fhwa.dot.gov/programadmin/clearzone.cfm>
-  Mailbox crash testing videos:  
[http://www.dot.state.tx.us/services/maintenance/mailbox\\_crash\\_test.htm](http://www.dot.state.tx.us/services/maintenance/mailbox_crash_test.htm)
-  Sign crash test video:  
<http://www.youtube.com/watch?v=mkctNXAHBAk>
-  Simplified handbook of traffic studies – sight distance (note error in target height – should be 3.5 feet)  
<http://www.ctre.iastate.edu/pubs/traffichandbook/4SightDistance.pdf>

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### Traffic Control Signs

#### **Negative Aspects of Signs:**

Signs must be appropriately placed and correctly installed in order to gain a benefit. Signs can detract from safety if used inappropriately by causing a distraction to drivers, or by encouraging drivers to “disregard” them as irrelevant. Misplaced signs can also represent a significant financial burden to the agency and can be a hazard to drivers, pedestrians and workers, so they should be used only when a benefit will be derived.

#### **Michigan Manual Of Traffic Control Devices:**

The State of Michigan adopts the federal Manual of Traffic Control Devices with changes. The Michigan Manual of Traffic Control Devices (MMUTCD) describes in detail how to properly use traffic control devices such as signs, signals and paint markings. Compliance with the manual is mandatory by Michigan State Law and failure to do so can result in the loss of State and federal road funding.

#### **Placement Rules for Sign Installation:**

In order for a sign placement to be successful it must meet the following conditions:

- 1) Fulfills a need – A sign must meet a “warrant” in the MMUTCD in order to be installed. Warrants describe the threshold conditions where a benefit can be derived from the installation of the sign.
- 2) Commands respect– A sign must be respected by drivers in order for it to be useful. The main barrier to drivers respect of signs is sign over use or misuse.
- 3) Command attention – A sign must be within the driver’s range of sight in order to be useful. The MMUTCD describes placement for signs to keep them in the driver’s range of sight without placing them where they may cause a hazard to road users.
- 4) Provides adequate time for response – Drivers must be able to react to a sign in time for it to be useful. Reaction time is divided into 4 parts:
  - a. Perception: Taking note of an object in driver’s field of vision.
  - b. Identification: Determining that the object is a traffic control sign, for example a stop sign.
  - c. Emotion: Decision to act on the message of the sign. In the case of a stop sign, the decision to stop prior to the sign.
  - d. Volition: The physical act of the driver applying the brakes and stopping.
- 5) Meets drivers expectations – Signs must be placed where drivers have come to expect them to be placed. For example Midwest drivers approaching an intersection assume that if they do not have a stop sign or signal facing their direction that the other leg of the intersection must stop. However, in Western states it is not uncommon to have totally uncontrolled intersections with no traffic control at all. This would be a conflict of what Midwestern drivers have come to expect.
- 6) Consistent with other applications – Signs must be applied consistently if drivers are to depend on and trust them. Inconsistent application of signs can lead to unsafe conditions as drivers begin to view signs as irrelevant.

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- 7) Conveys a simple message – The meaning that drivers should take from a sign should be immediately apparent. If a driver has to consciously think about what a sign means or what to do in response, the sign is not useful.

### Controlling Speeds

#### **Speed Limits:**

Research has shown that drivers typically drive a speed that “feels” safe. Speed limits outside of residential areas are based on the 85<sup>th</sup> percentile speed –the speed that 85 percent of drivers do not exceed. Research has shown the 85<sup>th</sup> percentile speed to be near the optimum speed for safety. Traffic safety studies have also shown that driving too slow with respect to the average speed can put drivers at the same risk as driving too fast.

#### **Stop Signs Are NOT For Speed Control:**

The MMUTCD Section 2B0.5 states that “Stop signs should **not** be used for speed control.” Over 20 research studies have concluded that stop signs are not effective for speed control and in many cases increase the speeds between the signs.

#### **Traffic Calming:**

Traffic calming techniques can be utilized to reduce speeds and mitigate some of the negative aspects of motor vehicle use on the pedestrian and bicycle users. Traffic calming techniques typically revolve around making physical improvements to transportation facilities or rely on education to change driver behavior.

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### RESOURCES

-  Michigan State Police – Setting Realistic Speed Limits  
<http://www.michigan.gov/speedlimits>
  
-  From the Institute of Highway Engineers  
*All-Way Stops Versus Speed Humps: Which is more effective at slowing traffic speeds?*, by David E. Clark, P.E.  
[www.ite.org/traffic/documents/AB00H1902.pdf](http://www.ite.org/traffic/documents/AB00H1902.pdf)
  
-  Research documents on the use of 4 way stop control  
<http://www.ci.troy.mi.us/TrafficEngineering/Multiway.htm>
  
-  Michigan Manual of Traffic Control Devices (MMUTCD)  
Statewide distribution from the Michigan Local Technical Assistance Program  
LTAP@mtu.edu  
906-487-2102
  
-  From the FHWA  
Standard Highway Signs  
[http://mutcd.fhwa.dot.gov/ser-shs\\_millennium\\_eng.htm](http://mutcd.fhwa.dot.gov/ser-shs_millennium_eng.htm)  
Updated Minimum Retroreflectivity Levels For Traffic Signs  
[http://safety.fhwa.dot.gov/roadway\\_dept/retro/](http://safety.fhwa.dot.gov/roadway_dept/retro/)
  
-  Traffic Calming – Site describing traffic calming treatments  
<http://www.trafficcalming.org/>  
<http://www.fhwa.dot.gov/environment/tcalm/>

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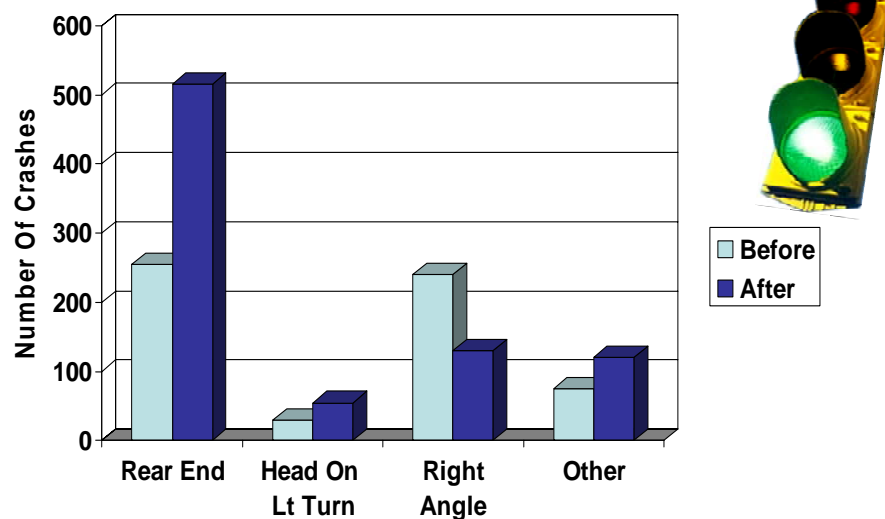
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## Traffic Signals

### Traffic Signals As a Safety Feature:

Traffic signals have very limited application as a safety feature. Traffic signals actually INCREASE the total number of crashes that occur at an intersection. However, the increased crashes are generally in the form of increased rear end crashes (which are typically not severe), while there is a corresponding reduction in the number of right angle crashes, (which are typically the most severe). Traffic signals are dynamic in that they change with time, meaning that drivers need to make a time critical decision whether to proceed or stop.

## Before And After Signal Installation Of 20 Intersections In Michigan



### Traffic Signal Warrants

Traffic signal installation needs to meet the 8 warrants in the MMUTCD.

- Warrant 1, Eight-hour vehicular volume: used in areas where the volume of vehicles is heavy enough over an eight-hour period (usually during normal work hours) to warrant a signal.
- Warrant 2, Four-hour vehicular volume: used in areas where the volume of vehicles is heavy enough over a four-hour period to warrant a signal. The volume to satisfy a four-hour warrant is higher than for an eight-hour warrant.
- Warrant 3, Peak hour: used in areas that experience very short but intense peaks in traffic volume. The volume to satisfy a peak hour warrant is higher than for a four- or an eight-hour warrant.
- Warrant 4, Pedestrian volume: used in areas where pedestrian volumes are high enough to justify a signal.



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- Warrant 5, School crossing: similar to warrant 4, but is satisfied by lower volumes of pedestrians to accommodate children instead of adults.
- Warrant 6, Coordinated signal system: used to justify a signal to help manage traffic flow in a system of coordinated signals.
- Warrant 7, Crash experience: used in areas that have a significant history of crashes and where there is a sufficient volume of traffic.
- Warrant 8, Roadway network: used in areas where several traffic operations issues related to traffic flow in a network of roads, can justify a signal.

### **Dilemma Zone:**

A Dilemma Zone is the period of time when the signal changes from green to red and an approaching car does not have enough time to stop or pass through under yellow. Dilemma Zones are a serious safety concern, because they generally result in a vehicle running a red light—drivers most often try to beat the light rather than hit the brakes hard. Dilemma Zones can be eliminated by appropriately setting the yellow timing to correspond with the approach speed of traffic and any vertical grades.

### **Red Light Running**

- RLR is the most common crash type in urban areas (about 20% of crashes at signalized intersections)
- Violation frequencies range as high as 1 per 3.5 min.
- Nationally, 46% of RLR crashes result in injury
- Signalized intersection fatalities – 40% are RLR related
- Economic impact of RLR is \$14 billion annually

### **Human Factors**

Human factors analysis is the study of how a driver perceives and reacts to the road environment. The goal of human factors study is to design transportation facilities with the limitation and characteristics of the driver in mind, thereby reducing driver error.