



## Roadway Signs I

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**PDH:** 3

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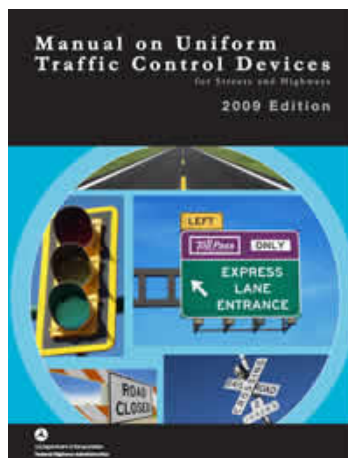


## INTRODUCTION

This course is the first of two that discusses how to effectively use signs to guide roadway traffic, and thereby reduce your liability exposure. This portion covers general sign information through intersection signage. The contents of this course are intended to serve as guidance and not as an absolute standard or rule. Its purpose is to help you to use the **Manual on Uniform Traffic Control Devices (MUTCD) – Part 2** more effectively and not replace it. Should there be any discrepancies between the contents of this course and the MUTCD - always follow the MUTCD.

Upon course completion, you should be familiar with the general design guidelines for traffic signs. The course objective is to give engineers and designers an in-depth look at the principles to be considered when selecting and designing for traffic control.

For this course, the *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) 2009 Edition* will serve as a reference for the fundamental design principles of traffic signs. The MUTCD is recognized as the **national standard** for all traffic control devices installed on any street, highway, bikeway, or private road open to public travel. Any traffic control device design or application contained within it is considered to be in the public domain and available for use.



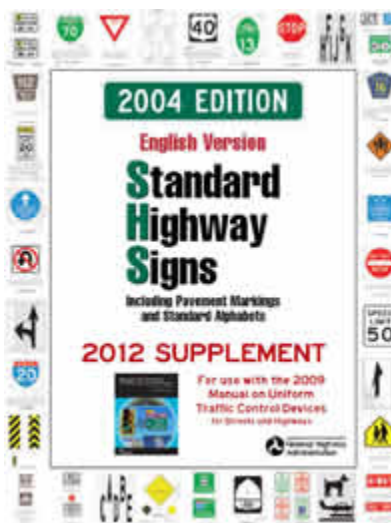
<http://mutcd.fhwa.dot.gov/pdfs/2009/mutcd2009edition.pdf>

Traffic signs are typically used for conveying laws and regulations, traffic and roadway conditions, and guidance and other information. These critical tools provide important information for safe travel on any U.S. roadway system.

Traffic signs are not a cure for all traffic problems. Road users process different types of visual and non-visual information differently: speed, roadway conditions, traffic, legal enforcement, noise levels, etc. Also, traffic signs serve as reminders of important information, so road users do not have to memorize everything.

The goal is to provide drivers with relevant information when they need it - resulting in safer, more efficient roadways with reduced liability risks. However, poor sign management can greatly reduce safety, contribute to roadway incidents, and increase liability exposure.

The *Standard Highway Signs and Markings* book contains detailed specifications for all adopted standard signs. All traffic control devices have to be similar to or mirror images of those shown in this manual. Any symbols or colors cannot be modified unless otherwise stated.



[http://mutcd.fhwa.dot.gov/SHSe/shs\\_2004\\_2012\\_sup.pdf](http://mutcd.fhwa.dot.gov/SHSe/shs_2004_2012_sup.pdf)

## MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD)

By law (23 CFR 655, Subpart F), the *Manual on Uniform Traffic Control Devices (MUTCD)* is recognized as “the national standard for all traffic control devices installed on any street, highway, bikeway, or private road open to public travel”. It is the definitive authority for traffic signs and pavement markings.

Nationwide consistency is the goal of the MUTCD by requiring uniform, understandable, and effective traffic control devices on all facilities open to public travel. It defines the nationwide standards for the installation and maintenance of the devices on all streets and highways. The MUTCD allows us to drive anywhere in the U.S. using the same basic signs with the same meanings. Drivers who see a particular sign should expect it to mean the same thing regardless of location.

**Table I-1. Evolution of the MUTCD**

Year	Name	Month / Year Revised
1927	Manual and Specifications for the Manufacture, Display, and Erection of U.S. Standard Road Markers and Signs (for rural roads)	4/29, 12/31
1930	Manual on Street Traffic Signs, Signals, and Markings (for urban streets)	No revisions
1935	Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)	2/39
1942	Manual on Uniform Traffic Control Devices for Streets and Highways — War Emergency Edition	No revisions
1948	Manual on Uniform Traffic Control Devices for Streets and Highways	9/54
1961	Manual on Uniform Traffic Control Devices for Streets and Highways	No revisions
1971	Manual on Uniform Traffic Control Devices for Streets and Highways	11/71, 4/72, 3/73, 10/73, 6/74, 6/75, 9/76, 12/77
1978	Manual on Uniform Traffic Control Devices for Streets and Highways	12/79, 12/83, 9/84, 3/86
1988	Manual on Uniform Traffic Control Devices for Streets and Highways	1/90, 3/92, 9/93, 11/94, 12/96, 6/98, 1/00
2000	Manual on Uniform Traffic Control Devices for Streets and Highways — Millennium Edition	7/02
2003	Manual on Uniform Traffic Control Devices for Streets and Highways	11/04, 12/07
2009	Manual on Uniform Traffic Control Devices for Streets and Highways	

The Federal Highway Administration (FHWA) publishes the MUTCD which establishes uniform standards for traffic control devices and promotes safety and efficiency on public roads. Road safety can be greatly increased by exceeding MUTCD requirements. Oversized signs may be appropriate for locations where speed, volume or other factors produce conditions that need additional visibility. Excessive methods should only be employed if a standard measure cannot meet the need. Otherwise, road users may tend to disregard the traffic control device.

The MUTCD has nine chapters (“Parts”):

**General**

**Signs**

**Marking**

**Highway Traffic Signals**

**Traffic Control Devices for Low-Volume Roads**

**Temporary Traffic Control**

**Traffic Control for School Areas**

**Traffic Control for Highway-Rail Grade Crossings**

**Traffic Control for Bicycle Facilities**

Since this course concentrates primarily on the subject of traffic signs, we will focus mainly on **Part 2 - Signs**.

### **SHALL, SHOULD, and MAY**

The terms “shall,” “should,” and “may” have specific meanings when used in the MUTCD.

**SHALL** – Required, mandatory or specifically prohibitive practice.

Any statements with “shall” conditions are typically used as a STANDARD in the MUTCD.

These items cannot be modified or compromised. There is no allowance for discretion and they must be followed.

**SHOULD** – Advisory or recommended practice in typical situations.

Deviation is appropriate if justified by engineering judgment or study. Statements marked as “should” are used for GUIDANCE in the MUTCD.

**MAY** – Permissive or optional practice without requirement or recommendation.

Items marked as “may” are typically used in OPTION statements in the MUTCD and can contain allowable modifications.

SUPPORT statements do not contain the verbs “shall”, “should”, or “may”. These statements are for informational purposes only (without any mandate, recommendation, or enforcement).

### **Road User**

The MUTCD defines a road user as *“a vehicle operator, bicyclist, or pedestrian, including persons with disabilities, within the highway or on a private road open to public travel”*. This group includes users of various skill levels and ages, pedestrians, wheelchairs, runners, rollerbladers, bicyclists, truck drivers, and motorcyclists. By meeting user needs, engineers can minimize any problems that the average road user may encounter.

## **FIVE BASIC REQUIREMENTS OF TRAFFIC CONTROL DEVICES**

In order to be effective, any traffic control device has to be used in the right way. The MUTCD lists the following principles to be used when selecting and applying each device:

### **1 - Fulfill a need**

A sign should only be installed if there is a need for warning, regulation or guide information. It is also vital to use signs that fulfill that need. If a need exists and the sign in question does not meet that need, use something else. Overusing signs can lead to disrespect and loss of emphasis value while underuse can result in persistent but correctable safety problems.

### **2 - Command attention**

Standard signs are designed to be noticed and catch the attention of road users. The high-contrast color combinations were chosen due to their ability to stand out and be easy to read. Oversized signs, doubled signs, or flashing beacons can also be used to emphasize the sign’s message.

Sign maintenance is the key to remain eye-catching. All signs need to be kept in good working order. They need to reflect light at night, and not be faded, cracked, or peeling. Signs in bad condition (dull, battered, vandalized, etc.) are unable to command attention, day or night.

### **3 - Command respect**

Road users are expected to willingly obey warnings and regulations that obviously fulfill a need. Warning and regulatory signs that seem unneeded or unreasonable are regularly disobeyed. Good sign management and maintenance is crucial to commanding respect for traffic control devices. Amateurish, homemade or damaged signs are more likely to be disregarded.

#### **4 - Have one simple message**

A sign needs to communicate its message in a way that is clear and readable. By using standard signs in the MUTCD that have been researched and evaluated by the FHWA, most drivers should understand their meanings.

#### **5 - Provide adequate time for proper response**

Traffic control devices should meet or exceed MUTCD standards so drivers have adequate time (Perception-Response Time – PRT) to react. Drivers need to have the time and distance to take the appropriate action before they reach a situation. If not, insufficient response time may result in roadway crashes.

Traffic speed is an important factor for determining driver response time. Vehicles operating at high speeds need longer response time and more distance to react. This increased distance can be obtained by using larger signs, or by placing signs in advance of the location where the information is needed.

Using the five basic requirements will help make your traffic control devices more effective. Design, placement, operation, maintenance, and uniformity should be taken into consideration to maximize the ability of a device to meet these principles. However, by disregarding the five requirements, you may find that road users disregard your traffic control devices.

## SIGNS

### RETROREFLECTIVITY

Drivers must be able to read a sign from a reasonable distance and have adequate reaction time to safely travel the roadway. As the national population gets older, the average driver gets older, and people continue driving at older ages. Improving nighttime visibility of signs and pavement markings becomes more important as the traveling public gets older. As we age, our eyes gradually become less light sensitive.



W3-1



W3-2



W3-3

**Retroreflectivity** is the ability of a traffic control device to reflect light from its surface back to its original source. Retroflective traffic signs can be used for increasing nighttime visibility. Maintaining retroreflectivity is a crucial element of traffic safety since fatal night crashes occur approximately three (3) times as often as daytime traffic fatalities.

#### Retroreflectivity Elements

**Light source** (vehicle headlights)

**Target** (traffic control device)

**Receptor** (driver's eyes)

Technologies involving glass beads or prismatic reflectors are more visible and bright since more light is reflected directly back to the original source.

All signs (regulatory, warning, and guide) and object markers need to be retroreflective or illuminated to display the same shape and color regardless of time and day. New materials or methods can be used as long as the traffic control devices meet the standard color requirements. Sign design should be uniform without any decrease in: **visibility, legibility, or driver comprehension during day or night conditions.**



Traffic sign retroreflective sheeting typically consists of either glass beads or microprisms. Some older types of sign sheeting use tiny spherical reflector glass beads to reflect light. Light enters the bead and reflects off the rear surface back along its original path to the source. Engineering grade sheeting uses glass bead reflector technology.

The retroreflective properties of glass beads depend on:

- **Chemical makeup of the beads**
- **Size**
- **Depth in binder**
- **Color, other properties of binder**

**Microprismatic sheeting** uses hundreds of small prisms per square inch (like bicycle reflectors) to reflect more of the light back to the driver. These types of signs appear much brighter than engineering grade or high intensity signs due to their efficiency. Using microprismatic sheeting for key warning and regulatory signs gives the signs a greater target value at night and meets the need for commanding user attention.

The FHWA publishes the *2014 Traffic Sign Retroreflective Sheeting Identification Guide* for your use. Table 2A-3 of the MUTCD displays the minimum levels of retroreflectivity for traffic signs.

### **Sign Type and Designation**

Over the years, traffic signs have been responsible for providing messages of increasing complexity. To meet this challenge, the MUTCD specifies standard design features to encourage adequate perception-reaction time for the road user. These features (size, shape, and color) are specific to the functional category of each traffic sign.

## SIGN CATEGORIES AND USE

CATEGORY	USE
Regulatory	Requires or prohibits actions by the road user
Warning	Warns user of conditions that may require an action to avoid a hazardous situation
Guide & Information	Helps user find their way, informs user of traveler services, etc.
Recreational and Cultural Interest	Guides user to recreation and cultural areas/facilities
Non-Traffic Control	Not meant for highway use, or contains information not related to highway use or traffic control

### Sign Color and Shape

A sign's color and shape is important in conveying traffic control information. These specific combinations inform drivers of the type of sign. The colors and shapes are designed to command attention and convey a clear simple message. Signs usually have one color (typically black or white) for the legend, which includes symbols, text and border. Some signs (such as prohibition signs) have two-color legends containing a red circle and slash over a black symbol. The Federal Highway Administration (FHWA) established a color code of appropriate colors for traffic control devices.

## COLOR CODE FOR TRAFFIC CONTROL DEVICES

<b>COLOR</b>	<b>MEANING</b>
Black	Regulation
Blue	Road user services guidance, tourist information, evacuation route
Brown	Recreational and cultural interest area guidance
Coral	Unassigned
Fluorescent Pink	Incident management
Fluorescent Yellow-Green	Pedestrian warning, bicycle warning, playground warning, school bus and school warning
Green	Indicated movements permitted, direction guidance
Light Blue	Unassigned
Orange	Temporary traffic control
Purple	Lanes restricted to use only by vehicles with registered electronic toll collection (ETC) accounts
Red	Stop or prohibition
White	Regulation
Yellow	Warning

Non-standard colors, or non-standard display methods can create driver confusion. For example, people would be reluctant to recognize a stop sign that is a shape other than octagonal, or a color other than red.

**Table 2A-5. Common Uses of Sign Colors**

Type of Sign	Legend									Background									
	Black	Green	Red	White	Yellow	Orange	Fluorescent Yellow-Green	Fluorescent Pink	Black	Blue	Brown	Green	Orange*	Red*	White	Yellow*	Purple	Fluorescent Yellow-Green	Fluorescent Pink
Regulatory	X		X	X					X					X	X				
Prohibitive			X	X										X	X				
Permissive		X													X				
Warning	X															X			
Pedestrian	X															X		X	
Bicycle	X															X		X	
Guide				X							X								
Interstate Route				X						X				X					
State Route	X														X				
U.S. Route	X														X				
County Route					X					X									
Forest Route				X							X								
Street Name				X								X							
Destination				X								X							
Reference Location				X								X							
Information				X						X		X							
Evacuation Route				X						X									
Road User Service				X						X									
Recreational				X							X	X							
Temporary Traffic Control	X												X						
Incident Management	X												X						X
School	X																		X
ETC-Account Only	X																X****		
Changeable Message Signs																			
Regulatory			X***	X					X										
Warning					X				X										
Temporary Traffic Control					X	X			X										
Guide				X					X			X**							
Motorist Services				X					X	X**									
Incident Management					X		X		X										
School, Pedestrian, Bicycle					X		X		X										

- \* Fluorescent versions of these background colors may also be used.
- \*\* These alternative background colors would be provided by blue or green lighted pixels such that the entire CMS would be lighted, not just the legend.
- \*\*\* Red is used only for the circle and slash or other red elements of a similar static regulatory sign.
- \*\*\*\* The use of the color purple on signs is restricted per the provisions of Paragraph 1 of Section 2F.03.

Signs usually have one color (typically black or white) for its legend which includes symbols, text and border. Exceptions include prohibition signs, etc. that have two-color legends containing a red circle and slash over a black symbol.

## Fluorescence

Fluorescent materials available for traffic signs include: orange (work zones); and yellow-green (school, bicycle, and pedestrian warning). These materials appear brighter than ordinary colors during daytime due to their efficient utilization of light/energy. Fluorescent signs are also more visible during inclement weather since they re-emit short-wave light/energy as longer, visible light waves which better penetrate clouds or fog.

**Table 2A-4. Use of Sign Shapes**

Shape	Signs
Octagon	Stop*
Equilateral Triangle (1 point down)	Yield*
Circle	Grade Crossing Advance Warning*
Pennant Shape/Isosceles Triangle (longer axis horizontal)	No Passing*
Pentagon (pointed up)	School Advance Warning Sign (squared bottom corners)* County Route Sign (tapered bottom corners)*
Crossbuck (two rectangles in an "X" configuration)	Grade Crossing*
Diamond	Warning Series
Rectangle (including square)	Regulatory Series Guide Series** Warning Series
Trapezoid	Recreational and Cultural Interest Area Series National Forest Route Sign

\* This sign shall be exclusively the shape shown.

\*\* Guide series includes general service, specific service, tourist-oriented directional, general information, recreational and cultural interest area, and emergency management signs.

## Sign Size

The *Standard Highway Signs and Markings* book displays traffic sign sizes depending on the traffic facility type. Standard sign sizes should be used unless engineering judgment indicates otherwise. Sign sizes should not be smaller than the minimum sizes contained in the MUTCD. However, larger sizes may be used where deemed appropriate (expressways, freeways, multi-lane divided roads, undivided highways with 5 or more lanes). Shapes and colors as close to the standard proportions should also be used.

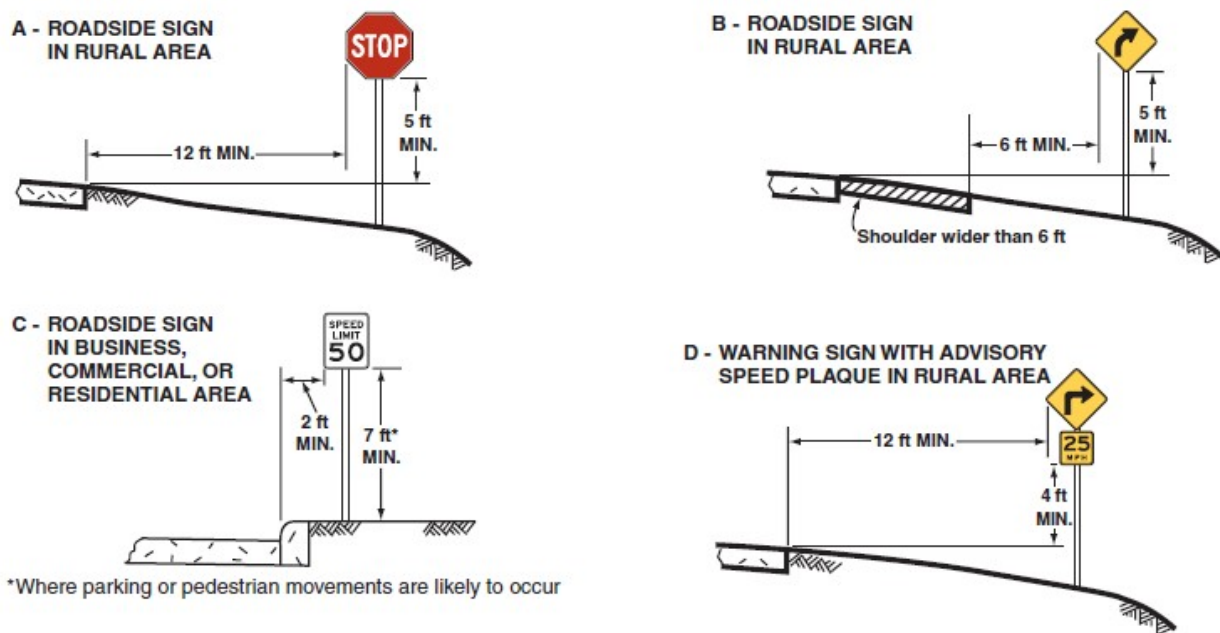
## SIGN LOCATION

Signs requiring different user decisions need to be spaced sufficiently far apart to allow for reasonable reaction time. Multiple signs should be compatible and provide a logical sequence of communication. The road user needs to have adequate time to adjust speed, avoid any potential hazard, and continue on their desired route. These signs should be placed on the right side of the roadway where they can be easily recognized and understood. Signs in other locations should be considered supplementary to signs in the normal locations.

Potential sign locations should:

- Be outside the clear zone unless placed on a breakaway or yielding support**
- Not be hidden from view**
- Optimize nighttime visibility**
- Minimize the effects of mud splatter and debris**
- Not obscure each other**

**Figure 2A-2. Examples of Heights and Lateral Locations of Sign Installations**



Signs need to be carefully placed so that the motorist is not overloaded with information. Multiple signs should be compatible and provide a logical sequence of communication to the road user. The motorist needs to have adequate time to adjust speed, avoid any potential hazard, and continue on their desired route.

For determining a sign’s location, the average speed of traffic would produce substandard response times. Using the highest traffic speeds would also result in unsuitable results. Research has shown that a value (the **eighty-fifth percentile speed**) between the average speed and the fastest speed is an effective compromise for sign locations. This speed is a good guideline for approximating a speed limit for a road. This is the speed at which 85% of the motorists drive on a road unaffected by bad weather or slow traffic. The eighty-fifth-percentile speed can be interpreted as the speed that most drivers consider safe and reasonable.

### Sign Priority

For locations where more than one sign is required, priority needs to be established regarding the order of placement. Regulatory signs take precedence over the other signs since they are typically located where a regulation is in effect. Guide, informational, recreational, and cultural interest signs are less crucial due to their location flexibility.

Traffic signs are commonly prioritized by importance into the following categories:

1. **Regulatory**
2. **Warning**
3. **Guide**
4. **Emergency services**
5. **Motorist services**
6. **Public transportation**
7. **Traffic Generators**
8. **General Information**

<b>ROADWAY PRIORITIES</b>			
<u>Signs</u>	<u>Roadway Classification</u>	<u>Traffic Volumes</u>	<u>Individual Signs</u>
Regulatory	Arterial	High	Stop
Warning	Collector	Low	Yield
Guide	Local		Do Not Enter Wrong Way Turn Restriction One Way Hazard ID

### Information grouping

Signs should be individually installed on separate posts/mountings except where: one sign supplements another; route or directional signs are grouped to clarify information; or regulatory signs that do not conflict with each other are grouped.

Related information can be grouped together to reinforce a message without causing confusion. This can be useful in areas with limited locations for sign installation. Unrelated signs should be spaced apart to prevent driver distraction.

### Acceptable Sign Groupings

- Street Name signs
- Do Not Enter sign on back of Stop sign
- One-Way sign mounted above Stop sign
- Speed Limit sign on back of No Passing Zone pennant
- Route Marker assemblies
- All Way sign under Stop sign
- Hill signs with % Grade or Next XX Miles sign

### Lateral Distance

A sign's proximity to the road directly impacts visibility. Close placement enhances readability but also increases the likelihood of damage by traffic. Signs installed further away from the roadway are less vulnerable to damage but harder to read.

Post-mounted signs should have a *minimum lateral clearance of 12 feet* from the edge of the travel way to the near edge of the sign. For shoulder widths over 6 feet, the *minimum offset should be 6 feet* from the shoulder's edge. Potential sites should be located as far as practical from the edge of shoulder with minimum traffic exposure to sign supports.

For curbed roadways with parking or pedestrians, the edge of the sign should be a *minimum offset of two feet* from the face of curb which allows for adequate vehicle door clearance. Increasing this lateral offset distance minimizes chances of sign damage by vehicles but caution needs to be exercised to prevent sidewalk blockage.

### Height Above the Roadway

The height of a sign can impact sign visibility, roadway safety, and pedestrian access. The minimum height for signs installed in rural areas is *5 feet* (measured from the edge of pavement elevation to the bottom of the sign). For urban areas with parking, pedestrian, or sight distance challenges, the *minimum height requirement is 7 feet*. At curb locations, this



distance is measured from the top of curb to the bottom of sign. The minimum height for roadways without curb is measured from the edge of traveled way elevation to the bottom of the sign. For areas with sidewalks, the *minimum height is 7 feet* (measured from the top of sidewalk to the bottom of the sign).

The MUTCD specifies only *minimum heights* for sign assemblies. For hillcrests, it may be useful to place the sign higher than normal for better visibility.

### MINIMUM SIGN HEIGHT

5 ft	Rural
7 ft	Parking or pedestrian movements (non-rural)
7 ft	Directional signs on expressways and freeways
8 ft	Height of sign if secondary sign present
5 ft	Secondary sign above the level of the pavement edge
7 ft	All route signs, warning signs, and regulatory signs on expressways and freeways

#### Angle to the roadway

In order to eliminate headlight glare and maximize retroreflection, post-mounted signs should be positioned at an angle of approximately 93 degrees from the line of approaching traffic. The sign location should be determined in relation to roadway traffic and not the edge of roadway. It may also be helpful to tilt reflectorized signs (forward or backwards) for better visibility to road users.

#### Location Adjustments

For sites where a sign cannot be installed at a location specified by the MUTCD, the following questions need to be addressed:

- Does the sign meet the five principles of signing?
- Will the sign cause any sight distance problems?
- Will vegetation need to be cut?
- Will the sign be visible to traffic?
- Will anything obstruct the sign's visibility?
- Will the sign block the views of other signs?

## The Americans With Disabilities Act (ADA) of 1990

The regulations of the Americans with Disabilities Act are designed to prevent any discrimination against disabled individuals, including road users. This act requires access needs of the disabled be accommodated through the use of specialized signs, pavement markings, sign placements, etc.

## REGULATORY SIGNS

Regulatory signs inform motorists of traffic regulations, laws, and applicable legal requirements. These signs require or prohibit the movement of vehicles, pedestrians, and other road users. Their function is to encourage the safe, orderly flow of traffic. All signs should clearly communicate its message and provide adequate visibility (retroreflective or illumination).

Unless specifically designated otherwise, all regulatory signs must be rectangular (exceptions include stop signs, yield signs and railroad crossing signs). The colors for regulatory signs are white, black, and red.



R1-1



R1-3P



R1-2



R1-2aP



R1-10P

Regulatory signs are used to fulfill a need. Drivers tend to disregard a regulation perceived as unneeded. However, other road users may expect them to obey the sign, and act accordingly which may result in crashes (example: Yield sign). Regulatory signs can be used to remind road users of statutory traffic laws (no parking, one way, etc.).

**Table 2B-1. Regulatory Sign and Plaque Sizes**

Sign or Plaque	Sign Designation	Section	Conventional Road		Expressway	Freeway	Minimum	Oversized
			Single Lane	Multi-Lane				
Stop	R1-1	2B.05	30 x 30*	36 x 36	36 x 36	—	30 x 30*	48 x 48
Yield	R1-2	2B.08	36x36x36*	48x48x48	48x48x48	60x60x60	30x30x30*	—
To Oncoming Traffic (plaque)	R1-2aP	2B.10	24 x 18	24 x 18	36 x 30	48 x 36	24 x 18	—
All Way (plaque)	R1-3P	2B.05	18 x 6	18 x 6	—	—	—	30 x 12
Yield Here to Peds	R1-5	2B.11	—	36 x 36	—	—	—	36 x 36
Yield Here to Pedestrians	R1-5a	2B.11	—	36 x 48	—	—	—	36 x 48
Stop Here for Peds	R1-5b	2B.11	—	36 x 36	—	—	—	36 x 36
Stop Here for Pedestrians	R1-5c	2B.11	—	36 x 48	—	—	—	36 x 48
In-Street Ped Crossing	R1-6,6a	2B.12	12 x 36	12 x 36	—	—	—	—
Overhead Ped Crossing	R1-9,9a	2B.12	90 x 24	90 x 24	—	—	—	—
Except Right Turn (plaque)	R1-10P	2B.05	24 x 18	24 x 18	—	—	—	—
Speed Limit	R2-1	2B.13	24 x 30*	30 x 36	36 x 48	48 x 60	18 x 24*	30 x 36



R1-1

### STOP Signs

- Not used for speed control
- Should be installed to minimize the number of vehicles having to stop
- Not installed on a major street unless justified by a traffic engineering study
- Minimum size of 36" x 36" for multilane approaches

A stop sign should be used on minor-street approaches when one of the following warrants is satisfied:

- Through street traffic volumes exceed 6000 vehicles per day
- An existing restricted view requires drivers to stop in order to see conflicting traffic
- Crash records indicate 3 or more crashes within a 12-month period, or 5 or more crashes within a 2-year period could have been corrected by sign installation.

Multi-way stop control is used where intersecting road traffic volumes are approximately equal. This is a quick, interim measure used during traffic signals installation. Multi-way stop control should be considered where 5 or more crashes have occurred in a 12-month period.

### **Minimum Volumes for Multi-way Stop Control**

- ❖ The total vehicular volume entering the intersection from the major street approaches (both ways) averages a minimum of 300 vehicles per hour for any 8 hours of an average day.
- ❖ The combined volume (vehicles, pedestrians and bicycles) entering the intersection from the minor street (both ways) averages a minimum of 200 units per hour for the same 8 hours, with an average delay to minor street traffic of at least 30 seconds per vehicle during the highest hour.
- ❖ But if the 85<sup>th</sup> percentile approach speed of the major street traffic exceeds 40 mph, the minimum volume warrants are 70% of the values in Items 1 and 2.

Optional criteria for consideration includes: high pedestrian volumes; left-turn conflicts; inadequate sight distance (minor approaches); and residential street intersections.

### **STOP AHEAD Sign**

- Installed in advance of a STOP sign with restricted visibility

### **DO NOT ENTER Sign**

- Only sign permitted to be mounted back-to-back with a STOP sign



R1-3P

### **ALL-WAY Sign**

- Used only at intersections where all approaches are controlled by STOP signs



R1-2

### **YIELD Signs**

For intersection approaches where a full stop is not necessary, less restrictive measures such as Yield signs should be considered. This sign assigns right-of-way to approaching traffic. Vehicles controlled by Yield signs need to slow down for existing conditions or stop to avoid conflicting traffic.

Yield signs may be used if engineering judgment shows that one of the following conditions is met:

- Intersection approaches where a full stop is not required
- Inadequate acceleration geometry and/or sight distance for merging traffic operation
- Median width of 30 feet or greater at intersection at second crossroad of a divided highway
- Location where engineering judgment indicates a problem correction by using a Yield condition

Yield signs are used for roundabouts to assign right-of-way at the entrances. It controls approaches and not the circulatory roadway of the roundabout. On multi-lane approaches with splitter islands, the Yield signs should be placed on both sides of the approach with the sign face only be visible from the entering roadway.



R2-1

### **SPEED LIMIT Signs**

Speed zones should be based on an engineering study that includes an analysis of current free-flowing vehicle speed distribution. Posted speed limits should be within 5 mph of the 85<sup>th</sup> percentile speed of the free-flowing traffic.

The Speed Limit sign indicates the limit for which the posting is required by law and displays it in multiples of 5 mph. It shall be located where the speed limit changes from one limit to another.

#### **Factors for Establishing Speed Limits**

Road characteristics, shoulder condition, grade, alignment, sight distance  
Pace speed  
Roadside development and environment  
Parking practices and pedestrian activity  
Reported crashes for a 12-month period



R3-5

### **INTERSECTION LANE CONTROL Signs**

Intersection Lane Control signs require drivers in certain lanes to turn, permit turns from lanes where turns are not typically permitted, require vehicles to remain in the same lane throughout an intersection, or indicate permissible lane movements.

#### **Applications of Intersection Lane Control Signs**

- Mandatory Movement Lane Control (R3-5, R3-5a and R3-7)
- Optional Movement Lane Control (R3-6)
- Advance Intersection Lane Control (R3-8 series)

## SELECTIVE EXCLUSION Signs

Selective Exclusion signs convey regulatory information that prohibits types of traffic from specific routes or facilities. These signs will clearly indicate the type of excluded traffic.

### Types of Exclusion Messages

No Trucks (R5-2),  
NO MOTOR VEHICLES (R5-3)  
NO COMMERCIAL VEHICLES (R5-4)  
NO TRUCKS (VEHICLES) WITH LUGS (R5-5)  
No Bicycles (R5-6)  
NO NON-MOTORIZED TRAFFIC (R5-7)  
NO MOTOR-DRIVEN CYCLES (R5-8)  
No Pedestrians (R9-3)  
No Skaters (R9-13)  
No Equestrians (R9-14)  
No Hazardous Material (R14-3)



R6-1



R6-2

## ONE WAY Signs

One Way signs are used on roadways to indicate where vehicles are allowed to travel in one direction only. These signs are typically installed parallel to the one-way street at all alleys and roads that intersect one-way roadways.



R7-1

### **PARKING Signs**

Parking Control signs should conform to the standards of shape, color and location. The basic design for parking signs is as follows:

**Red legend and border  
with white background**

**Prohibited parking at all or  
specific times**

**Green legend and border  
with white background**

**Limited-time parking**

Sign spacing is based on legibility and sign orientation when used to indicate limits of restricted zones, signs with arrows should be set at an angle of 30 to 45 degrees with the line of traffic flow for sight distance to approaching traffic.

Parking signs should display the following information (top to bottom) as listed:

- Restriction or prohibition
- Applicable times of day (if not all hours)
- Applicable days (if not every day)

For more information on the use of regulatory signs, see Part 2B of the MUTCD.

## **WARNING SIGNS**

Warning signs alert road users to unexpected conditions and/or unapparent situations near the roadway. These signs may require actions by the driver in order to ensure safe and efficient traffic operations. The use of warning signs should be minimized to prevent overuse which can produce disrespect for signs.



**Table 2C-1. Categories of Warning Signs and Plaques**

Category	Group	Section	Signs or Plaques	Sign Designations	
Roadway Related	Changes in Horizontal Alignment	2C.07	Turn, Curve, Reverse Turn, Reverse Curve, Winding Road, Hairpin Curve, 270-Degree Curve	W1-1,2,3,4,5,11,15	
		2C.08	Advisory Speed	W13-1P	
		2C.09	Chevron Alignment	W1-8	
		2C.10	Combination Horizontal Alignment/Advisory Speed	W1-1a,2a	
		2C.11	Combination Horizontal Alignment/Intersection	W1-10,10a,10b,10c,10d	
		2C.12	Large Arrow (one direction)	W1-6	
		2C.13	Truck Rollover	W1-13	
		2C.14	Advisory Exit or Ramp Speed	W13-2,3	
	Vertical Alignment	2C.15	Combination Horizontal Alignment/Advisory Exit or Ramp Speed	W13-6,7	
		2C.16	Hill	W7-1,1a,2P,2bP,3P,3aP,3bP	
		2C.17	Truck Escape Ramp	W7-4,4b,4c,4dP,4eP,4fP	
	Cross Section	2C.18	Hill Blocks View	W7-6	
		2C.19	Road Narrows	W5-1	
		2C.20,21	Narrow Bridge, One Lane Bridge	W5-2,3	
		2C.22,23,25	Divided Highway, Divided Highway Ends, Double Arrow	W6-1,2; W12-1	
		2C.24	Freeway or Expressway Ends, All Traffic Must Exit	W19-1,2,3,4,5	
		2C.26	Dead End, No Outlet	W14-1,1a,2,2a	
		2C.27	Low Clearance	W12-2,2a	
	Roadway Surface Condition	2C.28,29	Bump, Dip, Speed Hump	W8-1,2; W17-1	
		2C.30	Pavement Ends	W8-3	
		2C.31	Shoulder, Uneven Lanes	W8-4,9,11,17,17P,23,25	
		2C.32	Slippery When Wet, Loose Gravel, Rough Road, Bridge Ices Before Road, Fallen Rocks	W8-5,7,8,13,14	
		2C.33	Grooved Pavement, Metal Bridge Deck	W8-15,15P,16	
		2C.34	No Center Line	W8-12	
	Weather	2C.35	Road May Flood, Flood Gauge, Gusty Winds Area, Fog Area	W8-18,19,21,22	
	Traffic Related	Advance Traffic Control	2C.36-39	Stop Ahead, Yield Ahead, Signal Ahead, Be Prepared To Stop, Speed Reduction, Drawbridge Ahead, Ramp Meter Ahead	W3-1,2,3,4,5,5a,6,7,8
		Traffic Flow	2C.40-45	Merge, No Merge Area, Lane Ends, Added Lane, Two-Way Traffic, Right Lane Exit Only Ahead, No Passing Zone	W4-1,2,3,5,5P6; W6-3; W9-1,2,7; W14-3
		Intersections	2C.46	Cross Road, Side Road, T, Y, Circular Intersection, Side Roads	W2-1,2,3,4,5,6,7,8; W16-12P,17P
			2C.47	Large Arrow (two directions)	W1-7
			2C.48	Oncoming Extended Green	W25-1,2
		Vehicular Traffic	2C.49	Truck Crossing, Truck (symbol), Emergency Vehicle, Tractor, Bicycle, Golf Cart, Horse-Drawn Vehicle, Trail Crossing	W8-6; W11-1,5,5a,8,10,11,12P,14,15,15P,15a; W16-13P
		Non-Vehicular	2C.50,51	Pedestrian, Deer, Cattle, Snowmobile, Equestrian, Wheelchair, Large Animals, Playground	W11-2,3,4,6,7,9,16,17,18,19,20,21,22; W15-1; W16-13P
	New	2C.52	New Traffic Pattern Ahead	W23-2	
	Other Supplemental Plaques	Location	2C.53	Downward Diagonal Arrow, Ahead	W16-7P,9P
		HOV	2C.53	High-Occupancy Vehicle	W16-11P
Distance		2C.55	XX Feet, XX Miles, Next XX Feet, Next XX Miles	W7-3aP; W16-2P,2aP,3P,3aP,4P	
Arrow		2C.56	Advance Arrow, Directional Arrow	W16-5P,6P	
Street Name Plaque		2C.58	Advance Street Name	W16-8P,8aP	
Intersection		2C.59	Cross Traffic Does Not Stop	W4-4P,4aP,4bP	
Share The Road		2C.60	Share The Road	W16-1P	
Photo Enforced		2C.61	Photo Enforced	W16-10P,10aP	
New	2C.62	New	W16-15P		

Background colors for warning signs depend on their use. Warning signs are typically diamond-shaped with a black legend/border on a yellow background. Signs regarding pedestrians, bicyclists and playgrounds have a black legend/border with yellow or fluorescent yellow-green background. Bus, school and supplemental plaques should have a black legend/border with a fluorescent yellow-green background.

**School signs**

Pentagon-shaped



**Railroad warning signs**

Circular



**No passing signs**

Triangular



Effective warning signs can reduce incidents by improving driver Perception-Response Times (PRT). A standard PRT value is typically **2.5 seconds** (with 2.5 to 3.0 seconds for older drivers, and longer times for unexpected events).

Some warning signs may prove to be more effective than others or certain situations and should result in a significant reduction in related incidents. But like all traffic signs, improper use may cause disrespect for all warning signs, and minimize their effectiveness.

**When considering the use of a warning sign:**

Determine if the hazard can be removed.

If it will take time to remove the hazard, use a temporary sign to warn traffic.

If the hazard is impossible or too expensive to remove, install a warning sign.

Any temporary signage should be removed as soon as it is no longer needed.



The minimum size for all diamond-shaped signs is 36 x 36 inches for multilane roadways with posted speeds greater than 35 mph.

**Table 2C-4. Guidelines for Advance Placement of Warning Signs**

Posted or 85th-Percentile Speed	Advance Placement Distance <sup>1</sup>								
	Condition A: Speed reduction and lane changing in heavy traffic <sup>2</sup>	Condition B: Deceleration to the listed advisory speed (mph) for the condition							
		0 <sup>3</sup>	10 <sup>4</sup>	20 <sup>4</sup>	30 <sup>4</sup>	40 <sup>4</sup>	50 <sup>4</sup>	60 <sup>4</sup>	70 <sup>4</sup>
20 mph	225 ft	100 ft <sup>5</sup>	N/A <sup>5</sup>	—	—	—	—	—	—
25 mph	325 ft	100 ft <sup>5</sup>	N/A <sup>5</sup>	N/A <sup>5</sup>	—	—	—	—	—
30 mph	460 ft	100 ft <sup>5</sup>	N/A <sup>5</sup>	N/A <sup>5</sup>	—	—	—	—	—
35 mph	565 ft	100 ft <sup>5</sup>	N/A <sup>5</sup>	N/A <sup>5</sup>	N/A <sup>5</sup>	—	—	—	—
40 mph	670 ft	125 ft	100 ft <sup>5</sup>	100 ft <sup>5</sup>	N/A <sup>5</sup>	—	—	—	—
45 mph	775 ft	175 ft	125 ft	100 ft <sup>5</sup>	100 ft <sup>6</sup>	N/A <sup>5</sup>	—	—	—
50 mph	885 ft	250 ft	200 ft	175 ft	125 ft	100 ft <sup>6</sup>	—	—	—
55 mph	990 ft	325 ft	275 ft	225 ft	200 ft	125 ft	N/A <sup>5</sup>	—	—
60 mph	1,100 ft	400 ft	350 ft	325 ft	275 ft	200 ft	100 ft <sup>6</sup>	—	—
65 mph	1,200 ft	475 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft <sup>6</sup>	—
70 mph	1,250 ft	550 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	—
75 mph	1,350 ft	650 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft <sup>6</sup>

## INTERSECTIONS

Intersections are locations with conflicting vehicle streams sharing the same space. For urban areas, intersections may also be used by pedestrians and bicycles which can increase the accident potential of these features. Intersections tend to limit the operational efficiency and network capacity of urban street systems.

The majority of motor vehicle crashes occur at intersections. Proper use of intersection signs can aid in improving traffic safety and promoting efficient roadway operation. Sign studies can be initiated at specific intersections for several reasons: number of crashes; citizen complaints; sign inspection issues; proposed developments, etc.

The spacing between unrelated signs should be sufficient to allow them to be read one at a time. If not possible, the engineer may consider prioritizing the sign locations, and the consequences of not seeing each sign.

### Important Sign Considerations

- ❖ Intersection warning and guide signs should not be installed more than one block from the referenced intersection.
- ❖ Guide signs should also include supplemental messages such as “second intersection” or “second left.”

❖ Posted curve distance signs should not exceed the space between curves. Avoid placing signs in driveways or behind trees and other obstacles. Any reason for adjusting sign locations beyond the limits provided in the MUTCD should be documented. It is better to increase the distance warn too early, than to warn too late.

### Signs used at intersections

*Intersection regulatory signs* inform road users of traffic regulations, laws, and legal requirements (assign right-of-way, one-way roads, lane usage, etc.). A regulatory sign is needed if you are requiring or prohibiting the movement of vehicles, pedestrians, and other road users. These signs are intended to encourage traffic flow and enforce traffic ordinances.

#### Intersection Regulatory Signs



*Intersection warning signs* alert drivers to unexpected or unapparent conditions on or near the intersection. Research has shown a much quicker perception-reaction time for drivers if they have been adequately warned. Warning signs show the general layout of the intersection. An optional street name plate may also be used with intersection warning signs. Intersection warning signs involving sight distance problems are the most common.

Figure 2C-9. Intersection Warning Signs and Plaques



*Combination horizontal alignment/intersection signs* are used at intersections where side roads intersect a main road. These may be appropriate for locations where separate signs for intersections or curves might be misleading.

A maximum of one crossroad or two side road symbols can be shown on any of these signs.

### **Solving intersection sign problems**

The Cornell Local Roads Programs recommends using the following checklist if safety problems are occurring at an intersection:

*Check the sign locations for visibility.*

*Check the conditions of all intersection signs, including retroreflectivity.*

*Check sight distance for Stop signs, Yield signs and signal heads at intersections  
Stop Ahead, Yield Ahead or Signal Ahead signs may be required.*

*For approaches without a Stop sign, Yield sign or signal, check visibility of the intersection.*

*If drivers are still having problems, consider these measures:*

- *Emphasize the Stop sign with stop lines, reflective material, oversized stop signs, or flashing beacons.*
- *Additional Stop signs on the left or stop ahead signs*
- *Double-headed Arrows on the far side of T intersections to reduce stop-sign disobedience.*
- *Pedestrian Crossing or School Crossing signs where needed for safer crosswalks.*

*Check for Street Name signs at all intersections.*

- *Normally placed on the near left and far right corners of the intersection on the major road.*
- *Advance guide signs can be helpful on high-speed roads*
- *The minimum letter height of 6 inches for street name signs has been changed to 6 inches to aid older drivers.*
- *Four-inch height letters may still be used on low-speed, low-volume roads.*

*Check for directional signs where roads carry a significant amount of traffic to a tourist destination or population center..*

*Check for Route Marker assemblies at intersections with numbered county or state routes.*

*Check for Dead End signs on all dead end roads.*

*Check for No Outlet signs on roads leading into an isolated neighborhood with no other exit.*

*If the intersection is still operating poorly, the following steps can be taken to improve safety or operations:*

- *Adequate sight distance at intersections.*
- *Street lighting can help prevent nighttime incidents.*
- *Check the existing pavement markings.*
- *Consult a civil engineer on intersection alternatives.*

## SUMMARY

Traffic signs are critical tools that convey regulations, traffic, roadway conditions, and other important information. These devices allow users to travel safely on any U.S. roadway. The goal of traffic control is to provide drivers with relevant information when they need it.

The overall objective of this course was to give engineers and designers an in-depth look at roadway traffic signs selection and design principles. The *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) 2009 Edition* was used to explain the fundamental design principles of traffic signs. This text is the recognized **national standard** for all traffic control devices installed on any road or bikeway.

This course was the first of two and addressed general sign information through intersection signs. The contents of this course were intended to serve as guidance and not as an absolute rule. It was written to help you learn to use the MUTCD more effectively for establishing roadway traffic control using roadway traffic signs.

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(Note: All figures, tables, exhibits, etc. contained in this course are from the MUTCD, except where noted otherwise.)