FIVE REQUIREMENTS FOR EFFECTIVE TRAFFIC CONTROL DEVICES

- Fulfill a need
- Command attention
- Convey a clear, simple meaning
- Command respect from road users
- Give adequate time for proper response
Unwarranted stop sign

Source: ITE Journal, January 2004

Multi-way stop signs for traffic calming

Responding to Citizen Requests for Multiway Stops

BY PATRICK B. PAYNE

One of the main reasons for traffic calming is to reduce conflicts at intersections. Several different methods have been proposed to achieve this, including the use of stop signs. However, the effectiveness of stop signs for traffic calming has been debated. Unwarranted stop signs can create confusion and increase delays, while warranting stop signs can improve safety and reduce conflicts.

Considerations for the Installation of Stop Signs

- Warranted stop signs should be installed at intersections where there is a need for traffic control.
- Stop signs should be installed to promote traffic calming, not to create additional conflicts.
- The installation of stop signs should be based on traffic volume, speed, and other factors.

By carefully evaluating the need for stop signs and their potential impact on traffic flow, engineers and planners can ensure that stop signs are used as effectively as possible to reduce conflicts and improve traffic safety.

Source: ITE Journal, January 2004

Multi-way stop signs for traffic calming

Source: ITE Journal, January 2004
What is wrong here?

How many Chevrons is enough?
IMPORTANCE OF UNIFORMITY

- Design
- Meaning
- Application
- Placement
- Maintenance
Unacceptable

“STOP sign should have a white legend and border on a red background.”

WHY IS UNIFORMITY IMPORTANT?

- Varying driving conditions: snow, fog, rain
- Driver unfamiliarity: tourists, visitors, new residents
- Aging population
- Potential liability from non-uniform applications
UNIFORMITY ESTABLISHED BY:

- MUTCD – *Manual Uniform Traffic Control Devices*
- State Supplements
- Vehicle Code
- Traffic Control Devices Handbook
- Traffic Engineering Handbook

WHAT IS THE MUTCD?

**National MUTCD**

National standard for all traffic control devices installed on any street, highway or bicycle trail open to public travel.

*Web site:* mutcd.fhwa.dot.gov

*Compliance dates:* http://mutcd.fhwa.dot.gov/kno-compliance.htm
MUTCD PARTS

- 1 General Provisions
- 2 Signs
- 3 Markings
- 4 Highway Traffic Signals
- 5 Traffic Control Devices for Low Volume Roads
- 6 Temporary Traffic Control
- 7 Traffic Controls for School Areas
- 8 Traffic Controls for Highway-Rail Grade Crossings
- 9 Traffic Controls for Bicycles Facilities
- 10 Traffic Controls for Highway-LRT Grade Crossings

GENERAL SECTION
(MUTCD Section 1)
UNIFORMITY OF TRAFFIC CONTROL DEVICES (1A.06)

- Aids in recognition and understanding
- Reduces perception/reaction time
- Gives everyone same interpretation
- Assists in manufacturing and inventory
- Use of uniform TCD’s DOES NOT constitute uniformity
- Use of standard TCD’s where inappropriate is as objectionable as non-standard TCD

CHANGES IN FORMAT

CHAPTER 1A. GENERAL

Section 1A.01 Purpose of Traffic Control Devices

Support:

The purpose of traffic control devices, as well as the principles for their use, is to promote highway safety and efficiency by providing for the orderly movement of all road users on streets and highways throughout the Nation. Traffic control devices notify road users of regulations and provide warning and guidance needed for the reasonable, safe, uniform, and efficient operation of all elements of the traffic stream.

Standard:

Traffic control devices or their supports shall not bear any advertising message or any other message that is not related to traffic control.

Support:

Tourist-oriented directional signs and Specific Service signs are not considered advertising; rather, they are classified as motorist service signs.

Section 1A.02 Principles of Traffic Control Devices

Support:

This Manual contains the basic principles that govern the design and use of traffic control devices for all streets and highways open to public travel regardless of type or class or the public agency having jurisdiction. This Manual’s text specifies the restrictions on the use of a device if it is intended for limited application or for a specific system. It is important that these principles be given primary consideration in the selection and application of each device.

Guidance:

To be effective, a traffic control device should meet five basic requirements:
SECTION HEADINGS

- Standard ("shall") – required; no exceptions
- Guidance ("should") – recommended; engineering judgment or study
- Option ("may") – permissive
- Support – informational statement

UNIFORM SIGN CHART

TRAFFIC CONTROL DEVICES HANDBOOK

TRAFFIC SIGNING HANDBOOK

- Planning and engineering
- Sign design and materials (reflectorization)
- Sign supports and placement
- Sign shop organization
- Routine maintenance
- Inventory and inspection
- Vandalism
SIGN DESIGN

- Shape
- Color
- Size
- Lettering size
- Borders
- Illumination
- Reflectorization
THREE SIGN CLASSIFICATIONS

- Regulatory
- Warning
- Guide (FHWA Draft Policy)

USE OF SIGN SHAPES (2A.10)

<table>
<thead>
<tr>
<th>Shape</th>
<th>Signs Table 2A-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Octagon</td>
<td>*Stop</td>
</tr>
<tr>
<td>Equilateral Triangle</td>
<td>*Yield</td>
</tr>
<tr>
<td>Circle</td>
<td>Highway-Rail Grade Crossing (Advanced Warning) or Emergency Evacuation Route Marker</td>
</tr>
<tr>
<td>Pennant / Isosceles Triangle (Longer Axis Horizontal)</td>
<td>*No Passing</td>
</tr>
<tr>
<td>Pentagon pointed up</td>
<td>*School crossing series and *County route series</td>
</tr>
<tr>
<td>Crossbuck</td>
<td>Highway-Rail Grade Crossing</td>
</tr>
<tr>
<td>Diamond</td>
<td>Warning series</td>
</tr>
<tr>
<td>Rectangle</td>
<td>Regulatory, Guide, Warning series</td>
</tr>
<tr>
<td>Trapezoid</td>
<td>*Recreational series</td>
</tr>
</tbody>
</table>
The shape of the sign is important

ILLUMINATION AND RETRO REFLECTIVITY (2A.09)
(Effective Date: 1/22/08)

Standards:
Public agencies or officials having jurisdiction shall use an assessment or management method that is designed to maintain sign retroreflectivity at or above the minimum levels in Table 2A-3.

http://safety.fhwa.dot.gov/roadway_dept/retro/
MUTCD_Revision2.pdf
Section 2A.89 Maintaining Minimum Retroreflectivity—new section—from the effective date of the Final Rule for Revision 2 of the 2003 MUTCD:

- 4 years for replacement or continued use of an assessment or management method that is designed to maintain traffic sign retroreflectivity at or above the established minimum levels;
- 7 years for replacement of regulatory, warning, and ground-mounted guide (except street name) signs that are identified using the assessment or management method as failing to meet the established minimum levels, and
- 10 years for replacement of street name signs and overhead guide signs that are identified using the assessment or management method as failing to meet the established minimum levels.

### Table 2A-3. Minimum Maintained Retroreflectivity Levels

<table>
<thead>
<tr>
<th>Sign Color</th>
<th>Sheeting Type (ASTM D4956-04)</th>
<th>Additional Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beaded Sheeting</td>
<td>Prismatic Sheeting</td>
</tr>
<tr>
<td>White on Green</td>
<td>W(^{a}), G ≥ 7</td>
<td>W(^{a}), G ≥ 15</td>
</tr>
<tr>
<td></td>
<td>W(^{a}), G ≥ 7</td>
<td>W ≥ 120; G ≥ 15</td>
</tr>
<tr>
<td>Black on Yellow</td>
<td>Y(^{a}), O(^{a})</td>
<td>Y ≥ 50; O ≥ 50</td>
</tr>
<tr>
<td>Black on Orange</td>
<td>Y(^{a}), O(^{a})</td>
<td>Y ≥ 75; O ≥ 75</td>
</tr>
<tr>
<td>White on Red</td>
<td>W ≥ 35; R ≥ 7</td>
<td></td>
</tr>
<tr>
<td>Black on White</td>
<td>W ≥ 50</td>
<td></td>
</tr>
</tbody>
</table>

① The minimum maintained retroreflectivity levels shown in this table are in units of cd/1m\(^2\)/lx measured at an observation angle of 0.2° and an entrance angle of -4.0°.
② For text and fine symbol signs measuring less than 1200 mm (48 in) and for all sizes of bold symbol signs.
③ For text and fine symbol signs measuring less than 1200 mm (48 in).
④ Minimum Sign Contrast Ratio ≥ 3:1 (white retroreflectivity > red retroreflectivity).
⑤ This sheeting type should not be used for this color for this application.
Guidance:

Except for those signs specifically identified in the Option in this Section, one or more of the following assessment or management methods should be used to maintain sign retroreflectivity:

A. Visual Nighttime Inspection – The retroreflectivity of an existing sign is assessed by a trained sign inspector conducting a visual inspection from a moving vehicle during nighttime conditions. Signs that are visually identified by the inspector to have retroreflectivity below the minimum levels should be replaced.

B. Measured Sign Retroreflectivity – Sign retroreflectivity is measured using a retroreflectometer. Signs with retroreflectivity below the minimum levels should be replaced.

C. Expected Sign Life – When signs are installed, the installation date is labeled or recorded so that the age of a sign is known. The age of the sign is compared to the expected sign life. The expected sign life is based on the experience of sign retroreflectivity degradation in a geographic area compared to the minimum levels. Signs older than the expected life should be replaced.

D. Blanket Replacement – All signs in an area/corridor, or of a given type, should be replaced at specified intervals. This eliminates the need to assess retroreflectivity or track the life of individual signs. The replacement interval is based on the expected sign life, compared to the minimum levels, for the shortest life material used on the affected signs.

E. Control Signs – Replacement of signs in the field is based on the performance of a sample of control signs. The control signs might be a small sample located in a maintenance yard or a sample of signs in the field. The control signs are monitored to determine the end of retroreflective life for the associated signs. All field signs represented by the control sample should be replaced before the retroreflectivity levels of the control sample reach the minimum levels.

F. Other Methods – Other methods developed based on engineering studies can be used.

### SIGN PLACEMENT

<table>
<thead>
<tr>
<th>MUTCD</th>
<th>STATE VARIATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Height:</strong></td>
<td>7’ or 2.1m (Urban) 5’ or 1.5m (Rural)</td>
</tr>
<tr>
<td><strong>Lateral:</strong></td>
<td>2’ or 0.6m (Urban) 12’ or 3.6m (Rural) ETW 6’ or 1.8m (Rural) Shld</td>
</tr>
<tr>
<td><strong>Minimum overhead clearance:</strong></td>
<td>15.5’ or 4.7m</td>
</tr>
</tbody>
</table>
SIGN PLACEMENT
2003 MUTCD

Figure 2A-1. Examples of Heights and Lateral Locations of Signs for Typical Installations

Roadside Sign
Rural District

Not less than
1.5 ft
(0.5 m)

Not more than
6 ft
(1.8 m)

Roadside Sign
Residential

Not less than
1.5 ft
(0.5 m)

Not more than
12 ft
(3.7 m)

Warning Sign
With Advisory
Speed Plateau
Rural District

Not less than
1.5 ft
(0.5 m)

Not more than
6 ft
(1.8 m)

Signs too close to travel lane
PLACEMENT OF WARNING SIGNS
(2C.05)

MUTCD Uses PIEV based criteria which includes speed and conditions.

- Perception
- Identification (understanding)
- Emotion (decision making)
- Volition (execution of decision)

ADVANCE PLACEMENT OF WARNING SIGNS

Table 2C-4. Guidelines for Advance Placement of Warning Signs
(English Units)

<table>
<thead>
<tr>
<th>Posted or 25th-Percentile</th>
<th>Condition A: Speed reduction and lane changing in heavy traffic</th>
<th>Condition B: Deceleration to the listed advisory speed (mph) for the condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>mph</td>
<td>0'</td>
<td>10</td>
</tr>
<tr>
<td>30 mph</td>
<td>225 ft</td>
<td>NO*</td>
</tr>
<tr>
<td>25 mph</td>
<td>325 ft</td>
<td>NO*</td>
</tr>
<tr>
<td>20 mph</td>
<td>450 ft</td>
<td>NO*</td>
</tr>
<tr>
<td>35 mph</td>
<td>550 ft</td>
<td>NO*</td>
</tr>
<tr>
<td>40 mph</td>
<td>600 ft</td>
<td>125 ft</td>
</tr>
<tr>
<td>45 mph</td>
<td>750 ft</td>
<td>175 ft</td>
</tr>
<tr>
<td>50 mph</td>
<td>850 ft</td>
<td>220 ft</td>
</tr>
<tr>
<td>55 mph</td>
<td>950 ft</td>
<td>275 ft</td>
</tr>
<tr>
<td>60 mph</td>
<td>1150 ft</td>
<td>300 ft</td>
</tr>
<tr>
<td>65 mph</td>
<td>1300 ft</td>
<td>325 ft</td>
</tr>
<tr>
<td>70 mph</td>
<td>1500 ft</td>
<td>350 ft</td>
</tr>
<tr>
<td>75 mph</td>
<td>1750 ft</td>
<td>400 ft</td>
</tr>
</tbody>
</table>

Source: MUTCD
Don’t mix & match or SPOT it!

Don’t mix & match or SPOT it!

Bridge too low – 8’ 11”
30 ton steel tank - truck was off route

Less is more....
Avoid proprietary names
Variable speed limits in the UK

Florida To Implement Variable Speed Limit Signs

As part of its efforts to improve traffic flow and reduce congestion, the Florida Department of Transportation (FDOT) is implementing variable speed limit (VSL) systems along a portion of the state’s interstate highways. These VSL systems are designed to adjust speed limits based on real-time traffic conditions, such as congestion or weather. The system utilizes sensor data and other real-time information to dynamically adjust speed limits, aiming to optimize traffic flow and reduce the likelihood of accidents.

Source: Urban Transportation Monitor
Active speed warning display on I-70 in Colorado
This rural road had a speed limit compliance problem - speed limit signs 5 miles apart
IMPORTANT POINTS TO REMEMBER ABOUT SIGNS

- Avoid unwarranted multi-way stops
- Attract attention with flags for lane designation /traffic control changes
- Proposed retro-reflectivity levels
- Turn prohibitions can move problem
- Curve warning signs AHEAD of curve
- Post speed limit signs every half mile in urban areas – every 1-2 miles in rural areas
Orange flags to attract driver attention to traffic control change

 Abrupt short alignment deviation deceptive during darkness
Left-turn restrictions implemented to reduce rear-end collisions

Table 1. Left Turn and Rear-End Accidents During the Peak Hours on the Northbound and Southbound Approaches at Both Intersections

<table>
<thead>
<tr>
<th>Location</th>
<th>Before</th>
<th>After</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment intersections</td>
<td>16</td>
<td>0</td>
<td>-100%</td>
</tr>
<tr>
<td>Locations* within half a mile (0.8 km.) of the experiment intersections</td>
<td>10</td>
<td>18</td>
<td>+80%*</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>18</td>
<td>-30%</td>
</tr>
</tbody>
</table>

* Includes collector street intersections at the half mile points.
* For one year before and after the restrictions were introduced.
* Statistically significant at the 95% confidence level.

Left-turn restrictions can move collision problem
Non-standard sign on tight curves

DON’TS OF SIGNING – MIXED MESSAGES
DON'TS OF SIGNING – BAD COMBINATIONS

REMEMBER – THERE ARE REASONS WE HAVE SIGNS
INTERSECTION CONTROL

- Right of Way Control
- Turning Movements
- Other Intersection Control
- STOP Sign Evaluations
- Traffic Signals and Lighting

RIGHT OF WAY CONTROL

- Yield Signs
- STOP Signs -
  - Two - Way
  - Four - Way
- Traffic Signals
- Other
Section 2B.03  **YIELD** Sign Applications

Option:

**YIELD** signs may be used instead of **STOP** signs if engineering judgment indicates that one or more of the following conditions exist:

A. When the ability to see all potentially conflicting traffic is sufficient to allow a road user traveling at the posted speed, the 85th-percentile speed, or the statutory speed to pass through the intersection or to stop in a reasonably safe manner.

B. If controlling a merge-type movement on the entering roadway where acceleration geometry and/or sight distance is not adequate for merging traffic operation.

C. The second crossroad of a divided highway, where the median width at the intersection is 9 m (30 ft) or greater. In this case, a **STOP** sign may be installed at the entrance to the first roadway of a divided highway, and a **YIELD** sign may be installed at the entrance to the second roadway.

D. An intersection where a special problem exists and where engineering judgment indicates the problem to be susceptible to correction by the use of the **YIELD** sign.

---

Section 2B.05  **STOP** Sign Applications

Guidance:

**STOP** signs should be used if engineering judgment indicates that one or more of the following conditions exist:

A. Intersection of a less important road with a main road where application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law;

B. Street entering a through highway or street;

C. Unsignalized intersection in a signalized area; and/or

D. High speeds, restricted view, or crash records indicate a need for control by the **STOP** sign.
MULTI-WAY STOP SIGN WARRANTS

Guidance:
The decision to install a multiway stop control should be based on an engineering study.
The following criteria should be considered in the engineering study for a multiway STOP sign installation:
A. Where traffic control signals are justified, the multiway stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.
B. A crash problem, as indicated by 5 or more reported crashes in a 12-month period that are susceptible to correction by a multiway stop installation. Such crashes include right- and left-turn collisions as well as right-angle collisions.
C. Minimum volumes:
   1. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day, and
   2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours with an average delay to minor-street vehicular traffic of at least 90 seconds per vehicle during the highest hour, but
   3. If the 85th-percentile approach speed of the major-street traffic exceeds 65 km/h or exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the above values.
D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

PAVEMENT MARKINGS & STRIPING (MUTCD Section 3)
PAVEMENT MARKINGS

- Display regulations
- Supplement signs
- Guide traffic
- Warn traffic

PAVEMENT MARKING APPLICATIONS

- Centerlines
- Lane lines
- Edge Lines
- No passing zones
- Turn guide lines
- Pavement width transitions
- Limit lines
- Crosswalks
- Word legends
PAVEMENT MARKING TYPES

- Paint
- Thermoplastic (Lead pollution during removal)
- Tape (with RPMs)
- Raise pavement markings

PAVEMENT MARKING LIMITATIONS

- Fades (paint)
- Coated with dirt
- Obliterated by snow
- Can’t be seen in traffic congestion
COLORS (3A.04)

Yellow - Separation of traffic in opposing traffic or left edge line
White – Separation of traffic in same direction or right edge line
Red – RPM’s for roadways that shall not be entered
Blue – Disabled parking spaces; RPM’s for FH
Black – Provides Contrast
Green (CA Exception) – Curbs: Time limit for parking

Markings and medians obliterated by snow
FUNCTIONS & LIMITATIONS
(3A.01)

Longitudinal Lines:

- Double line – restrictions
- Solid line – discourages or prohibits crossing
- Broken line – permissive
- Dotted line - guidance

Single dashed line when passing sight distance available
Double yellow center line on curve with limited sight distance

Freeway lanes in opposite direction

These are the EB lanes of a freeway in Montana

What is wrong with this picture?
Dashed yellow center line on downhill side of this up hill passing lane!

STANDARD FOR CENTER LINE STRIPING

Standard:
The centerline markings on two-lane, two-way roadways shall be one of the following as shown in Figure 30-1:

A. Two-direction passing zone markings consisting of a normal broken yellow line where crossing the centerline markings for passing with care is permitted for traffic traveling in either direction.
B. One-direction no-passing zone markings consisting of a normal broken yellow line and a normal solid yellow line where crossing the centerline markings for passing is prohibited for traffic traveling to the right direction.
C. Two-direction no-passing zone markings consisting of two normal solid yellow lines where crossing the centerline markings for passing is prohibited for traffic traveling to either direction.

The centerline markings on undivided two-way roadways with four or more lanes for moving motor vehicle traffic always available shall be the two-direction no-passing zone markings consisting of two normal solid yellow lines as shown in Figure 30-1.

Guidance:
On two-lane roadways with three through lanes for moving motor vehicle traffic, two lines should be designated for traffic in one direction by using two- or two-direction no-passing zone markings as shown in Figure 30-2.

Standard:
Centerline markings shall be placed on all parcel urban arterials and collectors that have a traveled way of 6.1 m (20 ft) or more in width and an ADT of 6,000 vehicles per day or greater. Centerline markings shall also be placed on all parcel two-way streets or highways that have three or more lanes for moving motor vehicle traffic.
Triple left-turn guide markings

TRANSVERSE MARKINGS

- Limit lines
- Crosswalks
- Railroad markings
- Diagonal cross hatching
- Word legends (Use as few as possible…
  can’t be seen in congested conditions)
LIMIT LINES

- Provided at all stop signs (STOP legends are optional)
- Placed 4-5 feet behind cross street flow line
- Placed in advance of crosswalks at controlled locations

Source: MUTCD

Sign and limit line placement at intersections
LIMIT LINES

Pavement legends restricting left-turns
Pavement legends obliterated by traffic

Transverse markings on rural highway to slow traffic
(Reference provided on effectiveness studies)
Safety dots to deter tailgating
Source: Urban Transportation Monitor
On-street handicapped parking

TRAFFIC SIGNALS
(MUTCD Section 4)
SIGNAL WARRANTS

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume
- Warrant 3: Peak Hour
- Warrant 4: Pedestrian Volume
- Warrant 5: School Crossing
- Warrant 6: Coordinated Signal System
- Warrant 7: Crash Experience
- Warrant 8: Roadway Network

WARRANT 1 - VOLUMES

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

<table>
<thead>
<tr>
<th>Condition A—Minimum Vehicular Volume</th>
<th>Vehicles per hour on major street (total of both approaches)</th>
<th>Vehicles per hour on higher-volume minor-street approach (one direction only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of lanes for moving traffic on each approach</td>
<td>100%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>80%&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Major Street</td>
<td>Minor Street</td>
<td>500</td>
</tr>
<tr>
<td>1..............</td>
<td>1..............</td>
<td>600</td>
</tr>
<tr>
<td>2 or more...</td>
<td>1..............</td>
<td>600</td>
</tr>
<tr>
<td>2 or more...</td>
<td>2 or more...</td>
<td>500</td>
</tr>
</tbody>
</table>
WARRANT 1 - VOLUMES

### Condition B—Interruption of Continuous Traffic

<table>
<thead>
<tr>
<th>Number of lanes for moving traffic on each approach</th>
<th>Vehicles per hour on major street (total of both approaches)</th>
<th>Vehicles per hour on higher-volume minor-street approach (one direction only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Street</td>
<td>Minor Street</td>
<td>100%</td>
</tr>
<tr>
<td>1.............</td>
<td>1.............</td>
<td>750</td>
</tr>
<tr>
<td>2 or more...</td>
<td>1.............</td>
<td>900</td>
</tr>
<tr>
<td>2 or more...</td>
<td>2 or more...</td>
<td>900</td>
</tr>
<tr>
<td>1.............</td>
<td>2 or more...</td>
<td>750</td>
</tr>
</tbody>
</table>

WARRANT 1 - VOLUMES

**Standard:**

The need for a traffic control signal shall be considered if an engineering study finds that both of the following conditions exist for each of any 8 hours of an average day:

A. The vehicles per hour given in both of the 80 percent columns of Condition A in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection; and

B. The vehicles per hour given in both of the 80 percent columns of Condition B in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection.

These major-street and minor-street volumes shall be for the same 8 hours for each condition; however, the 8 hours satisfied in Condition A shall not be required to be the same 8 hours satisfied in Condition B. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.

**Option:**

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 70 km/h or exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, the traffic volumes in the 56 percent columns in Table 4C-1 may be used in place of the 80 percent columns.
WARRANT 2 - FOUR HOUR VOLUMES

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume

*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

WARRANT 3 – PEAK HOUR VOLUMES

Figure 4C-3. Warrant 3, Peak Hour

*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.
WARRANT 4 - PEDESTRIANS

Standard:

The need for a traffic control signal at an intersection or midblock crossing shall be considered if an engineering study finds that both of the following criteria are met:

A. The pedestrian volume crossing the major street at an intersection or midblock location during an average day is 100 or more for each of any 4 hours or 190 or more during any 1 hour;

B. There are fewer than 60 gaps per hour in the traffic stream of adequate length to allow pedestrians to cross during the same period when the pedestrian volume criterion is satisfied. Where there is a divided street having a median of sufficient width for pedestrians to wait, the requirement applies separately to each direction of vehicular traffic.

The Pedestrian Volume signal warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 90 m (300 ft), unless the proposed traffic control signal will not restrict the progressive movement of traffic.

Note: This warrant may change significantly within the next year

WARRANT 5 - SCHOOLS

Standard:

The need for a traffic control signal shall be considered when an engineering study of the frequency and adequacy of gaps in the vehicular traffic stream as related to the number and size of groups of school children at an established school crossing across the major street shows that the number of adequate gaps in the traffic stream during the period when the children are using the crossing is less than the number of minutes in the same period (see Section 7A.03) and there are a minimum of 20 students during the highest crossing hour.

Before a decision is made to install a traffic control signal, consideration shall be given to the implementation of other remedial measures, such as warning signs and flashers, school speed zones, school crossing guards, or a grade-separated crossing.

The School Crossing signal warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 90 m (300 ft), unless the proposed traffic control signal will not restrict the progressive movement of traffic.
WARRANT 6 – COORDINATED SIGNAL SYSTEMS

Section 4C.07 Warrant 6, Coordinated Signal System
Support: Progressive movement in a coordinated signal system sometimes necessitates installing traffic control signals at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles.

Standard:
The need for a traffic control signal shall be considered if an engineering study finds that one of the following criteria is met:
A. On a one-way street or a street that has traffic predominantly in one direction, the adjacent traffic control signals are so far apart that they do not provide the necessary degree of vehicular platooning.
B. On a two-way street, adjacent traffic control signals do not provide the necessary degree of platooning and the proposed and adjacent traffic control signals will collectively provide a progressive operation.

WARRANT 7 - CRASHES

Section 4C.08 Warrant 7, Crash Experience
Support: The Crash Experience signal warrant conditions are intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal.

Standard:
The need for a traffic control signal shall be considered if an engineering study finds that all of the following criteria are met:
A. Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency and
B. Five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period, each crash involving personal injury or property damage apparently exceeding the applicable requirements for a reportable crash; and
C. For each of any 8 hours of an average day, the vehicles per hour (vph) given in both of the 80 percent columns of Condition A in Table 4C-1 (see Section 4C.02), or the vph in both of the 80 percent columns of Condition B in Table 4C-1 exists on the major-street and the higher-volume minor-street approach, respectively, to the intersection, or the volume of pedestrian traffic is not less than 80 percent of the requirements specified in the Pedestrian Volume warrant. These major-street and minor-street volumes shall be for the same 8 hours. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.
WARRANT 8 – ROADWAY WORK

Section 4C.09  Warrant 8, Roadway Network

Support:
Installing a traffic control signal at some intersections might be justified to encourage concentration and organization of traffic flow on a roadway network.

Standard:
The need for a traffic control signal shall be considered if an engineering study finds that the common intersection of two or more major routes meets one or both of the following criteria:
A. The intersection has a total existing, or immediately projected, entering volume of at least 1,000 vehicles per hour during the peak hour of a typical weekday and has 5-year projected traffic volumes, based on an engineering study, that meet one or more of Warrants 1, 2, and 3 during an average weekday; or
B. The intersection has a total existing or immediately projected entering volume of at least 1,000 vehicles per hour for each of any 5 hours of a nonnormal business day (Saturday or Sunday).

A major route as used in this signal warrant shall have one or more of the following characteristics:
A. It is part of the street or highway system that serves as the principal roadway network for through traffic flow; or
B. It includes rural or suburban highways outside, entering, or traversing a City; or
C. It appears as a major route on an official plan, such as a major street plan in an urban area traffic and transportation study.

MARKINGS FOR LOW VOLUME ROADS
(MUTCD Section 5)
ENTIRE PART 5 IS NEW

- Outside of Cities, towns, and less than 400 AADT
- Not a freeway, expressway, I/C Ramp, or road on a designated state highway system
- Paved or unpaved

APPLICATION OF DEVICES ON LOW-VOLUME ROADS (5A.02)

- Focus on devices that:
  - warn of conditions not normally encountered
  - prohibit unsafe movements
  - provide minimal destination guidance

- Part 5 does not prohibit the installation nor the full application of traffic control devices on low-volume roads
MARKINGS FOR LOW-VOLUME ROADS (5E)

- Motorized traffic and crossing signs should be removed or covered when not in use
- NO TRAFFIC SIGNS sign may be used on unpaved, low-volume roads
- Center line markings should be placed on paved low-volume roads subject to engineering judgment or study
- Edge line markings may be placed on paved facilities with or without centerlines

TEMPORARY TRAFFIC CONTROLS
(MUTCD Section 6)

FHWA Docket No. FHWA-2006-25203
“Temporary Traffic Control Devices”
TEMPORARY TRAFFIC CONTROL

- TTC (Temporary Traffic Control)

- The needs and control of all road users (motorists, bicyclists, and pedestrians) per ADA Act of 1990

CONSTRUCTION SIGNING

- Large cause of crashes

- Regulatory speed limits instead of advisory
  (Vehicle code section 22362 within 400 feet)

- Arrow boards/changeable message signs

- Double fines zones
UNIFORM SIGN CHART


Flags and regulatory speeds in work zones
Article about work zone speed limits

Minimal warning of work zone
Highly visible guidance in work zone
Changeable message sign (CMS)

Poor construction sign
Half closure on a Multi-lane High Speed Roadway
Section 6 of the MUTCD

Interior lane closure on a Multi-lane Street
Section 6 of the MUTCD
Double fines in construction zones

TRAFFIC CONTROL FOR SCHOOL AREAS
(MUTCD Section 7)
TCS FOR SCHOOL AREAS

- No major changes in this part
- CVC dictates most of this Part
- Figures have been enhanced from the Traffic Manual Chapter to clarify CVC applications
DOUBLE FINES IN SCHOOL ZONES

- AB 1886
- Doubles base fine only
- Not well understood by law enforcement officers
- To date, fine collections have been variable

OTHER SECTIONS OF THE MUTCD

- Traffic Controls for Highway-Rail Grade Crossings
- 9 Traffic Controls for Bicycles Facilities
- 10 Traffic Controls for Highway-LRT Grade Crossings
MUTCD CHANGES

MUTCD CHANGES (2009?)
(Some Examples)

- Application of MUTCD private property roads used by the public
- Lettering size – 1” height per 30 feet of legibility distance
- New factors to be considered for establishing stop and yield control
- New guidance on roundabout signing and striping
- 36” x 36” minimum sign for diamond shaped warning signs on multi-lane conventional roads
- Speed reduction advisory sign where speed limit ahead being reduced by more than 10 mph
MUTCD CHANGES (2009?)
(Some Examples)

- Changes is lane reduction markings
- New warrant 9 for signals near rail at-grade crossings
- Flashing yellow arrow for permissive turns
- Countdown signals will be required for all new pedestrian indications
- Pedestrian walking speeds will be 3.5 feet per second for signal timing and 3.0 feet per second for ADA etc.
- New uneven lanes or shoulder drop-off signs and plaque

CITIZEN BROCHURES
www.ventura.org./vcpwa/transportation/traffic.htm

- Marked crosswalks
- Stops signs
- Speed limits
- Adult crossing guards
- Parking zones
- Pedestrian signals
- Parking permits
- Flashing beacons
- Encroachment permits
- Traffic signal systems
- Oversized vehicle permits
CITIZEN BROCHURES

Pedestrians should be very cautious when walking in a crosswalk, especially when their visibility is limited by vehicles already stopped at the crosswalk as illustrated below.

WHERE ARE CROSSWALKS NORMALLY MARKED?

Crosswalks are marked at intersections where there is substantial conflict between vehicle and pedestrian movements, where significant pedestrian concentrations occur, where pedestrians could not otherwise recognize the proper place to cross, and where traffic movements are controlled. Examples of such locations are:

- Approved school crossings.
- Signalized and four way stop intersections.

It is the County’s policy not to paint crosswalks at mid-block locations where traffic is not controlled by stop signs or traffic signals. Painted crosswalks should only be used where necessary to direct pedestrians along the safest route.

WHAT ARE SPECIAL SCHOOL CROSSWALKS?

Marked crosswalks established adjacent to a school building or school grounds must be painted yellow. Other established marked crosswalks may be painted yellow if the nearest point of the crosswalk is not more than 600 feet from a school building or grounds.

Crosswalks should be marked at all intersections on the suggested route to school, available from your local school. They should also be marked where there is high conflict between vehicles and students while crossing.

The best safety measure is to educate children on how and where to safely cross the street.

REQUESTS AND INQUIRIES

If you have questions, requests or suggestions concerning traffic please call the Transportation Department at (805) 684-2049 or through the “Contact Us” link at http://www.countyofventura.org.

Public Works Agency
Transportation Department
800 S. Victoria Avenue
Ventura CA 93009-1620
LESSONS LEARNED

Prepare for interviews (job or press – list of 86 questions!)

Do not contradict politicians in a public hearing or meeting

Keep current on technical information

Integrity and ethical values matter

QUESTIONS ?