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SECTION 8 - TRAFFIC CONTROL

8.1.0 GENERAL

The intent of this Section is to emphasize standardization of traffic control and traffic control devices. In this regard, the Texas Department of Transportation's Texas Manual on Uniform Traffic Control Devices (TMUTCD), latest edition, should be referred to and followed whenever possible.

8.2.0 PAVEMENT MARKINGS

In general, Part III of the latest edition of the TMUTCD should be consulted regarding pavement markings. Figures 8-1, 8-2, 8-3, and 8-5, in Section 8.7.0 of this Manual, identify policies as set forth by the City regarding specific marking widths, placements and spacings.

8.3.0 SIGNING

The latest edition of the TMUTCD should be referred to in regard to the type and placement of signs on proposed streets (see Figure 8-4, in Section 8.7.0 of this Manual, for City policy regarding "end of school zone" signing).

8.4.0 SIGNALIZATION

In identifying intersections for signal installations, the TMUTCD should be referenced for warrants. The City typically permits timber pole installations for temporary use only. Mast arm or strain pole installations shall be used for all permanent pole locations.

The City's DACS - Standard Specifications Manual identifies materials, size and makeup of permissible equipment.

NOTE: In an effort to provide for optimization of signal timing and signal progression, it is generally desirable to maintain spacings in excess of a quarter (1/4) mile.

8.5.0 TEMPORARY TRAFFIC CONTROL ZONES

This Section prescribes procedures and regulations for temporary traffic control zones on public right-of-way within the City. The criteria is intended to provide minimum traffic control measures for typical temporary traffic control operations within the corporate limits of the City.

This Section supplements the requirements of the latest edition of the TMUTCD issued by the Texas Department of Transportation relating to construction and repair activities. The state manual is the primary manual governing temporary traffic control zones on public streets and shall be referenced for information.

Any person who undertakes to perform any activity upon, in, under, above or about any public street, road, alley, sidewalk or any portion of the public right-of-way, shall use: barricades, warning signs and all other traffic control devices and procedures about the area during the duration of the activity within the public right of way. All devices shall be of the type and used in the manner required by

the latest edition of the TMUTCD and as indicated in this Section.

The provisions set forth in this Section shall apply to all individuals performing activities on or adjacent to any road, street, alley or sidewalk in the City and includes:

- All City employees.
- Contractors employed by the City.
- Public Utility Companies.
- Contractors employed by Utility Companies.
- All others whose work affects, either directly or indirectly, the free flow of vehicular, bicycle or pedestrian traffic within the City limits.

8.5.1 Fundamental Principles of Temporary Traffic Controls

Principles and procedures, which experience has shown tend to enhance the safety of motorists and workers in the vicinity of temporary traffic control areas, are included in the following listing. These principles and procedures provide a guiding philosophy of good temporary traffic control for the practitioner. They do not establish specific standards and warrants (individually addressed in this Section and the TMUTCD).

A. **Training**

Each person whose actions affect temporary traffic control zone safety, from upper-level management personnel through field personnel, should receive training appropriate to the job decisions each is required to make. Only those who are trained in safe traffic control practices, and who have a basic understanding of the principles established by applicable standards and regulations (including those in this Section and the TMUTCD), should supervise the selection, placement, and maintenance of traffic control devices in work and incident management areas.

B. **Traffic Safety**

Traffic safety in temporary traffic control areas should be an integral and high-priority element of every project from planning through design and construction. Similarly, maintenance and utility work should be planned and conducted with the safety of motorists, pedestrians, and workers kept in mind at all times. Formulating specific plans for incident management traffic control is difficult because of the variety of situations that can arise. Nevertheless, plans should be developed in sufficient detail to provide safety for motorists, pedestrians, workers, and enforcement/emergency personnel and equipment. A traffic control plan, in detail appropriate to the complexity of the work project or incident, should be prepared and understood by all responsible parties before the site is occupied.

C. **Mobility**

Traffic movement should be inhibited as little as practicable. Frequent and

abrupt changes in geometrics should be avoided and the activities should be scheduled during off-peak hours to reduce traffic congestion.

D. **Guidance**

The traveling public and pedestrians should be guided in a clear and positive manner while approaching and traversing the temporary traffic control zone. Adequate warning, delineation, and channelization by means of proper pavement marking, signs, or use of other devices should be provided where appropriate to assure the driver and pedestrian of positive guidance before approaching and while passing through the area. Signs, pavement markings, and other traffic control devices that are inconsistent with intended travel paths should be removed.

E. **Inspection**

To ensure acceptable levels of operation, routine inspection of traffic control elements should be performed. Temporary traffic control areas should be carefully monitored under varying conditions of traffic volume, light, and weather to ensure that traffic control measures are operating effectively and that all devices used are clearly visible, clean, and in good repair. Inspections should ensure that all traffic control measures implemented on the project are necessary, conform to the traffic control plan, and are effective in providing safe conditions for motorists, pedestrians, and workers.

8.5.2 Procedures

A. Requests for Temporary Traffic Control

Any person wishing to perform any work within the public right-of-way must obtain the proper permit(s) prior to starting such work.

In order to insure proper advance planning and coordination, except in emergency situations as noted in Section 8.5.2B.1., all requests for temporary traffic controls require advance notice be given to the Transportation Services Department. Written notification shall be given on forms provided by the City for all temporary traffic control zones. The advance notification requirements depend on the type of street the activity will occupy and the duration of the activity. The following minimum advance notifications are required for all temporary traffic control zones.

In all areas of the city the following notifications requirements shall apply:

- Long-term stationary - Work that occupies a location more than three (3) days. Two (2) weeks advance notice for all roadways and detours.
- Intermediate-term stationary - Work that occupies a location from overnight to three (3) days. Three (3) working days advance notice for Arterial and Collector streets, one (1) working day advance notice for Residential streets and two (2) weeks for detours.
- Short-term stationary - Daytime work that occupies a location from one (1) to twelve (12) hours. Three (3) working days advance notice for Arterial

and Collector streets and two (2) weeks for detours.

- Short, Duration - Work that occupies a location up to one (1) hour. Three (3) working days advance notice for Arterial streets.
- Mobile - Work that moves intermittently or continuously. Three (3) working day advance notice for all streets.

When arterial streets are to be completely close, advance warning signs shall be installed a minimum of one (1) week before the closure. The size, location and wording shall be determined on a case by case basis.

For the purpose of this Section; Arterial streets are any street with striping to provide two-lanes or more of traffic in one direction or streets located in the Central Business District. Collector streets are any street connecting two (2) or more arterial streets. All others are considered residential streets.

B. **Incident Management**

The primary function of traffic control at an incident area is to move traffic safely and expeditiously through or around the incident. An incident is an emergency work activity, major traffic accidents, natural disaster or special event.

1. Emergency Operations

During emergencies, the ability to install proper traffic control may be greatly reduced, and any devices on hand should be used for the initial response as long as they do not present a hazard themselves. If the incident is prolonged, standard temporary traffic control procedures and devices shall be used. Procedures for emergencies are as follows:

a. Provide temporary traffic control with devices on hand such as cones, vehicles, floggers or police officers to guide motorist and pedestrians around the incident.

b. During normal work hours, immediately contact the Transportation Services Department to report the location of the emergency. The Transportation Services Department shall determine what, if any, additional temporary traffic controls will be needed at the site.

c. Provide proper temporary traffic control as required to complete the activity.

2. Special Events

Special events such as parades, sporting events and non-construction street closures for filming and street events, can be planned for and coordinated. Therefore, proper temporary traffic control shall be provided for these events. Procedures for special events are as follows:

a. Applicants shall make application to the Round Rock Police Department for parade permits as required under the City of Round Rock Code of Ordinances, 1995 Edition.

b. The applicant shall submit a traffic control plan for approval to the Transportation Services Department, which indicates the proposed route of the parade and/or the streets to be closed, and the locations of all temporary traffic control devices to be used during the event.

c. The Transportation Services Department shall determine if the proposed traffic control plan will not interfere with any other previously planned activities and if any temporary traffic control devices other than police officers shall be required for the event.

d. If temporary traffic control devices are required for the event, the applicant shall provide a letter from a professional barricade company stating that all devices to be used during the event shall be set up and removed by them in accordance with the latest edition of the TMUTCD and this Section.

8.5.3 Requirements

A. Time Restrictions and Special Requirements

1. Time Restrictions

The Director of the Transportation Services Department or his designee may restrict the hours of construction, repair or other activities affecting the free flow of traffic to nights, weekends or restricted hours due to potential congestion, other construction activities hazards to pedestrian or motorist.

Daily lane closures on arterial roadways shall not be permitted during the hours of 6:00 a.m. to 9:00 a.m. and 4:00 p.m. to 7:00 p.m. Monday through Friday, except in emergencies or situations where it can be demonstrated that traffic flow or safety will not be adversely affected. Traffic lanes approved for daily closures which are not occupied by activities during the hours of 11:30 a.m. to 1:30 p.m. shall be opened to allow traffic to flow freely.

2. Special Requirements

The Director of the Transportation Services Department or his designee may require that any of the following special traffic control devices, working hours, project layout and operations be imposed on any temporary traffic control zone:

a. The use of additional barricades, signals, signs, floggers, police officers or other traffic control devices or safety procedures;

b. That the activity be performed only at certain hours during the day or night or during specified days of the week, month or year;

c. That only a specified area or not more than a specified number of traffic lanes, parking meters and/or parking lanes shall be blocked or closed at the same time or at specified times of day;

d. That material and equipment used in the activity and materials

removed from any excavation be located other than in the vehicle traffic lane of such a street; and

e. Any other restrictions deemed necessary to insure management of the rights-of-ways and the free flow of vehicular, bicycle and pedestrian traffic.

B. **Traffic Control Plan**

A Traffic Control Plan (TCP) describes temporary traffic controls to be used for facilitating vehicle and pedestrian traffic through a temporary traffic control zone. The TCP may range in scope from being very detailed, to merely referencing typical drawings contained in the TMUTCD, this Section or specific drawings contained in contract documents. The degree of detail in the TCP depends entirely on the complexity of the situation, and TCPs should be prepared by persons knowledgeable about the fundamental principles of temporary traffic control and the work activities to be performed.

If a traffic setup shown on standard detail sheets does not address the traffic controls needed for a specific site, then a Professional Engineer registered in the State of Texas, must prepare a TCP specific to the site. A standard detail or TCP which shows the proposed method of warning, directing and guiding traffic, shall be approved by the Director of the Transportation Services Department, prior to installing any devices on the right-of-way. The following information shall be provided with the standard detail or TCP:

1. Activity location, right-of-way and curb-lines, and existing traffic controls of the street sought to be closed or blocked.
2. Areas of the street to be closed or blocked.
3. Proposed pedestrian and vehicular detour routes.
4. Location and type of all barricades, signals, signs, channelizing devices, pavement markings and other warning devices to be used to direct traffic.
5. A schedule of construction showing each phase of work, start and completion dates for each phase, and proposed work hours.

Any changes in the plan shall be approved by the Transportation Services Department in advance of the change.

C. **Existing Traffic Control Devices**

1. Traffic Signals

If maintenance or construction activities require excavation in the vicinity of a signalized intersection, the Traffic Signals Section of the Transportation Services Department shall be notified at least three (3) working days prior to commencing work activities. Any damage to the traffic control signal or associated equipment, resulting from the maintenance or construction activity, will be repaired by the

Transportation Services Department and the cost of the repairs shall be paid by the contractor, utility, agency or department causing the damage.

2. Traffic Control and Street Name Signs

All traffic control or street name sign posts adjacent to construction or maintenance work site shall be protected from damage. If removal of such signs is necessary, the Signs and Marking Section of the Transportation Services Department will perform the work. All regulatory and/or warning signs that are applicable to traffic shall remain visible to the motorist. The contractor shall relocate existing signs on to temporary mounts as needed to facilitate construction activities. Any sign or support damaged by the construction or maintenance activity will be repaired by the Transportation Services Department and the cost of such repairs will be paid by the contractor, utility, agency or department causing the damage.

D. **Property Access**

1. Access to public and private property

Local access shall be maintained to all properties on all streets during construction and maintenance activities. The TCP shall provide for access to all sidewalks, business and residence entryways and driveways. If access cannot be maintained, the contractor, utility, department or supervisor shall notify the affected property owner, resident or tenant a minimum of one (1) week in advance of the pending work unless the work is of an emergency nature. Access shall, in all cases, be restored as soon as possible. To ensure this, the contractor or work crew shall only perform the work affecting the restricted access areas while access is not maintained.

2. Access to Emergency Service Facilities

Access to fire stations, hospitals, EMS facilities and police stations shall be maintained at all times. If work activities require some access restrictions or access can not be maintained, the contractor or work crew shall provide a minimum of two (2) weeks notice, to the affected emergency service facility prior to commencing the work, unless the work is of an emergency nature.

For emergencies, the contractor, utility, department or supervisor shall notify the occupant of the emergency service facility of the need to restrict their access and shall as soon as possible restore access to the property with steel plates or temporary pavement repairs.

E. **Steel Plates**

Where traffic must cross trenches, the contractor shall provide suitable bridges. For trenches less than eighteen (18) inches (450 millimeters) in width, sheet steel plates having a minimum thickness of three-quarter (¾) inches (19 millimeters) shall be used. For trench widths from twenty-four (24) inches (600 millimeters) to seventy-two (72) inches (1.8 meters), sheet steel plates having a minimum thickness of one (1) inch (25 millimeters) shall be used.

The thickness of plates for trench widths exceeding seventy-two (72) inches (1.8 meters) shall be established in an analysis completed by a Licensed Professional Engineer registered in the State of Texas.

The sheet steel plating may be installed in a "surface placement" or "flush placement" configuration. The type of steel sheet plating installation shall be based on the street classification, posted speed and/or anticipated length of time in service. Longer-term plating installations and/or plating installations in high-trafficked portions of roads/streets shall include consideration of "flush placement" of the plates (i.e. milling of the pavement surface is undertaken to insure that the top-of-plate elevations essentially match the existing elevations of adjacent pavement surfaces) to minimize the impact on vehicular traffic.

In either installation configuration, the sheet steel plates shall extend beyond the edge of the trench a minimum of eighteen (18) inches (450 millimeters) but no more than thirty (30) inches (750 millimeters) on both sides. Transition ramping shall be provided for all "surface placement" configurations by the installation of cold mix asphalt on all sides.

For safe traverse of plating installations during the term of service, the top surface of the installed plates shall be flat and free of any clips, chains, attachments, weldments or surface irregularities.

When the plate dimension in the direction of traffic flow exceeds six (6) feet (1.8 meters), a non-skid coating, approved by the City Engineer or designated representative, shall be applied to the entire surface area of all plates.

Additional methods of securing plates may be required depending on field conditions. The contractor should avoid using a long series of plates that run parallel to traffic wheel paths. If allowed the length of a series of plates that run parallel to traffic wheel paths shall not exceed thirty (30) feet (9 meters).

The use of steel plates shall be approved by the Transportation Services Department or successor department, if any prior to construction.

F. **Identification of Temporary Traffic Control Devices**

Temporary traffic control devices that are placed in public right-of-ways shall be marked or affixed with a sticker, clearly identifying the name, address and/or telephone number of the individual responsible for the device.

G. Responsibility of Traffic Control

It is the responsibility of the permit-holder for private activities or the job supervisor for public projects to ensure that all policies, procedures and requirements set forth in this Manual and the TMUTCD are met. Each work site shall have a designated competent person responsible and available on the project site or in the immediate area to ensure compliance with the traffic control plan and the provisions of this Manual. The competent person shall be required to demonstrate sufficient training in traffic control and competency in setting traffic control devises. Training Certificates shall be provided to the Transportation Services Department prior to setting any traffic control devices. Training certificates for competent persons shall be good for four (4) years from the date of training. After such time the competent person must show that additional training or re-certification has been achieved in order to maintain competent person status. Competent persons who continually fail to demonstrate competence in setting temporary traffic controls shall be required to provide additional documentation of training.

H. Noncompliance

Failure or refusal to comply with the provisions of this manual and/or those set by the Director of the Transportation Services Department or his designee shall be unlawful and grounds for suspension or revocation of the permit for the work or activity.

A permit holder or owner shall comply with each provision of this Manual, and any other rule or regulation adopted by the Director of the Transportation Services Department. No activity may take place in the rights-of-way without first obtaining a proper permit. All un-permitted activity in the rights-of-way will be halted, and work may not resume until a proper permit is obtained.

A permit holder or owner who repeatedly fails to comply with the following:

1) a permit provision;

2) a provision of this manual;

3) traffic control plans and specifications;

4) a traffic control device inspection report; or

5) commits a violation that may negatively impact a person's safety and welfare may be suspended from work for a period not to exceed four (4) work days.

A suspended permit holder or owner shall halt all worksite activity immediately upon receipt of the order from the Director of the Transportation Services Department or his designee. The permit holder or owner is directed to remedy any immediate hazards to public safety and welfare, and

may be allowed to correct the deficiency that caused the suspension. The suspension period will not commence until all the violations are cured to the satisfaction of the Director of the Transportation Services Department or his designee.

Any activity occurring within the public right-of-way, for which a valid permit cannot be produced on the site, shall be halted immediately. Work shall not resume until a permit has been produced or issued.

Notice of noncompliance shall be made on Traffic Control Device Inspection Reports and shall be issued on site to the job site supervisor, foreman or crew leader.

8.5.4 Temporary Traffic Control Elements

The temporary traffic control zone includes the entire section of roadway between the first advance warning sign through the last traffic control device, where traffic returns to its normal path and conditions. Most temporary traffic control zones can be divided into four areas: the advance warning area, the transition area, the activity area, and the termination area.

A. **Temporary Traffic Control Components**

The four components that constitute a temporary traffic control zone are described in the order that drivers encounter them. They include the following:

1. Advance Warning Area

In the advance warning area, drivers are informed of what to expect. The advance warning may vary from a single sign or flashing lights on a vehicle to a series of signs in advance of the temporary traffic control zone transition area. The true test of adequacy of sign spacing is to evaluate how much time the driver has to perceive and react to the condition ahead. In this regard, the use of speed, roadway condition, and related driver expectancy must be considered in order to derive a practical sign spacing distance. As a guide, Table 8-2 in this Section should be used in conjunction with consideration of actual or anticipated field conditions.

Advance warning is normally not needed when the activity area is sufficiently removed from the driver’s path that it does not interfere with traffic.

2. Transition Area

When redirection of the driver's normal path is required, traffic must be channelized from the normal path to a new path. This redirection is intended to occur at the beginning of the transition area. In mobile operations, this transition area moves with the work space. Transition

areas usually involve strategic use of tapers, which (because of their importance) are discussed in more detail in Section 8.5.4B. of this Manual.

3. Activity Area

The activity area is an area of roadway where the work takes place. It is composed of the work space and the traffic space, and may contain one or more buffer spaces.

a. Work Space

The work space is that portion of the roadway closed to traffic and set aside for workers, equipment, and material. Work space may be fixed or may move as work progresses. Work spaces are usually delineated by channelizing devices or shielded by barriers to exclude traffic and pedestrians.

b. Traffic Space

The traffic space is the portion of the roadway in which traffic is routed through the activity area.

c. Buffer Space

The buffer space is an optional feature in the activity area that separates traffic flow from the work activity or a potentially hazardous area and provides recovery space for an errant vehicle. Neither work activity nor storage of equipment, vehicles, or material should occur in this space. Buffer spaces may be positioned longitudinally and laterally, with respect to the direction of traffic flow.

i. Longitudinal Buffer Space

The longitudinal buffer space may be placed in the initial portion of a closed lane in advance of the workspace. When a protection vehicle is placed in advance of the work space, only the space upstream of the vehicle constitutes the buffer space.

The longitudinal buffer space should be used where a closed lane separates opposing traffic flows. Typically, it is formed as a traffic island and defined by channelizing devices. A guide for the length of longitudinal buffer space is shown in Table 8-1.

ii. Lateral Buffer Space

A lateral buffer space may be used to separate the traffic space from the workspace or a potentially hazardous area, such as an excavation or pavement drop-off. A lateral buffer space also may be used between two (2) travel lanes, especially those carrying opposing flows. The width of the lateral buffer space should be determined by good engineering judgment.

4. Termination Area

The termination area is used to return traffic to the normal traffic path. The termination area extends from the downstream end of the work area to the END ROAD WORK signs, if posted. Conditions may be such that posting of the END ROAD WORK signs is not helpful. For example, the END ROAD WORK signs should normally not be used if other temporary traffic control zones begin within 1.6 kilometers (a mile) of the end of the work space in rural areas, or about four hundred (400) meters (a quarter-mile) within urban areas. For normal daytime maintenance operations, the END ROAD WORK sign is optional.

B. **Tapers**

A common important element of a temporary traffic control zone is a roadway taper. Tapers may be used in both the transition and termination areas. Tapers are created using a series of channelizing devices or pavement markings placed to move traffic out of or into its normal path. Whenever tapers are to be used near interchange ramps, crossroads, curves, or other influencing factors, it may be desirable to adjust the length of tapers. Longer tapers are not necessarily better than shorter tapers (particularly in urban areas characterized by short block lengths, driveways, etc.), because extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes unnecessarily. The real test of taper length involves observation of driver performance after traffic control plans are put into effect. Types of taper lengths are presented in Table 8-3. The suggested maximum space between devices in a taper is presented in Table 8-4 (The spacing in feet approximates the speed in miles per hour (i.e.: a 55 mph speed road should normally have devices space).

1. Merging Taper

A merging taper requires the longest distances because drivers are required to merge with an adjacent lane of traffic at the prevailing speed. The taper should be long enough to enable merging drivers to adjust their speeds and merge into a single lane before the end of the transition. For freeways, expressways, and other roadways having a speed of forty-five (45)_mph or greater, the minimum length for merging tapers should be computed by a formula $L = W \times S$. For residential, urban, and other streets with speeds less than forty-five (45) mph, the formula $L = W \times S^2/60$ should be used. Under either formula, L is the taper length in feet, W is the lateral shift of traffic due to the partially or fully closed lane (in feet), and S is the posted speed, the off-peak 85th percentile speed prior to work starting or the anticipated operating speed. The formula $L = W \times S^2/60$ is used for speeds less than forty-five (45) mph because slower traffic can merge safely in a shorter distance.

Table 8-1 Guidelines for Length of Longitudinal Buffer Space

Speed * (mph)	Length (meters)	Length (feet)
20	11	35
25	17	55
30	26	85
35	36	120
40	51	170
45	66	220
50	84	280
55	101	335
60	125	415
65	146	485

* Posted speed

2. Shifting Taper

   A shifting taper is used when merging is not required, but a lateral shift is needed. Approximately one-half L has been found to be adequate. Where more space is available, it may be beneficial to use longer distances. Guidance for changes in alignment may also be accomplished by using horizontal curves designed for normal highway speeds.

3. Shoulder Taper

   A shoulder taper may be beneficial on high-speed roadways with improved shoulders that may be mistaken for driving lanes (when work is

occurring in the shoulder area). If used, shoulder tapers approaching the activity area should have a length of about one-third L. If a shoulder is used as a travel lane either through practice or during a temporary traffic activity, a normal merging or shifting taper should be used.

4. Downstream Taper

   The downstream taper may be useful in termination areas to provide a visual cue to the driver that access is available to the original lane/path that was closed. When a downstream taper is used, it should have a minimum length of about thirty (30) meters (100 feet) per lane, with devices spaced about six (6) meters (20 feet) apart.

5. One-Lane, Two-Way Taper

   The one-lane, two-way traffic taper is used in advance of an activity area that occupies part of a two-way roadway in such a way that a portion of the road is used alternately by traffic in each direction. Typically, traffic is controlled by a temporary traffic signal or a flagger. A short taper having a maximum length of thirty (30) meters (100 feet) with channelizing devices at approximately six (6) meters (20 foot) spacings should be used to guide traffic into the one-way section.

Table 8-2 Taper Length Criteria for Temporary Traffic Control Zones

Type of Taper	Taper Length
Upstream tapers	
Merging taper	L minimum
Shifting taper	1/2 L minimum
Shoulder taper	1/3 L minimum
Two-way traffic taper	30 meters (100 feet) maximum
Downstream tapers (use is optional)	30 meters (100 feet) minimum
Formulas for L*	

Speed	Formula
40 mph or less	$L = WS^2 / 60$
45 mph or greater	L = WxS

*L = Taper length in meters (feet).
W = Width of offset in meters (feet).
S = Posted speed

When computing metric taper length L in meters, use W in meters and S in MPH. When computing English taper length L in feet, use W in feet and S in MPH.

Table 8-3 Typical Transition Lengths and Suggested Maximum Spacing of Devices

		Minimum Desirable Taper Lengths* (Feet)			Suggested Maximum spacing of Devices (Feet)	
Posted Speed MPH	**Formula**	**10 ft Offset (feet)**	**11 ft Offset (feet)**	**12 ft Offset (feet)**	**On a Taper (feet)**	**On a tangent (feet)**
30	$L=WS^2/60$	150	165	180	30	60-75
35		205	225	245	35	70-90
40	L=WS	265	295	320	40	80-100
45		450	495	540	45	90-110
50		500	550	600	50	100-125
55		550	605	660	55	110-140
60		600	660	720	60	120-150
65		650	715	780	65	130-165
70		700	770	840	70	140-175

* Taper lengths have been rounded

Table 8-3 Typical Transition Lengths and Suggested Maximum Spacing of Devices (Cont'd)

		Minimum Desirable Taper Lengths * (meters)			Suggested Maximum Spacing of Devices (meters)	
Posted Speed MPH	**Formula**	**10 ft Offset (meters)**	**11 ft Offset (meters)**	**12 ft Offset (meters)**	**On a taper (meters)**	**On a tangent (meters)**
30	$L=WS^2/60$	45	50	55	10	20-25
35		65	70	75	12	24-30
40		80	90	100	13	26-32
45	L=WS	135	150	165	14	28-35
50		150	165	180	16	32-40
55		165	185	200	18	36-45
60		180	200	220	20	40-50
65		195	215	235	22	44-55
70		210	235	255	23	46-57

* Taper lengths have been rounded

8.5.5 Pedestrian and Worker Safety

A. **Pedestrian Considerations**

There are three (3) threshold considerations in planning for pedestrian

safety in temporary traffic control zones:

1. Pedestrians should not be led into direct conflicts with work site vehicles, equipment, or operations.
2. Pedestrians should not be led into direct conflicts with mainline traffic moving through or around the work site.
3. Pedestrians should be provided with a safe, convenient travel path that replicates as nearly as possible the most desirable characteristics of sidewalks or footpaths. Every effort should be made to separate pedestrian movement from both work site activity and adjacent traffic. Whenever possible, signing should be used to direct pedestrians to safe street crossings in advance of an encounter with a temporary traffic control zone. Signs should be placed at intersections so that pedestrians, particularly in high-traffic-volume areas, are not confronted with mid-block work sites that will induce them to skirt the temporary traffic control zone or make a mid-block crossing. All pedestrian passage ways/routes should comply with the ADA wherever possible.

B. **Worker Safety Considerations**

Following the Fundamental Principles noted above, in Section 8.5.1 of this Manual, will usually provide the degree of control and traffic operation that will bring about safe conditions for the worker. Of particular importance is maintaining work areas with traffic flow inhibited as little as possible, providing standard and clear traffic control devices that get the driver's attention and provide positive direction.

All workers should be trained in how to work next to traffic in a way that minimizes their vulnerability. In addition, workers with specific traffic control responsibilities shall be trained in traffic control techniques, device usage, and placement. Workers in the right-of-way shall be attired in bright, highly visible clothing similar to that of floggers.

8.5.6 Hand-Signal Control

This form of traffic control provides one of the best methods for handling traffic safely and efficiently at short-duration work sites. It is essential that proper care and procedures are used by qualified personnel.

A. **Qualifications For Flaggers**

Since flaggers are responsible for human safety and make the greatest number of public contacts of all temporary traffic control personnel, it is important that a qualified person be selected. A flagger should possess the following minimum qualifications:

- Average intelligence
- Good physical condition, including sight and hearing
- Mental alertness & ability to react in an emergency

- Courteous but firm manner
- Neat appearance
- Sense of responsibility for the safety of the public & workers
- Capable of communicating verbally with drivers
- Trained in safe traffic control practices

B. **Flagging Equipment**

For daytime work, the flagger's vest, shirt, or jacket shall be orange, yellow, strong yellow green, or fluorescent versions of these colors. For nighttime work, similar outside garments shall be retroreflective. The retroreflective material shall be orange, yellow, white, silver, strong yellow-green, or a fluorescent version of one of these colors and shall be visible at a minimum distance of one thousand (1,000) feet.

Hand-signaling devices, such as STOP/SLOW paddles, lights, and red flags are used to control traffic through temporary traffic control zones. The STOP/SLOW paddle, which gives drivers more positive guidance than red flags, shall be the primary hand-signaling device. The standard STOP/SLOW sign paddle shall be a minimum of four hundred and fifty (450) millimeters (18 inches) wide and octagonal in shape with letters at least one hundred and fifty (150) millimeters (6 inches) high. A rigid handle should be provided. This combination sign should be fabricated from light semi-rigid material, and shall have an octagonal shape. The background of the STOP face shall be red with white letters and border. To improve conspicuity, the STOP/SLOW paddles may be supplemented by one or two symmetrically positioned alternately flashing white high-intensity lamps on each side. The background of the SLOW face shall be orange with black letters and border. When used at night, the STOP/SLOW paddle shall be retroreflectorized in the same manner as signs.

Flags used for emergency signaling purposes shall be a minimum of six hundred (600) millimeters (24 inches) square, made of a good grade of red or red orange material securely fastened to a staff about one (1) meter (3 feet) long. The free edge should be weighted so the flag will hang vertically, even in heavy wind. When used at night, flags shall be retroreflective.

C. **Flagging Procedures**

The use of the sign paddle and flag are illustrated in Figure 8-6, in Section 8.7.0 of this Manual. The following methods of signaling with a paddle should be used:

To Stop Traffic -

The Flagger shall face traffic and show the stop face of the paddle to traffic. For greater emphasis, the free arm may be raised with the palm toward approaching traffic.

When It Is Safe for Traffic to Proceed –

The flagger shall stand parallel to the traffic movement and show the slow face of the paddle to traffic, motion traffic ahead with his free arm.

To Alert or Slow Traffic –

Where it is desired to alert or slow traffic by means of flagging, the flagger shall face traffic and show the slow face of the paddle to traffic. For added emphasis, the flagger may slowly raise and lower his free hand with the palm down.

8.5.7 Temporary Traffic Control Zone Devices

The following Section describes the design and applications of traffic control devices used in temporary traffic control zones. A traffic control device is a sign, signal, marking or other device placed on or adjacent to a street or highway (by authority of a public body or official having jurisdiction) to regulate, warn, or guide traffic.

A. **Signs**

Signs used in temporary traffic control zones fall into three (3) categories, warning, regulatory, and guide.

1. Warning Signs

   This category of signs is used when it is necessary to warn traffic of exiting potentially hazardous conditions on or adjacent to the roadway or sidewalk. Warnings signs require caution on the part of the vehicle operator or the pedestrian and may require a reduction of speed or maneuver in the interest of safety.

   Warning signs in temporary traffic control zones have black legends with an orange background. Yellow warning signs within the temporary traffic control zone which are still applicable may remain in place. Warning signs shall be retroreflective or illuminated for nighttime visibility. Roadway lighting does not meet the requirement for sign illumination.

2. Regulatory Signs

   Regulatory Signs impose legal obligations and restrictions on all traffic. They may only be used under the authority of the agency responsible for traffic control. Therefore, no regulatory sign shall be used without the authorization of the Transportation Services Department.

3. Guide Signs

   Guide signs show route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, or cultural information. The following guide signs used as needed at temporary traffic control zones:

   a. Standard route markings, where temporary route changes are necessary.

b. Directional signs such as motorist service signing, recreational and cultural interest area signs, driveway entrance signs, civil defense signing, and street name signs. When used with detour routing, these signs may have a black legend on an orange background.

c. Special information signs relating to work being done. These signs shall have a black legend on an orange background.

4. Sign Mounting and Placement Principles

As a general rule, signs should be located on the right-hand side of the roadway. When special emphasis is needed or on one-way roadways, signs shall be placed on both the left and right sides of the roadway, where space is available. Signs shall be placed in positions where they will convey their messages most effectively. The following statements provide good placement principles.

- Visibility to oncoming motorist and pedestrians is essential.
- Signs should never be positioned where essential sight lines from intersecting driveways or streets are blocked. (see Figure 8-9 Use of Hand Signaling Devices by Flagger in Section 8.7.0 of this Manual).
- The first warning sign shall never be placed in the street itself.
- Signs used only during the day shall be covered or removed at night.
- Signs shall be removed or changed immediately if condition change.

Typical construction warning sign size and spacing requirements are shown in Table 8-4. Portable sign supports shall only be used for Short-term stationary or Short Duration activities, as defined in Section 8.5.9 of this Manual. Signs mounted on portable sign supports shall be mounted a minimum of three hundred (300) millimeters (1 foot) above ground level. Temporary and fixed sign supports shall be used for all Long-term Stationary or Intermediate-term Stationary activities. Signs mounted on temporary and fixed sign supports shall be mounted a minimum of 2.1 meters (7 feet) above ground level. Only warning signs found in the TMUTCD may be used at temporary traffic control zones. Any variation must be approved by the Transportation Services Department. Advisory speed signs may only be used if authorized by the Transportation Services Department.

5. Arrow Displays

Arrow Displays are intended to provide additional warning and directional information to assist in merging and controlling traffic through and around temporary traffic control zones. Arrow displays will not solve difficult traffic problems by themselves, but they can be very

effective when properly used to reinforce signs, barricades, cones and other traffic control devices; for this reason, arrow displays are required for all lane closures. Necessary signs, barricades or other traffic control devices shall be used in conjunction with the arrow displays.

B. **Channelizing Devices**

Channelizing devices are used to warn and alert drivers and pedestrians of conditions created by work activities in or near the travel way, to protect workers in the temporary traffic zone, and to guide and direct drivers and pedestrians safely through or around the temporary traffic control zone. Channelizing devices should be constructed and ballasted to perform in a predictable manner when inadvertently struck by a vehicle. If struck, they should yield or break away, and fragments or other debris from the device should not penetrate the passenger compartment of the vehicle or be a potential hazard to workers or pedestrians in the immediate area.

The devices include traffic cones / tubular marker, vertical panels, plastic drums, barricades and barriers.

1. Traffic Cones / Tubular Markers

The primary purpose of this group of devices is to channelize traffic and to delineate short duration activities. Cones shall be predominantly orange, fluorescent red-orange, or fluorescent yellow-orange, and shall be made of a material that can be struck without damaging vehicles on impact. Cones used for delineating traffic shall be a minimum of seven hundred (700) millimeters (28 inches) in height. Cones used for marking of wet paint on striping operations may be four hundred and fifty (450) millimeters (18 inches) in height. Tubular markers shall be predominantly orange, minimum fifty-one (51) millimeters (2 inches) wide when facing traffic, and made of material that can be struck without damaging vehicles. Tubular markers shall be a minimum of seven hundred (700) millimeters (28 inches) height.

For nighttime use, cones and tubular markers shall be retroreflective or equipped with lighting devices for maximum visibility. Retroreflection of cones shall be provided by a white band one hundred and fifty (150) millimeters (6 inches) wide, no more than seventy-five (75) to one hundred (100) millimeters (3 to 4 inches) from the top of the cone, and an additional one hundred (100) millimeter (4 inch) wide white band a minimum of fifty (50) millimeters (2 inches) below the one hundred and fifty (150) millimeter (6 inch) band. Retroreflection of tubular markers shall be provided by two seventy-five (75) millimeter (3 inch) wide white bands placed a maximum of fifty (50) millimeters (2 inches) from the top, with a maximum of one hundred and fifty (150) millimeters (6 inches) between bands. If cones are used at night, the temporary traffic control zone must be continuously manned in order to ensure that cones or tubular markers are not displaced by wind or moving traffic.

2. Vertical Panels

Vertical panels may be used to channel traffic, divide opposing lanes of traffic, divide traffic lanes or in place of barricades where space is limited. Vertical Panels shall be made of a material that can be struck without damaging vehicles on impact.

Vertical panels shall be a minimum of two hundred (200) to three hundred (300) millimeters (8 to 12 inches) wide and at least six hundred (600) millimeters (24 inches) high. They shall have orange (fluorescent red-orange or fluorescent yellow-orange) and white stripes, and be retroreflective. Panel stripe widths shall be one hundred fifty (150) millimeters (6 inches), except where panel heights are less than nine hundred (900) millimeters (36 inches), when one hundred (100) millimeter (4 inch) stripes may be used. If used for two-way traffic, back-to-back panels shall be used.

Markings for vertical panels shall be alternating orange and white retroreflectorized stripes (sloping downward at an angle of forty-five (45) degrees in the direction traffic is to pass). Vertical panels used on expressways, freeways, and other high-speed roadways shall have a minimum of 174,193 square millimeters (270 square inches) of retroreflective area facing traffic.

3. Drums

Drums are most commonly used to channelize or delineate traffic flow but may also be used singly or in groups to mark specific locations. Drums are highly visible and have good target value, given the appearance of being formidable obstacles and, therefore, command the respect of drivers.

Drums used for traffic warning or channelization shall be constructed of lightweight, flexible, and deformable materials and be a minimum of nine hundred (900) millimeters (36 inches) in height; and have at least an four hundred and fifty (450) millimeters (18 inch) minimum width, regardless of orientation. Steel drums shall not be used. The markings on drums shall be horizontal, circumferential, alternating orange and white retroreflective stripes one hundred (100) two hundred (200) millimeters (4 to 6 inches) wide. Each drum shall have a minimum of two orange and two white stripes. Any non-retroreflective spaces between the horizontal orange and white stripes, shall not exceed fifty (50) millimeters (2 inches) wide. Drums shall have closed tops that will not allow collection of roadwork or other debris.

4. Barricades

A barricade is a portable or fixed device having from one (1) to three (3) rails with appropriate markings used to control traffic by closing, restricting or delineating all or a portion of the right of way.

Barricades are located adjacent to traffic and are therefore subject to

impact by errant vehicles. Because of their vulnerable position and the hazard they could create, they should be constructed of lightweight materials and have no rigid stay bracing for A-frame designs.

There are three types of barricades: Type I, Type II and Type III. Figure 8-7, in Section 8.7.0 of this Manual, illustrates the proper stripping configuration for various barricade applications.

Type I Barricades

Type I Barricades are intended for the use in situations where traffic will be maintained through the temporary traffic control zone. They may be used singly or in groups to mark specific conditions or may be used in a series for channelizing traffic.

Type II Barricades

Type II Barricades may be used much like the Type I. Type II Barricades have more reflective area and they are intended to be used on higher speed roadways or where high visibility is needed. Where barricades may be susceptible to overturning in the wind, sandbags may be placed on the lower parts of the frame supports to provide ballast but shall not be placed on the top of any striped rails.

Type III Barricades

Type III Barricades are intended to be used in temporary traffic control zones for which sections of the roadway will be closed to traffic. At least one (1) Type III barricade shall be erected at the points of closure. Type III barricades used at a road closure may extend completely across a roadway or from curb to curb. Where provision is made for access of authorized equipment and vehicles, the responsibility for the Type III barricades should be assigned to a person to ensure proper closure at the end of each work day.

When a roadway is legally closed but access must still be allowed for local traffic, the Type III barricade should not be extended completely across a roadway. A sign with the appropriate legend concerning permissible use by local traffic shall be mounted.

5. Safety Fences

Safety fences are used to separate pedestrians and motorist from specific conditions in the right-of-way. They must be a minimum of 1.2 meters (4 feet) tall and may be made out of wood, orange polyurethane plastic or chain link material. If the fence is to be placed within the roadway, the fence shall be retroreflective and/or have stripped barricade panels and warning lights. Lights, if required, shall be placed at least every nine (9) meters (30 feet) along the fence. In all cases, fences must be set back a minimum of three hundred (300) millimeters (1 foot) from the existing lane as marked on the street.

6. Pedestrian Walkways

Pedestrian Walkways separate pedestrians from both the work site and adjacent traffic. A canopied walkway will be required when the distance to the construction activity is less than the height of the work activity. Pedestrian Walkways should be sturdily constructed and adequately lighted for nighttime. Figure 8-8, in Section 8.7.0 of this Manual, illustrates a typical canopied pedestrian walkway and provides the specifications for their use.

Sight distance must be maintained at corners and openings. Ends of pedestrian walkways placed in traffic lanes, facing oncoming traffic must have stripped barricade panels. In all cases, walkways must be set back a minimum of three hundred (300) millimeters (1 foot) from the existing lane as marked on the street. In places where pedestrians are judged especially vulnerable to impact by errant vehicles, all foot traffic should be separated and protected by longitudinal barrier systems.

7. Portable Barriers

When work activities necessitate excavations to remain open within the roadway, portable barriers shall be used to protect vehicles from the excavation. Portable barriers are designed to prevent vehicles from penetrating work areas behind the barrier while minimizing vehicle occupant injuries. They may also be used to separate two-way traffic. These devices are usually Concrete Traffic Barriers (CTB), Low Profile Barriers (LPB) or Water Filled Traffic Barriers (WFTB).

When serving the additional function of channelizing traffic, the barrier taper shall meet the standard channelizing taper lengths. The channlizing barrier shall be supplemented by standard delineators, channelizing devices, or pavement markings. Channelizing barriers should not be used for a merging taper except in low-speed urban areas.

8. Warning Lights

The lightweight and portability of warning lights are advantages that make these devices useful as supplements to the retroreflectorization on hazard warning devices. The flashing lights are effective in attracting a driver's attention and, therefore, provide an excellent means of identifying the hazard.

As used herein, warning lights are portable, lens-directed, enclosed lights. The color of the light emitted shall be yellow. They may be used in either a steady-burn or flashing mode.

Warning lights shall have a minimum mounting height of seven hundred and fifty (750) millimeters (30 inches) to the bottom of the lens. Type A low-intensity flashing warning lights and Type C steady-burn warning lights shall be maintained so as to be visible on a clear night from a distance of nine hundred (900) meters (3,000 feet).

Type A low-intensity flashing warning lights are most commonly mounted on barricades, drums, vertical panels, or advance warning signs, and are intended to warn drivers that they are approaching or are in a potentially hazardous area. All warning signs shall have a Type A warning light.

Type C steady-burn lights are intended to be used to delineate the edge of the traveled way on detour curves, on lane changes, on lane closures, and on other similar conditions. All devices used in tapers shall have Type C warning lights. All other channelizing devices may use either Type C warning lights or an approved large reflectors/ object markers.

C. **Temporary Pavement Markings**

Adequate pavement markings shall be maintained along all streets in temporary traffic control zones. The work should be planned and staged to provide the best possible conditions for the placement and removal of the pavement markings. It is intended, to the extent possible, that motorists be provided markings within a work area comparable to or better than the markings on each approach to the temporary traffic control zone. The following guidelines apply to the use of temporary pavement markings.

1. Inappropriate pavement markings should be removed and the new markings placed before opening the affected lane or lanes to traffic.
2. Conflicting pavement markings shall be obliterated to prevent confusion to drivers. Proper pavement marking obliteration leaves a minimum of pavement scars and completely removes old marking materials. Obliterated markings shall be unidentifiable as pavement markings under day or night, wet or dry conditions. Overlaying existing stripes with black paint or asphalt does not meet the requirements of covering, removal, or obliteration. Sand blasting is the preferred method of obliteration. However, light grinding maybe used on thermoplastic and or roadways that will be resurfaced prior to final striping.
3. When a temporary roadway is constructed to bypass a closed portion of the street, appropriate reflectorized pavement markings shall be placed on the approach to, and throughout the length of hard-surfaced temporary roadways.
4. Temporary pavement markings shall be maintained in long-term stationary work areas and shall match and meet the markings in place at both ends of the work area.
5. Temporary pavement markings should be provided in intermediate-term stationary work areas, to the extent practicable.
6. Short-Term pavement markings should normally be used only on newly resurfaced roadways. However, they maybe used in other situation with prior approval.

7. Pavement marking installations within temporary traffic control zones shall be accomplished only on weekends unless prior approval has been obtained from the Transportation Services Department.

8.5.8 Maintenance and Inspection

In order for the traffic control devices to "command respect and authority," they must be well-maintained. Deteriorated traffic control devices lose their effectiveness and the intent for which they were installed.

Signs, cones, barricades and other devices shall be kept in their proper position, clean and legible at all times. Signs and other devices which do not apply to work site shall be removed or covered. Damaged, defaced or dirty signs, cones, barricaded and other devices shall be cleaned, repaired or replaced.

Barricades and sign supports shall be neatly constructed and shall not appear makeshift or hastily thrown together. They shall be repaired and cleaned as needed to keep up their appearance.

Special care shall be taken to see that traffic control devices are not obstructed by weeds, shrubbery, construction materials or equipment. If weeds, shrubs or trees require trimming or removal, such work shall be performed by the person responsible for the installed device.

Warning lights, if used, shall be inspected at the end of every working day to insure that they are in proper working condition, clean and properly placed.

It is the responsibility of the job supervisor to assure that the traffic control devices are in proper position and doing the job for which they are intended. Repair and maintenance should be schedule during off-peak traffic periods. Such repair/maintenance includes replacing worn out devices or cleaning signs, cones and barricades. However, if the repair or maintenance is of an emergency nature, such as misplaced barricade or cone, it shall be done immediately.

Routine, periodic inspection and maintenance of traffic control at a work site is essential. The frequency of such inspection will depend upon the particular job site. Heavier traffic and higher traffic speeds will necessitate frequencies such as every hour or two. However, on a low volume, low speed street, such as in a residential area, two inspections per day may be adequate; one at the beginning and one at the end of the work day.

8.5.9 Duration of Work

Work duration is a major factor in determining the number and types of devices used in temporary traffic control zones. The five (5) categories of work duration and their time at a location are as follows:

- Long-term stationary: Work that occupies a location more than three (3) days.

- Intermediate-term stationary: Work that occupies a location from overnight to three (3) days.
- Short-term stationary: Daytime work that occupies a location from one (1) to twelve (12) hours.
- Short, Duration: Work that occupies a location up to one (1) hour.
- Mobile Work that moves intermittently or continuously.

A. **Long-Term Stationary**

At long-term stationary temporary traffic control zones, there is ample time to install and realize benefits from the full range of traffic control procedures and devices that are available for use. Generally, larger channelizing devices are used, as they have more retroreflective material and offer better nighttime visibility. The larger devices are also less likely to be displaced or tipped over - an important consideration during those periods when the work crew is not present. Furthermore, as long-term operations extend into nighttime, retroreflective and/or illuminated devices are required. Temporary roadways and barriers can be provided, and inappropriate markings should be removed and replaced with temporary markings.

B. **Intermediate-Term Stationary**

During intermediate-term stationary work, it may not be feasible or practical to use procedures or devices that would be desirable for long-term stationary temporary traffic control zones, such as altered pavement markings, barriers, and temporary roadways. The increased time to place and remove these devices in some cases could significantly lengthen the project, thus increasing exposure time. In other instances, there might be insufficient payback time to make more elaborate traffic control economically attractive.

C. **Short-Term Stationary**

Most maintenance and utility operations are short-term stationary work. The work crew is present to maintain and monitor the temporary traffic control zone. The use of a flagger is an option. Lighting and/or retroreflective devices should be chosen to accommodate varying seasonal, climatic, and visibility situations.

D. **Short Duration**

During short-duration work, there are hazards involved for the crew in setting up and taking down the traffic controls. Also, since the work time is short, the time during which motorists are affected is significantly increased as the traffic control is expanded. Considering these factors, it is generally held that simplified control procedures may be warranted for

short-duration work. Such shortcomings may be offset by the use of other, more dominant devices such as special lighting units on work vehicles.

E. **Mobile**

Mobile operations are work activities that move along the road either intermittently or continuously. Mobile operations often involve frequent short stops, each as much as fifteen (15) minutes long, for activities such as litter cleanup, pothole patching, or utility operations and are similar to stationary operations. Warning signs, flashing vehicle lights, flags, and/or channelizing devices should be used.

Mobile operations also include work activities in which workers and equipment move along the road without stopping, usually at slow speeds. The advance warning area moves with the work area. Traffic should be directed to pass safely. Parking may be prohibited, and work should be scheduled during off-peak hours. For some continuously moving operations-such as street sweeping - where volumes are light and visibility is good, a well-marked and well-signed vehicle may suffice. If volumes and/or speeds are higher, a shadow or backup vehicle equipped as a sign truck, preferably supplied with a flashing arrow display, should follow the work vehicle. Where feasible, warning signs should be placed along the roadway and moved periodically as the work progresses. In addition, vehicles may be equipped with such devices as flags, flashing vehicle lights, truck-mounted attenuators, and appropriate signs. These devices may be required individually or in various combinations, including all of them, as determined necessary.

Safety should not be compromised by using fewer devices simply because the operation will frequently change its location. Portable devices should be used. Flaggers may be used, but caution must be exercised so they are not exposed to unnecessary hazards. The control devices should be moved periodically to keep them near the work area. If mobile operations are in effect on a high-speed travel lane of a multilane divided highway, flashing arrow displays should be used.

F. **Typical Applications**

For typical applications of temporary traffic control zones, see TMUTCD.

Table 8-4 Typical Construction Warning Sign Size and Spacing

Roadway Classification	**Posted Speed**	**Sign Spacing ****	**Long-term Stationary Or Intermediate-term Stationary Approach Warning Signs CW20 Series And CW22-1 Sign**		Short-term Stationary Or Short Duration Approach Warning Signs CW21 Series		Other Warning Signs
			Standard	**Minimum (4)**	**Standard**	**Minimum (4)**	Standard
	MPH	**Approx. m (feet)**	**Mm (inches)**	**mm (inches)**	**mm (inches)**	**mm (inches)**	**mm (inches)**
Conventional	30	40 (120)	1219x1219 (48x48)	914x914 (36x36)			
	35	50 (160)			914x914 (36x36)		914x914 (36x36)
	40	75 (240)					
	45	100 (320)		Use Standard Size		Use Standard Size	
	50	120 (400)					
	55	150 2 (500)					
	60	180 2 (600)			1219x1219 (48x48)		1219x1219 (48x48)
	65	210 2 (700)					
	70	240 2 (800)					
Expressway or Freeway	*	3 ***			***	***	***

* For typical sign spacings on expressways and freeways, see the typical applications diagrams.

** Minimum distance from work to 1st Advance Warning sign and/or distance between each additional sign.

*** Smaller sign sizes may be used where sign designs have not been included in the Standard Highway Sign Designs Manual, Federal Highway Administration, latest edition.

General Notes:

1. Special or larger size signs may be used as may be necessary.
2. Distance between signs should be increased as required to have 450 meters (1500') advanced warning.
3. Distance between signs should be increased as required to have 0.8 km (1/2 mile) or more advance warning.
4. For use only on secondary roads or city streets where speeds are low.
5. Only diamond shaped warning sign sizes are indicated.*

8.7.0 FIGURES

Figure 8-1 Lane Line Spacing

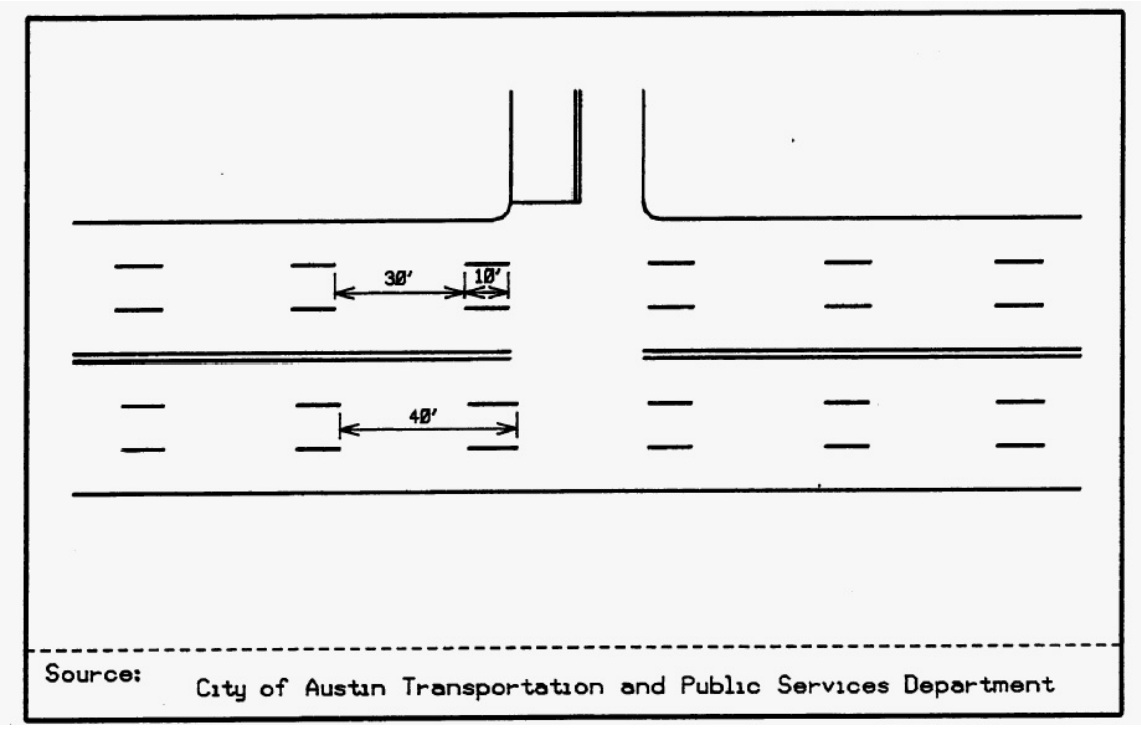


Figure 8-2 End of School Zone Markings

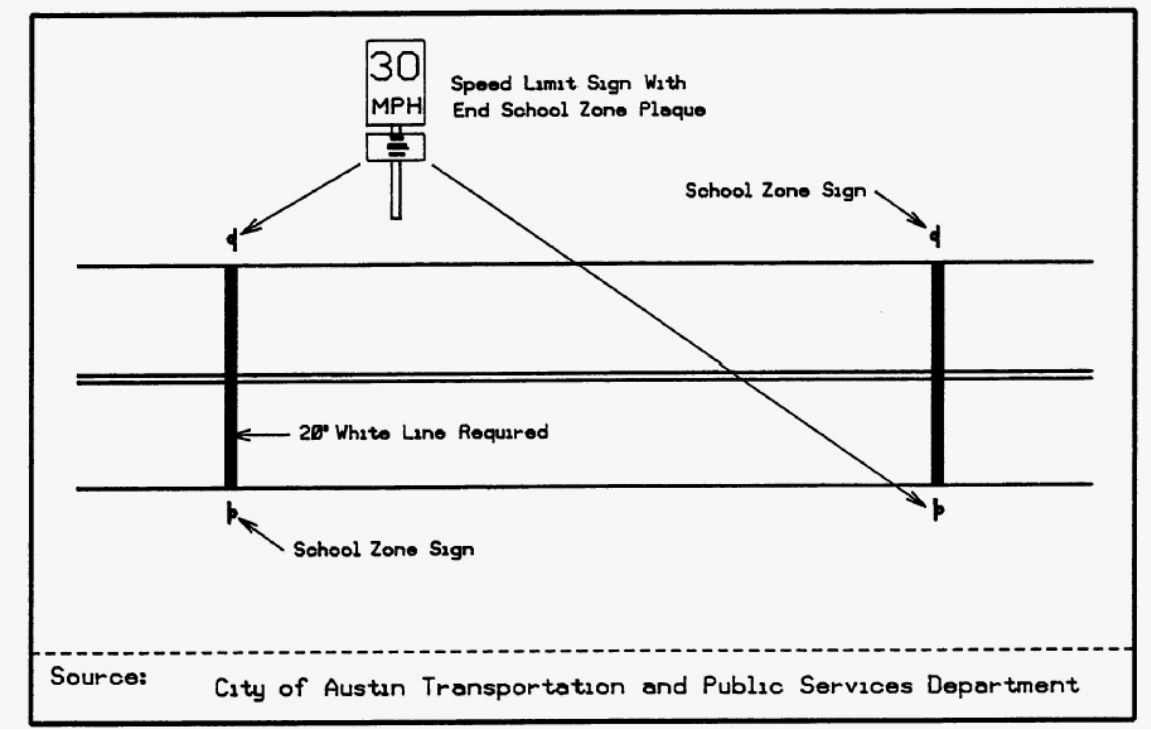


Figure 8-3 School Crosswalks

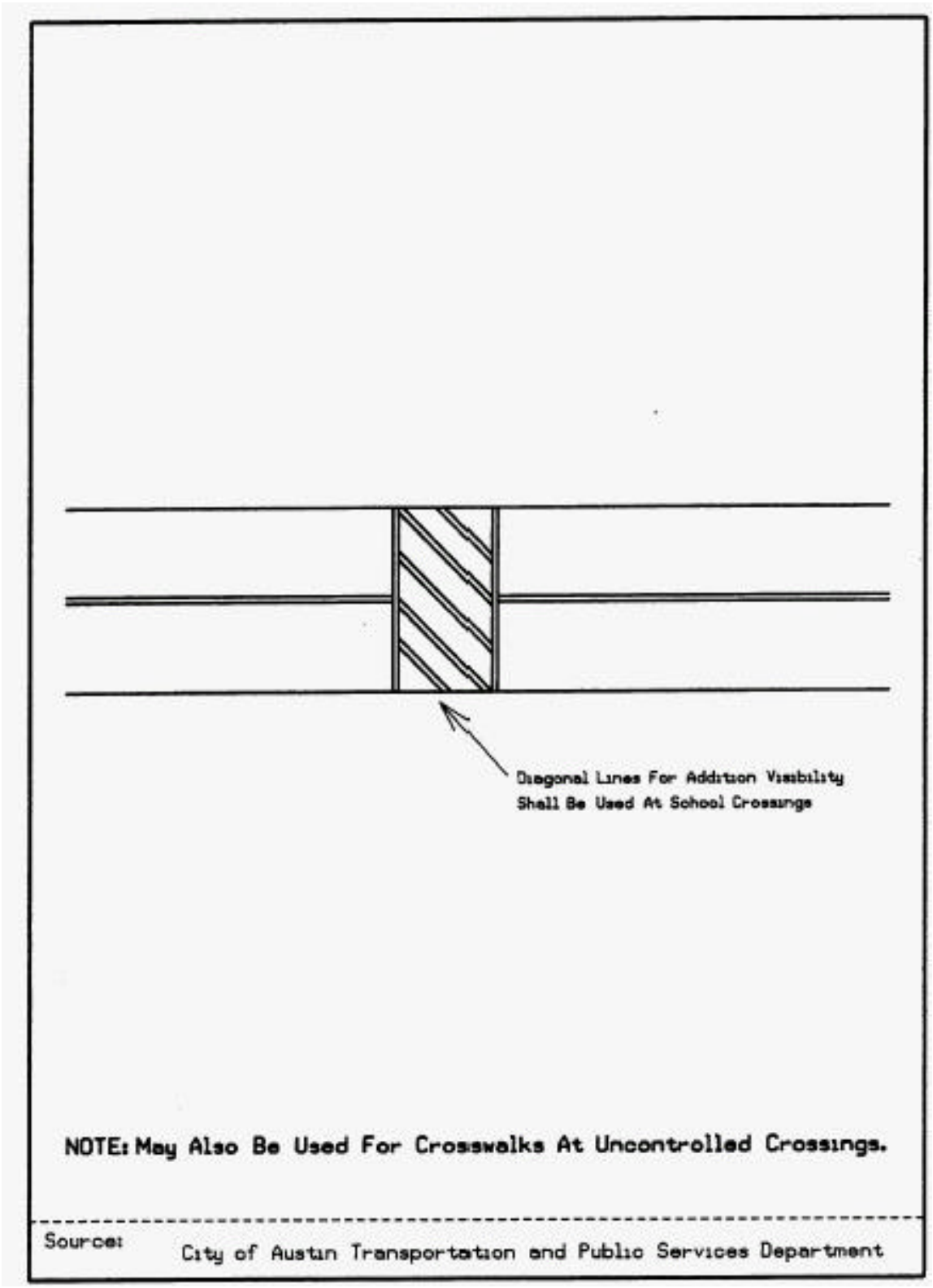


Figure 8-4 End of School Zone Signage

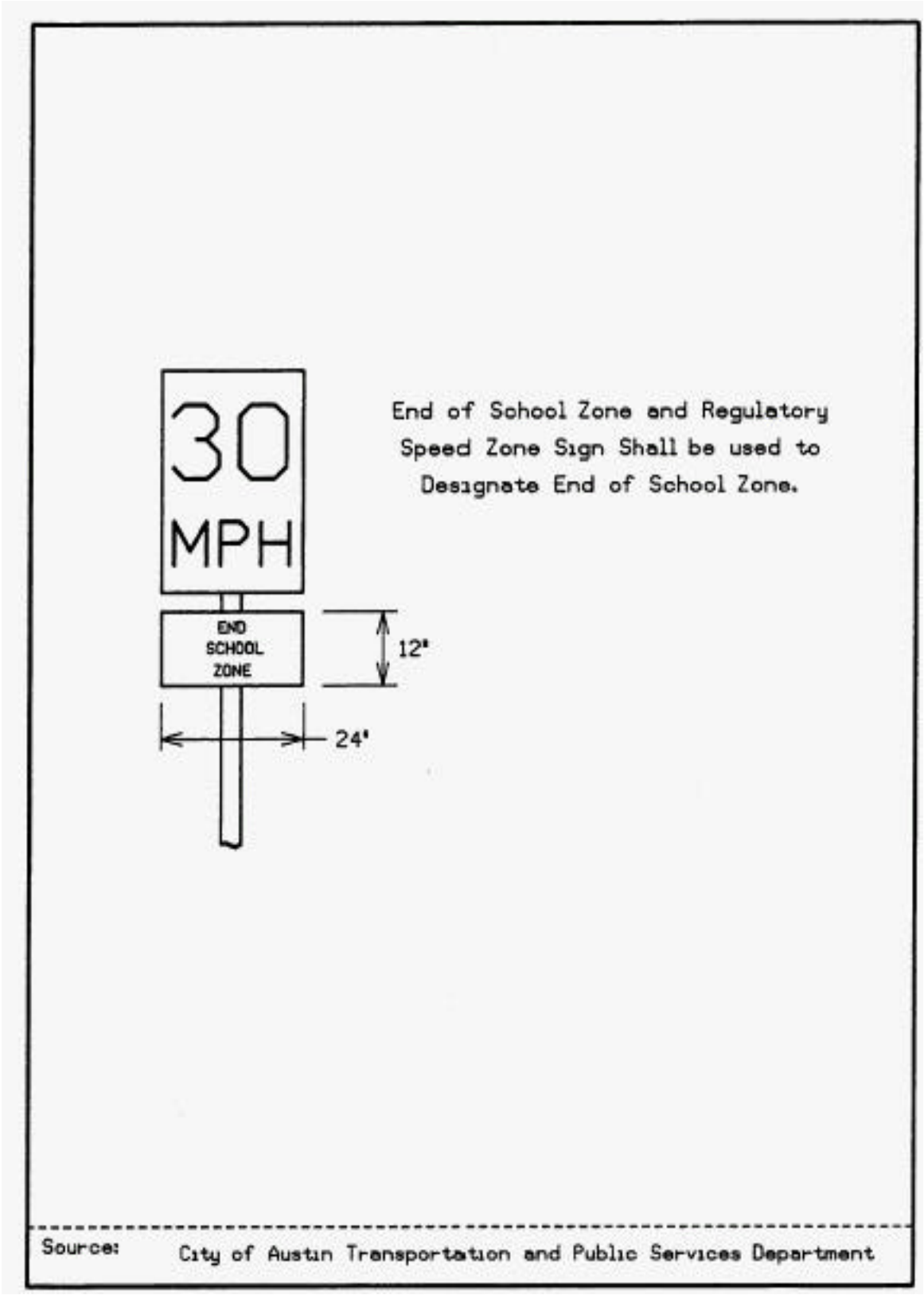


Figure 8-5 Typical Striping

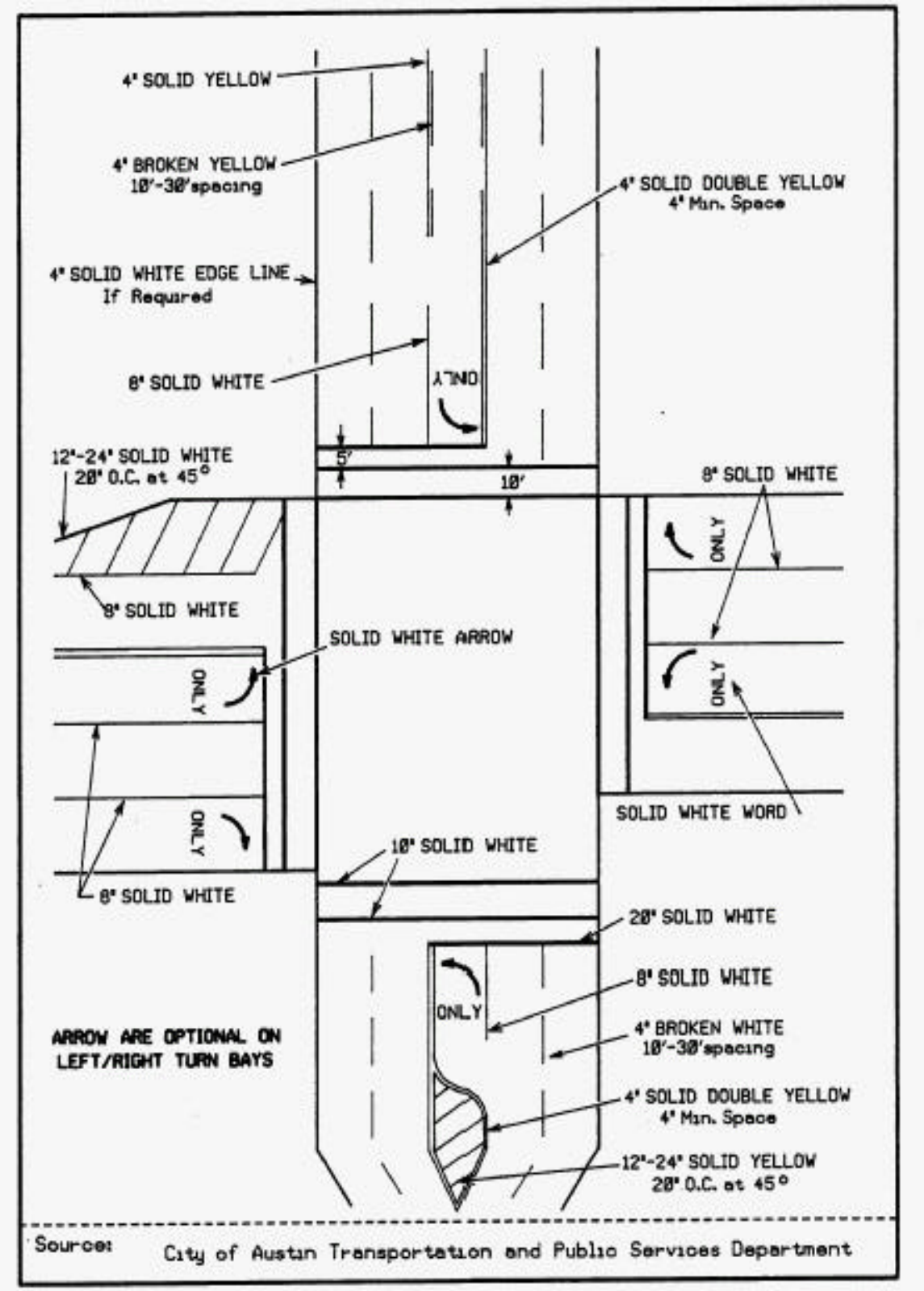


Figure 8-6 Flagger Hand Signals

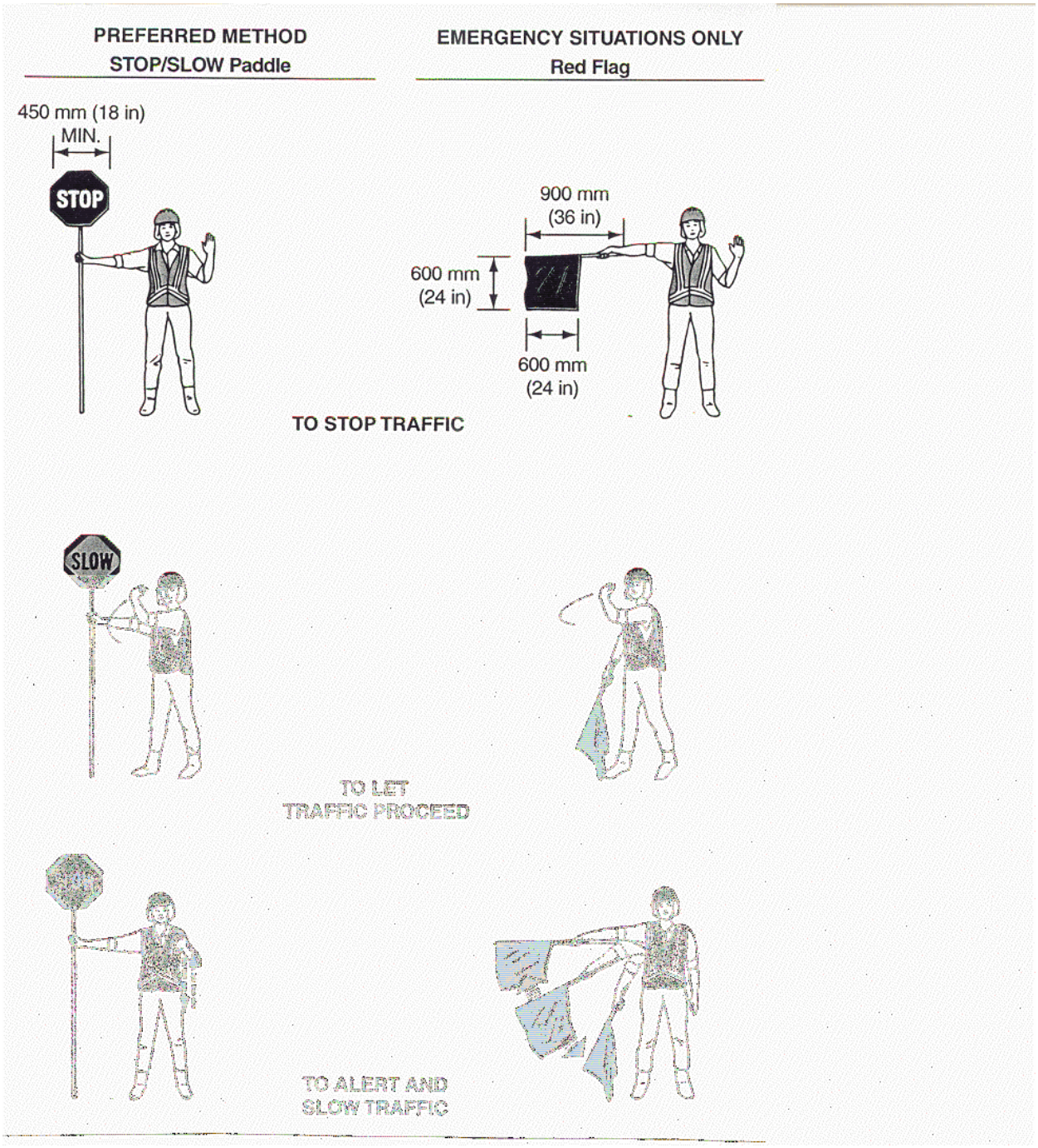
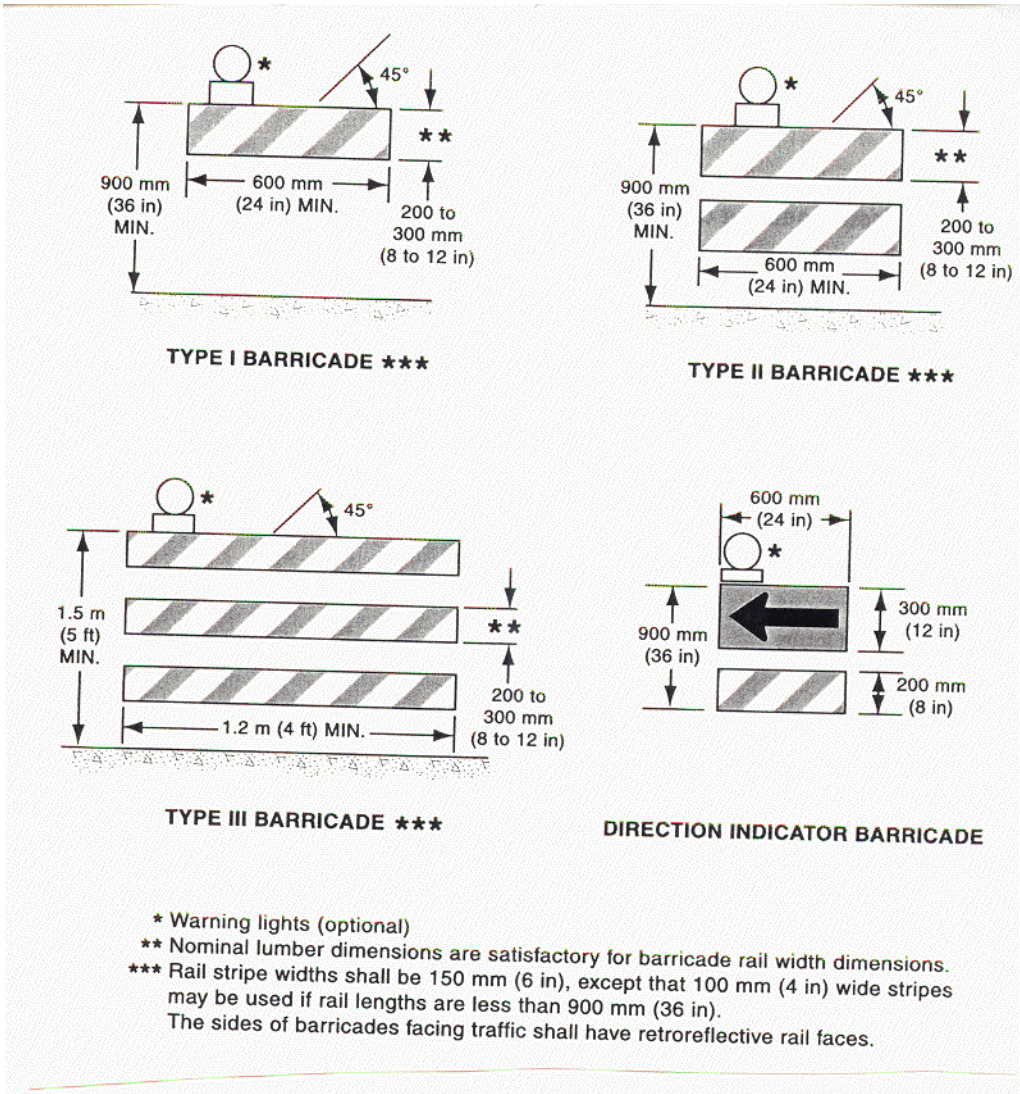
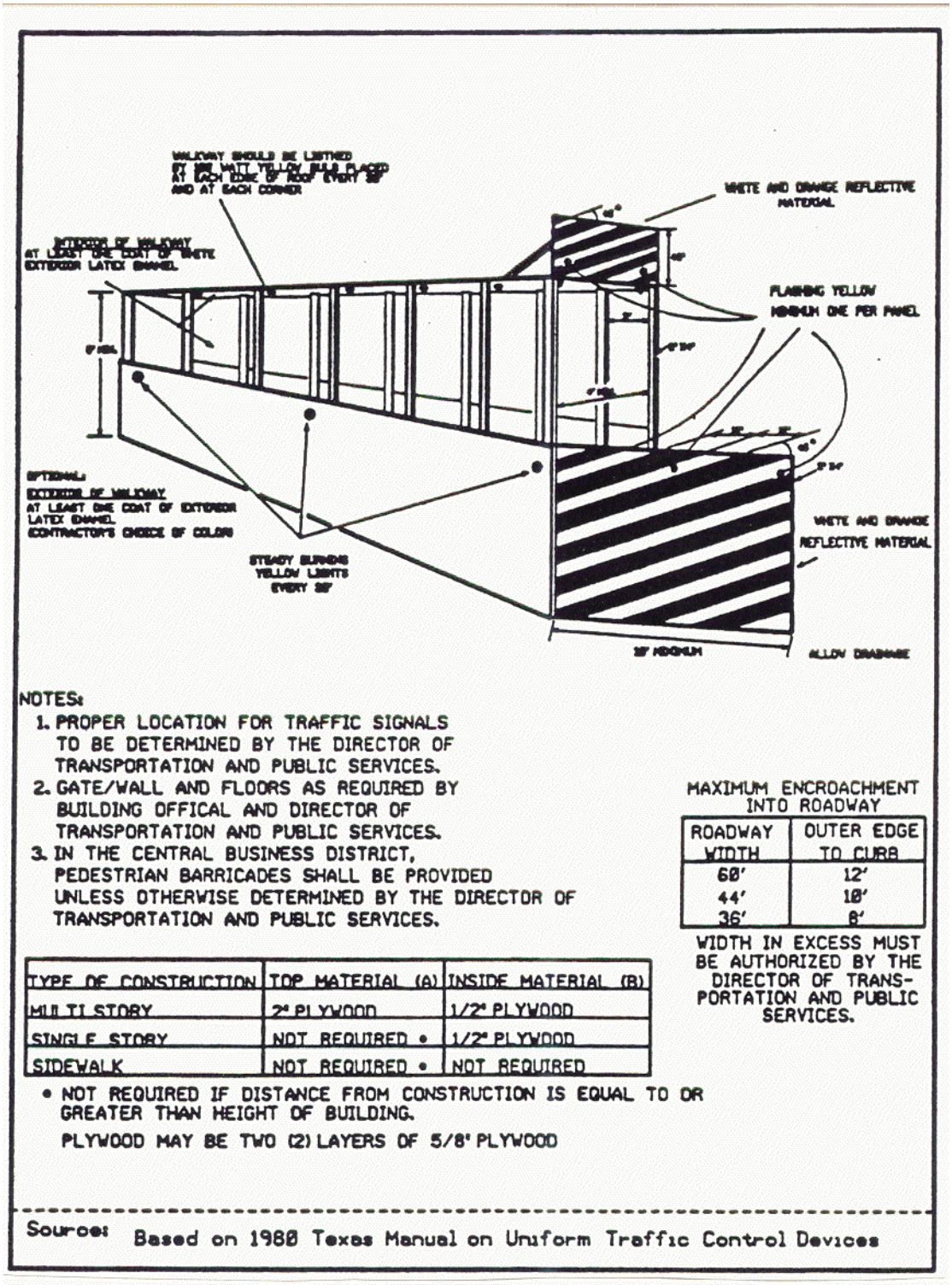


Figure 8-7 Barricading Details



* Warning lights (optional)
** Nominal lumber dimensions are satisfactory for barricade rail width dimensions.
*** Rail stripe widths shall be 150 mm (6 in), except that 100 mm (4 in) wide stripes may be used if rail lengths are less than 900 mm (36 in).
The sides of barricades facing traffic shall have retroreflective rail faces.

Figure 8-8 Construction Traffic Control for Pedestrians



NOTES:

1. PROPER LOCATION FOR TRAFFIC SIGNALS TO BE DETERMINED BY THE DIRECTOR OF TRANSPORTATION AND PUBLIC SERVICES.
2. GATE/WALL AND FLOORS AS REQUIRED BY BUILDING OFFICAL AND DIRECTOR OF TRANSPORTATION AND PUBLIC SERVICES.
3. IN THE CENTRAL BUSINESS DISTRICT, PEDESTRIAN BARRICADES SHALL BE PROVIDED UNLESS OTHERWISE DETERMINED BY THE DIRECTOR OF TRANSPORTATION AND PUBLIC SERVICES.

MAXIMUM ENCROACHMENT INTO ROADWAY

ROADWAY WIDTH	OUTER EDGE TO CURB
60'	12'
44'	10'
36'	8'

WIDTH IN EXCESS MUST BE AUTHORIZED BY THE DIRECTOR OF TRANSPORTATION AND PUBLIC SERVICES.

TYPE OF CONSTRUCTION	TOP MATERIAL (A)	INSIDE MATERIAL (B)
MULTI STORY	2" PLYWOOD	1/2" PLYWOOD
SINGLE STORY	NOT REQUIRED •	1/2" PLYWOOD
SIDEWALK	NOT REQUIRED •	NOT REQUIRED

• NOT REQUIRED IF DISTANCE FROM CONSTRUCTION IS EQUAL TO OR GREATER THAN HEIGHT OF BUILDING.

PLYWOOD MAY BE TWO (2) LAYERS OF 5/8" PLYWOOD

Source: Based on 1980 Texas Manual on Uniform Traffic Control Devices