CHAPTER 6M. OTHER TTC ZONE DESIGN FEATURES AND SAFETY DEVICES

Section 6M.01 General

Support:

01 Although certain devices and design features, such as lighting, barriers, dividers, crash cushions, and screens, are sometimes used in TTC zones to supplement traffic control devices or enhance traffic operations or safety for road users, they are not considered to be traffic control devices. The following Sections describe the most commonly used devices and design features. Section 1D.04 contains additional information about these devices and design features.

Section 6M.02 Positive Protection and Temporary Traffic Barriers

Support:

01 Temporary traffic barriers, including portable or movable barriers, are devices designed to help prevent penetration by vehicles while minimizing injuries to vehicle occupants, and to protect workers, bicyclists, and pedestrians.

Guidance:

02 *Except as otherwise required, at a minimum, longitudinal traffic barriers and/or other positive protection devices should be considered in work zone situations that place workers at increased risk from motorized traffic, and where positive protection devices offer the highest potential for improved safety for workers and road users.*

Support:

03 Considerations for positive protection include, but are not limited to, the following circumstances:

A. Work zones that provide workers no means of escape from motorized traffic such as tunnels or bridges;
B. Long-term stationary work zones of two weeks or more resulting in substantial worker exposure to motorized traffic;
C. Projects with anticipated operating speeds of 45 mph or greater, especially when combined with high traffic volumes;
D. Work operations that place workers, pedestrians, or bicyclists close to travel lanes open to traffic; and
E. Roadside hazards, such as drop-offs or unfinished bridge decks, that will remain in place overnight or longer.

04 Work zone setups vary depending on the nature of the positive protection used.

05 23 CFR Part 630.1108(a) contains additional requirements for certain projects.

Option:

06 Temporary traffic barriers may be used to separate two-way vehicular traffic.

Standard:

07 **Temporary traffic barriers shall be supplemented with standard delineation, pavement markings, or channelizing devices for improved daytime and nighttime visibility if they are used to channelize vehicular traffic. The delineation color shall match the applicable pavement marking color.**

08 **Temporary traffic barriers, including their end treatments, shall be crashworthy (see definition in Section 1C.02).**

09 **Short intermittent segments of temporary traffic barrier shall not be used because they nullify the containment and redirective capabilities of the temporary traffic barrier, increase the potential for serious injury both to vehicle occupants and pedestrians, and encourage the presence of blunt leading ends. Adjacent temporary traffic barrier segments shall be properly connected in order to provide the overall strength required for the temporary traffic barrier to perform properly.**

Option:

10 Steady-burn warning lights (see Section 6L.07) may be mounted on temporary traffic barrier installations.

10a Side reflectors or top mounted reflectors (facing the road user) may be used on temporary traffic barriers.

Guidance:

10b *If used, the spacing of these reflectors should not exceed a distance in feet equal to 1.0 times the speed limit in mph through the TTC zone.*

Support:

11 Temporary traffic barrier includes portable concrete, portable steel, or movable barrier which can all be moved laterally and/or longitudinally when needed and/or from site to site. More specific information on the use of temporary traffic barriers is contained in Chapters 8 and 9 of "Roadside Design Guide," 4th Edition, 2011, AASHTO.

12 More specific information on the use of portable barriers can be obtained from Caltrans' Standard Plans and Standard Specifications. Refer to Section 1A.05 for information regarding these publications.

Section 6M.03 Temporary Raised Islands

Standard:

01 **Temporary raised islands shall be used only in combination with pavement striping and other suitable channelizing devices.**

Option:

02 A temporary raised island may be used to separate vehicular traffic flows in two-lane, two-way operations on roadways having a vehicular traffic volume range of 4,000 to 15,000 average daily traffic (ADT) and on freeways having a vehicular traffic volume range of 22,000 ADT to 60,000 ADT.

03 Temporary raised islands also may be used in other than two-lane, two-way operations where physical separation of vehicular traffic from the TTC zone is not required.

Guidance:

04 *Temporary raised islands should have the basic dimensions of 4 inches high by at least 12 inches wide and have rounded or chamfered corners.*

05 *The temporary raised islands should not be designed in such a manner that they would cause a motorist to lose control of the vehicle if the vehicle inadvertently strikes the temporary raised island. If struck, pieces of the island should not be dislodged to the extent that they could penetrate the occupant compartment or involve other vehicles.*

Standard:

06 **At pedestrian crossing locations, temporary raised islands shall have an opening or be shortened to provide at least a 60-inch wide passageway for the crossing pedestrian.**

Section 6M.04 Detectable Edging for Pedestrians

Support:

01 Individual channelizing devices, tape or rope used to connect individual devices, other discontinuous barriers and devices, and pavement markings are not detectable by persons with vision disabilities and are incapable of providing detectable path guidance on temporary or realigned sidewalks or other pedestrian facilities.

Guidance:

02 *A continuously-detectable edging should be provided throughout the length of a temporary pedestrian facility such that it can be followed by pedestrians using long canes for guidance. This edging should extend at least 8 inches above the surface of the sidewalk or pathway, with the bottom of the edging a maximum of 2 inches above the surface. This edging should be continuous throughout the length of the facility except for gaps at locations where pedestrians or vehicles will be turning or crossing. This edging should consist of a prefabricated or formed-in-place curbing or other continuous device that is placed along the edge of the sidewalk or walkway. This edging should be firmly attached to the ground or to other devices. Adjacent sections of this edging should be interconnected such that the edging is not displaced by pedestrian or vehicular traffic or work operations, and such that it does not constitute a hazard to pedestrians, workers, or other road users.*

Support:

03 Examples of detectable edging for pedestrians include:

A. Prefabricated lightweight sections of plastic, metal, or other suitable materials that are interconnected and fixed in place to form a continuous edge.
B. Prefabricated lightweight sections of plastic, metal, or other suitable materials that are interconnected, fixed in place, and placed at ground level to provide a continuous connection between channelizing devices located at intervals along the edge of the sidewalk or walkway.
C. Sections of lumber interconnected and fixed in place to form a continuous edge.
D. Formed-in-place asphalt or concrete curb.
E. Prefabricated concrete curb sections that are interconnected and fixed in place to form a continuous edge.
F. Continuous temporary traffic barrier or longitudinal channelizing barricades placed along the edge of the sidewalk or walkway that provides a pedestrian edging at ground level.
G. Chain link or other fencing equipped with a continuous bottom rail.

Guidance:

04 Detectable pedestrian edging should be orange, white, or yellow and should match the color of the adjacent channelizing devices or traffic control devices, if any are present.

05 *If prefabricated edging is used to separate pedestrians and vehicular traffic, such edging should be certified as crashworthy (refer to Sections 6A.03-04). If section of lumber is used to form a railing system, any part of the railing that is more than 3 feet above pavement should be treated lumber and cause no harm to bare hand touching it.*

Section 6M.05 Crash Cushions

Support:

01 Crash cushions are systems that mitigate the effects of errant vehicles that strike obstacles, either by smoothly decelerating the vehicle to a stop when hit head-on, or by redirecting the errant vehicle. The two types of crash cushions that are used in TTC zones are stationary crash cushions and truck-mounted attenuators. Crash cushions in TTC zones help protect the drivers from the exposed ends of barriers, fixed objects, shadow vehicles, and other obstacles. Specific information on the use of crash cushions can be found in "Roadside Design Guide," 4th Edition, 2011, AASHTO.

Standard:

02 **Crash cushions shall be crashworthy (see definition in Section 1C.02). They shall also be designed for each application to stop or redirect errant vehicles under prescribed conditions. Crash cushions shall be periodically inspected to verify that they have not been hit or damaged. Damaged crash cushions shall be promptly repaired or replaced to maintain their crashworthiness.**

Support:

03 Stationary crash cushions are used in the same manner as permanent highway installations to protect drivers from the exposed ends of barriers, fixed objects, and other obstacles.

Standard:

04 **Stationary crash cushions shall be designed for the specific application intended.**

05 **Truck-mounted attenuators shall be energy-absorbing devices attached to the rear of shadow trailers or trucks and shall be used in accordance with the manufacturer's specifications. If used, the shadow vehicle with the attenuator shall be located in advance of the work area, workers, or equipment to reduce the severity of rear-end crashes from errant vehicles.**

Support:

06 Trucks or trailers are often used as shadow vehicles to protect workers or work equipment from errant vehicles. These shadow vehicles are normally equipped with flashing arrows, changeable message signs, and/or high-intensity rotating, flashing, oscillating, or strobe lights and are located properly in advance of the workers and/or equipment that they are protecting. However, these shadow vehicles might themselves cause injuries to occupants of the errant vehicles if they are not equipped with truck-mounted attenuators.

Guidance:

07 *The shadow truck should be positioned a sufficient distance in advance of the workers or equipment being protected so that there will be sufficient distance, but not so much so that errant vehicles will travel around the shadow truck and strike the protected workers and/or equipment.*

Support:

08 Chapter 9 of "Roadside Design Guide," 4th Edition, 2011, AASHTO contains additional information regarding the use of shadow vehicles.

09 Information about designs and types of crash cushions currently approved for use on State highways is available from Caltrans' Division of Traffic Operations in Sacramento.

10 More specific information on the use of crash cushions can be obtained from Caltrans' Standard Plans, Standard Specifications and Traffic Safety Systems Manual. Refer to Section 1A.05 for information regarding these publications.

Section 6M.06 Rumble Strips

Support:

01 Transverse rumble strips consist of intermittent, narrow, transverse areas of rough-textured or slightly-raised or depressed road surface that extend across the travel lanes to alert drivers to unusual vehicular traffic conditions. Through noise and vibration they attract the driver's attention to such features as unexpected changes in alignment and to conditions requiring a stop.

02 Longitudinal rumble strips consist of a series of rough-textured or slightly-raised or depressed road surfaces located along the shoulder to alert road users that they are leaving the travel lanes.

Option:

02a Portable transverse rumble strips may be used for flagging operations, as they are easy to set out, remove and/or relocate.

Standard:

03 **If it is desirable to use a color other than the color of the pavement for a longitudinal rumble strip, the color of the rumble strip shall be the same color as the longitudinal line the rumble strip supplements.**

04 **If the color of a transverse rumble strip used within a travel lane is not the color of the pavement, the color of the rumble strip shall be white, black, or orange.**

04a **The color of a portable transverse rumble strip used within a travel lane shall be black or orange.**

Support

04b The height of the portable transverse rumble strip shall be from 5/8 to 3/4 inch, including the height of adhesives, if used. The width of each portable transverse rumble strip shall not be less than 12 inches, nor more than 13 inches. Each portable transverse rumble strip shall be at least 10 feet long and shall have a minimum weight of 105 lbs.

Option:

05 Intervals between transverse rumble strips may be reduced as the distance to the approached conditions is diminished in order to convey an impression that a closure speed is too fast and/or that an action is imminent. A RUMBLE STRIPS (C45(CA)) sign warning drivers of the onset of rumble strips may be placed in advance of any transverse rumble strip installation.

Guidance:

06 *Transverse rumble strips should be placed transverse to vehicular traffic movement. They should not adversely affect overall pavement skid resistance under wet or dry conditions.*

07 *In urban areas, even though a closer spacing might be warranted, transverse rumble strips should be designed in a manner that does not promote unnecessary braking or erratic steering maneuvers by road users.*

08 *Transverse rumble strips should not be placed on sharp horizontal or vertical curves.*

09 *Rumble strips should not be placed through pedestrian crossings or on bicycle routes.*

10 *Transverse rumble strips should not be placed on roadways used by bicyclists unless a minimum clear path of 4 feet is provided at each edge of the roadway or on each paved shoulder.*

11 *Longitudinal rumble strips should not be placed on the shoulder of a roadway that is used by bicyclists unless a minimum clear path of 4 feet is also provided on the shoulder.*

12 *If used for flagging operation, 2 arrays (1 array is a single group or set) of portable transverse rumble strips should be placed transverse to the vehicular traffic movement in advance of and approach to each flagger station. Each array should consist of 3 rumble strips spaced no less than 6 feet and no more than 10 feet apart. The 1st array should be placed adjacent to the ONE LANE ROAD AHEAD (W20-4) sign and the 2nd array should be placed adjacent to the Flagger symbol W20-7 sign. Refer to Figure 6P-10.*

Standard:

13 **If portable transverse rumble strips are used for flagging operations, the RUMBLE STRIPS (C45(CA)) sign shall be placed half way between the ROAD WORK AHEAD (W20-1) sign and the ONE LANE ROAD AHEAD (W20-4) (refer to Figure 6P-10.**

14 **If the portable transverse rumble strips become out of alignment (skewed) by more than 6 inches, measured from one end to the other, they shall be readjusted to bring the placement back to the original location.**

Section 6M.07 Screens

Support:

01 Screens are used to block the road users' view of activities that can be distracting. Screens might improve safety and motor vehicle traffic flow where volumes approach the roadway capacity because they discourage gawking and reduce headlight glare from oncoming motor vehicle traffic.

Guidance:

02 *Screens should not be mounted where they could adversely restrict road user visibility and sight distance and adversely affect the operation of vehicles.*

Option:

03 Screens may be mounted on the top of temporary traffic barriers that separate two-way motor vehicle traffic.

03a Temporary traffic screen may be mounted on top of temporary traffic barriers, when barriers are used in transition and crossover areas for glare-control on high-volume roadways.

Guidance:

03b *If used, temporary traffic screen panels should be a minimum of 24 inches in height.*

04 *Design of screens should be in accordance with Chapter 9 of "Roadside Design Guide," 4th Edition, 2011, AASHTO.*

Section 6M.08 Lighting for Night Work

Support:

01 Utility, maintenance, or construction activities on highways are frequently conducted during nighttime periods when vehicular traffic volumes are lower. Large construction projects are sometimes operated on a double-shift basis requiring night work (see Section 6N.18).

Standard:

01a **Highway construction work lighting shall be as per Construction Safety Order 1523 (California Code of Regulations Title 8, Division 1, Chapter 4, Subchapter 4, Article 3, § 1523 - Illumination). See Section 1A.05 for information regarding this publication.**

Guidance:

02 *When nighttime work is being performed, floodlights should be used to illuminate the work area, equipment crossings, and other areas.*

03 *When used, floodlighting should be installed in a manner that minimizes glare to approaching road users, flaggers, or workers.*

04 *The adequacy of the floodlight placement and elimination of potential glare should be determined by driving through and observing the floodlighted area from each direction on all approaching roadways after the initial floodlight setup, at night, and periodically. Lighting should be sufficient so as to give road users the capability to identify a worker as a person. Care should be taken to minimize the potential for shadows to conceal workers within the work area.*

Support:

05 Desired illumination levels vary depending upon the nature of the task involved. An average horizontal luminance of ~~5 foot candles~~ 10-foot candles (108 lux) can be adequate for general activities. Tasks requiring high levels of precision and extreme care can require an average horizontal luminance of 20 foot candles.

Standard:

06 **Except in emergency situations, flagger stations shall be illuminated at night.**