Guidance on Pedestrian Treatments for Rail Crossings

Updated 7/08/2025

Rail Crossings and Engineering Branch
Rail Safety Division
California Public Utilities Commission

Contents

INTRODUCTION

The California Public Utilities Commission (CPUC/Commission) is the state agency that regulates the safety of all rail crossings in California. Section 1202 of the Public Utilities Code grants the CPUC the exclusive power to determine and prescribe the manner, including the particular point of crossing and the terms of installation, operation, maintenance, use, and protection of each crossing. CPUC authorization is required to construct or modify a rail crossing.

The Commission initially published a document about pedestrian-rail crossings in 2008. Since then, best practices for pedestrian safety treatments have been extensively developed and widely implemented at many at-grade rail crossings (crossings) in California. CPUC staff recommends safety treatments such as those described in this guidance as part of crossing modifications and new construction in the interest of promoting uniform safety design practices.

DISCLAIMER

CPUC assumes no liability for the use of information contained in this document. This document is meant to provide general guidance and cover existing design principles.

Suggestions and corrections regarding this document can be submitted to rceb@cpuc.ca.gov .

LIST OF ACRONYMS

The following is a list of some of the terms and abbreviations used throughout this document. Refer to the Glossary for further information.

CPUC/Commission	California Public Utilities Commission
Caltrans	California Department of Transportation
FRA	Federal Railroad Administration
LRT	Light Rail Transit
ADA	Americans with Disabilities Act
FHWA	Federal Highway Administration
GO	CPUC General Order
DIB	Caltrans Design Information Bulletin

1. PRIMARY CONSIDERATIONS

Primary considerations for addressing pedestrian safety at crossings include accessibility laws and regulations, channelization and pedestrian automatic gates, geometrics, and other pedestrian safety factors.

1.1. Accessibility Laws and Regulations

Consistent with current guidelines and regulations at both the state and federal level, if pedestrian traffic is expected, a pedestrian access route should be provided to allow all pedestrians, including pedestrians with disabilities, to safely traverse the crossing.

For California, state accessibility information is available from the following: Caltrans Design Information Bulletin (DIB) 82-06, *Pedestrian Accessibility Guidelines for Highway Projects* [(1)]. This is the primary reference regarding accessibility requirements on State Highways in California.

Federal accessibility guidelines and regulations are published by the U.S. Access Board.

Local jurisdictions and other entities covered by the federal Americans with Disabilities Act (ADA)[(2)] must ensure that the facilities they build or alter are accessible to people with disabilities. The U.S. Access Board's ADA accessibility guidelines specify the minimum level of accessibility in new construction and alteration projects and serve as the basis for enforceable standards maintained by other agencies.

In August 2023, the Access Board issued its final rule that provides minimum guidelines for the accessibility of pedestrian facilities in the public right-of-way. The Public Right-of-Way Accessibility Guidelines (PROWAG)[(3)] address certain features common to public sidewalks, such as curb ramps, accessible routes, ground and floor surfaces, crosswalks, bus stops and shelters. The U.S. Access Board's aim is to ensure that agencies provide access for persons with disabilities wherever the agencies install or alter a new pathway and that the same degree of convenience, connection, and safety afforded to the public generally is available to individuals with disabilities. PROWAG[(3)] does not require alterations to existing public rights-of-way but applies when agencies alter a pedestrian route or facility as part of a planned project to improve existing public rights-of-way.

1.2. Gates and Channelization

1.2.1. Pedestrian Automatic Gates with Channelization

The most effective configuration of warning devices to address pedestrian compliance includes pedestrian automatic gates with flashing light signals in combination with emergency egress swing gates and channelization. In 2010, the *North Lane Pedestrian Safety Study* [(4)] was completed to assess pedestrian compliance at a crossing in Burlingame, California. The study findings demonstrated the effectiveness of fencing and channelization in conjunction with pedestrian automatic gates and emergency egress swing gates.

During the approach of a train, this configuration:

- Provides clear visibility of warning devices along each pedestrian approach.
- Provides a continuous physical barrier between pedestrians and an approaching train.
- Allows pedestrians to exit the crossing area during the approach of a train through the emergency egress swing gates.

When a train is not approaching the crossing, this configuration:

- Allows for free movement of pedestrians through the crossing area.
- Channelizes pedestrians in a manner where they will be able to clearly observe any warning devices.

1.2.2. Alternative Configurations of Gates and Channelization for Locations with Geometric Constraints

At locations where physical constraints do not allow for the installation of pedestrian automatic gates, alternative configurations have been used that meet some of the same needs.

For example, at station platforms where space is limited, a continuous row of entry swing gates has sometimes been extended across the entire approach to the tracks, in combination with flashing light signal assemblies and fencing or channelization. Disadvantages to this configuration include concerns that pedestrians in wheelchairs must open and then maneuver around the entry swing gates, and that the crossing user can open the entry swing gate to enter the crossing at any time.

As another example, a vehicular automatic gate arm has sometimes been placed across both the sidewalk and the vehicular lanes. While this can help discourage pedestrians from entering the crossing, there are potential safety concerns for pedestrians that need to exit the crossing. The vehicular automatic gate arm can obstruct any pedestrians that were unable to exit the crossing prior to the arm descending. Therefore, an emergency egress route must be provided to allow pedestrians to exit the crossing.

The use of pedestrian automatic gates in combination with emergency egress swing gates and channelization provides greater overall benefits than other configurations such as a continuous row of entry swing gates or a vehicular automatic gate arm extending across the sidewalk. Although the alternative configurations mentioned above provide a physical barrier between pedestrians and an approaching train, they are less effective in deterring violations of activated warning devices. The use of pedestrian automatic gates allows an unobstructed normal pedestrian route when trains are not approaching the crossing.

1.3. Geometric Design Considerations

1.3.1. Crossing Angle and Alignment

The angle between the pathway or sidewalk and track is a critical element in the design of crossings. A perpendicular angle is ideal to allow pedestrians to better identify an approaching train and provides the shortest distance across the tracks. A narrow angle may significantly increase the distance and time required for a person to cross the tracks.

However, at some crossings it may not be practical to achieve a perpendicular angle due to other geometric constraints. In such cases, an angle between 60 and 90 degrees can minimize[5] the potential for wheelchairs or strollers to get stuck in the gaps between the rail and the crossing surface.

1.3.2. Slope and Vertical Profile

On approaches to the tracks, where feasible, running slopes should be limited to 1:20 (5%) and cross slopes should be limited to 1:50 (2%). A level area should be included where a wheelchair can stop in advance of the tracks. In some cases, these slopes can be difficult to obtain where tracks are higher than the sidewalk approaches. Consider providing ramps or landings where slopes are greater than 5%. Through the crossing, where feasible, provide a smooth and planar vertical alignment. This may be a special design consideration at crossings with multiple tracks. Caltrans provides guidelines in its Pedestrian Accessibility Guidelines for Highway Projects[1], 4.3.7 Ramps (DIB 82-06). Additional details are included in the PROWAG[3].

Figure 1.3.1 – Example of Approach Slope and Landing

1.3.3. Clear Width

Along a sidewalk or other pedestrian access route, a continuous and unobstructed width must be provided. This is typically referred to as clear width. Railings, channelization, or other obstructions should not reduce the minimum horizontal width or impede pedestrian movement. The following requirements are stated in *PROWAG*[3] related to clear width:

- Except as provided in R302.2.1 and R302.2.2, the continuous clear width of *pedestrian access routes* shall be 48 inches (1220 mm) minimum, exclusive of the width of any *curb*.
- Where the clear width of *pedestrian access routes* is less than 60 inches (1525 mm), passing spaces shall be provided at intervals of 200 feet (61 m) maximum. Passing spaces shall be 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum. Passing spaces and *pedestrian access routes* are permitted to overlap.

Additional clear width above the minimum requirements should be considered based on site-specific conditions.

1.3.4. Emergency Egress Route

Where vehicular or pedestrian automatic gate arms extend across a pedestrian approach, a pedestrian emergency egress route should be provided to allow a pedestrian to exit the crossing during the approach of a train. When the gate arm is activated and counterweights are extended, the emergency egress route should continue to allow for pedestrians to exit the crossing. Careful placement and channelization of the emergency egress route may help to discourage pedestrians from using it as a pedestrian approach to the crossing.

1.3.5. Continuous Sidewalk Segments

Sidewalks should provide a continuous path through the crossing and connect to a normal pedestrian route. Construction or extension of a sidewalk through a crossing, along with associated pedestrian treatments, should be considered where there is observed pedestrian activity, pedestrian generators, or pedestrian destinations nearby. Discontinuous sidewalk segments at a track may present a potential for tripping or falling or may result in pedestrians walking in the roadway. Where a continuous path is not available and cannot be provided, pedestrians should be redirected to an alternate route using barricades and appropriate wayfinding signage. Redirection of the pedestrians should take place well in advance of the crossing, at the nearest crosswalk where pedestrians can safely access the alternate route.

1.4. Pedestrian Safety Evaluation Factors

Many factors should be considered when selecting warning devices and the overall configuration of a crossing. When evaluating pedestrian safety, these considerations include pedestrian use, number of tracks, train operations, and clearing sight distance.

1.4.1. Pedestrian Use

Crossings should be designed to accommodate the type of pedestrian use expected. Consider potential safety impacts of major pedestrian generators or destinations near the crossing, such as: train stations, bus stops, schools, hospitals, senior centers, retail/commercial centers, event centers, and business districts.

Additional factors for consideration are observed behavior such as trespassing, circumventing warning devices, or periodic surges in pedestrian volumes, along with the history of previous incidents at the crossing.

1.4.2. Number of Tracks and Train Operations

The number of tracks and train operations should be considered when designing pedestrian treatments at crossings. Where multiple tracks are present, trains approaching on one of the tracks can impair visibility of an approaching train on another track. This should be a fundamental consideration in combination with any evaluation of sight distance.

Rail corridors with multiple tracks and a mixture of different train services (e.g., slow moving freight railroad, high speed commuter railroad, frequent light rail transit) place pedestrians in challenging situations. Where multiple tracks are present, pedestrians may not be expecting trains to approach on different tracks. The varying train operations make it difficult for pedestrians to establish accurate expectations about train operations.

Crossings near stations present additional concerns. Pedestrians focused on catching a train stopped at the station or transferring to another mode of transportation may be distracted and not aware of trains approaching on another track. Some trains may continue through stations at speed when pedestrians expect the train to be moving slowly or to stop at the station near the crossing.

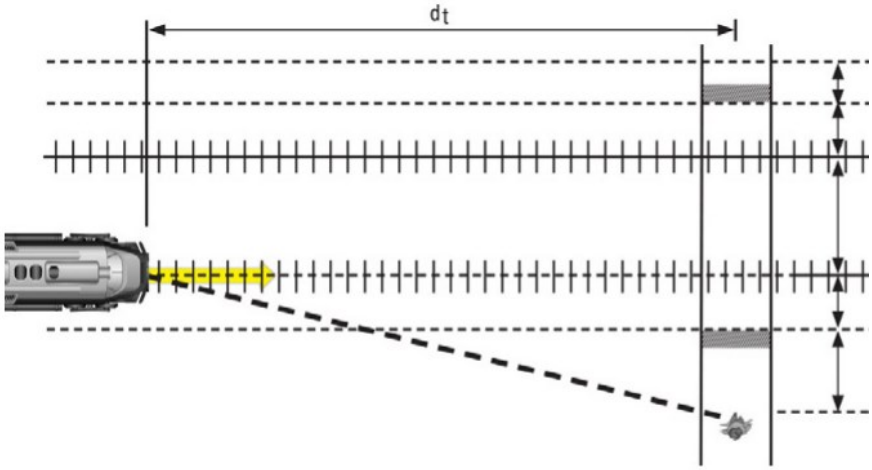
Crossings within a Quiet Zone add further concerns. Approaching trains do not usually sound their horns and pedestrians may not be able to identify the direction of an approaching train.

1.4.3. Clearing Sight Distance

The Clearing Sight Distance for pedestrians is the unobstructed distance along the track that a pedestrian must be able to see, in both directions along the track, to identify an approaching train to decide if it is safe to proceed through the crossing. The unobstructed distance depends on train speed, number of tracks, perception-reaction time, and walking speed of the pedestrian. Along a pedestrian approach, if the available sight distance is insufficient, then it should be improved by removing or reducing sight obstructions, such as trimming vegetation or reducing fence/wall heights. Additionally, if a train activated warning device is not present and the sight distance cannot be further improved, then considerations should be made to install a train activated warning device. Typically, each pedestrian approach at a crossing should be provided with a similar set of pedestrian safety treatments to provide consistent expectations. Alternative considerations may include prohibition of pedestrians at the crossing or construction of a grade separated crossing.

The Clearing Sight Distance calculation for pedestrians is similar to the calculation used for vehicles but requires different assumptions specific to pedestrians. Refer to *FHWA Handbook*[6], Appendix C, Table C-2 for example sight distances, and Figure C-6 for illustrating the pedestrian sight distance triangle, see Figure 1.4.1.

Figure 1.4.1 - Pedestrian Sight Distance Triangle



Source: FHWA Highway-Rail Crossing Handbook[6], Third Edition, Figure C-6.

Table C-2 of the FHWA Highway-Rail Crossing Handbook[6] reference makes specific assumptions for walking speed, number of tracks, distance between tracks, perception-reaction time, distance prior to the first track, and distance beyond the furthest track. The distances stated in the table should be considered minimum distances for the specific set of assumptions. These factors should be adjusted for analysis of a specific location. The needed Clearing Sight Distance will be greater when the maximum authorized train speed is higher. For example, the table identifies a distance of 180 feet needed for a 10 miles per hour (MPH) train speed, increasing up to 1,585 feet for a 90 MPH train speed. It should be noted that crossing users cannot be expected to reliably judge the precise approach speed of a train. Clearing Sight Distance is one of several factors that must be considered when evaluating the safety of a rail crossing.

1.5. New or Experimental Devices

The California Manual on Uniform Traffic Control Devices (CA MUTCD) is the standard for all official traffic control devices in California. Local roadway agencies may propose experimentation projects to evaluate proposed crossing warning devices, new technology, or other additional safety measures at designated crossings. However, traffic control devices installed at a highway-rail crossing require authorization by the CPUC. An agency must request and receive approval from the California Traffic Control Devices Committee and Federal Highway Administration prior to installation of experimental traffic control devices.

1.6. Grade-Separated Rail Crossings

A grade-separated rail crossing allows pedestrians to cross the tracks at a different level than the track by walking across an overhead structure or through an underpass. ADA[2] accessibility of such rail crossings can be achieved by using ramps or elevators.

Channelization such as rail right-of-way fencing must be used to guide pedestrians toward the grade-separated rail crossing and to discourage pedestrians from crossing the tracks at grade.

For additional information, refer to the AASHTO "Guide for the Planning, Design, and Operation of Pedestrian Facilities" [7].

Underpass Considerations:

- Vertical clearance above pathway: The vertical clearance to obstructions above the pathway should be approximately 10 feet where practical. Where less vertical clearance is necessary, it must provide at least 8 feet above the pathway. See the Caltrans Highway Design Manual[8] Section 1003.1(3).
- Width: A tunnel width of 15 feet wide may help to invite use by all pedestrians while giving people a feeling of security when passing one another. The minimum inside clear width of a pedestrian tunnel should be 10 feet.
- Lighting: Adequate lighting should be included to provide for the security and safety of pedestrians and bicyclists.
- Drainage: Adequate drainage should be provided at and around the underpass.

Overhead Considerations:

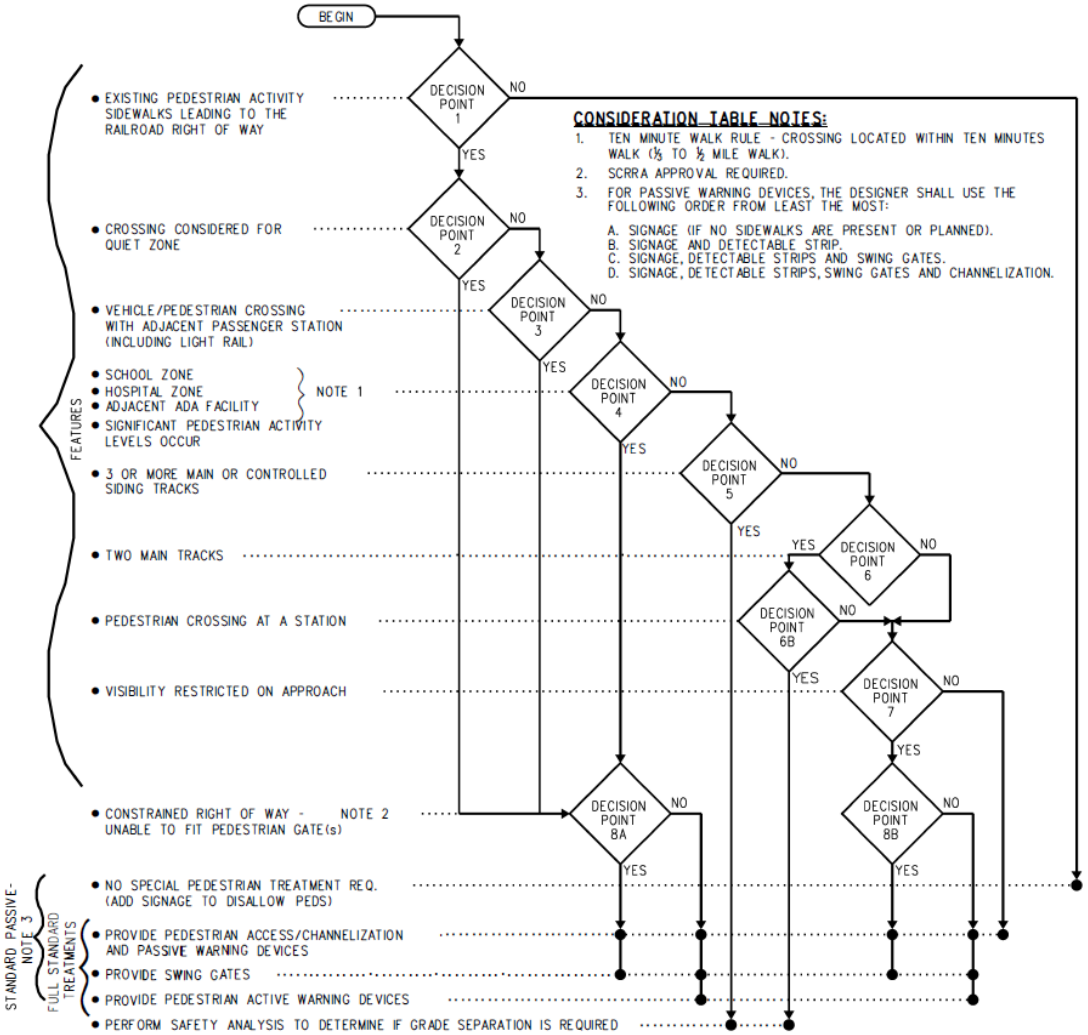
- Vertical clearance above track: The minimum vertical clearance above railroad tracks is 22-feet 6-inches or more, as discussed in CPUC GO 26-D[9]. Greater vertical clearance is typically required by railroads. To provide the necessary vertical clearance above the tracks, a pedestrian overhead structure may require longer ramps than a pedestrian underpass.
- Width: The minimum inside clear width on a pedestrian bridge should be 10 feet.
- Column placement: Pier protection walls are typically required by railroads where columns are placed within 25 feet of tracks.

2. OVERVIEW OF DESIGN ELEMENTS

A wide variety of design elements exist that can provide pedestrian safety improvements. Below are examples of design elements that are in use in California. The need for and location of these design elements is typically based on considerations discussed in Section 1. The use and placement of each design element may vary depending on the considerations at a particular location. Some of the design considerations are discussed in this section.

There may be additional considerations based on location-specific conditions. A design consideration flowchart such as *Metrolink Standard 4004*[10] is useful in guiding the selection of pedestrian safety design elements.

Figure 2.0.1 –Example of a Pedestrian-Rail Grade Crossing Design Consideration Flowchart



Source: Metrolink Engineering Standards[10] (ES) 4004 - Pedestrian Crossing Design Consideration Table, as updated 10/02/2018

2.1. Surfaces and Markings

2.1.1. Crossing Surface

The crossing surface should provide a smooth transition over the track and be free of holes and unnecessary gaps along the normal pedestrian route. The crossing surface should be level and flush with the top of the rail. Concrete crossing panels are typically used between the rails and extend approximately two feet outside the rails for new constructions. Other materials such as asphalt concrete may also be used.

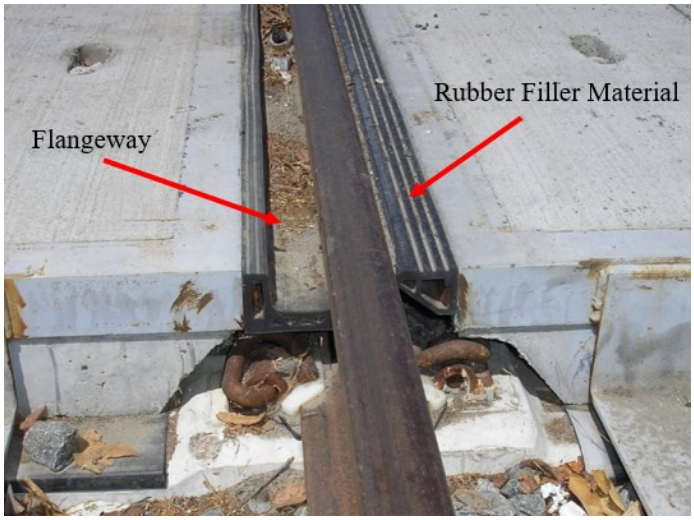
Specific treatments to provide a smooth crossing surface vary depending on the type of crossing surface material. For pre-cast concrete crossing panels, a rubber filler material is typically pre-attached to the panel adjacent to each side of the rail. Lifting holes in the crossing panels can be filled with sand and covered with grout. At the outer edges of the normal pedestrian route, asphalt can be used to provide a transition between the level of the sidewalk and the level of railroad ties. This can help to avoid a drop-off at the end of the concrete panels. A 2-foot strip of asphalt can be used as a transitional material between the pre-cast concrete panel and the concrete sidewalk approach to allow a smooth surface to be more easily maintained.

The flangeway gap is the space between the inner edge of a rail and the crossing surface where the train wheels pass. Flangeway filler material is recommended where feasible, and where there is pedestrian, wheelchair, or cyclist use, particularly where the tracks are at a skew angle. Most materials reduce the horizontal and vertical gap to that necessary for a wheel flange. PROWAG[3] Section R302.6.4.2 provides regulations on flangeway gaps. Limiting the width of that gap, to the extent practical, reduces the potential for crossing users to trip or get lodged in the gap when using canes or narrow wheels of wheelchairs, bicycles, or strollers.

Any gap between the outer edge of the rail and the concrete panels should be reduced or eliminated. Filler material can be used to eliminate or minimize these gaps as shown in the Figure 2.1.1.

Sidewalk width and surface should be ADA[2] compliant with uniform width through the crossing. See Section 1.3 for clear width guidance.

Figure 2.1.1 - Flangeway Gap With Rubber Inserts Side Profile



2.1.2. Detectable Warning Surfaces

Detectable warning surfaces used at pedestrian crossings provide both visual and tactile indication to visually impaired pedestrians that they are entering or exiting an area where additional caution is required such as vehicular lanes, the edge of rail platforms, or railroad tracks. Detectable warning surfaces are used at pathway grade crossings where pedestrian travel is permitted and at sidewalk grade crossings and extend across the full width of the pathway or sidewalk. At rail crossings, detectable warning surfaces warn the pedestrians of tracks in the pedestrian pathway ahead and indicate a safe stopping point where pedestrians can stand clear of approaching trains.

The physical surface consists of raised truncated domes aligned in a grid pattern consistent with PROWAG[3]. The color of the surface must contrast visually with adjacent walking surfaces, either light-on-dark or dark-on-light. A yellow detectable warning surface typically provides the necessary contrast on both asphalt and portland cement concrete.

Detectable warning surfaces extend at least 2 feet in the direction of pedestrian travel and across the full width of the pedestrian approach (see Figure 2.1.1). The edge of the detectable warning surface nearest the rail crossing must be located at least 2 feet in front of the train-activated warning device (if present), and at least 12 feet from the nearest rail. For additional specifications such as color and contrast detail, see PROWAG[3] R305.

At crossings with only LRT operation, if there is no warning device along the approach, the closest edge of the detectable warning surfaces may be located less than 12 feet from the nearest rail. At LRT stations, the distance may be reduced based on the dimensions of the LRT vehicles, requirements of the transit agency, and the clearance requirements in CPUC GO 143-B[9].

In relation to both entry and emergency egress swing gates, the detectable warning surfaces are placed in front of the swing gates. Detectable warning surfaces should not be placed between the swing gates and the tracks.

Figure 2.1.1 - Detectable Warning Surface

2.1.3. Pedestrian Pavement Markings

Pedestrian pavement markings are provided on the surface of the sidewalk or pathway to provide pedestrians visual warning or guidance. Markings for pedestrians should be routinely maintained to provide both long-lasting slip/skid resistance and high legibility.

Pedestrian pavement markings include stop lines, pedestrian warning markings, and pathway edge lines. Stop lines identify the point where a pathway user such as a bicycle must stop during the approach of a train, while pedestrian warning markings warn pedestrians to look for trains before entering the crossing. Pathway edge lines guide a user to follow the pedestrian access route through the crossing.

Stop Line

At sidewalk crossings and station crossings, stop lines should be incorporated into and made part of the detectable warning surface. At a pathway grade crossing where there are higher speeds of pathway users, such as bicyclists or skaters, a stop line should be provided. The stop line can be incorporated into the detectable warning by using a detectable warning surface that is a white color, maintains sufficient contrast with the pavement or concrete, be a transverse line that extends across the full width of the pathway, and extends 24 inches in the direction of travel.

Pedestrian Warning Markings

Pedestrian warning markings are markings on the pavement that provide warning messages visible to pedestrians approaching the tracks. There are currently no regulatory standards specifically for pedestrian warning markings. At sidewalk and pathway crossings which are not used by bicyclists and skaters, pedestrian warning markings are typically preferred in place of the stop line. In this case, the warning markings would be considered to act as the stop line.

If used, a yellow color background is recommended to indicate a warning message. The yellow color associates the marking with the most common color of detectable warning.

A warning message stating "LOOK" can be used to warn pedestrians that they should look out for approaching trains before crossing the tracks. The text should be supplemented by left and right arrows to communicate that the pedestrian should look along the tracks both to the left and to the right (see Figure 2.1.2). The LOOK message is consistent with the text of the R15-8 sign. If the width is much wider than the LOOK text and arrows, the message can be repeated at regular intervals across the entire width as shown in Figure 2.1.3.

Figure 2.1.2 – "LOOK" warning marking

Figure 2.1.3 – "LOOK" warning marking for wide approaches

The pedestrian warning markings should be installed as a contrasting line or rectangle extending across the approach and matching the width of the detectable warning surface along the normal pedestrian route. The pedestrian warning markings should have a yellow background and black text. Additional black pavement markings can be used in combination with light-colored pavement markings to enhance the contrast with a light-colored pavement. The legends, including letters, arrows, and any accompanying symbols, should be simple and clear. The size and spacing of letters and symbols are also critical to marking legibility.

The pedestrian warning markings should extend at least 8 inches in the direction of travel. Lettering should be all capital text at least 5 inches tall. The pavement markings should be placed just in advance of the detectable warning surface. If such placement would not be effectively seen by approaching pedestrians due to geometric constraints, then placement may be considered closer to the track.

Pathway Edge Lines

A conspicuous roadway edge line (or marked curb extension) through the track area assists motorists in recognizing and following the vehicular travel lane. The roadway edge line assists motorists in avoiding accidental turns toward the sidewalk or railroad right-of-way.

The roadway edge line should be white on the right side of the vehicular approach. The roadway edge line can be supplemented by raised pavement markers (RPM) that match the color of the roadway edge line it is supplementing. Reflective RPM's provide better visibility than non-reflective RPM's in dark conditions. Refer to Part 3 of the CA MUTCD[(11)].

Similarly, pathway edge lines through the track area should be used to assist pedestrians in recognizing and following the designated pathway. Where space allows, the roadway edge line should be separate from the pathway edge line through the track area. The pathway edge lines are typically white and used to identify both the normal pedestrian route extending across the tracks and the route to the Emergency Egress Swing Gate, if present. Pathway edge lines can be beneficial where the distance across the tracks is long, due to a skewed grade crossing or multiple tracks. Refer to Part 8 of the CA MUTCD [(11)].

The pathway edge lines should be continuously striped through the track area including the crossing surface (see Figure 2.1.4). The pathway through the track area and the transition to the emergency egress route should be paved and free of gaps or tripping hazards.

Figure 2.1.4 – Examples of Striping Through Track Area

Consider using black pavement marking outlines in combination with light-colored pavement markings to enhance the contrast with a light-colored pavement. Refer to Chapter 3A of the CA MUTCD[11] for additional information on pavement marking colors.

If the crossing is within an intersection identified within a school route, the crosswalk markings through the crossing may be striped in yellow to match the intersection crosswalk. Refer to Chapter 7C of the CA MUTCD[11] for additional information on crosswalk markings (see Figure 2.1.5).

Figure 2.1.5 – Crosswalk markings through track area

Pathway edge lines, similar to a crosswalk, are a minimum of 12 inches wide. Where the pathway is immediately adjacent to the roadway, there may be a single white edge line used between the pathway and the roadway. Where there is a wide shoulder area between the roadway edge line and the pedestrian pathway, consider using diagonal markings with lines at least 8 inches wide to discourage vehicular travel within that area (see Figure 2.1.5). Refer to Section 3B.24 of the CA MUTCD[11] for additional information on diagonal markings.

Figure 2.1.5 – Diagonal markings separating vehicular way from pedestrian path

2.1.4. Tactile Directional Indicators

Tactile Directional Indicators (TDI), which are distinct from detectable warning surfaces, may be used to convey wayfinding information to pedestrians with vision impairments. This wayfinding information can provide orientation clues to identify the pedestrian access route across the tracks. This treatment is used at some station platforms to identify the location of accessible routes across the tracks (see Figure 2.1.6). Tactile directional indicators, if used, are typically placed along the center of a pedestrian access route. For additional information refer to TCRP Research Report 248[13]: "Tactile Wayfinding in Transportation Settings for Travelers Who Are Blind or Visually Impaired".

Tactile directional indicators should not be used to delineate the edge of a sidewalk or pathway. This treatment is not typically used on sidewalks due to the potential for confusion with a roadway edge. If a person navigates along a tactile directional indicator that is immediately adjacent to a vehicular lane, it may increase the potential for conflicts between pedestrians and vehicles.

Figure 2.1.6 - Detectable Directional Surface

2.2. Signage

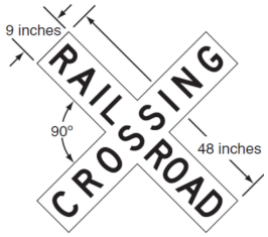
2.2.1. Commission Standard Signs

The CA MUTCD[11] and Commission GO 75-D[9] (as amended) specify standard warning signage for use at pedestrian at-grade crossings.

Crossings along a pathway exclusively used for pedestrians and/or bicycles must post the Commission Standard 1-D "Pedestrian and Bicycle Only" Crossing sign found in GO 75-D[9] (see Figure 2.2.1). Along a sidewalk, the Commission Standard 1-D pedestrian crossing sign is omitted.

Pedestrian crossings with GO 75-D[9] Standard train-activated warning device assemblies must include the Crossbuck sign (R15-1) (see Figure 2.2.1). A Crossbuck sign is not required at pedestrian pathway crossings not equipped with train-activated warning devices (passive crossing).

Figure 2.2.1 - Crossbuck (R15-1) and Commission Standard 1-D signs



Crossbuck Sign (R15-1)

Commission Standard 1-D Sign

Figure 2.2.2 - Commission Standard 1-D Sign Placement Below Flashing Light Signals

2.2.2. CA MUTCD Standard Signs

CA MUTCD[11] also includes the following standard signs generally intended for pedestrians.

Signs or symbols on swing gates and intended for pedestrian information should be appropriately sized for pedestrian usage and visibility. Some signs (e.g. R15-8, W10-9) are available for either vehicular or pedestrian use. The smaller sign dimensions provided in CA MUTCD[11] Part 9 are typically better for pedestrian and bicycle facilities. The larger dimensions of vehicular signage, when placed along a sidewalk or pathway, may reduce visibility of other signs or warning devices.

The LOOK (R15-8) sign is used for warning pedestrians to look both ways for trains when on approach to and entering the crossing.

The Light Rail Transit (Trolley) Crossing / LOOK BOTH WAYS (W82-1(CA)) sign, is a warning sign for light rail crossings. In common practice, the sign is mounted on swing gates facing pedestrians at light rail station crossings, or at other conspicuous locations to warn crossing users to look both ways for LRT vehicles.

The Skewed Crossing (W10-12) sign is the standard sign used to warn that the tracks are not perpendicular to the pathway or sidewalk, which may be valuable information for bicyclists and pedestrians in wheelchairs or with carts/strollers (see Figure 2.2.3).

Figure 2.2.3 - CA MUTCD Standard Signs

R15-8 *W82-1(CA)* *W10-12*

See Part 8 of CA MUTCD[11] for additional details.

The Emergency Notification System (I13-1) sign (see Figure 2.2.4) must be installed on each approach at all highway-rail grade crossings, and at all highway-LRT grade crossings, to provide information to road users so that they can notify the railroad company or transit agency about emergencies or malfunctioning traffic control devices.

To provide visibility for both vehicles and pedestrians in a variety of situations, ENS signs, for typical installations, should:

- Be placed on a warning device mast along the right side of each roadway approach to the track.
- Be oriented to face the same direction as other signs on the warning device mast.

Consider placement of ENS signs for pedestrians along each pedestrian approach to maintain conspicuity of signs.

Figure 2.2.4 - Emergency Notification System Sign

2.2.3. National MUTCD Standard Train Activated Another Train Coming Sign

The national MUTCD[12] of the Federal Highway Administration includes the train activated W10-16 blank out sign as an option to provide notification of an incoming second train at crossings where multiple tracks are present (Refer to National MUTCD[12]), section 8B.18 of for further guidance).

Figure 2.2.5 – W10-16 ANOTHER TRAIN COMING sign

2.3. Fencing and Other Channelization

Pedestrians should be channelized to cross the tracks at a designated crossing. Channelization may include fencing, railings, walls, landscaping, or other treatments. Landscaping alone typically does not provide effective channelization. When used along the approach, railing (or fencing), is typically placed on the edge(s) of the pedestrian sidewalk or pathway. Along the rail right-of-way, channelization should be used to prevent trespassing.

Considerations include type of fencing, fence height, surface treatments, vegetation, placement along approaches, and placement along the rail right-of-way.

Local pedestrian destinations and travel patterns should be considered when selecting the placement, length and height of fencing or other channelization at specific crossing locations.

2.3.1. Approach Channelization

The purpose of approach channelization is to deter pedestrians from deviating from the normal pedestrian route along the approach to the crossing. Fencing, railing, or other types of channelization can be used to guide pedestrians along the normal pedestrian route. Approach channelization minimizes the likelihood of

pedestrians circumventing gates or bypassing other safety treatments at the crossing. Channelization, when used with pedestrian automatic gates, typically extends 15 feet along the curb in advance of the detectable warning surface. At skewed crossings where the crossing is offset from the roadway and provides a slightly longer path to cross the tracks, consideration should be made to extend the channelization further to deter pedestrians from using the roadway as the pedestrian gets to the crossing (see Figure 2.3.1).

Figure 2.3.1 – Extended channelization at a skewed crossing

In designing channelization along each sidewalk approach to the crossing, the following should be considered:

- Placement of railing along the curb.
- Placement of railing, fencing, walls, or other channelization along the back of sidewalk.
- Ensure fencing or other channelization are low height in the immediate vicinity of the crossing.
- Surface treatments to discourage walking outside the normal pedestrian route.
- Emergency Egress Swing Gates adjacent to any pedestrian automatic gates.
- Additional channelization for crossings offset from roadway.

2.3.2. Discontinuous sidewalk segments

Where sidewalk is discontinued at or near a crossing, approach channelization and signage should be provided to guide pedestrians toward the designated pedestrian route across the tracks. The signage should be placed not only at the crossing but at the intersection upstream from the crossing to provide advance warning that there is no pedestrian crossing up ahead.

At locations where a sidewalk cannot be provided on both sides of the roadway, local agencies should place pedestrian barricades and signage directing pedestrians to the designated pedestrian route. Typically, a pedestrian barricade includes signage such as the R9-3 No Pedestrians Symbol sign or the R49(CA) "NO PED CROSSING - USE CROSSWALK" sign. See Caltrans Standard Plan ES-7Q for recommended

pedestrian barricade specifications. The most common type of pipe rail configuration for pedestrian barricades is the Caltrans Type I (See Figures 2.3.2 to 2.3.6). Other types of fencing or channelization may be used in place of pedestrian barricades.

Figure 2.3.2 – Example of Pedestrian Barricade

Figure 2.3.3 – Pedestrian Barricade Drawing

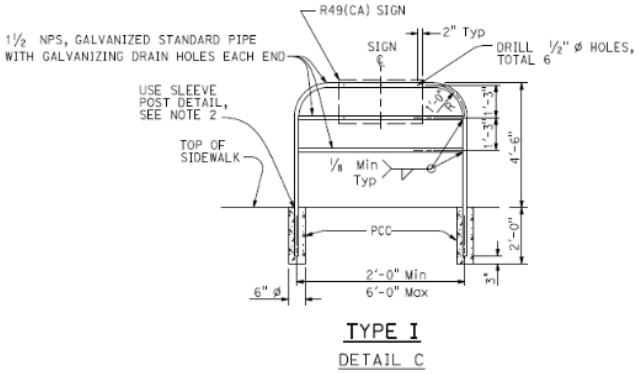


Figure 2.3.4 - No Pedestrian Crossing Sign – R9-3

Figure 2.3.5 - NO PED CROSSING -USE CROSSWALK Sign – R49(CA)

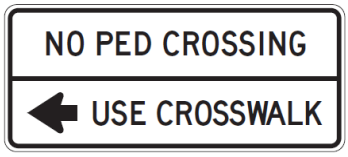


Figure 2.3.6 – USE CROSSWALK Supplemental Plaque (R9-3bP)

2.3.3. Rail Right-of-Way Channelization

Fencing is an effective deterrent to trespassing and restricts access to the railroad right-of-way. In general, fencing should extend along the rail right-of-way to discourage pedestrians from deviating from the normal pedestrian route. Any gap between the fencing and pedestrian automatic gates at the crossing should be no larger than 6 inches to deter bypassing of the gate arms.

In general, fencing should extend a significant distance along the rail right-of-way to discourage pedestrians from bypassing the warning devices. A fence extending 150 feet along the rail right-of-way would sufficiently deter a pedestrian from circumventing the warning devices. Local pedestrian destinations and travel patterns should be considered when selecting where to focus resources on installation of rail right-of-way fencing.
See Metrolink Engineering Standards[10] plans ES-4000 series for examples. For national guidance on channelization see the FHWA Handbook[6] Chapter 2 (Pedestrian and Bicycle Accessibility).

In selecting the appropriate fence type, the designer should consider vandal resistance, maintainability, and the difficulty of climbing (see Figures 2.3.7 to 2.3.12).

Where railroad right-of-way access must be provided to allow access by railroad maintainers, locked vehicular access gates are often provided near the maintenance access driveway. If pedestrian channelization is part of the crossing design, the right-of-way access gates should be designed to discourage circumvention by pedestrian.

2.3.4. Fencing Height

Limiting the height of fences, walls, landscaping, and channelization at a crossing is advisable to improve the sightlines between the pedestrian and train operator on approach to a crossing. However, low fence heights can potentially reduce the effectiveness of pedestrian channelization. Typical practice provides a fence height of 4 feet when used for channelization at a crossing. This height should be increased if necessary to effectively channelize pedestrians adjacent to slopes and elevation differences. Fence heights lower than 4 feet have been used in some cases where expected users have an eye level as low as 43 inches.

Fence heights along the rail right-of-way should be approximately 4 feet high within 150 feet of crossings, and transition to 6 to 8 feet high beyond 150 feet from crossings. These fence heights are for a typical situation where the surrounding ground is level. To channelize pedestrians while maintaining visibility, the fence height may need to vary due to slopes and elevation differences.

Low fence heights on rail right-of-way can reduce the effectiveness of fencing as a deterrent to trespassing. In selecting the length of limited height fencing, consider the location-specific clearing sight distance for pedestrians. As an example, for a train speed of 60 miles per hour, with the assumptions shown in Figure 1.4.1 for a two-track crossing, there is a corresponding pedestrian Clearing Sight Distance of 1,060 feet. Refer to Section 1.4 for more information. Near crossings where full channelization and pedestrian automatic gate arms are installed, if trespassing is a significant concern, a fence or channelization height of more than 4 feet may be justified.

2.3.5. Types of Fencing and Channelization

Pipe Rail

Pipe rail is frequently used for pedestrian barricades and metal railings on the approach to a crossing. The pipe rail is typically made with 2-inch diameter steel pipe.

Figure 2.3.7 - Example of Pipe Rail Channelization

Steel Picket or Wrought Iron

Steel picket or wrought iron fencing is frequently used for pedestrian channelization on the approach to a crossing, within station areas, and within raised medians as it serves as a better trespassing deterrent.

Figure 2.3.8 - Example of Steel Picket Fencing

Chain Link

Chain link fencing is typically used to separate pedestrian areas from adjacent property or rail right-of-way. Chain link fencing may be easier to climb and may require more frequent repairs. Figure 2.3.9 shows typical chain link fencing, while Figure 2.3.10 shows chain link fencing with a tighter mesh which may be more durable and difficult to climb.

Figure 2.3.9 - Chain Link Fencing – Standard Size

Figure 2.3.10 - Chain Link Fencing – Tight Mesh

Welded Wire Mesh

Welded Wire Mesh fencing is used for pedestrian channelization in a variety of locations including the approaches to a crossing, within station areas, and along the rail right-of-way. Some advantages over chain link fencing may include aesthetics, less likelihood of vandalism, and greater difficulty to climb.

Figure 2.3.11 - Example of Welded Wire Mesh Fencing

Expanded Metal Mesh

Expanded Metal Mesh fencing is used to prevent access to the rail right-of-way. The Expanded Metal Mesh provides a very tight mesh which discourages climbing and vandalization.

Figure 2.3.12 - Examples of Expanded Metal Mesh Fencing

2.3.6. Surface Channelization Treatments

An uneven surface can be used to discourage pedestrians from walking outside of the normal pedestrian route. Some treatments include oversized ballast, large river rock, angular rubble, or other types of uneven surfaces. For example, some projects use rock blankets (angular rocks embedded in concrete ranging in size from 8 inches to 12 inches). Other projects have considered angular rubble in sizes from 3 inches to 12 inches for channelization. Refer to Figures 2.3.13 to 2.3.16 for examples.

Figure 2.3.13 – Uneven Textured Surface using Rock Blankets (Plan)

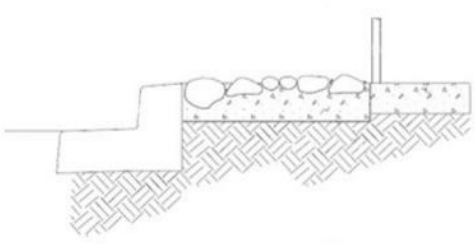


Figure 2.3.14 – Uneven Textured Surface using Rock Blankets (Photo)

Figure 2.3.15 – Uneven Textured Surface using Large Rubble (Plan)

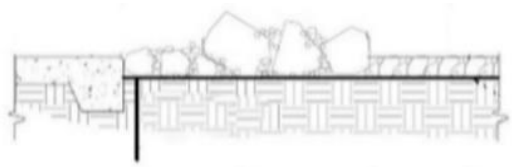


Figure 2.3.16 – Uneven Textured Surface using Large Rubble (Photo)

2.3.7. Landscaping

Landscaping with vegetation can supplement other pedestrian channelization treatments, such as surface channelization treatments or fencing. However, vegetation must be maintained frequently to be effective in channelizing pedestrians while not impairing sight distance. Irrigation is an important consideration in arid climates.

2.4. Swing Gates

Swing gates are pedestrian barriers that can be opened by pedestrians to exit or enter a crossing. When paired with pedestrian automatic gate arms they are designed to be used as an emergency egress for pedestrians that are occupying an activated crossing. In some past projects they have been installed as a point of entrance without the use of pedestrian automatic gate arms as entry swing gates. Swing gates must open away from the track and automatically return to the closed position upon release.

2.4.1. Emergency Egress Swing Gates

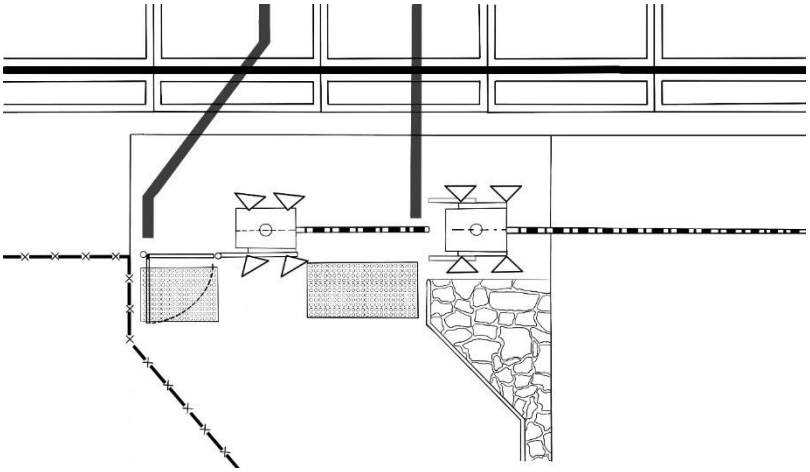
Emergency egress swing gates are used in conjunction with automatic pedestrian gates that extend across the normal pedestrian route. The emergency egress swing gate will allow pedestrians to exit the crossing if they are in a crossing when the crossing warning devices are activated. The emergency egress swing gates are supplemented with signs prohibiting pedestrians from entering the crossing through the emergency egress swing gate and signs on the track side informing pedestrians to push open the emergency egress swing gate when exiting the crossing.

Figure 2.4.1 – Emergency Egress Swing Gate

Placement and Orientation

The placement of the emergency egress swing gates must be conspicuous to pedestrians that are in the crossing. To discourage pedestrians from using the emergency egress swing gate as an approach to the crossing, the pedestrian automatic gate is typically located along the normal pedestrian route while the emergency egress swing gate is offset from the normal pedestrian route (see Figure 2.4.2). Emergency egress swing gate should be orientated to be in line with the pedestrian automatic gate. If the emergency egress swing gate is orientated at an angle due to right-of-way constraints, the emergency egress swing gate and related signage must remain visible to pedestrians that are in the crossing.

Figure 2.4.2 – Example of Pedestrian Automatic Gates in Conjunctions with Swing Gates



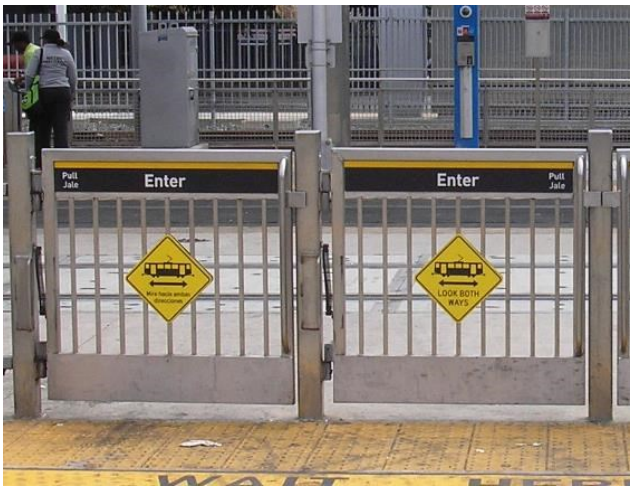
Gaps between the pedestrian automatic gate, emergency egress swing gate, and channelization such as fencing or walls should be no larger than 6 inches. The placement and orientation of fencing or other channelization near the emergency egress swing gates must not prevent them from fully opening and must not hinder the ability of pedestrians to exit the crossing.

Figure 2.4.3 – Eliminating Gap Between Pedestrian Automatic Gate and Emergency Egress Swing Gate

2.4.2. Entry Swing Gates

In some past projects, an entry swing gate was used to slow pedestrians by encouraging them to stop, watch for approaching trains, then pull the entry swing gate open prior to entering the crossing. The entry swing gates are supplemented with signs informing pedestrians to open the gates by pulling and to watch for approaching trains. The same entry swing gate typically includes signs on the track side informing pedestrians to push open the swing gate when exiting the crossing. Some pedestrian crossings utilize multiple entry swing gates side by side. This configuration has been used at light-rail station crossings, as seen in Figure 2.4.4.

Figure 2.4.4 – Example of Entry Swing Gates



Disadvantages to this configuration include concerns that pedestrians in wheelchairs must open and then maneuver around the entry swing gates, and that the crossing user can open the entry swing gate to enter the crossing at any time. Entry swing gates should not be used in new projects.

2.4.3. Swing Gate Design

Swing gate design and configuration must be considered in detail to effectively channelize pedestrians while ensuring that all crossing users can operate and move through the gates. Considerations include dimensions, hinges, kickplates, handles, maneuvering clearance, placement, orientation, and attached signage.

Accessibility Requirements for Swing Gates

Swing gates should allow all pedestrians, including pedestrians with disabilities, to safely traverse the crossing. Considerations should include the clear width through an opened swing gate, the height of a swing gate, height of a handle if provided, the force required to open the swing gate, and the ability to use feet to push open a swing gate when moving away from the tracks.

Swing Gate Dimensions

Swing gate dimensions vary. Typical installations provide a 3-foot by 3-foot swing gate, with the top of the swing gate at a height of 3-feet 6-inches above ground. This typical width exceeds the minimum 32-inch clear width included in Caltrans DIB 82-06[1].

The height of the swing gate should approximately match the height of adjacent channelization.

Hinges and Closure Mechanisms

Swing gates must always automatically close fully when not in use. Currently, several hinge designs exist for returning a swing gate to its normally closed position. Routine maintenance of the swing gate hinge and closure mechanisms is critical to the operation of the swing gate and the effectiveness of the channelization. The appropriate hinge design should be evaluated and may depend on the level of usage, environmental conditions, frequency of maintenance, and other factors.

PROWAG[3] R403.4 discusses that the force required to activate operable parts is not to exceed 5 pounds.

Gravity hinges (see Figure 2.4.5) have been widely used. With proper design and regular maintenance, they can open easily and close reliably.

Hydraulic hinges may have benefits of reduced opening force, adjustability of the closure speed, and reduced maintenance.

The closing speed of swing gates should be slow enough to avoid contacting the pedestrian that opened the swing gate, but fast enough to prevent other pedestrians from moving towards the tracks through a gate that remains partially open. At minimum, swing gates must be adjusted so that from the open position of 70 degrees, the gate moves to a closed position in no less than 1.5 seconds. (Refer to ADA[2] 2010 Section 404.2.8.2 for details.)

External springs have been used in some cases to pull a swing gate shut. However, external springs should be avoided on swing gates because they may not reliably pull the swing gate closed.

Latches that keep a swing gate closed must be avoided because they might prevent the swing gate from opening.

Figure 2.4.5 - Example of Gravity Hinge

Kickplates

A kickplate is a smooth surface incorporated into a swing gate to allow an individual in a wheelchair to push the swing gate open using their feet. See Figure 2.4.6. A kickplate is placed on the track side of a swing gate. It must extend the full width of the swing gate and at least 10 inches above the ground. Refer to ADA[2] 2010 Section 404.2.10.

Figure 2.4.6 - Emergency Egress Swing Gate Equipped with a Kickplate

Handles

The operation of swing gates must be possible with one hand and without the need for tight grasping, pinching, or twisting of the wrist. Handles can be used on Entry Swing Gates to allow for the gate to easily be pulled open. See PROWAG[3] R403.4.

Handles should not be used on Emergency Egress Swing Gates. Such handles are unnecessary because pedestrians are prohibited from pulling these gates open.

Signs

Signs mounted on swing gates can help to identify the location of the swing gate, identify the appropriate use of the swing gate, and provide additional warning that pedestrians should look for approaching trains. Signs or symbols on swing gates should be appropriately sized for pedestrian usage and visibility. Signs needs to be securely mounted to the gate to prevent them from sliding down and contacting the ground.

- Emergency Egress Swing Gates:
    - On the track side of the Emergency Egress Swing Gate, a sign should be posted stating "PUSH TO EXIT".
    - On the side of the Emergency Egress Swing Gate facing away from the track, a "DO NOT ENTER" sign or symbol should be posted.

- Entry Swing Gates:
    - On the side of the Entry Swing Gate facing away from the track, a sign should be posted stating "PULL TO OPEN". As a supplemental sign on the Entry Swing Gate, the R15-8 "LOOK" sign, or the W82-1(CA) sign may also be used to alert pedestrians that trains approach from both directions.
    - On the track side of the Entry Swing Gate, a sign should be posted stating "PUSH TO EXIT".

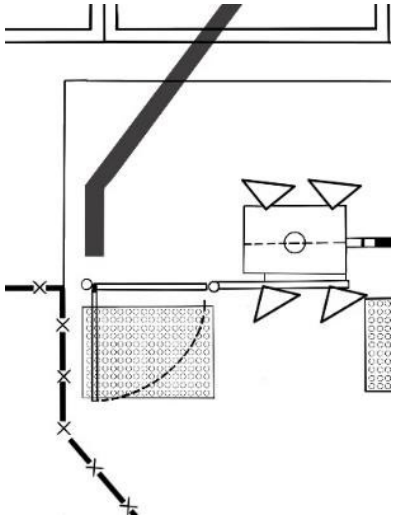
Hinge Location

Placement and orientation of swing gates should not interfere with the ability of pedestrians to exit the crossing. The hinges on the swing gates should be placed such that the gate can open without obstructing pedestrians that are exiting the crossing. In some cases, clearances greater than the minimum swing gate maneuvering clearances (see Table 1) may be required to ensure that pedestrians can freely exit the crossing. If a pedestrian must make a turn after moving through the swing gate, the hinge side of the gate should be placed to allow the pedestrian to easily move in the direction of the pathway.

Clear Width

Pedestrians with disabilities must be provided continuous clear width to move through an emergency egress swing gate. The orientation and hinge location of the swing gate should ensure that an open swing gate does not impede pedestrians that are moving away from the track area. Typically swing gates should open at least 90 degrees.

Figure 2.4.7 – Allowing Emergency Egress Swing Gate to open up to 90 degrees



2.5. Train Activated Warning Devices

Train activated warning devices provide warning to pedestrians when a train is approaching the crossing. They generally consist of warning devices that, when activated, provide visual and audible indications to vehicles and pedestrians of an approaching train. Train activated warning devices are required to be in compliance with CPUC GO 75-D[9] and CA MUTCD[11].

2.5.1. Flashing Light Signal Assemblies

Flashing light signal assemblies are comprised of pairs of alternately flashing red lights, an audible warning device, and a crossbuck sign. This type of train activated warning device is identified in CPUC GO 75-D[9] as a Standard 8 warning device and includes "alternately flashing red lights facing each approach" (see Figure 2.5.1).

Figure 2.5.1 - Flashing Light Signal Assembly/Standard 8 Warning Device

The configuration of flashing light signal assemblies must be considered in detail to effectively provide warning to crossing users along each approach. Flashing light signal assembly placement and orientation should provide clear visibility of a flashing light signal pair to pedestrians on each approach. If there are multiple pedestrian approaches to a crossing with train activated warning devices, additional flashing light signal pairs must be included for each pedestrian approach to provide clear visibility for those approaches as required by CPUC GO 75-D[9].

Generally, along a roadway with sidewalks for pedestrian use, a train activated warning device is provided for the vehicular approach to the crossing (vehicular warning device). However, along the sidewalk, pedestrians can approach the crossing from either direction. Location-specific conditions may merit consideration of additional warning for pedestrians coming from the approach opposite of vehicles, such as; additional flashing light signal pairs mounted to the vehicular warning device; minor adjustments to the direction of rear-facing flashing light signal pairs on the vehicular warning device to be specifically directed toward pedestrians; or additional flashing light signal assemblies installed on the side of the track that is opposite of the vehicular warning device.

Along a sidewalk, the CPUC Standard 1-D pedestrian crossing sign is omitted. If a flashing light signal assembly is placed at a crossing exclusively used by pedestrians and/or bicyclists, the CPUC Standard 1-D pedestrian crossing sign must be attached to the mast of the warning device below the flashing light signal pairs.

2.5.2. Vehicular Warning Devices with Gate Arm

Vehicular warning devices with gate arms are comprised of a flashing light signal assembly combined with a gate arm to block the path of vehicles entering the crossing when a train is approaching. This type of train activated warning device is identified in GO75-D[9] as a Standard 9 warning device.

Generally, vehicular warning devices are placed at the setbacks per the CA MUTCD to minimize the length of the gate arm needed to cover the vehicular lanes. In such cases, pedestrians are typically channelized to walk on the side of the warning device that is opposite of the roadway. Consideration must be given to offset the normal pedestrian route far enough away from the vehicular warning device so that, when activated, the counterweight for the gate arm does not impede the path of a pedestrian trying to exit the crossing.

In some cases, vehicular warning devices are set back further than the requirements in the CA MUTCD and are intended to be used to block both the sidewalk and vehicular lanes, when activated. If a vehicular automatic gate arm extends across both the sidewalk and vehicular lanes, an ADA[2]-compliant emergency egress route must be provided to allow pedestrians to exit the crossing during the approach of a train. The material for the ADA[2]-compliant emergency egress route does not need to match the same material as the adjacent sidewalk.

2.5.3. Pedestrian Automatic Gates

Pedestrian automatic gates are comprised of flashing light signal assemblies equipped with a gate arm. They are similar to vehicular warning devices with gate arms, with the major difference being that a shorter gate arm is used to only block the path of pedestrians and the counterweight is typically omitted (unless a longer gate arm is needed to cover the width of a wider pedestrian route). This warning device is considered a variant of the Standard 9 warning device described in GO75-D[9]. It is commonly referred to as a Standard 9 Pedestrian Gate.

Figure 2.5.2 - Example of a Pedestrian Automatic Gate/Standard 9 Pedestrian Gate

The pedestrian automatic gate arms are normally in the vertical position to allow unimpeded flow of the normal pedestrian route through the crossing when there is no train approaching. When a train approaches the crossing, the pedestrian automatic gates will be activated, and the gate arms will be lowered to block the normal pedestrian route through the crossing. Emergency egress swing gate are installed in conjunction with pedestrian automatic gates to allow pedestrians to exit the crossing when the normal pedestrian route is blocked by the activated gate arm.

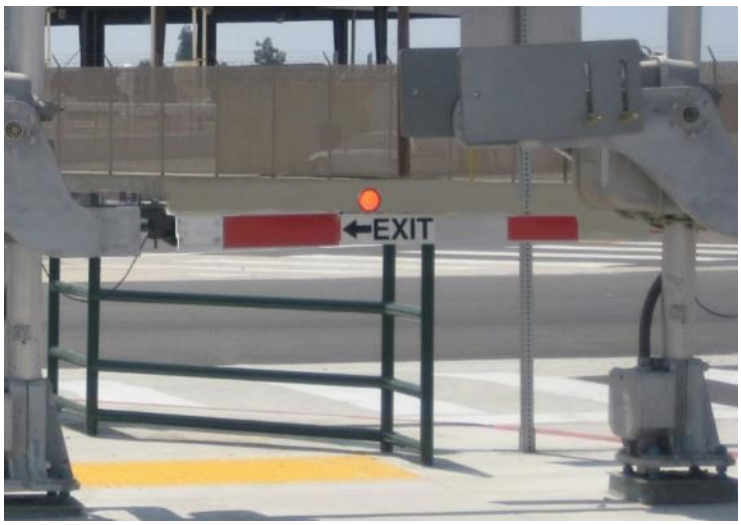
Pedestrian automatic gates are used in combination with emergency egress swing gates (see Section 2.4.1) and other channelization to provide a continuous physical barrier between pedestrians and an approaching train. The combination of these elements more effectively channelizes pedestrians to the normal pedestrian route than a pedestrian automatic gate alone.

Crossings with pedestrian automatic gates will require a larger footprint than crossings without them, due to emergency egress swing gates and other channelization. Therefore, additional public right-of-way for sidewalk may need to be acquired in each quadrant of the rail crossing to allow sufficient space to install them.

Placement and Orientation

Pedestrian automatic gate placement and orientation must not physically interfere with any part of the adjacent vehicular automatic gate, counterweight, gate mechanism, swing gates, fencing, or other channelization. In some configurations the pedestrian automatic gate arm and the vehicular automatic gate arm are arranged in alignment, with the tip of the activated pedestrian automatic gate arm descending between the counterweights of the vehicular automatic gate (see Figure 2.5.3). The pedestrian automatic gate arm must avoid conflict with the mechanism housing during normal operation and maintenance. Gate-mounted red lights must be visible when the pedestrian automatic gate arm is in the horizontal position.

Figure 2.5.3 – Activated Pedestrian Gate Arm Decending Between the Counterweights



In cases where pedestrian automatic gate arms and vehicular automatic gate arms cannot be placed in close proximity, channelization treatments should be placed to avoid gaps larger than 6 inches.

Gate Arm Mounting Height

MUTCD allows for pedestrian automatic gate arms to be mounted at a minimum height of 3 feet and maximum height of 4 feet. Gate arm heights outside this range may not effectively block pedestrians. Pedestrian automatic gate arms should be mounted at approximately 3.5 feet (42 inches) above the ground to the bottom of the pedestrian gate arm.

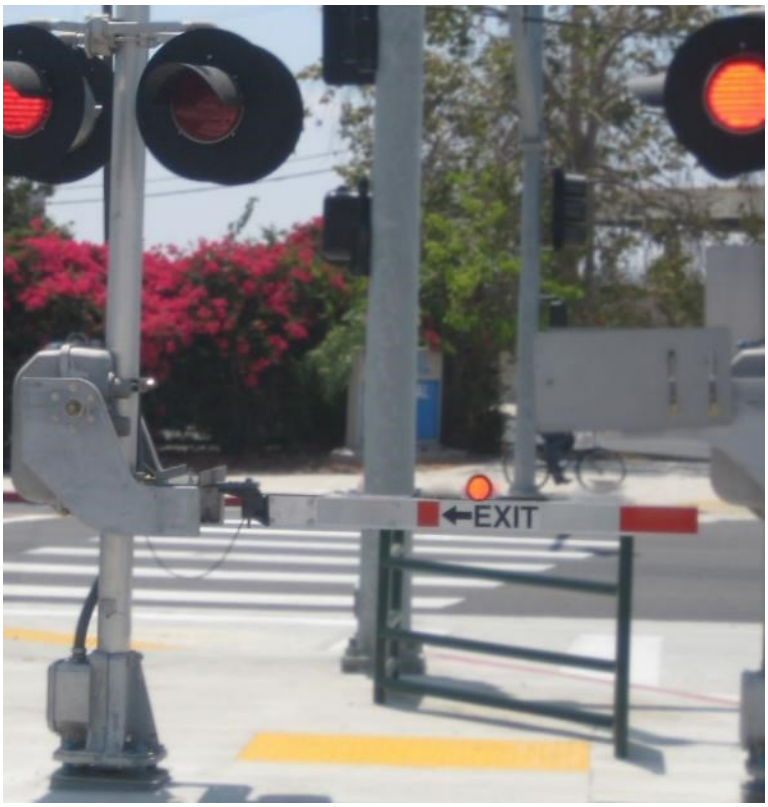
Gate Arm Lights

One red light that is steadily illuminated when the warning system is activated must be provided on the pedestrian automatic gate arm. If additional gate-mounted red lights are used, such as for longer gate arms, they must be installed in pairs and flash alternately in unison with the other flashing light signal pairs.

Gate Arm Messaging

A decal with the word "EXIT" and an arrow pointing to the emergency egress swing gate is typically placed on the side of the pedestrian automatic gate arm that is facing the tracks. Pedestrians that are within the crossing when the pedestrian automatic gate arms are horizontal can observe this additional information to direct them toward the emergency egress route.

Figure 2.5.4 – EXIT Decal on Pedestrian Gate Arm



Horizontal Hanging Bar

In cases where there is a concern of pedestrians going under the activated pedestrian automatic gate arm, a horizontal hanging bar may be attached below the pedestrian automatic gate arm to deter violation of the warning device.

Figure 2.5.5 - Example of a Horizonal Hanging Bar

A pedestrian automatic gate arm is driven by a separate mechanism than the vehicular automatic gate arm so that if either of the gate arms is unable to descend, it will not impact the operation of the other gate arm.

Pathway Edge Line

Pathway edge lines should be provided in the crossing area to guide pedestrians through the crossing, similar to crosswalk lines for a roadway intersection. The pathway edge lines should be 12" wide and be striped through the entire track area. The pathway through the track area and the transition to the emergency egress route should be paved and free of gaps or tripping hazards.

2.6. Audible Warning Device

CPUC GO 75-D[9] requires an audible warning device (mechanical or electronic bell) as part of a flashing light signal assembly. The bell sounds while the flashing light signal pairs are flashing. The bell is used to alert roadway users to an approaching train. Some designs include the bell at the top of the mast, however they can be mounted at a lower point to better direct the sound. To discourage vandalism, bells should not be mounted lower than the lowest pair of flashing light signals, which is required to be at least 7 feet above the ground. The bell may be silenced as the gate arm is being raised.

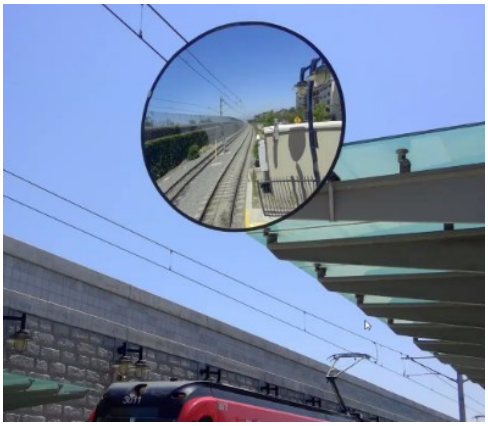
Uni-directional bells are available to focus the sound toward the pedestrian approaches. The sound level should be no less than 75dB(A) measured at approximately 10 feet from the bell along all pedestrian approaches.

The placement and operation of bells are subject to GO75-D[9]. If bell placement, design, or operation deviate from the requirements of GO 75-D[9] at a particular crossing, the deviation must be requested, reviewed, and authorized by the Commission.

2.7. Convex Mirrors

Convex mirrors are occasionally used at or near stations to provide pedestrians greater visibility of a train approaching from behind an obstruction, a second train approaching after a first train has passed, or a train approaching from behind the pedestrian.

Figure 2.7.1 – Example of a Convex Mirror at a Station Crossing



2.8. Lighting

Lighting should be considered for all crossings with pedestrian usage. Generally, lighting is provided on vehicular approaches to a crossing and is placed close enough to the normal pedestrian route to provide sufficient lighting for pedestrians through the track area. Lighting for pathway crossings should also be considered.

Adequate lighting along the normal pedestrian route should be provided on both the approaches and through the track area, so that pedestrians can identify and avoid any hazards, such as uneven/rough crossings, potholes, or debris while approaching and traversing the crossing during nighttime or low light weather conditions. Additionally, lighting at the crossing can serve as a deterrent for loitering and vandalism during nighttime.

Lighting should be placed at least within 50 feet of the crossing area to maximize the light output over the crossing area for pedestrians. Access for maintenance of the lights and maintenance access for railroad employees to the railroad right-of-way should also be considered in the placement of the lights. For more information refer to FRA Guideline for Grade Crossing Illumination and Caltrans Roadway Lighting Manual.

Figure 2.8.1 – Example of Illumination for both vehicular and pedestrian approaches

CONCLUSION

CPUC's Rail Crossings and Engineering Branch is available to discuss the design of rail crossing related projects. For additional information regarding CPUC rules and regulations, contacts and other related details please refer to www.cpuc.ca.gov/crossings.

LIST OF REFERENCES

(1) Caltrans Design Information Bulletin 82-06 (*DIB 82-06*): Pedestrian Accessibility Guidelines for Highway Projects, California Department of Transportation (Caltrans), November 16, 2017.

(2) Federal Americans with Disabilities Act (ADA) – ADA Standards for Accessible Design (2010 Standards)

(3) Public Right-of-Way Accessibility Guidelines (*PROWAG*), U.S. Access Board, Final Rule published in the Federal Register on August 8, 2023.

(4) Report – North Lane Highway-Rail Crossing Pedestrian Safety Study (*North Lane Pedestrian Safety Study*), Adavant Consulting, 2010.

(5) Factors influencing single-bicycle crashes at skewed railroad grade crossings, Journal of Transport & Health (2017).

(6) Highway-Rail Crossing Handbook (*FHWA Handbook*), 3rd Edition, Federal Highway Administration – Office of Safety Design, prepared by ITE, FHWA and FRA, Report No. FHWA-SA-18-040/FRA-RRS-18-001, July 2019.

(7) Guide for the Planning, Design, and Operation of Pedestrian Facilities, 2nd Edition, American Association of State Highway Transportation Officials (AASHTO), 2021.

(8) Caltrans Highway Design Manual (*HDM*)– 7th Edition, 2020.

(9) California Public Utilities Commission (CPUC) General Orders (G.O.) on Rail Safety
- GO 26-D (railroad clearances)
- GO 72-B (crossing surfaces)
- GO 75-D (warning devices)
- GO 118-A (railroad worker walkways)
- GO 143-B (rail transit)

(10) Metrolink Engineering and Construction references, Southern California Regional Rail Authority (SCRRA/Metrolink) – Engineering and Construction Department.
- Engineering Standard Drawings – 4000 series – Grade Crossings, updated January 19, 2021.
- SCRRA Highway-Rail Grade Crossing Manual, dated January 2021.

(11) California Manual on Uniform Traffic Control Devices (*CA MUTCD*), California Department of Transportation (Caltrans), 2014 edition Revision 9 effective April 1, 2025.
- Part 8: Traffic Control for Railroad and Light Rail Transit Grade Crossings

(12) Manual on Uniform Traffic Control Devices, 11th Edition (*MUTCD 11th Edition*), Federal Highway Administration (FHWA), December 2023.
- As of 2025, *MUTCD 11th Edition* has not yet been adopted for use in California. It is expected to be adopted with amendments for use in California by January 2026.

(13) TCRP Research Report 248: Tactile Wayfinding in Transportation Settings for Travelers Who Are Blind or Visually Impaired, National Academies of Sciences, Engineering, and Medicine, 2025. Washington, DC: The National Academies Press.

GLOSSARY

The following terms are provided to support this document. Where possible, CPUC staff has used terms from general industry references, but use in this document is focused on crossings with pedestrian facilities.

Access Board: The U.S. Access Board is an independent federal agency devoted to accessibility for people with disabilities and a leading source of information on accessible design.

ADA: The Americans with Disabilities Act (ADA) is a federal civil rights law that prohibits discrimination against people with disabilities in everyday activities.

AREMA: American Railway Engineering & Maintenance-of-Way Association. This industry group produces and publishes recommended practices for railroad infrastructure.

Automatic: Where used to describe a warning device assembly at a crossing, such as a gate or flashing light signal, this term indicates that the warning device assembly is automatically activated upon the approach of a train.

Ballast: Crushed stone that serves as a bed for railroad tracks and provides both track support and drainage.

CA MUTCD: California Manual on Uniform Traffic Control Devices, published by California Department of Transportation (Caltrans). This publication sets standards for traffic control devices (signs, markings, signals, etc.) in the State of California.

Caltrans: The State of California Department of Transportation.

Channelization: For the purposes of this document, pedestrian channelization is a treatment of fencing, walls, gates and/or other design elements used to physically guide or restrict pedestrians to the normal pedestrian route.

Commission: For the purposes of this document, refer to CPUC.

CPUC: California Public Utilities Commission. The CPUC regulates utilities including the safety of railroad and rail transit.

Crossing: For the purposes of this document, a location where railroad or light rail transit tracks cross at the same level as a pedestrian route.

Crossing Angle: The angle at which railroad and/or light rail transit tracks intersect the highway and/or pathway.

Crossing Surface: The crossing surface is the material placed at the track between and just outside the rails, such as pre-fabricated concrete panels.

Crossbuck sign: The regulatory sign in an X formation with the words RAILROAD CROSSING which is identified in the CA MUTCD as R15-1.

Detectable Warning Surface: Truncated domes placed on the walking surface that a pedestrian's feet can detect or are detectable by use of a long cane. These devices warn of a transition between areas reserved for pedestrians or bicycles to areas of potential conflict, such as vehicular lanes or railroad tracks.

DIB: Caltrans Design Information Bulletin (DIB)

Emergency Egress Route: For the purposes of this document, the portion of a crossing that provides a route for pedestrians to exit the crossing area while an automatic gate is activated and extended across the normal pedestrian route.

FHWA: The Federal Highway Administration (FHWA) is a federal agency within the within the U.S. Department of Transportation.

Flashing Light Signal Pair: An element of a flashing light signal assembly consisting of two red signal indications arranged horizontally that are activated to flash alternately when rail traffic is approaching or present at a grade crossing.

Flashing Light Signal Assembly: A warning device consisting of flashing light signal pair(s) and other required elements of the assembly, such the Crossbuck sign.

FRA: The Federal Railroad Administration (FRA) is a federal agency within the U.S. Department of Transportation.

GO: A General Order (GO) of the California Public Utilities Commission that contains rules and standards for public utilities and regulated industries in California.

Grade-Separated Rail Crossing: A crossing of a roadway or pathway at a different level than the railroad or light rail transit system track**.**

Individual with Disability: An individual who has a physical impairment, including impaired sensory, manual, or speaking abilities, that results in functional limitation in gaining access to and using a building or facility.

Light Rail Transit: Light rail transit (LRT) is a type of rail transportation that typically uses electric rail cars in urban areas. LRT typically operates at speeds lower than 55 MPH. LRT operations use single-unit light rail transit cars (such as streetcars and trolleys) or assemblies of multiple light rail transit cars coupled together.

Normal Pedestrian Route: For the purposes of this document, the portion of a crossing that provides the usual route for pedestrians to navigate along a sidewalk or pathway through the crossing area. An emergency egress route is not considered to be part of the normal pedestrian route.

Pathway: A general term denoting a public way for purposes of travel by authorized users outside the traveled way and physically separated from the roadway by an open space or barrier and either within the highway right-of-way or within an independent alignment. Some pathways are authorized for exclusive use by pedestrians, and some are authorized for shared use by pedestrians, bicycles, and other types of users. A sidewalk is not considered a pathway.

Pathway Grade Crossing: The general area where a pathway and railroad or light rail transit tracks cross at the same level, within which are included the tracks, pathway, and traffic control devices for pathway traffic traversing that area. Pathway users may include higher speed users such as bicyclists and skaters.

Pavement Markings: Markings set into the surface of, applied upon, or attached to the pavement for the purpose of regulating, warning, or guiding traffic.

Pedestrian: A pedestrian is a person who travels on foot, or who uses assistive mobility device(s), such as a wheelchair**.**

Pedestrian Access Route: An accessible, continuous, and unobstructed path of travel for use by pedestrians with disabilities within a pedestrian circulation path, which is a prepared exterior or interior surface provided for pedestrian use in the public right-of-way. (Refer to PROWAG R104.3)

Pedestrian Automatic Gate: A train-activated warning device assembly with an automatic gate that is placed exclusively for pedestrians or other pathway users.

PROWAG: Public Right-of-Way Accessibility Guidelines, published by U.S. Access Board

Public Right-of-Way: Public land acquired for or dedicated to transportation purposes, or other land where there is a legally established right for use by the public for transportation purposes. (Refer to PROWAG R104.3). For the purposes of this document, this term refers to right-of-way legally used by the public, such as pedestrians, bicycles or motorists, which is not exclusively devoted to the use of rail transportation.

Rail Right-of-Way: A strip of land devoted to rail transportation purposes, such as railroad or light rail transit.

Sidewalk Grade Crossing: The portion of a crossing where a sidewalk and railroad tracks or a sidewalk and light rail transit tracks cross at the same level, within which are included the tracks, sidewalk, and traffic control devices for sidewalk users traversing that area.

Sight Distance: The unobstructed distance a person can see.

Station Crossing: A pathway grade crossing that is associated with a station platform.

Swing Gate: A self-closing fence-type gate designed to swing open away from the crossing and return to the closed position upon release.

Train-activated Warning Device Assembly: Train-activated warning device assembly defined in Commission General Order 75-D (or as amended) such as flashing light signals and automatic gates.