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ERRATA

February 2012

Dear Customer:

Recently, we were made aware of some technical revisions that need to be applied to the *Roadside Design Guide*, 4th Edition.

Please replace the existing text with the corrected text to ensure that your edition is both accurate and current.

AASHTO staff sincerely apologizes for any inconvenience.

Errata to *Roadside Design Guide,* 4th Edition

Page	Existing Text	Corrected Text
3-21	Example 3-D does not have "Discussion" text to follow after the figure.	Add the following text: **"Discussion**—Since the critical foreslope is within the suggested clear-zone distance of 9 to 10.5 m [30 to 34 ft], it should be flattened if practical or considered for shielding. However, if this is an isolated obstacle and the roadway has no significant crash history, it may be appropriate to do little more than delineate the drop-off in lieu of foreslope flattening or shielding."
5-58	Figure 5-47 has partial text missing.	Substitute Figure 5-47 with the attached revised figure.
6-2	Figure 6-1 shows incorrect metric and U.S. measurements for median widths.	Substitute Figure 6-2 with the attached revised figure.
6-7	Figure 6-4 shows incorrect image of Brifen Wire Rope Safety Fence.	Substitute Figure 6-7 with the attached revised figure.
8-31	In Table 8-7, text is missing from the FHWA Acceptance Level column (row 3).	Add "CC89A" after CC89.
8-33	In Section 8.4.2.3.3, the last sentence reads: "The opposite direction crash test was not performed; therefore, until further testing is done, the HEART™ should be used only in locations with one-way traffic."	This sentence should read: "The HEART™ can be used in bi-direction traffic provided the plastic side panels are lapped in the direction of traffic flow and an acceptable transition is used."
8-48, 8-49	In Table 8-12, Sand Filled Barrels is placed in the wrong section.	Substitute Table 8-12 with the attached revised table.
11-7	Figure 11-5 shows incorrect measurement of taper for LS.	Substitute Figure 11-5 with the attached revised figure.
G-1	Definition of Clear Zone reads: "The total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired width is dependent upon the traffic volumes and speeds and on the roadside geometry."	The definition should read: "The unobstructed, traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles. The clear zone includes shoulders, bike lanes, and auxiliary lanes, except those auxiliary lanes that function like through lanes."

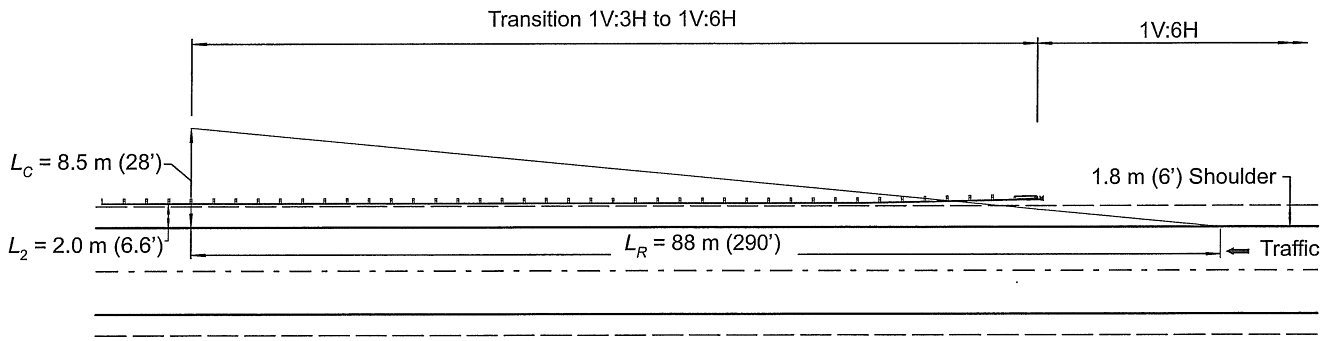


Figure 5-47. Example of Barrier Design for Non-Traversable Embankments

Discussion—The area of concern begins at the top of the critical slope. This location is determined by reviewing the plan and cross-section details as well as any proposed grading that can be done to eliminate or significantly reduce the length of the barrier, where appropriate. Because the purpose of a barrier installation is to reduce the likelihood of a vehicle from reaching a non-traversable terrain feature or fixed object, the designer may elect to shield more of the slope by selecting a larger clear zone distance. However, the benefit/cost issues of additional guardrail should be considered before increasing the guardrail length. It might be advantageous to review planned barrier lengths on site for proper length-of-need before installation. Refer to Chapter 8 for additional grading details.

The barrier may be terminated by anchoring it in a backslope or installing a crashworthy terminal. A buried-in-backslope terminal can shield the entire embankment area if the site grading is done appropriately. Before installing a buried-in-backslope terminal, the site layout and detailed review of the cross sections should be conducted. This will include consideration of ditch configurations, drainage requirements, and the configuration of the backslope.

Based on the installation site conditions, it was determined that a parallel guard rail terminal be used. Note that the 15.2-m [50-ft] end terminal was flared 300 mm [1 ft] off the edge of shoulder to reduce nuisance hits.

$$X = \frac{(8.5 - 2.0)}{\frac{8.5}{88}} = \frac{6.5}{.097} = 67.3\,m \qquad X = \frac{(28 - 6.6)}{\frac{28}{290}} = \frac{21.4}{.097} = 221.6\,ft \qquad (5\text{-}8)$$

Given:

ADT = 650 vpd

Speed = 100 km/h [60 mph]

Embankment slope = 1V:6H

Horizontal curvature = 450 m [1,475 ft] radius

Select: Clear zone, L_C = 5.0 to 5.5 m [16 to 18 ft] (Table 3-1)

(5.5 m [18 ft] chosen by designer)

Adjustment factor for curvature = 1.4 (Table 3-2)

Adjusted clear zone = (5.5) (1.4) = 7.7 m [(18) (1.4) = 25 ft]

Runout length, L_R = not applicable (see Discussion)

Barrier offset, L_2 = 1.2 m [4 ft]

Flare rate: not applicable

the repairs. Another concern associated with the installation of a median barrier is that it will limit the options of maintenance and emergency service vehicles to cross the median. In snowy climates, a median barrier also may affect the ability to store snow in the median. There may be other environmental impacts depending on the grading needed to install the barrier. For these reasons, a one-size-fits-all recommendation for the use of median barrier is not appropriate.

Studies *(7, 10)* have shown that median barriers can significantly reduce the occurrence of cross-median crashes and the overall severity of median-related crashes. With the potential to reduce high-severity crashes, it is recommended that median barriers be considered for high-speed, fully controlled-access roadways that have traversable medians, as shown in Figure 6-1.

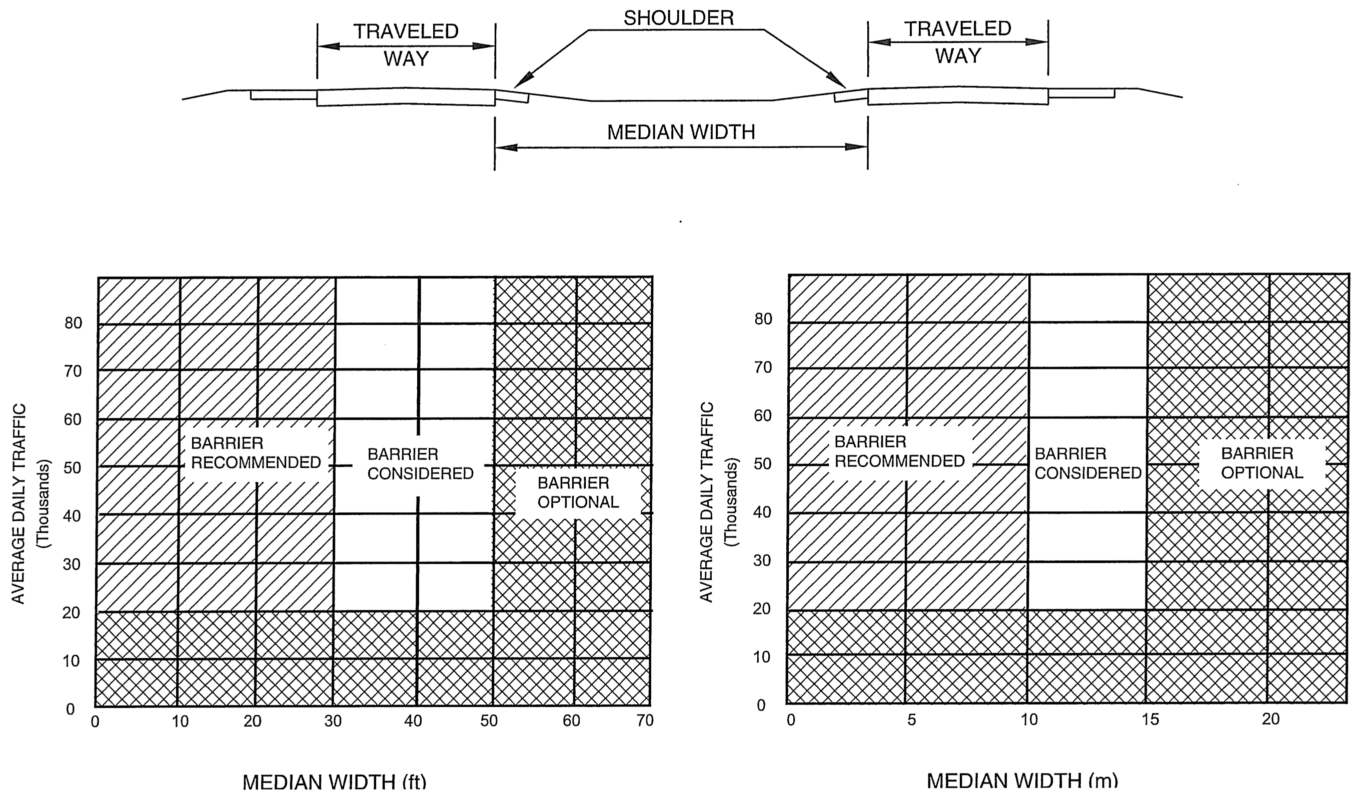


Figure 6-1. Guidelines for Median Barriers on High-speed, Fully Controlled-Access Roadways

Figure 6-1 shows recommended guidelines for the use of median barriers on high-speed, fully controlled-access roadways for locations where the median is 9.1 m [30 ft] in width or less and the average daily traffic (ADT) is greater than 20,000 vehicles per day (vpd). For locations with median widths less than 15.2 m [50 ft] and where the ADT is less than 20,000 vpd, a median barrier is optional. However, the facility should be designed to facilitate future barrier placement if there are significant increases in ADT or a rise in the number of cross-median crashes occurs. For locations where median widths are greater than 9.1 m [30 ft] but less than 15.2 m [50 ft] and where the ADT is greater than 20,000 vpd, a cost/benefit analysis or an engineering study may be conducted at the discretion of the transportation agency to determine the appropriate application for median barrier installations. The analysis should include the following factors in the evaluation: traffic volumes, vehicle classifications, median crossover history, crash incidents, vertical and horizontal alignment relationships, and median–terrain configurations.

The high-tension systems also result in less damage to the barrier and, in many cases, the cables remain at the proper height after an impact that damages several posts. Although no manufacturer claims that their barrier remains functional in this condition, there may be a residual safety value under certain crash conditions. The posts can be installed in cast or driven sockets in the ground to facilitate removal and replacement.

There are currently five high-tension cable barrier systems that have been accepted by FHWA as meeting NCHRP Report 350, Test Level (TL) 3 conditions. Modified versions of all five systems have been successfully tested at the NCHRP Report 350 Test Level 4 condition and approved for 1V:6H or flatter slopes.

All of the systems also have been approved for limited use on 1V:4H slopes. Among the limitations is the fact that this configuration requires a TL-4 system that only functions at TL-3 because of the vehicle dynamics inherent with steeper grades. The systems' lateral placement within the median also is limited to no farther than 1.2 m (4 ft) down the 1V: 4H slope for adjacent traffic impacts and no closer than 2.7 m (9 ft) from the ditch bottom for opposite-side impacts.

All of these systems use weak posts to support the cables. However, they each utilize a unique post design. The following are the currently accepted high-tension cable barrier systems:

- *Brifen Wire Rope Safety Fence*—Manufactured by Brifen USA, Inc., the Brifen system uses three or four cables. One is placed in a slot on the post while the others intertwined between the posts (see Figure 6-4).
- *The Cable Safety System (CASS™)*—Manufactured by Trinity Industries, Inc., CASS uses three cables that are placed in a slot on the posts and separated by spacer blocks (see Figure 6-5).
- *NU-CABLE™*—Manufactured by the Nucor Steel Marion Inc., the NU-CABLE high-tension cable barrier system uses three or four cables attached to U-channel steel posts by unique hook bolts (see Figure 6-6).
- *Blue Systems (Safence)*—The Safence system is a three or four-cable design. For a median barrier, all four cables are centered within the top portion of slotted posts (see Figure 6-7).
- *Gibraltar Cable Barrier System*—The Gibraltar Cable Barrier System uses C-posts to support three or four cables. A steel hairpin and lock plate are used to attach the cables to the posts (see Figure 6-8).

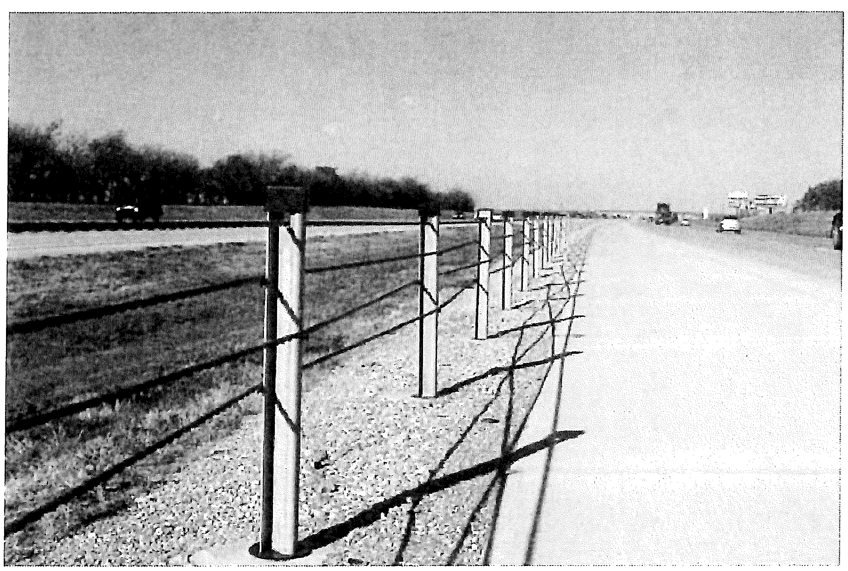


Figure 6-4. Brifen Wire Rope Safety Fence

Table 8-12. Comparative Maintenance Characteristics

Sacrificial Crash Cushions			
Crash Cushion	**Regular Maintenance**	**Crash Maintenance**	**Material Inventory**
Thrie-Beam Bullnose Guardrail System	Can be inspected on a drive-by. Cable tension should be checked periodically.	Rail elements and posts should be replaced. Cables and foundation tubes are normally reusable.	Slotted thrie-beam rail elements and wood posts.
ABSORB 350®	Normally can be inspected on a drive-by. Periodic on-site inspections should be performed to be certain that all parts are properly connected. Need to check water level. When winterized, check deicing agent.	Nose-piece and damaged energy-absorbing elements should be replaced.	Replacement nosepiece, energy-absorbing elements, and fluid supply. Other parts per manufacturer's recommendation.
ADIEM™	Modules should be closely inspected for damage.	Damaged concrete modules should be replaced. Damaged covers also should be replaced. Most other parts normally are reusable.	Replacement concrete modules, covers, and other parts per the manufacturer's recommendation.
BEAT-SSCC™	Normally can be inspected on a drive-by. Periodic on-site inspections should be performed to be certain that all parts are properly connected and anchor cable is not slack.	Damaged tubes and posts should be replaced. Impact head is normally reusable.	End tube, second tube, breakaway posts.
BEAT-BP™	Normally can be inspected on a drive-by. Periodic on-site inspections should be performed to be certain that all parts are properly connected and anchor cable is not slack.	Damaged tubes and posts should be replaced. Impact head is normally reusable.	End tube, second tube, standard line tubes, breakaway posts, and standard line posts.
QUADTREND 350®	As this device uses sand-filled containers, there is concern for freezing of sand in cold climates. See Section 8.4.3 for more information.	Most major components should be reusable after a crash.	Spare parts per manufacturer's recommendation.
NCIAS	Can be inspected on a drive-by.	Crushed units should be removed from site; minor damage can be repaired on-site by jacking.	Spare cylinders to replace badly damaged units.
Sand-Filled Barrels	Can be inspected on a drive-by for external damage. If lids are not riveted on, sand content should be checked periodically. See Section 8.4.3 for information on using sand-filled barrels in cold climates.	Individual sand barrels should be replaced after a crash; units damaged by nuisance hits also should be replaced. Debris should be removed from the site.	Spare barrels, sand support inserts, and lids; supply of sand.
Reusable Crash Cushions			
QuadGuard®	Normally can be inspected on a drive-by; missing or displaced cartridges can be readily noted. Should be periodically inspected on-site to be certain that all parts are properly connected.	Nose, expended cartridges, and damaged fender panels should be replaced. Unit should be repositioned.	Spare cartridges, nose units, fender panels, and other parts per manufacturer's recommendation.
Universal TAU-II™ Family	Normally can be inspected on a drive-by. Periodic on-site inspections should be performed to be certain that all parts are properly connected.	After a frontal impact, the system can be pulled out to restore the proper length. Replace damaged cartridges. During some side impacts, the sliding panels may be damaged.	Cartridges, sliding panels, pipe panel mounts, and nose pieces per manufacturer's recommendations.

Table 8-12. Comparative Maintenance Characteristics (*continued*)

TRACC™	Normally can be inspected on a drive-by. Periodic on-site inspections should be performed to be certain that all parts are properly connected.	The rip plates need replacement. Newer versions of the TRACC eliminate need for extensive disassembly. The nose and fender panels also may need replacement.	Replacement rip plates, nose sections, fender panels, and other replacement parts per manufacturer's recommendation.
QUEST®	Normally can be drive-by inspected. Periodic on-site inspections should be performed to be certain that all parts are properly connected.	The nose, fender panels, and energy-absorbing rails or tubes need replacement after impacts. Open design allows for easy repair.	The nose, fender panels, and energy-absorbing rails or tubes and other parts per manufacturer's recommendations.
Low Maintenance and/or Self-Restoring Crash Cushions			
Crash Cushion	**Regular Maintenance**	**Crash Maintenance**	**Material Inventory**
Compressor	Normally can be inspected on a drive-by.	This unit is designed to take repeated impacts without any additional recovery procedures and with minimal or no repairs.	Spare parts per manufacturer's recommendation.
EASI-CELL®	Normally can be inspected on a drive-by. Plastic cylinders may deteriorate after several years of exposure to the elements.	This unit is designed to withstand multiple impacts without cylinder replacement. All cylinders need to be replaced when the minor axis of the cylinders in the rear most row measures 230 mm [9 in.] or less.	Spare parts per manufacturer's recommendation.
HEART™	Normally can be inspected on a drive-by.	Repair will depend on the severity of the impact. Minor side impacts may require no repair. End-on impacts may require only pulling the system back into place and replacing the nose bolt.	Spare parts per manufacturer's recommendation.
QuadGuard LMC and Elite	Normally can be inspected on a drive-by. Periodic on-site inspections should be performed to be certain that all parts are properly connected.	Much of unit is reusable after a crash. Unit tends to self-restore to some extent but should be evaluated after each impact. Unit may need to be repositioned. When diameter of last cartridge becomes less than 660 mm [26 in.], all cartridges should be replaced.	Fender panels and other replacement parts per manufacturer's recommendation.
REACT 350®	Can be inspected on a drive-by.	The system is considered fully reusable. Repositioning is normally all that is needed after an impact. After side impacts, inspect stabilizer rods. If the cylinders cannot be restored to 90 percent of the original diameter, they should be replaced.	Spare parts per manufacturer's recommendation.
Smart Cushion SCI	Can be inspected on a drive-by for external damage. If the frontal collapse has been initiated, the unit should be inspected and reset.	The system will need two shear bolts and possibly a new delineator plate under design criteria impacts.	Shear bolts and delineator panel.

surface treatment course to accommodate multiple patron use. Special measures also may be needed where highway traffic conditions encourage hard braking or high acceleration by vehicles entering or exiting the mailbox turnout.

Edge dropoffs often are found at rural mailbox locations. The daily use by the delivery vehicles may loosen the soil at the edge of the pavement. When the soil at the edge is eroded, a drop of 100 mm [4 in.] or more may result. These edge dropoffs can make it difficult for drivers to safely return to the pavement if the vehicle strays onto the unstable soil. The use of paved turnouts is one solution. Another approach is a recent paving innovation called the Safety Edge, which shapes the edge of the traveled way into a 30 degree angle rather than a vertical drop. This new angle is optimal in allowing motorists to return their vehicle to the pavement without overcorrecting or losing control.

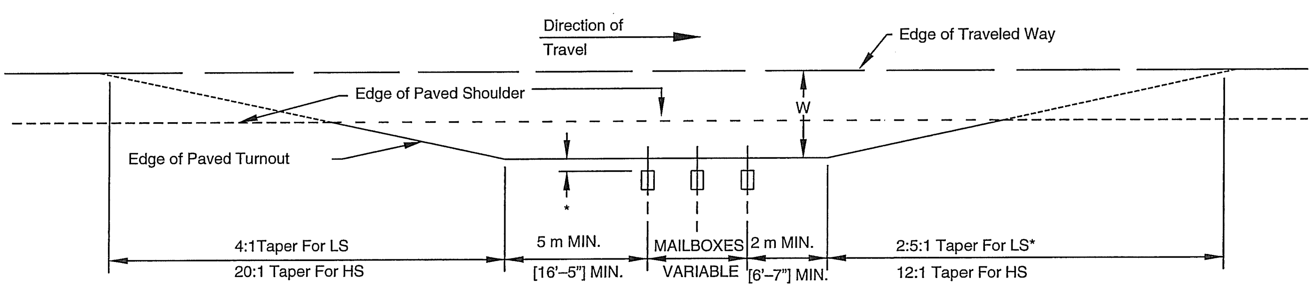
Drivers usually are required to slow their vehicles in traffic, which increases the risk of a crash. The ideal way to minimize this risk is to provide a speed-change lane. A wide surface-treated shoulder is ideal for this purpose. Unfortunately, suitable shoulders are not available at most mailbox turnout locations and it would be far too expensive to provide shoulders or turnouts that would allow a speed change outside the traveled way. Figure 11-5 presents a mailbox turnout layout considered appropriate for different traffic conditions.

The minimum space needed for maneuvering to a parallel position in and out of traffic also is shown in Figure 11-5. However, when only the minimum space is provided, the typical driver probably would slow considerably before starting into the low-speed turnout. This tendency renders such minimum space unsuitable for high-speed highways where driver expectancy does not include such slow-moving traffic.

Before entering a 2.4-m [8-ft] wide turnout with a 20:1 taper for high-speed traffic, as shown in Figure 11-5, a driver probably would not slow as much before clearing the traveled way. Although this is not an ideal exit maneuver, it probably would not create an unacceptable hazard on most rural highways for the few stops generated by a single mailbox.

Increasing the width of the turnout to 3.6 m [12 ft] and maintaining the 20:1 taper rate suggested in Figure 11-5 would induce a driver using the turnout to enter it at a fair rate of speed, but it will not be as fast as the through speed. Although this still is not ideal, it should be acceptable for most sites. The exception may be found on highways operating at high speeds and carrying more than 3,000 vehicles per day, with a high percentage of them on long trips. For these conditions, mail stops should be kept to a minimum and consideration should be given to providing shoulders or turnouts at the mail stops to facilitate greater speed-change opportunities outside the traffic stream.

The tapers shown in Figure 11-5 represent theoretical layouts. It may be more practical to square the ends of the turnout or to provide a stepped layout by strengthening and widening the shoulder to the full width of the turnout for the entire length of the taper. It also may be simpler to construct a continuous turnout-width shoulder rather than individual turnouts where mailbox turnouts are closely spaced.



LS = A Minimum Design for Roads Carrying Low-Speed Traffic and for Local and Collector Roads.
HS = For Roads Carrying High-Speed Traffic.
W = For Suggested Widths, see Table 11-1.
MAILBOXES = For Mailbox Spacing and Variable Length, see Section 11.2.4, Mailbox Support and Attachment Design.
* = For Mailbox Face Offset, see Table 11-1, 0 mm to 300 mm [0" to 12"].

Figure 11-5. Mailbox Turnout