Index 521-001 Concrete Barrier

Design Criteria

FDOT Design Manual (FDM); ***AASHTO Roadside Design Guide***, 4th Edition; ***AASHTO Manual for Assessing Safety Hardware (MASH)***, Test Level 2 & 4 Criteria; ***AASHTO LRFD Bridge Design Specifications***, 7th Edition.

Design Assumptions and Limitations

For concrete barrier information including crash test level classification, hazard setback requirements, and general placement information, see ***FDM 215***.

For barrier intended to protect bridge piers that theoretically do not have sufficient strength to resist the ***LRFD*** equivalent static impact force, see ***Index 521-002*** (Pier Protection Barrier).

A. General:

Index 521-001 defines concrete barrier segments for various conditions that will be used together to design a complete concrete barrier system on a project-specific basis.

The design of concrete barrier requires that differing segments and features be shown and labeled correctly in the Plans, where the requirements of the Index are not violated including section dimensions and geometry of barriers.

B. Concrete Barrier Types:

1. Median Barrier (All Design Speeds) – double-faced rigid barrier used in medians to prevent crossover collisions and to shield vehicles from miscellaneous hazards, including sign supports, light supports, and piers.
2. Shoulder Barrier (All Design Speeds) – single-faced rigid barrier typically used on outside shoulders when minimized barrier deflection (or setback) is required to shield vehicles from miscellaneous hazards, including sign supports, light supports, and piers.
3. Curb & Gutter Barrier (Design Speeds ≤ 45 mph) – single-faced rigid barrier used to shield vehicles from miscellaneous hazards in urban areas, which may be used in conjunction with adjoining raised curb for water conveyance.
4. Wall Shielding Barrier (All Design Speeds) – single-faced rigid barrier used to shield vehicles from continuous retaining walls and adjacent miscellaneous hazards, including sign supports and light supports.

   Note: Shielding of walls is a project-specific decision based on the relative smoothness and anticipated impact angle of the retaining wall. The use of concrete barrier can increase crashworthiness as compared to walls that are rough, grooved, or not in compliance with the taper rates shown in Table 2.

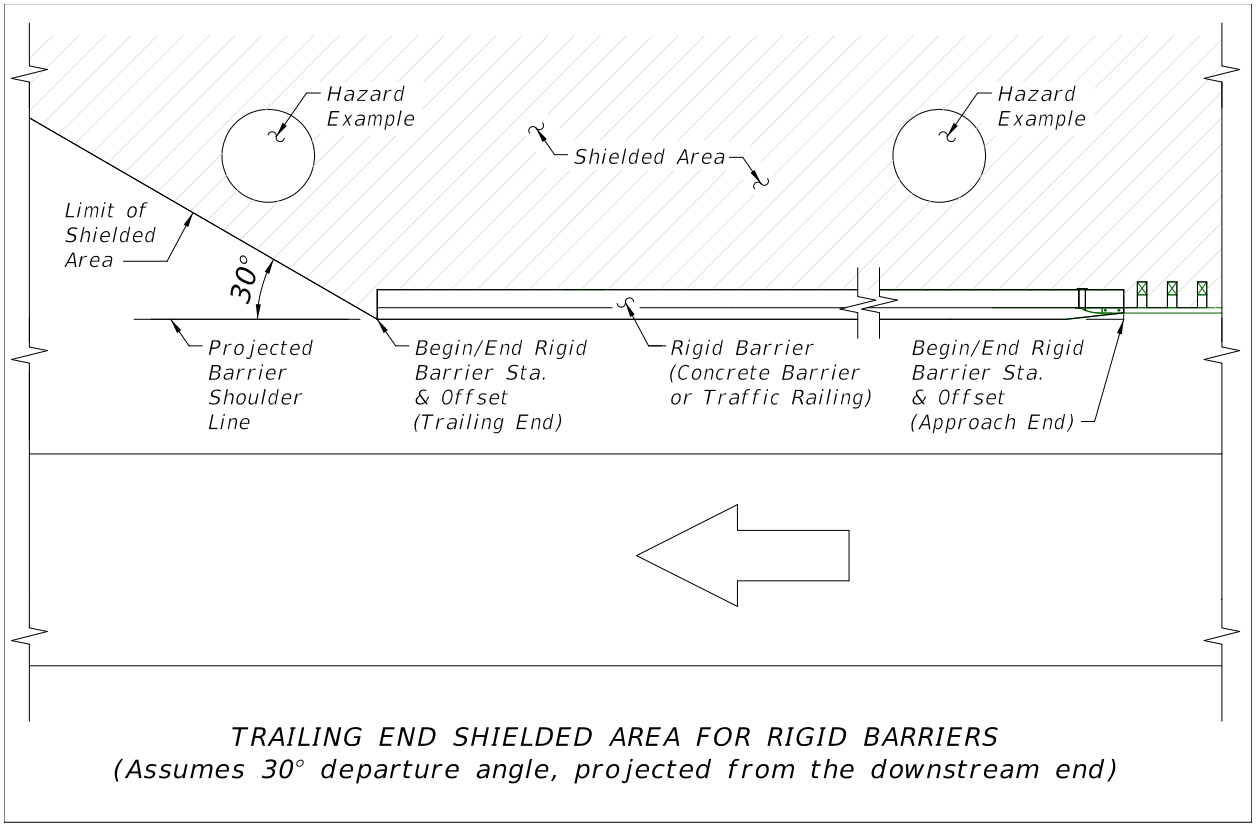
C. Shielding Hazards - Determining Length of Need and Begin/End Barrier Stations:

The standard method of determining barrier placement for shielding hazards is based on the Runout Length and the Length of Need (LON) calculation in the ***AASHTO Roadside Design Guide (RDG)***, 4th Edition.

See the FDOT ***Concrete Barrier Length of Need (LON)*** Excel program for plan view details and assistance with determining Begin/End LON Stations for shielding various hazard configurations. This program is located in the Design Tools column on the ***Standard Plans*** website.

On the trailing end, place barrier to shield hazards assuming a 30 degree vehicle departure angle from the roadway. See ***Figure 1***, below.

Figure 1: Trailing End Barrier Placement



D. End Treatments:

End Treatments are required for all Concrete Barrier ends both not connecting to a different barrier type (Barrier End Connection / Continuation) and under the following conditions of ***Table 1***, below.

Table 1: Barrier End Treatment Usage

Barrier Type:	Barrier End Location:	Applicable End Treatment Type(s):
Median Barrier	Approach – Inside Clear Zone	• Guardrail Approach Terminal (1) • Crash Cushion (2)
	Approach – Outside Clear Zone	• Sloped End Treatment (3)
	Trailing End	• Sloped End Treatment (3)
Shoulder Barrier	Approach – Inside Clear Zone	• Guardrail Approach Terminal (1) • Crash Cushion (2)
	Trailing End	• None
Curb & Gutter Barrier	Approach – Inside Clear Zone	• Guardrail Approach Terminal (1) • Sloped End Treatment (Restricted Use per ***FDM 215***) (4)
	Trailing End	• None
Wall Shielding Barrier	Approach – Inside Clear Zone	• Guardrail Approach Terminal (1) • Crash Cushion (2)
	Trailing End	• None

Note: If the barrier end is within the Clear Zone of any nearby lane with approaching traffic (e.g. 2-lane, 2-way facility), then "Approach End – Inside the Clear Zone" criteria applies.

End Treatment Types:

1. Guardrail Approach Terminal: Design placement of Guardrail Approach Terminals along with the required Approach Transition Connection to Rigid Barrier in accordance with ***Index 536-001*** (Guardrail). See the ***Standard Plans Instructions*** for ***Index 536-001*** for LON design information.
2. Crash Cushion (C.C.): Design placement of a Crash Cushion in accordance with ***Standard Plans Instructions*** for ***Index 544-001***. See Part C for LON design information.
3. Sloped End Treatment for Median Barrier: Design placement of the 25-foot length treatment in accordance with the Index drawings.
4. Sloped End Treatment for Curb & Gutter Barrier: This treatment has restrictions on use per the requirements of ***FDM 215***. Use only when a Guardrail Approach Terminal will not fit due to constrained project conditions. Design placement of the Sloped End Treatment in accordance with the Index drawings. Use the 25-foot length treatment option where space is available for it. Use the 10-foot length treatment option only where space is not available for the other options. See Part C for LON design information.

E. Barrier End Connections / Continuations:

1. Guardrail: Connect to guardrail using the Approach or Trailing Transition Connections to Rigid Barrier in accordance with the details in ***Index 536-001***.
2. Pier Protection Barrier: Connect to Pier Protection Barrier in accordance with the details in ***Index 521-002***. Align gutter lines.
3. Single-Slope Traffic Railing:
    a. 36" Height Traffic Railing (bridge application): Connect to Traffic Railing in accordance with the Index details. The ***Standard Plans*** details for Traffic Railing provide for the 38" to 36" height transition on the bridge approach slab. Align gutter lines.
    b. 38" Height Traffic Railing (Junction Slab / MSE Wall coping or other): Connect to Traffic Railing in accordance with the ***Standard Plans***. Align gutter lines.
4. Existing F-Shape Barrier or Traffic Railing: Connect to F-Shape sections using the Median Barrier or Shoulder Barrier's Connection to F-Shape details as shown in ***Index 521-001***. Between the new Single-Slope section and existing F-Shape section, provide longitudinal space for the 12'-6" Connection Segment plus any ¾" Doweled Joints required per ***Index 521-001*** details. Curb & Gutter Barrier connections to F-Shape sections require project-specific concrete transition details.

F. Variable Section Width Segments:

For shielding vehicles from specific roadside features, Concrete Barriers can transition to Variable Section Width segments per ***Index 521-001***. Variable Section Width segments include the "Median Barrier – 56" Height Section" (with transitions), the "Median Barrier – 38" Height Split Section" (with transitions), the "Median Barrier – 44" Height Split Section" (with transitions), and the "Wall Shielding Barrier – 56" Height Section" (with transitions). The corresponding callout points for the begin and end of these segments are shown in the ***Index 521-001*** drawings.

Variable Section Width segments require project-specific designs for their transition and tangent dimensions, which must follow the geometry requirements of ***Index 521-001*** along with the taper rates provided in part G.

Where the ***Index 521-001*** drawings show 'Reduced Shoulder' widths, an evaluation is needed to determine acceptability for the project-specific conditions. Consider needs such as the general useable shoulder width and Emergency Shoulder Use (ESU) per ***FDM 211***. Coordinate decisions with the District office. In general, if the 'Reduced Shoulder' violates minimum shoulder width criteria, then the requirements of ***FDM 122*** will apply.

G. Barrier Taper Rates:

Where conditions require the face of barrier to deviate from running parallel to the roadway, the shift in lateral offset must not exceed the taper rates provided in ***Table 2***, below.

Table 2: Maximum Barrier Taper Rates

Barrier Type:	**Design Speed (mph):**	**Approach End *Max. Taper Rate:**	**Trailing End *Max. Taper Rate**
Median Barrier (Double-Faced)	All	1:20	1:20
Shoulder Barrier (Single-Faced), Curb & Gutter Barrier, and Wall Shielding Barrier	70	1:20	1:5
	60	1:18	1:5
	55	1:16	1:5
	50	1:14	1:5
	45	1:12	1:5
	40	1:10	1:5
	30	1:8	1:5

*Taper Rate is measured relative to the roadway centerline (lateral offset : length)

H. 56” Height Sections for Barrier-Mounted Sign Support:

As shown in ***Index 521-001***, the 56” Height Sections require a project-specific structural design for the Concrete Barrier section. The structural design must include the required foundation, pedestal width, anchor bolts, steel reinforcing through the barrier, and all other components as required to support the project-specific sign support.

I. Drainage Slots for Shoulder Barriers:

As shown in ***Index 521-001,*** the Drainage Slots for Shoulder Barriers are intended for limited usage and are generally called for at toll sites only. These Drainage Slots are not intended to replace traditional drainage inlet structures for most locations.

The use of Drainage Slots for Shoulder Barriers requires approval of the District Drainage Engineer.

J. Shoulder Rocking or Minor Grade Separations:

The shoulder pavement may be lowered up to 3” on one or both sides of a barrier as described in ***Index 521-001***. The resulting pavement gutter line will be located beneath the barrier’s sloped face, at its lower vertical face (a.k.a., the “reveal”). The overall barrier height is then increased by up to 3”. Note that the actual pavement lowering dimensions are determined by the Engineer of Record (EOR) and must be called for per the Plans Content Requirements, Part A.

For the shoulder rocking profile changes required, see ***FDM 211***.

Plans Content Requirements

A. General:

In the Roadway Plan views, label Begin and End Stations of the Concrete Barrier types as they correspond to the callout points shown in ***Index 521-001*** (e.g. Begin Median Barrier Sta., Begin Shldr. Barrier Sta., Begin Curb & Gutter Barrier Sta., or Begin Wall Shielding Barrier Sta.).

On the Typical Sections, Cross Sections, Roadway Plan views, and all other appropriate sheets, show the Concrete Barrier system to scale, using Concrete Barrier section dimensions from ***Index 521-001*** as applicable. Label geometry of barrier sections as needed to effectively communicate usage of ***Index 521-001*** components to the contractor, particularly at the starting and stopping points of different section types and transitions for Variable Section Width segments. Where applicable, designate connecting drainage, lighting, and all other features as linked per ***Index 521-001*** details. With the project-specific geotechnical information provided in the Plans, include the definition of 'Type B Stabilization LBR 40' as linked to the ***Flexible Pavement Design Manual***.

If shoulder rocking or minor grade separations are used, label this shoulder information at the barrier's gutter line. Call out transition points where the shoulder height changes from the default locations shown in ***Index 521-001.*** For additional shoulder rocking plans requirements, see ***FDM 915***.

For 56" Height Sections, project-specific structure designs are required as described in Part H.

B. Summary of Permanent Barrier Wall Table:

Tabulate the individual Pay Items as defined in the ***Basis of Estimates Manual*** and ***Specification 521***. Produce the Summary of Permanent Barrier Wall table. See the CADD Production Support Office website for details.

The location callouts of barrier segments will be listed as Station to Station, but the length of the corresponding segments must be measured along the centerline of the barrier and include the effect of curvature.

Curb & Gutter Barrier and Wall Shielding Barrier are each subsets of single-faced Shoulder Concrete Barrier in the Pay Item structure.

Different Pay Items are required for Variable Section Widths using either the Median Concrete Barrier category for double-faced applications or the Shoulder Concrete Barrier category for single-faced applications. The begin and end points for measurement are shown in ***Index 521-001***. The length of Variable Section Widths is measured at the centerline of the overall system.

Payment

Item number	Item Description	Unit Measure
521-1-11	Median Concrete Barrier, 38” Height	LF
521-1-12	Median Concrete Barrier, 38” Short Grade-Separated	LF
521-1-13	Median Concrete Barrier, 38” Tall Grade-Separated	LF
521-1-14	Median Concrete Barrier, Variable Section Width for Sign or Pier Shielding	LF
521-72-40	Shoulder Concrete Barrier, 38” or 44” Height	LF
521-72-41	Shoulder Concrete Barrier, 38” Retaining Section	LF
521-72-42	Shoulder Concrete Barrier, 38” Trench Footing Section	LF
521-72-43	Shoulder Concrete Barrier, 38” Curb & Gutter Barrier	LF
521-72-60	Shoulder Concrete Barrier, 38” Wall Shielding Barrier	LF
521-72-61	Shoulder Concrete Barrier, Variable Section Width for Wall or Sign Shielding	LF

See the ***BOE*** and ***Specification 521*** for additional information on payment, pay item use and compensation.