Chapter 2

Design Geometrics and Criteria

The following are changes, additions or deletions to the January 2012, Topic #625-000-007, Plans Preparation Manual (PPM), for use on Turnpike projects only.

2.1.5 Cross Slopes

Add the following paragraphs

For new or replacement bridges on six-lane roadways, or roads that have the potential to be widened to six or more lanes, the cross slope of the bridge should be designed at 0.03 if possible.

Median through-lane widening, turn lanes, tapered or parallel single lane ramps adjacent to two through-lanes do not automatically warrant a 3% cross slope. Surface drainage will be reviewed and used as the deciding factor. New two lane ramps, however, will be designed with 3% for both lanes through the gore area. It is understood that Figure 2.1.1 depicts through lanes, and that auxiliary lanes can be applied with a cross slope in the same direction as the adjacent through lane even if this causes more than three lanes to be sloped in the same direction. This approach does not require a Design Variation, but shall meet lane spread requirements for storm water runoff.

2.1.6 Roadway Pavement

Add the following paragraph

TPPPH Section 16.2.7.1 contains the minimum standards for pavement designs on the Turnpike System. FTE's Flexible Pavement Design Guide for Toll Locations with Electronic Data Collection (January 2010), provides pavement design requirements for toll gantry locations; alternate designs shall be coordinated and approved by the Department prior to implementing in plans. Submittal of design does not constitute approval.

http://design.floridasturnpike.com/prod_design/roadway/bituminouspavementdesign.html

2.1.7.1 Pavement Thickness Transition Guidelines

Add the following Paragraph

At bridge and ramp toll plaza approaches that are rigid pavement, for a 150 foot length before and after the concrete slab, the ultimate pavement design asphalt thickness shall be placed flush with the concrete at the ultimate profile grade. The initial pavement section shall transition to the ultimate thickness at a rate of 0.08% (1 inch/100 feet).

2.3 Shoulders

Add the following paragraphs

Where single lane ramps meet cross roads, additional ramp lanes are usually added for accel/decel or right or left turns. Unless these additional lanes are more than 500 feet long measured along the ramp baseline, single lane 6 feet ramp shoulders should be used throughout. A similar 500 feet length would apply to ramp plaza approaches and departures. Frequent short changes in ramp width should not warrant corresponding short changes in ramp shoulder width. The shoulder transitions may be longer than the multi-lane ramp segment.

Other shoulder requirements:

- Single lane ramps shall have 4' paved inside and outside shoulders.
- "2-Lane Ramp Interstate" within PPM Table 2.3.1 shall also be applied to ramps with more than 2-lanes, and thus have a 4' paved inside shoulder and a 10' paved outside shoulder.
- Though PPM Figure 2.0.1 only shows "2-Lanes" for multi-lane ramps, the shoulder configuration (6' inside shoulder and 10' outside shoulder) shall also be applied when more than two ramp lanes occur.
- Ramps shall have audible edge lines.
- Twelve foot inside and outside paved shoulders shall be provided for mainline sections that are 3-lanes or more in one direction, and that have a truck DDHV greater than 250. Additional stabilization and continuation of the shoulder cross slope beyond the twelve foot paved width are not required. This shoulder width requirement also needs to be applied to bridges when the above conditions occur.

Deviations to the above requirements will require an approved technical memorandum, similar in effort to preparing and processing a standard Design Variation.

2.3.1 Limits of Friction Course on Paved Shoulders

Add the following paragraph

Shoulder pavement on the high side where the shoulder slopes toward the travel lanes, the shoulder pavement will be flush with the adjacent travel way friction course to avoid trapping water on the shoulder.

http://design.floridasturnpike.com/prod_design/roadway/roadwayguidedrawings.html

2.3.2 Shoulder Warning Devices (Rumble Strips)

Add the following paragraph

The minimum thickness of structural asphalt on shoulders where ground-in rumbles strips are to be used is 1.5 inches. On existing shoulders without rumble strips that call for new rumble strips to be placed, the minimum thickness of existing structural asphalt and proposed asphalt shall be no less than 1.5 inches.

2.3.4 Shoulder Rocking

Add the following paragraphs

Cross slope for full width shoulders in a tangent section may be varied from 3% to a maximum of 6% . A minimum longitudinal gutter grade of 0.24% shall be met. The minimum distance between the low point and high point is 100'. This criterion applies to sections of the mainline where the profile grade line will require varying the inside or outside shoulder slope as a means of maintaining minimum spread criteria.

For the outside shoulder the Turnpike will allow one of three types of treatment in areas where the outside shoulder slope must be varied in order to meet minimum spread criteria.

1. Use concrete barrier wall with inlets. If the shoulder slope must be varied then the above criteria for varying the shoulder slope and longitudinal gutter grade must be met. Design shall include provisions to assure that the reveal of the concrete barrier is not compromised.

2. Use guardrail with shoulder gutter and inlets to collect storm water. If the shoulder slope must be varied then the above criteria for varying the shoulder slope and longitudinal gutter grade must be met.

3. Use guardrail in conjunction with a permanent erosion mat in fill sections with a front slope steeper than 1:4 and embankment height less than or equal to 10 feet. Storm water will be allowed to flow over the shoulder and the miscellaneous asphalt onto the sodded front slope

2.4 Roadside Slopes

Add the following paragraphs

Though a 1:4 front slope rate can be applied without restrictions per PPM Chapter 4, a 1:6 rate to the edge of a clear zone is required on widening and reconstruction projects. In addition, a 1:2 front slope rate with guardrail can be applied regardless of fill height when constrained conditions exist, which requires justification via an approved technical memorandum and coordination / concurrence with FTE Maintenance and FTE Drainage.

Sufficient space from face of guardrail to the beginning of the 1:2 slope shall be provided on all guardrail and 1:2 slope applications to allow for a 4’ guardrail deflection. If a concrete barrier is used instead of guardrail and shoulder gutter, then a 4’ wide level bench shall be constructed within the fill behind the barrier before proceeding with a 1:2 slope.

2.6 Grades

Table 2.6.2 Maximum Change in Grade Without Vertical Curves

Add following note

The minimum distance required between VPI’s used to develop the Profile Grade Line (PGL) is 3 * Design Speed.

2.8 Curves

2.8.2 Vertical Curves

Add as paragraphs 2 thru 4

The minimum vertical curve lengths and minimum K values listed in the notes in PPM Tables 2.8.5 and 2.8.6 require some clarifications and restrictions:

Service Interchanges Per AASHTO, it is intended that a "platform" about 200 feet in length be provided on the ramp in advance of the gore using the Freeway K values.

System Interchanges K values for the higher system ramp design speeds should be used except for the "platform" area.

2.9 Superelevation

Add the following note

For ramp design speeds less than 35 mph. See AASHTO ***Exhibit 3-30 Maximum Relative Gradient*** for superelevation transition rates.

2.10 Vertical Clearance

Change the following table

Table 2.10.2 Minimum Vertical Clearances for Signs and Toll Gantries

ELEMENTS	CLEARANCE 1, 2
Overhead Sign Structures	18'-0" clearance over the entire width of the pavement and shoulder to the lowest Sign component
Overhead Toll Gantries	18'-6" clearance over the entire width of the pavement and shoulder to the lowest Toll Gantry component. See Chapter 34 for more information on vertical clearance at Toll Gantries.

1. For notes 1 and 2, see PPM.

2.11 Horizontal Clearance

Change the following figure title

Figure 2.11.1 Horizontal Clearance to Barriers"

2.14.5 Crossovers on Turnpike Facilities

Add the following section

Median u-turns throughout the Turnpike are used to accommodate turnarounds between interchanges for maintenance, service, and law enforcement personnel. The primary purpose of the u-turns is to alleviate adverse travel time for emergency vehicles by providing strategic u-turn locations along Florida's Turnpike.

Coordination efforts between Turnpike Production Design, Traffic Operations, FHP Troop K, and Service/Maintenance departments, helped provide the direction needed to identify and develop Turnpike specific criteria for the design and locations (sometimes relocation) of the official use u-turns on the system. Design guidelines from AASHTO's A Policy of Highway and Streets (2004), along with outcome of the internal coordination efforts, were used to develop Turnpike specific criteria during the time when the state was developing standards for crossovers on Limited Access Facilities.

The following is a summary of Florida's Turnpike crossover spacing criteria:

Criteria	Turnpike Requirement
U turn spacing	1 to 2 miles apart
Interchange Location	Not within 1 mile
Median width opening	≥ 20 feet (concrete barrier wall separated)

All crossovers within a project's limit are to be evaluated by the design consultant for the spacing criteria listed above and for sight distance deficiency. Findings are to be documented and submitted to the department for review and an internal decision will be made as to relocate or close the location.

Crossover Guide Drawings can be found at the following link:

http://design.floridasturnpike.com/prod_design/roadway/roadwayguidedrawings.html

Additional guide drawings are available within the PPM, Chapter 2.

2.17 Toll Plazas

Add the following sections

2.17.1 Horizontal Taper Rates

The desirable Horizontal Taper Rates at plazas are as follows:

Mainline Plazas -	Up to 8 total lanes	25:1
	10 to 14 total lanes	20:1
	16 plus total lanes	15:1
Ramp Plazas -	All types	20:1

Note: Tapers adjacent to dedicated or future dedicated SunPass lanes are to be designed for the highest anticipated travel speed.

There will need to be a parallel roadway lane section to accommodate storage queues on the approach side of the toll plazas after the approach flare.

2.17.2 Cross Slopes and Transitions

The normal cross slope for the concrete slab around all plazas is 0%. This serves as a standard datum for vertical clearance, which is constant to the canopy, canopy signs, toll booth slab, coin basket, tunnel, etc. The approach crowned roadway will need to be warped up and widened to meet the plaza slab. The grading for the plaza approaches and departures will be designed for the maximum number of lanes foreseeable with only the lateral limits reduced for the initial construction.

2.17.3 Profile Grades

For ramp plazas the approach grade shall be +1.00% with +0.50% minimum. Departure grades shall be -0.50% minimum and -1.00% desirable. It is desired that plazas be on a crest to keep water from sheet flowing through the plazas, however, straight through grades are commonly used where right of way, profile grade and earthwork act as constraints. For a straight grade through a small plaza, a 0.50% minimum or a 1.50% maximum grade may be used.

Mainline plazas have been built on flat grades, but it is desirable to have at least +0.50% approach and -0.50% departure grades.

Higher speed AVI (Automatic Vehicle Identification) or SunPass lanes may need vertical curves or staggered grade breaks so as not to exceed the "Maximum Change in Grade Without Vertical Curves" shown in the PPM Table, 2.6.2.

When setting the PGL elevation within 300 feet of a mainline toll plaza, the Designer must consider the 3 feet roadway base clearance above SHW (seasonal high water), the finished floor elevation at 1 foot (0.3 m) above the 100 year storm, the wide pavement cross slope, the plaza perimeter drainage ditches, and the possible expansion of the plaza in the future. As the SHW in Florida may be within 1 foot of natural ground, it is not unusual for the PGL at the plaza to be 5 or 6 feet (1.5 to 1.8 m) above natural ground.

An important location to check for roadway base vertical clearance to SHW is near the midway point on the plaza approach or departure taper. A uniform rise of cross slope from –2.00% to 0.00% times the increasing pavement width would yield calculated EOP (edge of pavement) elevations that would plot as a "sag" curve. To avoid this, a non-uniform cross slope transition rate or a "spline" can be used between a "straight" PGL and a straight, preset, ultimate EOP profile.

2.17.4 Toll Plaza Clear Zones/Horizontal Clearance

Clear zones are a function of design speed that would range from 70 mph (110 kph) to zero. In general, clear zones would be reduced from the basic mainline width up to the approach flare, to a decreasing ramp/auxiliary lane clear zone width in the flare, to a 4 foot clear zone for curb or a 10 foot clear zone for shoulder border where the outside EOP parallels the centerline. This "Use Good Engineering Judgment" approach is also relevant for ramp terminals near cross roads.

The current design practice for toll plazas include the design of toll island attenuators for the full design speed of the approach roadway. However, the Administration Building and other amenities are placed within 10 to 25 feet from the edge of pavement, with no barrier to shield the hazard. This is a design inconsistency. The developed clear zone criteria for the generic toll plaza designs are based on Turnpike site-adapt experience as well as AASHTO and FDOT Criteria on general highway safety. This criteria sets minimum values for clear zones. The

purpose of this criteria is to provide a consistent and rational design for toll plaza design. These values are reduced by 10 to 25 feet for ramps and auxiliary lanes so that the clear zone is offset by a near constant offset from the through-lanes. This method of clear zone development is applied to toll plazas and approaches.

Toll plaza approaches (the tapered area between the theoretical through or travel lanes and the edge of pavement) are considered as auxiliary lanes. Furthermore, because of the prolonged length of these tapers for mainline plazas (either one-or two- way), these approaches are considered as ramps with a design speed midway between a stop condition and the design speed of the approach roadway. The rational for application of a lower design speed to the tapered approach assumes that vehicles traveling along the edge of pavement must have made a conscious controlled action to take this path and begin deceleration similar to an exit ramp. The similarities in the development of the clear zone between an exit ramp and a toll plaza are shown in **Figures 2-1** and **Figures 2-2**. At any plaza, a low speed clear zone similar to a low speed collector can be applied for decelerating vehicles depending on the border treatment. This "A" distance as shown on Fig. 2, should be either 5.5 feet from edge of pavement for curb and gutter borders or 10 feet for shoulder borders. Thus the clear zone at any point in a toll plaza or approaches can be defined as the widest offset, either "X" as measured from the projected through lanes; "Z" as measured from the toll plaza tapers; or "A" as measured from the edge of toll plaza.

It should be noted that if the "X" distance is beyond the edge of the toll plaza for a design speed of greater than 45 mph, curb and gutter should not be used as a border treatment.

This tiered classification should only be applied to tolled lanes. Mainline lanes near ramp plazas, AVI express lanes, or untolled lanes at one-way plazas, such as Alligator Alley should continue to maintain standard roadway clear zones or appropriate site barriers. The one apparent inconsistency in this development of safety criteria is the length of great attenuators at the toll islands.

Current practice includes the design of all attenuators for the full design speed of the approach roadway. Safety at the plaza is of utmost importance; therefore, "USE GOOD ENGINEERING JUDGEMENT" and design consistency. See Design Guide Line. Design decisions regarding this issue shall be included in the design documentation file. This practice is consistent with the use of a wider clear zone for the projected through-lanes.

DESIGN GUIDE LINE

Approach Roadway	Design Speed	Bays*
Main Line Plazas	All	9
Ramp Plaza Curved Approach	25-40, Including Sunpass	2
Ramp Plaza from Main Line	50, Including Sunpass	4
Ramp Plaza from Cross Road	25-40	2

*** Quadguard used as example only. The same approach applies to all QPL crash cushions.**

Clear Zone Development

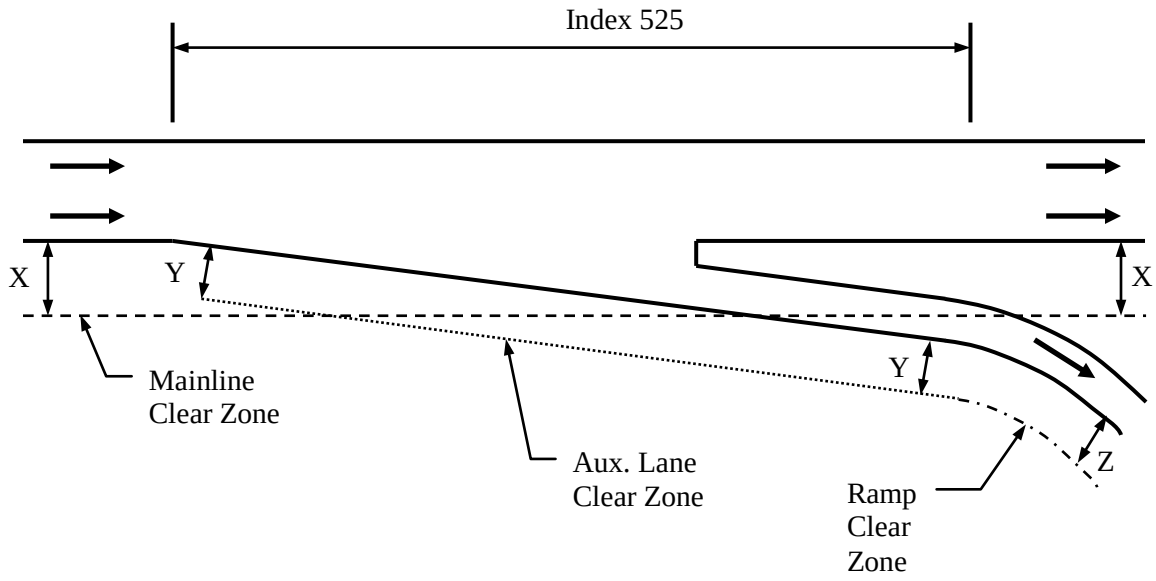

Figure 2-1
Clear Zones At An Exit Ramp

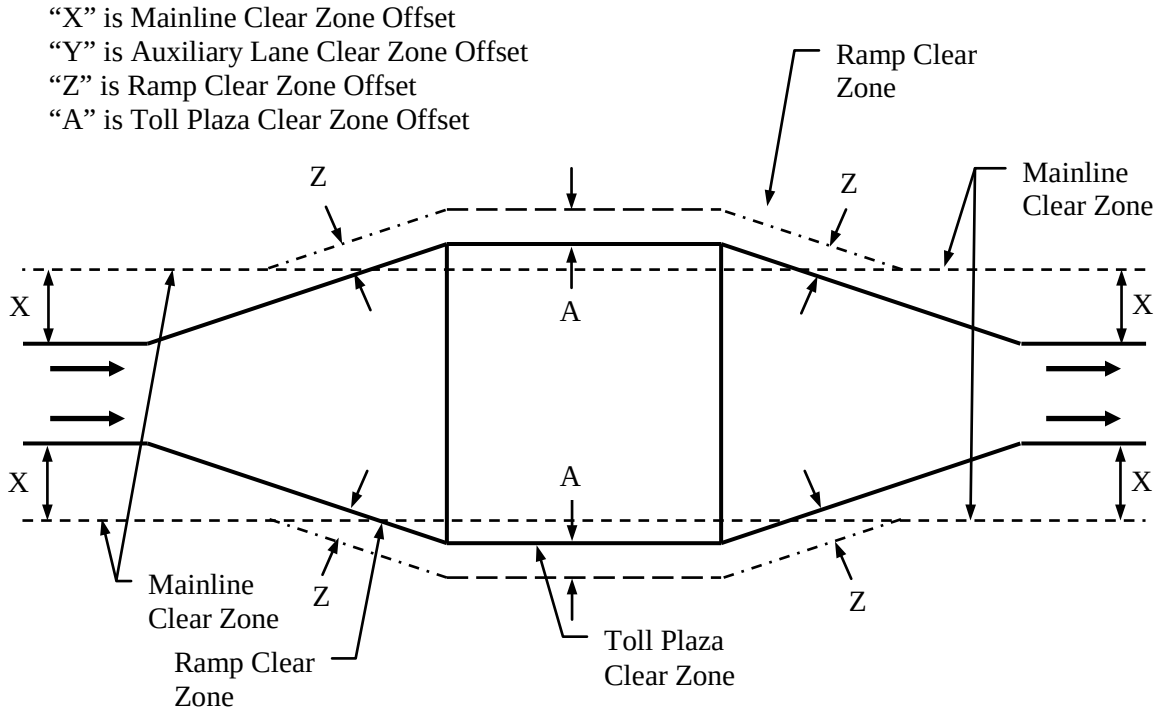

Figure 2-2
Clear Zone Development For A Mainline Toll Plaza

2.17.5 Queue Storage Criteria

The standard vehicle length used for queue storage analysis at toll plazas is 25 feet, which has a safety factor of 1.5. The maximum length of queue in a toll lane is 12 vehicles (300 feet) for mainline plazas and 6 vehicles (150 feet) for ramp plazas.

For ramp plaza booths, the minimum distance from the crossroad is 300 feet. However, where the same ramp plaza building takes tolls for both On-ramp movements or On and Off-ramp movements (such as at a "Par-Clo" or a "Trumpet"), the minimum distance will be increased to 500 feet. The distance is increased to provide additional vehicular weaving and storage space. When setting this distance, the possibility of future booth and cross road lane additions and their R/W impacts, a weave analysis, and toll-processing rates shall be considered. A weave analysis is not only important where multiple traffic directions are being accommodated, but also when designated AVI lanes are included.

2.18 Sodding

Add the following section

On resurfacing projects where there is more than 12 feet of travel lane pavement draining to the edge, the **minimum** sod dimension is 2 feet 8 inches. Where there is less than 12' of travel lane pavement draining to the edge, the **minimum** sod dimension is 1 foot 4 inches. Typically, the 2 feet 8 inches occurs on the outside shoulder and the 1 foot 4 inches on the inside shoulder.

For all slopes adjacent to new construction or widening, sodding shall be used throughout the entire limits of the project.